Introduction to Psycholinguistics

Selected Readings

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"We must find out more about language! Already we know enough about it to know it is not what the great majority of men, lay or scientific, think it is. The fact that we talk almost effortlessly, unaware of the exceedingly complex mechanism we are using, creates an illusion. We think we know how it is done, that there is no mystery; we have all the answers. Alas, what wrong answers! ... Natural man, whether simpleton or scientist, knows no more of the linguistic forces that bear upon him than the savage knows of gravitational forces. He supposes that talking is an activity in which he is free and untrammeled. He finds it a simple, transparent activity, for which he has the necessary explanations. But these explanations turn out to be nothing but statements of the needs that impel him to communicate. They are not germane to the process by which he communicates."

Whorf (1959)

Preface

Introduction to Psycholinguistics – Selected Readings is a coursebook intended for university students majoring in English. Through excerpts of readings on the theoretical background and research findings, it provides an overview of the discipline that explores the psychological processes underlying the comprehension, production, and acquisition of language with insights into the relationship between language, mind, and culture. Whereas linguistics is the study of language itself (including such topics as the internal structure and diachronic development of language), psycholinguistics is an empirical and theoretical study of the mental faculty that underpins our consummate linguistic ability (Altmann, 2001).

Each of the 6 chapters consists of (A) selected and adapted readings/excerpts that are fundamental to understanding an aspect of psycholinguistics, with references to their original sources and webliography, (B) further reading and additional online resources for expansion of the chapter topic, (C) a list of key concepts corresponding to terms from the readings, and (D) discussion questions and activities designed to summarize the main points from the chapter. All the chapter readings (earlier used or recommended as class materials, i.e. handouts, created from public domain sources and adapted to current trends in contemporary English, e.g. politically correct language) and further reading are cited in the References section at the end of this coursebook.

By the time students reach the end of this coursebook, they will have gained a better understanding and be more knowledgeable in answering the following focus questions (definitely not a comprehensive list but rather a selection): Is there a universal grammar common to all human language? If so, what are the underlying psychological processes? If not, what are alternative explanations for the demonstrated similarities between languages? What are the differences in our processing

of oral and written stimuli? How does our perception of language change depending upon whether the input is oral or visual? How do people choose a specific word for a specific context when speaking in English? Why does the following sentence not make sense in English: *"How you meaning words the what know do does?" How do people connect the shapes on this page to the sounds they make as they are read aloud? Is language an exclusively human phenomenon? If not, to what extent do other species exhibit linguistic systems? If so, what is it about human psychology and biology that distinguishes linguistically our species from others? Considering the limited input, how do children know subtle grammatical distinctions without being taught explicitly? Is there any order to how babies acquire language items in English as their native tongue (L1)? Why is simultaneous translation considered to be an amazing feat? Do we shape language or does language shape us as human beings? What is the relationship between language and thought?

Students will be able to identify key research questions / hypotheses in scientific articles on different aspects of psycholinguistics and critically evaluate the evidence so as to apply them to their own research interests and gain an appreciation of the relationship between human language and the brain. Yet, not only articles but also certain movies and documentaries can be said to be inspired by psycholinguistic issues, such as *Arrival* (2016), *Still Alice* (2014), *Is the Man Who Is Tall Happy?* (2013), *The Grammar of Happiness* (2012), *The Linguists* (2008), and *The Wild Child* (1970).

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Contents

Chapter 1
General issues

(A) Readings:

1. Warren, P. (2013). *Introducing Psycholinguistics.* Cambridge University Press. pp. 1-12.

Psycholinguistics can be defined as the study of the mental representations and processes involved in language use, including the production, comprehension and storage of spoken and written language. A number of issues arise from this definition. Some are to do with *representations*, such as: How are words stored in *the mental lexicon*, i.e. the dictionary in our heads? Is this mental lexicon like a dictionary or more like a thesaurus? How is the meaning of a sentence represented in our memory? Is the plural form "cats" represented in the mental lexicon or just the singular "cat"? Other questions concern the *processes* that might operate on those representations, such as: How do we recognize words so effortlessly? Do we analyze the speech signal phoneme-by-phoneme or do we identify complete syllables or even larger units? When we speak, how do we convert an idea into an utterance? What stages do we have to go through during the construction of utterances? Do the processes involved in language production and comprehension influence one another, and if so in what ways?

This outline sketch of language use (Table 1) gives an overview of areas of interest in psycholinguistics, which clearly has links to other areas of linguistics, shown in the fifth column (Areas of linguistics):

Processes	*Production*		*Comprehension*	*Areas of linguistics*
				discourse analysis
central	intention	message ('idea')	interpretation	
	planning	sentence structure	parsing	syntax/semantics
	lexicalisation	words	word recognition	morphology/syntax
peripheral	articulation	sounds/letters	perception	phonetics/phonology

Table 1. Overview of areas of interest in psycholinguistics. Warren (2013).

From the language producer's (speaker's, writer's) perspective, the production of a message takes us from an underlying intention, through stages of planning sentence structures and selecting words, to the articulation of that intention as a sequence of sounds or letters, as shown by the arrow. From the comprehender's (listener's, reader's) viewpoint, the goal is to perceive or recognize elements such as letters and sounds in the input, to recognize words and to work out the connections between these words in sentence structures, in order to arrive at a message-level interpretation. The arrow in the 'comprehension' column shows such a 'bottom-up' flow of information from the input to an interpretation. This is a simplification, though, as there is evidence for 'top-down' information flow too, e.g. when a listener starts to gain an understanding of the sentence they are hearing this can influence the efficiency with which they recognize subsequent words in the sentence. Most psycholinguists today support the idea of interactive processing in both production and comprehension, with information flowing in both directions (bottom-up and top-down) as well as between elements at the same level (so recognizing one word has an effect on the likelihood of recognizing similar words).

It is reasonable to claim that the main focal areas of psycholinguistics have tended to be sentences and words. So, production studies have focused on the generation of sentence structure and on syntactic planning, as well as on word finding and word building. Similarly, much of the study of comprehension has dealt with word recognition and sentence parsing (working out the syntactic structure of sentences).

Psycholinguistics as a term appears to have first been used to refer to the psychology of language in the 1920s. However, the birth of psy-

cholinguistics as a discipline is often linked to a seminar at Cornell University in 1951. The interdisciplinary nature of the field is reflected in the fact that this seminar was reported in both a psychology journal and a linguistics one. Courses and research in psycholinguistics are also found in multidisciplinary cognitive science units throughout the world, and the issues studied in this area are also of interest to computer scientists (particularly those interested in artificial intelligence and human-computer interaction), philosophers, and others. Neuropsychologists might especially be interested in locating the language faculties within the physical structures of the brain. A more linguistic perspective may be that studying language use can inform our theories of language structure. It can provide the performance data to support theories of competences, psychological validity for linguistic constraints, and so on.

1. i. How do psycholinguists conduct research in psycholinguistics?

Although some of our knowledge in this field comes from introspection and the observation of daily behavior, most of the major insights have come through the generation and testing of hypotheses through experiments. More recently, there has been a marked increase in high-tech observation, measuring brain activity while participants are engaged in language-related tasks. Because of this combination of types of evidence, psycholinguistics tends to blend the theoretical and descriptive insights of linguistics with the experimental methodology and rigour of psychology.

1. i. a) Observation

Sophisticated experimental procedures and equipment have only become available relatively recently, and so it is no surprise that early discoveries in psycholinguistics were based on more observational approaches and post-mortem observations (see McFee, 1990). Early approaches also focused in particular on speech production, since the spoken output is most easily observed. We can observe where speakers make errors and relate these errors to hypotheses about the speech planning and production processes. We can also look at the correction of errors (self-correction) as an indication that speakers are monitoring their own output. Rather less often, we can note when speakers are in a 'tip-

of-the-tongue' state and find out from them what they can remember of an elusive word, and see what this might tell us about the processes involved in finding words (also see: "the groping phenomena").

1. i. b) Experiment

Experimental methods have become highly sophisticated over the past half century, in particular with the ready availability of software that allows a high level of control over the presentation of stimuli and collection of data, with precise timing. Advantages of experimental over observational approaches include the reduction of observer bias and the increased control over what participants are required to do. The disadvantages of experimental approaches, however, is the relative lack of "ecological validity" – it is usually only in experimental settings that participants are asked to make an explicit judgement about whether or not a stimulus they have heard is a word of their language, or makes sense in their language. Typically, experimental techniques involve some kind of response time measure, where the time taken by participants to carry out some language-related task is recorded, often together with their accuracy in that task. It is assumed that the time taken by the participant to complete the task depends on how much spare capacity they have, which will in turn depend on the nature of the linguistic processing going on at the same time. Another challenge when it comes to experiments is the ethical dimension of working with different participants (or patients) and gaining informed consent for participation in the studies.

2. Carroll, D. W. (2008). *Psychology of Language* (5th ed.). Thomson Wadsworth. pp. 1-15.

Psycholinguistics is part of the emerging field of study called cognitive science. Cognitive science is an interdisciplinary venture that draws upon the insights of psychologists, linguists, computer scientists, neuroscientists, and philosophers to study the mind and mental processes. Some of the topics that have been studied by cognitive scientists include problem solving, memory, imagery, and language. Anyone who is seriously interested in any of these topics must be prepared to cross disciplinary lines, for the topics do not belong to any one field of study but

rather are treated in distinctive and yet complementary ways by various disciplines.

As the name implies, psycholinguistics is principally an integration of the fields of psychology and linguistics. Linguistics is the branch of science that studies the origin, structure, and use of language. Like most interdisciplinary fields, however, psycholinguistics has a rich heritage that includes contributions from diverse intellectual traditions. These contrasting approaches have often led to controversies in how to best think of or study language processes.

At its heart, psycholinguistic work consists of two questions. One is: What knowledge of language is needed for us to use language? In a sense, we must know a language to use it, but we are not always fully aware of this knowledge. A distinction may be drawn between tacit knowledge and explicit knowledge. Tacit knowledge refers to the knowledge of how to perform various acts, whereas explicit knowledge refers to the knowledge of the processes or mechanisms used in these acts. We sometimes know how to do something without knowing how we do it. We may distinguish between knowing *how to* speak and knowing *what processes* are involved in producing speech. Generally speaking, much of our linguistic knowledge is tacit rather than explicit. Another primary psycholinguistic question is: What cognitive processes are involved in the ordinary use of language? Although we do few things as often or as easily as speaking and listening, we will find that considerable cognitive processing is going on during those activities.

These questions reemerge in different forms in studies of adult language comprehension and production, the social use of language, language use in aphasia, and language in children.

2. i. Examples related to language and cognitive processing

2. i. a) Garden path sentences

What happens when we comprehend a sentence? We get a hint of what is involved when the process breaks down (syntactic processing). For example, consider the sentence: *The novice accepted the deal before he had a chance to check his finances, which put him in a state of conflict when he realized he had a straight flush.* Sentences such as this are sometimes called *garden path sentences* because the subjective im-

pression is one of following "a garden path" to a predictable destination until it is obvious that you were mistaken in your original interpretation and thus are forced to backtrack and reinterpret the sentence. These sentences are easy for the grammar to produce, but hard for the parser because they are "led down the garden path" to the wrong structure. In terms of knowledge, we have stored in our memory at least two different meanings of the word 'deal'. One is related to a business transaction, and the other, relevant in this case, pertains to card games. This knowledge of the two meanings of the word 'deal' is part of our semantic knowledge of the language. Another part of our semantic knowledge is knowledge of the relationships among words, such as 'deal' and 'finances'. From a processing standpoint, we appear to select the one that is most appropriate, and we have little or no conscious awareness of the alternative (or how else would we have the garden path experience?). That is, we are able, by some process, to focus our attention on what we believe is the relevant meaning of 'deal'. There is more to garden path sentences than what we are immediately aware of. Some grammatically complex sentences are easy to parse, while some grammatically easy sentences are hard to parse. In the course of comprehending language, we are *making decisions*—we are doing mental work.

2. i. b) Language in aphasia

Although the primary focus is on language processes in healthy individuals, we can learn more about language by studying individuals with impaired language functioning. Aphasia is a language disorder that occurs due to brain damage. One type of aphasia, called Wernicke's aphasia, involves a breakdown in semantics. For example: *Before I was in the one here, I was over in the other one. My sister had the department in the other one*. The semantic relationships between words in this string are seriously disrupted, suggesting that the patient's semantic knowledge has been impaired due to brain damage. In contrast, phonological knowledge was spared; the speech, although devoid of meaning, was articulated smoothly and with appropriate pausing and intonation. It also displays appropriate syntactic structure, which is typical in Wernicke's aphasia. Although the details of the links between brain structures and language elude us, what is presently known is both fascinating and instructive. Depending on the exact location of the injury, its severity, and

many other factors, an individual who has sustained a brain injury may display a wide variety of reactions. One person may have normal comprehension but be deficient in language production. Another may have no loss of ability with sentence structure but have greater than normal problems finding words. Still, other individuals may be unimpaired in comprehension and production but be unable to repeat exactly what they have heard and/or understood. In healthy individuals with intact brains, various facets of language – sentence structure, meaning, sounds – appear to form a smoothly coordinated system of communication; however, in individuals suffering and living with brain damage, this system is revealed to be a combination of separate parts, for the deficits in such persons are often selective rather than total. Thus, brain injuries enable us to analyze an apparently unified program of language abilities into its separate components and raise questions about how such abilities become integrated in cases where there were no injuries or conditions that would lead to difficulties in language processing and language production.

2. i. c) Language in children

An area of considerable concern to psycholinguists is language acquisition. As difficult as it is to infer linguistic knowledge in adults (and how linguistic knowledge and usage overlap), the problem is even more intractable with children. Imagine a young child, about 1 year old, interacting with her mother. Typically, children around this age produce one word at a time. When the mother leaves the room and then returns with the child's favorite doll, the child says 'doll', not 'mother'. Later, when the mother is helping her with lunch, the child points at the milk and says 'more'. Still later, when the child is struggling with her shoes and the mother asks her what she is doing, the simple response is 'off'. What can we conclude from these observations? For starters, the child might know, at least in a tacit manner, some of the rules of language to use words appropriately. We could infer that she uses 'more' not as an isolated word or imitation but as a request that the mother bring the milk closer. 'Doll' is less clear; the child might be making a comment on her environment by labeling a thing she finds interesting, or she may be asking for the doll. How do we determine what she is trying to say? Although there is disagreement over exactly how much knowledge to attri-

bute to young children, it appears that children know more than they say and that comprehension is ahead of production. Children somewhat older than the child mentioned in the example above commonly express themselves using two words at a time, by eliminating the closed-class or function words (prepositions, conjunctions, and so on) in favor of open-class or content words (nouns, verbs, adjectives) (see: pivot grammar). This pattern suggests that children have an intuitive understanding of these two grammatical classes, which is part of their syntactic knowledge. Is the orderly pattern of development observed in child language the result of an orderly biological program or of an orderly social environment?

2. ii. Historical overview

Blumenthal (1987) has observed that the interdisciplinary field of psycholinguistics flourished twice: once around the turn of the last century, principally in Europe, and once in the middle of the 20th century, principally in the United States. In both instances, it was a somewhat asymmetrical merger of disciplines. In the early decades of the 20th century, linguists turned to psychologists for insights into how human beings use language. In the later period, psychologists turned to linguists for insights into the nature of language. In between these two periods, behaviorism dominated both fields, each of which practiced a form of benign neglect toward one another.

From the development of the first psychological laboratory, at the University of Leipzig in Germany in 1879, until the early 1900s, psychology was defined as the science of mental life. A major figure in early scientific psychology was Wilhelm Wundt (1832-1920), a man trained in physiology who believed that it was possible to investigate mental events such as sensations, feelings, and images by using procedures as rigorous as those used in natural sciences. Moreover, Wundt believed that the study of language could provide important insights into the nature of the mind. Blumenthal refers to Wundt as the master psycholinguist because Wundt wrote extensively about many different aspects of language. One of Wundt's contributions to the psychology of language was developing a theory of language production. He regarded the sentence, not the word, as the primary unit of language and saw the production of speech as the transformation of a complete thought process

into sequentially organized speech segments (comprehension was thought to be basically the same process in reverse). These two notions – the view that speech production is a word-by-word process as opposed to the view that it begins with a whole sentence – continue to be of interest to language researchers.

In the first few decades of the 20th century in the United States, there was mounting opposition to the focus on mental life as a goal for psychology. By the 1920s, behaviorism took over the mainstream of experimental psychology. Behaviorists favored the study of objective behaviour, often in laboratory animals, as opposed to the study of mental processes. Moreover, behaviorists had a strong commitment to the role of experience in shaping behavior. Emphasis was placed on the role of environmental contingencies (such as reinforcement and punishment; trial and error) and on models present in the immediate environment. From the 1920s to the 1950s, psychologists expressed relatively little interest in language. Behaviorists preferred instead to speak of "verbal behaviour". The behavior of speaking correctly was, it was assumed, the consequence of being raised in an environment in which correct language models were present and in which children's speech errors were corrected. The manner in which parents shape their children's utterances was described by the behaviorist B. F. Skinner in his book *Verbal Behavior*: "In teaching the young child to talk, the formal specifications upon which reinforcement is contingent are at first greatly relaxed. Any response which vaguely resembles the standard behavior of the community is reinforced. When these begin to appear more frequently, a closer approximation is insisted upon. In this manner, very complex verbal forms may be reached" (1957: 34). Although this analysis seems straightforward or even obvious, the role of adult speech in child language acquisition is both more controversial and more complex than is suggested in this quote.

Another major topic of research was *meaning*. A number of behaviorist accounts of meaning were developed, most of which emphasized associations among words. Noble and McNeely (1957) constructed an index of the meaningfulness of individual words by measuring the number of associations a person could produce in a designated period of time. Later studies showed that high-meaningfulness words were more easily learned in a variety of tasks than low-meaningfulness words. It

was also about this time that Osgood and his associates developed the semantic differential (1954), a tool for measuring the associative meanings of words by asking people to rate words on dimensions such as 'good/bad' and 'strong/weak'.

Despite the inherent interconnections between the fields, psychology and linguistics went their separate ways for a period of several decades. By the early 1950s, psychologists and linguists became more interested in discussing issues together. Tanenhaus describes the events in the following way: "In 1951 the Social Science Research Council sponsored a conference that brought together several leading psychologists and linguists. . . . The proceedings of the conference outlined a psycholinguistic research agenda that reflected a consensus among participants that the methodological and theoretical tools developed by psychologists could be used to explore and explain the linguistic structures that were being uncovered by linguists" (Newmeyer, 1988: 4). A second, larger conference occurred two years later and included anthropologists and communications engineers as well as psychologists and linguists. It was out of these exchanges that the term psycholinguistics first came into use. Not everyone was fond of the term. One of the participants at the first conference, Roger Brown, complained that a "psycholinguist" sounded more like a deranged polyglot than a psychologist interested in language, but the name stuck.

The second period of interdisciplinary psycholinguistics took a firmer hold in the late 1950s, beginning with the emergence of the linguist Noam Chomsky. Chomsky is generally regarded as the most influential figure in 20th-century linguistics, and Newmeyer has characterized the Chomskyan influence in linguistics as a revolution. Chomsky has also played a powerful role in how psychologists perceived language because he argued that the behaviorists' accounts of language were inadequate and severely criticized Skinner. Let us look at some of his arguments. One theory advanced by behaviorists is called the associative chain theory, which states that a sentence consists of a chain of associations between individual words in a sentence. In other words, each word in a sentence serves as a stimulus for the next word, and thus the entire sentence is produced left to right (at least for European languages). Lashley (1951) had earlier argued against such a view, claiming that there is something more to the structure of a sentence than the associa-

tions between adjacent words. Chomsky advanced this notion further. Consider the following sentences:

(a) Colorless green ideas sleep furiously.
(b) Furiously sleep ideas green colorless.
(c) George picked up the baby.
(d) George picked the baby up.

Chomsky suggested that associations between words could not possibly explain the existence of sentences such as (a). Even though the associations between these words are almost non-existent, the sentence is syntactically acceptable. But, if the words are presented backward, as in sentence (b), it is not a sentence at all. Now consider sentences (c) and (d). It is part of our intuitive knowledge of the language that these sentences are synonymous, but this simple fact poses problems for the associative chain theory. Clearly, there is a relationship between 'pick' and 'up' in these sentences, but the relationship is more complex in (d) than in (c), because the words are separated. To comprehend the sentence, we must somehow know that these words are part of a linguistic unit, or a constituent. Chomsky has also argued that language acquisition cannot be explained in terms of children's language experience. His primary argument is called the poverty of stimulus argument. This argument states that there is not enough information in the language samples given to children to fully account for the richness and complexity of children's language. Chomsky's argument is this: The language children acquire is intricate and subtle, and the sample of speech given to them during the course of language development is anything but. Therefore, although parents may assist the child's language development in some ways and influence the rate of development somewhat, the pattern of development is based not on parental speech (or caregiver language) but on innate language knowledge. The Chomskyan revolution has had a powerful effect on psychological thinking about language. In the late 1960s, Chomsky noted that "the study of language may very well, as was traditionally supposed, provide a remarkably favorable perspective for the study of human mental processes" and that linguistics could be profitably viewed as a branch of cognitive psychology. That is, linguists were examining the kinds of linguistic knowledge needed for ordinary language use and realized that this knowledge must be used, in some way, by those who use the language. As Dan Slobin (1971: 3) puts it, a person

who has learned a language has formed something that is "psychologically equivalent" to a grammar. Thus, psychologists became very interested in linguistics in general and in Chomsky's transformational grammar in particular.

George Miller (1920-2012), a psychologist, created an important bridge between psychology and linguistics by introducing psychologists to Chomsky's ideas and their psychological implications. Miller collaborated with Chomsky on several articles and papers in the early 1960s and was at the forefront of research during this period to determine the psychological reality of linguistic rules.

Language development became an especially popular topic for investigators during this period. Several longitudinal investigations of child language, in which a sample of a child's speech is collected at several points over a period of years, emerged in the early 1960s, and various "grammars" for child language were written, modeled after adult grammars but differing in the specific rules. The major questions for language acquisition researchers were posed in the following way: What set of rules governs the child's developing grammar, and when does this set develop? Theoretical analyses of language development emphasized the role of innate factors. Together with Chomsky, the most influential person in this regard was Eric Lenneberg, whose 1967 book *Biological Foundations of Language* pulled together evidence from aphasia, studies of delayed language development, and the available neurophysiological information into an elegant argument for the role of innate factors in language development (also see: Critical Period Hypothesis).

Another strong advocate of innate factors was David McNeill (1933–), who proposed a theory of development based on the concept of language universals. The revolution of the 1960s and early 1970s emphasized the role of linguistic theory in psycholinguistic research and the role of innate mechanisms in language acquisition. These themes continue to be influential, but there are indications that psychological interest in linguistic theory has waned. Arthur S. Reber (1940–) examined the number of references to Chomsky in psycholinguistic studies and found that they rose sharply in the late 1960s, peaked in the mid-1970s, and then fell off by the early 1980s. Although it might be interesting to look at citations of other linguists, these data nonetheless appear to re-

flect the trend among psychologists to shy away from directly incorporating linguistic concepts into psychological research. Reber cites several reasons for these changes. One was that throughout the 1960s and 1970s linguistic theories underwent rapid and (to psychologists, at least) confusing changes (see Reber, 1987). These changes made it difficult for psychologists to base their studies on any particular linguistic view, and some psychologists became wary of linguistics, preferring instead to develop a psychological view of language that was not tied to any specific linguistic theory.

2. iii. Where do things stand in the present?

Although early psycholinguistics primarily focused on syntax, more recently there has been an upsurge in interest in phonology, semantics, and pragmatics. These developments have led to a more well-rounded field, with research that cuts across these different areas. Second, although early research in psycholinguistics focused on language comprehension, there has been a strong surge of interest in language production recently. It is tempting to think that comprehension and production are mirror images of one another. However, this view is misleading, as there are processes in production that are not merely the reverse of comprehension. Third, the development of techniques that allow researchers to see visual images of the brain has stimulated considerable interest in the brain mechanisms and pathways associated with language. For more than a hundred years, the primary method used in neurolinguistics was the study of language in individuals with aphasia. We can now observe the functioning of intact brains during various language tasks. Finally, psycholinguistics has matured to the point that we are beginning to see applications of psycholinguistic principles that are useful to the society. At the same time, tangible progress has been made in applying psycholinguistic research to topics such as reading, bilingualism, language disorders, and teaching English as a foreign language (EFL). These advances have been made possible by integrating the insights from different disciplines within cognitive science.

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3. Field, J. (2004). *Psycholinguistics: The Key Concepts.* Routledge. pp. 185-188.

Nativism is the view that language is genetically transmitted, and that children are born with an innate language faculty. A conflict between two views of the origin of knowledge (including linguistic knowledge) goes back over two thousand years. Plato expressed the view that a child could not possibly, in the short time available to it, acquire the range of knowledge that an adult displays. Nativist arguments were eclipsed in the mid-twentieth-century heyday of behaviorism, when language was viewed as a habit acquired through a process of stimulus, reinforcement and reward. But they resurfaced powerfully with Chomsky's critique of behaviourist doctrine in his 1959 review of B. F. Skinner's *Verbal Behavior*. Chomsky concluded that language acquisition was only explicable if one postulated the existence of a faculty, present from birth, which supported it. The neurologist Lenneberg also argued in favour of nativism on the grounds that language shows features similar to other types of behavior which are biologically triggered. This suggested to him that it was controlled by some innate mechanism.

In the Chomskyan tradition, a number of standard arguments are invoked against the empiricist view that language is acquired entirely through exposure to adult speech:

a. *Timescale.* In the period of only five years, the child acquires a vocabulary of about 5000 words and the ability to produce a range of well-formed utterances, some of which the child may never have heard before.

b. *Lack of correlation between intelligence and language acquisition.* Children achieve mastery of their first language regardless of variations in intelligence and in their ability to perform other cognitive operations.

c. *Input: 'Poverty of stimulus'.* Chomsky described as 'degenerate' the adult speech from which the child supposedly acquires language. It contains all the features of natural connected speech (hesitations etc.) – including errors of grammar, repetitions and simplifications. It exemplifies only a limited range of the possible sentences of the language. The child is exposed to a range of speakers, with different voices, intonation patterns and accents. Finally, the input provides examples of language

performance when the child's goal is to develop competence. How is the child to build the latter solely on random evidence of the former?

c. *Input: linearity.* An empiricist view assumes that the child induces the rules of grammar by generalising from specific utterances. But Gold's Theorem calculates that this process cannot account for the way in which the child acquires the concept of structure- dependency (the recognition that language is composed of sets of phrases which are organised into a hierarchy). It cannot account for anything more than a finite-state (word-by-word) grammar.

c. *Input: negative evidence.* Infants are said to require negative evidence (evidence of sentences which are not acceptable) to show them which syntactic patterns are not permissible; this is self-evidently not available in the input they receive. Example: An infant exposed to Italian has evidence that utterances occur 'with subject pronoun' and (more frequently) 'without subject pronoun'. An infant exposed to English encounters many examples of the 'with subject pronoun' condition, but never any of the negative rule that 'without subject pronoun' is not permissible in English.

c. *Input: carer correction.* Carers tend to correct facts rather than syntax (though they are more likely to repeat grammatically correct sentences). Any attempts to correct syntax and phonology produce little immediate effect.

d. *Order of acquisition.* Within a given language (and even across languages), there is evidence that children acquire certain syntactic features in a set order. The child also produces language for which there is no evidence in the input: for example, incorrect Past Simple forms such as 'goed' or 'seed'. This cannot come from adult examples; it indicates that the child is in the (fluctuation) process of building up a system of language for itself.

Nativist accounts of language acquisition vary widely: not least, in how they represent what it is that is genetically transmitted. Chomsky originally hypothesised that infants are born with a Language Acquisition Device (LAD), a mechanism which enables them to trace patterns in the impoverished data with which they were presented. In his later work, the LAD is replaced with the concept of a Universal Grammar (UG), alerting the child to those features which are common to most or all

of the world's languages and enabling it to recognise them in the speech it hears. UG consists of a set of principles which specify the essential nature of language: they include structure-dependency and the presence of words. It also includes a set of parameters, linguistic features which can be set according to the language that the child is acquiring.

Steven Pinker (1954—) takes a more radical nativist view, asserting that we are innately endowed with *mentalese*, an internal language of thought. First language acquisition involves translating this language into strings of words specific to the language being acquired. Mentalese is abstract but closely parallels speech. The mapping between mentalese and speech is assisted by Universal Grammar which, in Pinker's account, includes specific linguistic information such as the existence of nouns and verbs and the categories of subject and object.

Furthermore, there are differing accounts of the status of Universal Grammar at the time the child is born. For instance, *continuity theory* asserts that UG is hard-wired in the child, with all its features present from birth. They cannot all be applied at once, however, because the development of one piece of linguistic knowledge may be dependent upon another having been established and/or upon the child's cognitive development. Thus, the concept of Subject / Verb / Object cannot be achieved until after the child has recognised the word as an independent unit and developed the memory capacity to retain a three-word utterance.

By contrast, *maturational theory* suggests that the acquisition of syntactic concepts is biologically programmed in the child, just as the growth of teeth or the development of vision is programmed.

While the nativist view still commands widespread support, alternatives have increasingly come under consideration. This is partly because research into *child-directed speech* has shown that it is not as impoverished as Chomsky assumed. It is partly because the Chomskyan view of language as infinitely productive and creative has been questioned in the light of evidence that pre-assembled formulaic chunks play an important role in many utterances. It is also because connectionist computer models have demonstrated that learning can indeed take place by dint of tracing patterns across multiple examples of linguistic features and adjusting the system to take account of errors.

4. Chomsky, N. (2006). *Language and Mind* (3rd ed.). Cambridge University Press. pp. 23-28.

We must recognize that even the most familiar phenomena require explanation and that we have no privileged access to the underlying mechanisms, no more so than in physiology or physics. Only the most preliminary and tentative hypotheses can be offered concerning the nature of language, its use, and its acquisition. As native speakers, we have a vast amount of data available to us. For just this reason, it is easy to fall into the trap of believing that there is nothing to be explained, that whatever organizing principles and underlying mechanisms may exist must be "given" as the data is given. Nothing could be further from the truth, and an attempt to characterize precisely the system of rules we have mastered that enables us to understand new sentences and produce a new sentence on an appropriate occasion will quickly dispel any dogmatism on this matter. The search for explanatory theories must begin with an attempt to determine these systems of rules and to reveal the principles that govern them.

The person who has acquired knowledge of a language has internalized a system of rules that relate sound and meaning in a particular way. The linguist constructing a grammar of a language is in effect proposing a hypothesis concerning this internalized system. The linguist's hypothesis, if presented with sufficient explicitness and precision, will have certain empirical consequences with regard to the form of utterances and their interpretations by the native speaker. Evidently, knowledge of language – the internalized system of rules – is only one of the many factors that determine how an utterance will be used or understood in a particular situation. The linguist who is trying to determine what constitutes knowledge of a language – to construct a correct grammar – is studying one fundamental factor that is involved in performance, but not the only one. This idealization must be kept in mind when one is considering the problem of confirmation of grammars on the basis of empirical evidence. There is no reason why one should not also study the interaction of several factors involved in complex mental acts and underlying actual performance, but such a study is not likely to proceed very far unless the separate factors are themselves fairly well understood.

In a good sense, the grammar proposed by the linguist is an *explanatory theory*; it suggests an explanation for the fact that (under the idealization mentioned) a speaker of the language in question will perceive, interpret, form, or use an utterance in certain ways and not in other ways. One can also search for explanatory theories of a deeper sort. The native speaker has acquired a grammar on the basis of very restricted and degenerate evidence; the grammar has empirical consequences that extend far beyond the evidence. At one level, the phenomena with which the grammar deals are explained by the rules of the grammar itself and the interaction of these rules. At a deeper level, these same phenomena are explained by the principles that determine the selection of the grammar on the basis of the restricted and degenerate evidence available to the person who has acquired knowledge of the language, who has constructed for himself this particular grammar. The principles that determine the form of grammar and that select a grammar of the appropriate form on the basis of certain data constitute a subject that might, following a traditional usage, be termed "universal grammar". The study of universal grammar, so understood, is a study of the nature of human intellectual capacities. It tries to formulate the necessary and sufficient conditions that a system must meet to qualify as a potential human language, conditions that are not accidentally true of the existing human languages, but that are rather rooted in the human "language capacity," and thus constitute the innate organization that determines what counts as linguistic experience and what knowledge of language arises on the basis of this experience. Universal grammar, then, constitutes an explanatory theory of a much deeper sort than particular grammar, although the particular grammar of a language can also be regarded as an explanatory theory.

In practice, the linguist is always involved in the study of both universal and particular grammar. When he constructs a descriptive, particular grammar in one way rather than another on the basis of what evidence he has available, he is guided, consciously or not, by certain assumptions as to the form of grammar, and these assumptions belong to the theory of universal grammar. Conversely, his formulation of principles of universal grammar must be justified by the study of their consequences when applied in particular grammars. Thus, at several levels the linguist is involved in the construction of explanatory theories, and

at each level there is a clear psychological interpretation for his theoretical and descriptive work. At the level of particular grammar, he is attempting to characterize knowledge of a language, a certain cognitive system that has been developed – unconsciously, of course – by the normal speaker–hearer. At the level of universal grammar, he is trying to establish certain general properties of human intelligence. Linguistics, so characterized, is simply the subfield of psychology that deals with these aspects of mind.

I will try to give some indication of the kind of work now in progress that aims, on the one hand, to determine the systems of rules that constitute knowledge of a language, and on the other, to reveal the principles that govern these systems. Obviously, any conclusions that can be reached today regarding particular or universal grammar must be quite tentative and restricted in their coverage. And in a brief sketch such as this only the roughest outlines can be indicated. To try to give something of the flavor of what is being done today I will concentrate on problems that are current in that they can be formulated with some clarity and studied, though they still resist solution.

I believe that the most appropriate general framework for the study of problems of language and mind is the system of ideas developed as part of the rationalist psychology of the seventeenth and eighteenth centuries, elaborated in important respects by the romantics and then largely forgotten as attention shifted to other matters. According to this traditional conception, a system of propositions expressing the meaning of a sentence is produced in the mind as the sentence is realized as a physical signal, the two being related by certain formal operations that, in current terminology, we may call *grammatical transformations.* Continuing with current terminology, we can thus distinguish the *surface structure* of the sentence, the organization into categories and phrases that is directly associated with the physical signal, from the underlying *deep structure*, also a system of categories and phrases, but with a more abstract character. Thus, the surface structure of the sentence "A wise man is honest" might analyze it into the subject "a wise man" and the predicate "is honest." The deep structure, however, will be rather different. It will, in particular, extract from the complex idea that constitutes the subject of the surface structure an underlying proposition with the subject "man" and the predicate "be wise." In fact, the deep structure, in

the traditional view, is a system of two propositions, neither of which is asserted, but which interrelate in such a way as to express the meaning of the sentence "A wise man is honest."

If this approach is correct in general, then a person who knows a specific language has control of a grammar that *generates* (that is, characterizes) the infinite set of potential deep structures, maps them onto associated surface structures, and determines the semantic and phonetic interpretations of these abstract objects. From the information now available, it seems accurate to propose that the surface structure determines the phonetic interpretation completely and that the deep structure expresses those grammatical functions that play a role in determining the semantic interpretation, although certain aspects of the surface structure may also participate in determining the meaning of the sentence in ways that I will not discuss here. A grammar of this sort will therefore define a certain infinite correlation of sound and meaning. It constitutes a first step toward explaining how a person can understand an arbitrary sentence of his language.

5. Miller, G. A. (1967). *The Psychology of Communication: Seven Essays.* Basic Books Inc. pp. 74-86.

Interest in psycholinguistics . . . is not confined to psychologists and linguists. Many people have been stirred by splendid visions of its practical possibilities. One thinks of medical applications to the diagnosis and treatment of a heterogeneous variety of language disorders ranging from simple stammering to the overwhelming complexities of aphasia. One thinks too of pedagogical applications, of potential improvements in our methods for teaching reading and writing, or for teaching second languages. If psycholinguistic principles were made sufficiently explicit, they could be imparted to those technological miracles of the twentieth century, the computing machines, which would bring into view a whole spectrum of cybernetic possibilities...

The integration of psycholinguistic studies has occurred so recently that there is still some confusion concerning its scope and purpose; efforts to clarify it necessarily have something of the character of personal opinion. In my own version, the central task of this new science is to describe the psychological processes that go on when people use sen-

tences. The real crux of the psycholinguistic problem does not appear until one tries to deal with sentences, for only then does the importance of productivity become completely obvious. It is true that productivity can also appear with individual words, but there it is not overwhelming. With sentences, productivity is literally unlimited.

Before considering this somewhat technical problem, however, it might be well to illustrate the variety of processes that psycholinguists hope to explain. This can best be done if we ask what a listener can do about a spoken utterance, and consider his alternatives in order from the superficial to the inscrutable.

The simplest thing one can do in the presence of a spoken utterance is to listen. Even if the language is incomprehensible, one can still hear an utterance as an auditory stimulus and respond to it in terms of some discriminative set: how loud, how fast, how long, from which direction, etc.

Given that an utterance is heard, the next level involves matching it as a phonemic pattern in terms of phonological skills acquired as a user of the language. The ability to match an input can be tested in psychological experiments by asking listeners to echo what they hear; a wide variety of experimental situations - experiments on the perception of speech and on the rote memorization of verbal materials - can be summarized as tests of a person's ability to repeat the speech that he hears under various conditions of audibility or delay.

If a listener can hear and match an utterance, the next question to ask is whether he will accept it as a sentence in terms of his knowledge of grammar. At this level we encounter processes difficult to study experimentally, and one is forced to rely most heavily on linguistic analyses of the structure of sentences. Some experiments are possible, however, for we can measure how much a listener's ability to accept the utterance as a sentence facilitates his ability to hear and match it; grammatical sentences are much easier to hear, utter, or remember than are ungrammatical strings of words, and even nonsense (*pirot, karol, elat, etc.*) is easier to deal with if it looks grammatical (*pirots karolize elatically*, etc.). Needless to say, the grammatical knowledge we wish to study does not concern those explicit rules drilled into us by teachers of traditional grammar, but rather the implicit generative knowledge that we all must acquire in order to use a language appropriately.

From O'Grady & Archibald (2016: 354)

A particularly celebrated case of a dissociation between language and cognitive development involves Christopher, considered to be a linguistic savant. Now an adult, Christopher can read, write, and communicate in about twenty languages (including English, Danish, Dutch, Finnish, French, German, Modern Greek, Hindi, Italian, Norwegian, Polish, Portuguese, Russian, Spanish, Swedish, Turkish, and Welsh). He learned some of these languages as a child (based on minimal exposure) and taught himself others as an adolescent and adult, often with amazing speed, as the following account of his encounter with Dutch illustrates. Shortly before he was due to appear on Dutch television, it was suggested that he might spend a couple of days improving his rather rudimentary Dutch with the aid of a grammar and dictionary. He did so to such good effect that he was able to converse in Dutch — with facility if not total fluency — both before and during the programme. Christopher has a non-verbal IQ (depending on the test) of between 56 and 76, and a mental age of 9 years, 2 months. He has trouble with addition (he can handle simple cases such as 12 + 13, but not 'carrying over' as in 14 + 19); he is very bad at drawing; and he can't figure out how tic-tac-toe works. He is unable to care for himself and lives in a home for adults with special needs.

Beyond grammatical acceptance comes semantic interpretation: we can ask how listeners interpret an utterance as meaningful in terms of their semantic system. Interpretation is not merely a matter of assigning meanings to individual words; we must also consider how these component meanings combine in grammatical sentences. Compare the sentences: 'Healthy young babies sleep soundly' and 'Colorless green ideas sleep furiously'. Although they are syntactically similar, the second is far harder to perceive and remember correctly - because it cannot be interpreted by the usual semantic rules for combining the senses of adjacent English words. The interpretation of each word is affected by the company it keeps; a central problem is to systematize the interactions of words and phrases with their linguistic contexts.

At the next level it seems essential to make some distinction between interpreting an utterance and understanding it, for understan-

ding frequently goes well beyond the linguistic context provided by the utterance itself. A husband greeted at the door by 'I bought some electric light bulbs today' must do more than interpret its literal reference; he must understand that he should go to the kitchen and replace that burned-out lamp. Such contextual information lies well outside any grammar or lexicon. The listener can understand the function of an utterance in terms of contextual knowledge of the most diverse sort.

Finally, at a level now almost invisible through the clouds, a listener may believe that an utterance is valid in terms of its relevance to his own conduct. The child who says 'I saw five lions in the garden' may be heard, matched, accepted, interpreted, and understood, but in few parts of the world will he be believed.

The boundaries between successive levels are not sharp and distinct. One shades off gradually into the next. Still the hierarchy is real enough and important to keep in mind. Simpler types of psycholinguistic processes can be studied rather intensively; already we know much about hearing and matching. Accepting and interpreting are just now coming into scientific focus. Understanding is still over the horizon, and pragmatic questions involving belief systems are at present so vague as to be hardly worth asking. But the whole range of processes must be included in any adequate definition of psycholinguistics.

I phrased the description of these various psycholinguistic processes in terms of a listener; the question inevitably arises as to whether a different hierarchy is required to describe the speaker. One problem a psycholinguist faces is to decide whether speaking and listening are two separate abilities, coordinate but distinct, or whether they are merely different manifestations of a single linguistic faculty.

The mouth and ear are different organs; at the simplest levels we must distinguish hearing and matching from vocalizing and speaking. At more complex levels it is less easy to decide whether the two abilities are distinct. At some point they must converge, if only to explain why it is so difficult to speak and listen simultaneously. The question is where they converge. Suppose we accept the notion that a listener recognizes what he hears by comparing it with some internal representation. One trouble with this hypothesis is that a listener must be ready to recognize any one of an enormous number of different sentences. It is

inconceivable that a separate internal representation of each of them could be stored in his memory in advance. Halle and Stevens suggest that these internal representations must be generated as they are needed by following the same generative rules that are usually used in producing speech. In this way, the rules of the language need not be learned once by the ear and again by the tongue. This is a theory of a language user, not of a speaker or a listener alone. A listener's first [attempt to interpret the speech signal] probably derives in part from syntactic markers in the form of intonation, inflection, suffixes, etc., and in part from his general knowledge of the semantic and situational context. Syntactic cues indicate how the input is to be grouped and which words function together; semantic and contextual contributions are more difficult to characterize, but must somehow enable him to limit the range of possible words that he can expect to hear. With an advance hypothesis about what the message will be, we can tune our perceptual system to favour certain interpretations and reject others.

I have already offered the opinion that *productivity* sets the central problem for the psycholinguist and have referred to it indirectly by arguing that we can produce too many different sentences to store them all in memory. Original combinations of elements are the lifeblood of language. It is our ability to produce and comprehend such novelties that makes language so ubiquitously useful. As psychologists have become more seriously interested in the cognitive processes that language entails, they have been forced to recognize that the fundamental puzzle is not our ability to associate vocal noises with perceptual objects, but rather our combinatorial productivity - our ability to understand an unlimited diversity of utterances never heard before and to produce an equal variety of utterances similarly intelligible to other members of our speech community.

As psychologists have learned to appreciate the complexities of language, the prospect of reducing it to the laws of behavior so carefully studied in lower animals has grown increasingly remote. We have been forced more and more into a position that non-psychologists probably take for granted, namely, that language is rule-governed behavior characterized by enormous flexibility and freedom of choice.

Obvious as this conclusion may seem, it has important implications for any scientific theory of language. If rules involve the concepts

of right and wrong, they introduce a normative aspect that has always been avoided in the natural sciences. One hears repeatedly that the scientist's ability to suppress normative judgements about his subject matter enables him to see the world objectively, as it really is. To admit that language follows rules seems to put it outside the range of phenomena accessible to scientific investigation.

At this point, a psycholinguist who wishes to preserve his standing as a natural scientist faces an old but always difficult decision. Should he withdraw and leave the study of language to others? Or should he give up all pretense of being a 'natural scientist', searching for causal explanations, and embrace a more phenomenological approach? Or should he push blindly ahead with his empirical methods, hoping to find a causal basis for normative practices but running the risk that all his efforts will be wasted because rule-governed behavior in principle lies beyond the scope of natural science?

To withdraw means to abandon hope of understanding scientifically all those human mental processes that involve language in any important degree. To persevere means to face the enormously difficult, if not actually impossible, task of finding a place for normative rules in a descriptive science. Difficult, yes. Still one wonders whether these alternatives are really as mutually exclusive as they have been made to seem. The first thing we notice when we survey the languages of the world is how few we can understand and how diverse they all seem. Not until one looks for some time does an even more significant observation emerge concerning the pervasive similarities in the midst of all this diversity.

Every human group that anthropologists have studied has spoken a language. The language always has a lexicon and a grammar. The lexicon is not a haphazard collection of vocalizations, but is highly organized; it always has pronouns, means for dealing with time, space, and number, words to represent true and false, the basic concepts necessary for propositional logic. The grammar has distinguishable levels of structure, some phonological, some syntactic. The phonology always contains both vowels and consonants, and the phonemes can always be described in terms of distinctive features drawn from a limited set of possibilities. The syntax always specifies rules for grouping elements sequentially into phrases and sentences, rules governing normal intonation, rules for transforming some types of sentences into other types.

The nature and importance of these common properties, called 'linguistic universals', are only beginning to emerge as our knowledge of the world's languages grows more systematic (Greenberg, 1963). These universals appear even in languages that developed with a minimum of interaction. One is forced to assume, therefore, either that (a) no other kind of linguistic practices are conceivable, or that (b) something in the biological makeup of human beings favours languages having these similarities. Only a moment's reflection is needed to reject (a). When one considers the variety of artificial languages developed in mathematics, in the communication sciences, in the use of computers, in symbolic logic, and elsewhere, it soon becomes apparent that the universal features of natural languages are not the only ones possible. Natural languages are, in fact, rather special and often seem unnecessarily complicated.

A popular belief regards human language as a more or less free creation of the human intellect, as if its elements were chosen arbitrarily and could be combined into meaningful utterances by any rules that strike our collective fancy. The assumption is implicit, for example, in Wittgenstein's well-known conception of 'the language game'. This metaphor, which casts valuable light on many aspects of language, can if followed blindly lead one to think that all linguistic rules are just as arbitrary as, say, the rules of chess or football. As Lenneberg has pointed out, however, it makes a great deal of sense to inquire into the biological basis for language, but very little to ask about the biological foundations of card games [...].

In the jargon of biology, language is 'a species-specific form of behavior'. Other animals have signalling systems of various kinds and for various purposes – but only man has evolved this particular and highly improbable form of communication. Those who think of language as a free and spontaneous intellectual invention are also likely to believe that any animal with a brain sufficiently large to support a high level of intelligence can acquire a language. This assumption is demonstrably false. The human brain is not just an ape brain enlarged; its extra size is less important than its different structure. Moreover, Lenneberg has pointed out that nanocephalic dwarfs, with brains half the normal size but grown on the human blueprint, can use language reasonably well, and even Down's Syndrome sufferers, unable to perform the sim-

plest functions for themselves, can acquire the rudiments. Talking and understanding language do not depend on being intelligent or having a large brain. They depend on 'being human'.

6. Pinker, S., & Jackendoff, R. (2005). The faculty of language: What's special about it? *Cognition, 95,* 201-236.

In an article by Hauser, Chomsky, and Fitch (The Faculty of Language: What is it, who has it, and how did it evolve, 2002), they offer a hypothesis about what is special about language, with reflections on its evolutionary genesis. The article (henceforth: HCF) has attracted much attention both in the popular press and among other language scientists. HCF differentiate (as we do) between aspects of language that are special to language (the "Narrow Language Faculty" or FLN) and the faculty of language in its entirety, including parts that are shared with other psychological abilities (the "Broad Language Faculty" or FLB). The abstract of HCF makes the very strong proposal that the narrow language faculty "only includes recursion and is the only uniquely human component of the faculty of language." Recursion refers to a procedure that calls itself, or to a constituent that contains a constituent of the same kind. In the article itself, the starkness of this hypothesis is mitigated only slightly. The authors suggest that "most, if not all, of FLB is based on mechanisms shared with non-human animals. In contrast, we suggest that FLN—the computational mechanism of recursion – is recently evolved and unique to our species". Similarly, "we propose in this hypothesis that FLN comprises only the core computational mechanisms of recursion as they appear in narrow syntax and the mappings to the interfaces" (i.e. the interfaces with mechanisms of speech perception, speech production, conceptual knowledge, and intentions).

In other words, HCF are suggesting that recursion is the mechanism responsible for everything that distinguishes language both from other human capacities and from the capacities of animals. These assertions are largely independent: there may be parts of the narrow language faculty other than recursion even if the narrow faculty is the only part that is uniquely human; and the narrow faculty might consist only of recursion even if parts of the broad faculty are uniquely human as well. The authors go on to speculate that the recursion mechanism, defining

what is special about language, may not even have evolved for language itself but for other cognitive abilities such as navigation, number, or social relationships.

HCF's hypothesis appears to be a radical departure from Chomsky's earlier position that language is a complex ability for which the human brain, and only the human brain, is specialized. The state of the evidence for HCF's hypothesis that only recursion is special to language is as follows:

- *Conceptual structure*: HCF plausibly suggest that human conceptual structure partly overlaps with that of other primates and partly incorporates newly evolved capacities.
- *Speech perception*: HCF suggest it is simply generic primate auditory perception. But the tasks given to monkeys are not comparable to the feats of human speech perception, and more recent experimental demonstrations of human–monkey differences in speech perception, are not discussed.
- *Speech production*: HCF's recursion-only hypothesis implies no selection for speech production in the human lineage. But control of the supralaryngeal vocal tract is incomparably more complex in human language than in other primate vocalizations. Vocal imitation and vocal learning are uniquely human among primates (talents that are consistently manifested only in speech). And syllabic babbling emerges spontaneously in human infants. HCF further suggest that the distinctively human anatomy of the vocal tract may have been selected for size exaggeration rather than speech. Yet the evidence for the former in humans is weak, and does not account for the distinctive anatomy of the supralaryngeal parts of the vocal tract.
- *Phonology*: Not discussed by HCF.
- *Lexicon*: HCF discuss two ways in which words are a distinctively human ability, possibly unique to our species. But they assign words to the broad language faculty, which is shared by other human cognitive faculties, without discussing the ways in which words appear to be tailored to language—namely that they consist in part (sometimes in large part) of grammatical information, and that they are bidirectional, shared, organized, and generic

in reference, features that are experimentally demonstrable in young children's learning of words.

- *Morphology*: Not discussed by HCF.
- *Syntax*: Case, agreement, pronouns, predicate-argument structure, topic, focus, auxiliaries, question markers, and so on, are not discussed by HCF. Recursion is said to be human-specific, but no distinction is made between arbitrary recursive mathematical systems and the particular kinds of recursive phrase structure found in human languages.

7. Steinberg, D. D., Nagata, H., & Aline, D. P. (2001). *Psycholinguistics: Language, Mind and World* (2nd ed.). Routledge. pp. 144-165.

Can the natural communicative signs of animals in the wild be regarded as language? In order to answer this question, let us consider what characterizes human language and compare it to the communicative signs of animals. One of the most important characteristics of human language is its *creativity*. Using individual words we create simple structures, such as "The man ran". We can make more complex sentences where we can include an object: "The man played the guitar". We can add [elements], to make relative clauses: "The man who bought the bicycle played the guitar". We can ask questions: "Does the man who bought the bicycle play the guitar?" We can make abstract conditional structures about objects not present and events which have not occurred: "If it had rained yesterday, I would have bought an umbrella". In this last sentence, what is truly remarkable is that none of the events talked about – the falling of rain and the buying of an umbrella – had actually occurred.

When we look at animal communication, however, it is clear that whether it is prompted by hunger, anger, danger, attraction, submission, or the need to congregate or disperse, one signal has a fixed meaning and combinations of signs to form more complex structures rarely occur. Although some animal communication systems seem to have the potential of generating an indefinite number of communication patterns, such as that of the black-capped chickadee, it has yet to be shown that such a potential is employed in communication. Even the elemental three- and four-word novel utterances produced by 2-year-old

children have no known counterpart in natural animal communication. Although animals do have ways of adding information, these means are essentially quantitative and not qualitative. Thus, a louder sound might mean more danger, a faster tail-wag might mean more excitement, and the bee's altering the angle of its dance can refine its direction-giving. Natural animal communication seems to be quite specific and stereotyped. Animal calls or signs or scents have a fixed meaning, and, whatever means an animal might use for communicating, it has never been demonstrated that it involves creative recombination or the use of complex structures that are typical of human language.

This lack of language creativity and complexity is true even of the animals who have been taught language by humans. The studies with Lana, Koko, Buzz, Doriss, and Alex the parrot, demonstrate only a minimal degree of achievement. At best, they can make or understand only simple combinations, e.g. 'QUESTION banana red', 'purt pipe net', or coin a few new words, such as 'white-tiger' for zebra. Neither in its natural state nor in its 'research-educated' state has any animal been able to demonstrate a linguistic ability that meets that of the ordinary 3-year-old human child. The research with animals clearly shows that animals have only a rudimentary language ability, whether in the wild or through training. What is puzzling and requires explanation is why their language ability is so low when their overall intellectual ability is high. Apes exhibit, for example, intelligent complex behavior regarding social organization, food acquisition, and problem-solving. Documented studies with apes going as far back as the First World War demonstrate that they are creative and inventive in solving other types of problems. Why, then, are they not able to learn more of the language which is taught to them? After all, human children learn language (speech or sign) in all of its complexity. And why couldn't the apes at least have learned to *comprehend* human speech, given that they have a hearing acuity which is as good as or better than human hearing? After all, there are human beings who are born with a deficit in speech production, yet they can learn to comprehend language in all of its complexity.

Contemporary theorists basically offer two types of explanations on the issue of animals vs. humans in the acquisition of language. Pro-intelligence theorists like Piaget, Putnam, and others, including ourselves, hold that animals lack certain aspects of intelligence which are needed

for the learning of such a complex ability as language. Innatists like Chomsky, on the other hand, argue that the effect is due to animals being born without a special language ability, an ability that is little related to intelligence. Chomsky has offered a very telling argument against researchers who teach language to animals. If apes really had the ability to use a grammar, they surely would have used it on their own by now; especially with language being so advantageous for survival. It would be rather odd to think that an animal would have developed, through evolution, the highly complex capacity for language but would not have used that capacity, until humans from universities came along to show them how. Whether animals lack intelligence as the empiricists say, or lack a special language ability as the rationalists say, it seems evident that animals do *not* have the capacity for a grammar-based language.

(B) Further reading and online resources:

1. Aitchison (2008), pp. 7-48; 96-114
2. Altmann (2001)
3. Altmann (2006)
4. Ammari (2011)
5. Asoulin (2016)
6. Chomsky (1969)
7. Cutler (2005), pp. 1-20; 103-118
8. Deacon (1997), pp. 102-142; 433-463
9. Erard (2012)
10. Everett (2013), pp. 1-252
11. Fernández & Cairns (2011), pp. 1-69
12. Field (2003), pp. 1-6
13. Field (2004)
14. Garman (1990), pp. 3-170
15. Lidz & Gagliardi (2015)
16. MacWhinney (2015)
17. Menn (2017), pp. xiii-xviii
18. Miller (1991)
19. O'Grady & Archibald (2016), pp. 1-18
20. Pinker (2011), pp. 1-19

21. Pinker (2008)
22. Pinker (1995)
23. Scovel (1998), pp. 1-6
24. Steinberg, Nagata & Aline (2001), pp. 291-307
25. Steinberg & Sciarini (2006), pp. 208-216
26. Traxler (2012), pp. 1-6

27. What do all languages have in common?
28. How realistic is the way Amy Adams' character hacks the alien language in *Arrival*?
29. Do animals have language?
30. Human language and animal communication
31. Steven Pinker: Linguistics as a window to understanding the human brain
32. Steven Pinker: Language and Consciousness (interview with J. Mishlove)
33. Noam Chomsky interview on Language and Knowledge (1977)
34. Noam Chomsky vs. B. F. Skinner
35. The Concept of Language (Noam Chomsky)
36. Savant: Christopher Taylor
37. CUP ELT: Interview with David Crystal

(C) Key concepts:

acquisition
activation
animals
arbitrary
articulation
behaviorism
bottom-up
Chomskyan theory
cognition
communication
grammar
hard-wired
hypothesis
innate
input
internalization
LAD
mental lexicon
morphology
nature
pragmatics
prescriptive
process
production
psycholinguistics
recursion
representations
semantics
storage
surface structure

comprehension	neurolinguistics	syntax
decoding	nurture	tacit knowledge
deep structure	observation	the groping phenomena
descriptive	parsing	thought
experiment	phonology	top-down
explicit knowledge	pivot grammar	UG
garden path	poverty of stimulus	universality

(D) Discussion questions and activities:

1. Why is it important to distinguish between language and general intelligence? What about the distinction between language and communication?

2. Is language restricted to humans? Can animal communication be regarded as language? Who is Nim Chimpsky? When Nim was 2 years old, 38% of his utterances were full or partial imitations. Almost 2 years later, the number of imitations had gone up to 54%. What can be concluded from this? (see Aitchison 2008: 24-48; Field 2003: 50-53; Steinberg & Sciarini 2006: 104-121)

3. What is 'the waggle dance' and what may be concluded from the way the message is transmitted in terms of *displacement*?

4. The electric fish also uses communication signals, but it cannot inform other electric fish that a submarine is around. What does this example tell us about the *design features* of (human) language and communication systems used by animals? (see Aitchison 2008; Hockett 1963).

5. In terms of organs used in speech, what characteristics of e.g., human teeth, need to be mentioned when articulation of certain sounds is concerned? What characteristics of human lips and the tongue are important to mention when it comes to the articulation of sounds and the stoppage of the airstream? Is the human larynx adapted to speech and how? What does it contain? In terms of breathing while speaking, what can be concluded about the breathing adaptations required for talking?

6. What are the main characteristics that all languages have in common?

7. Why are linguists interested in describing rather than prescribing grammar?

8. How is psycholinguistics connected to dictionary-making? Do dictionaries follow descriptive grammar rules or prescriptive grammar rules?

9. In the context of language characteristics, what does 'arbitrariness' mean? How is it connected to psycholinguistics?

10. Which concept is the odd one out? Explain:
a. innate b. UG c. tabula rasa ('blank slate') d. LAD

11. When do garden paths arise? Explain the garden path processing that occurs in these sentences. Then read each sentence aloud in order to make the meaning clear:

a. The communist farmers hated died.
b. The horse raced past the barn fell.
c. The prime number few.
d. The man who hunts ducks out on weekends.
e. Mary gave the child the dog bit a bandaid.
f. The girl told the story cried.
g. I convinced her children are noisy.
h. The man who whistles tunes pianos.
i. The old man the boat.
j. The raft floated down the river sank.

What is the reaction of linguists to the claim that sentences of this sort are 'wrong'?

12. Discuss how psycholinguistics is linked to morphology, phonology, syntax, semantics, and pragmatics.

13. Discuss the historical development of psycholinguistics as a discipline. What does the future of psycholinguistics look like?

14. How do the views of contemporary psycholinguists differ from the views of the behaviourists from the first half of the 20th century?

15. If you discovered someone who spoke a language that no one else could understand, how would you go about trying to understand what the person was trying to say?

16. Which of the following forms are possible (yet made-up) words of English? Explain why they could be possible and the rest impossible:

a. mbood	b. frall	c. coofp	d. wordms
e. ktleem	f. sproke	g. flube	h. bsarm

17. Why did behaviorists prefer to talk of verbal behavior instead of language?

18. Why might some people think that one speech style or dialect is better than another? Is this a psycholinguistic issue or a social issue? Why?

19. What determines the meaning of a sentence?

20. What is meant by the claim that human language is universal? Why is this claim a critical issue in psycholinguistics?

21. Consider the following sentences, each of which is acceptable to some speakers of English. Try to identify the prescriptive rules that are violated in each case:

a) He don't know about the race.
b) You was out when I called.
c) That window's broke, so be careful.
d) Jim and me are gonna go campin' this weekend.
e) I seen the parade last week.
f) He been lost in the woods for ten days.
g) My car needs cleaned 'cause of all the rain.
h) Julie ain't got none.
i) Somebody left their book on the train.

What is the reaction of linguists to the claim that sentences of this sort are 'wrong'?

22. What arguments did Chomsky give against behaviorist views of language?

23. Explain the connection between Chomskyan theory and the nature vs. nurture debate.

24. What is Chomsky stating in this paragraph?

> "It is fair to assume, not as a matter of logical necessity, but as a plausible hypothesis, that the 'state of mind' of a person who knows a language is characterized by a generative grammar, a

> system of rules and principles that determines a sound-meaning connection for an infinite set of sentences." (Knowledge of Language, 1969)

25. In Steinberg, Nagata & Aline (2001), and Steinberg & Sciarini (2006) it is stated:

> "Let us now consider some of the major arguments which Chomsky presents in support of his Universal Grammar (UG) theory. The arguments and the emphasis he places on each have changed as he has revised his theory of grammar over the years. Chomsky's four main arguments for the necessity of UG are: (1) degenerate, meagre, and minute language input, (2) impoverished stimulus input, (3) ease and speed of child language acquisition, and (4) irrelevance of intelligence in language learning. As yet there is *no* credible evidence which supports UG. All of Chomsky's arguments for UG have been shown to be inadequate."
>
> Discuss each argument and their counterarguments.

26. What else might you want to know more about in context of what this Chapter deals with?

Chapter 2
Language and the brain

(A) Readings:

1. Steinberg, D. D., & Sciarini, N. V. (2006). *An Introduction to Psycholinguistics* (2nd ed.). Pearson Education Limited. pp. 242-262.

The general structure of the brain is that of a whole which is divided into vertical halves that seem to be mirror images of one another. It looks much like a walnut with the two parts joined around the middle, except that there is little space between the two halves. Each half of the brain is called a hemisphere. There is a *left hemisphere* and a *right hemisphere*. The hemispheres come out of the brain stem, which connects to the spinal cord.

The hemispheres maintain connection with one another through a bundle of fibres called the *corpus callosum*. The brain, together with the spinal cord, is referred to as the central nervous system of the human body. There is a covering on each hemisphere, called the *cortex*, which is a furrowed outer layer of cell matter. It is the cortex that is concerned with higher brain functions in both humans and animals.

The cerebral cortex developed last in the course of evolution. While in fish, for example, the cerebral cortex is barely visible, and is one of the smallest parts of the brain, in humans it has increased in size and complexity to become the largest part of the brain. In time, due to the growth in the number and complexity of brain cells in the life of the human, the cerebral cortex becomes more dense and takes on a greyer and less pink appearance.

Each cerebral hemisphere is divided into four parts or *lobes*: from front to back there are the *frontal*, *temporal*, *parietal* (located above the

temporal), and the *occipital*. This division of the brain into lobes is loosely based on physical features and not on actual separations.

General functions such as cognition (to some degree) occur in the frontal lobe, hearing occurs in the temporal lobe, general somaesthetic sensing (feeling in the arms, legs, face, etc.) in the parietal lobe, and vision in the occipital lobe. Each hemisphere has these lobes with these functions. There are other hemispheric-specific functions that are also located in some of these areas. For example, the left hemisphere typically involves language.

The *corpus callosum* not only serves to connect the hemispheres but is itself a principal integrator and coordinator of the mental processes carried out in the two hemispheres. See Figure 1 for an overhead view of the hemispheres and a side view of a typical right hemisphere. The locations of the lobes are noted in both views.

1. i. Language areas

The areas that have been proposed for the processing of speaking, listening, reading, writing, and signing are mainly located at or around the Sylvian and Rolando fissures. Several specific areas have been identified:

- The front part of the parietal lobe, along the fissure of Rolando, is primarily involved in the processing of sensation, and may be connected with the speech and auditory areas at a deeper level.
- The area in front of the fissure of Rolando is mainly involved in motor functioning, and is thus relevant to the study of speaking and writing.
- An area in the upper back part of the temporal lobe, extending upwards into the parietal lobe, plays a major part in the comprehension of speech. This is 'Wernicke's area'.
- In the upper part of the temporal lobe is the main area involved in auditory reception, known as 'Heschl's gyri', after the Austrian pathologist R. L. Heschl (1824–1881).
- The lower back part of the frontal lobe is primarily involved in the encoding of speech. This is 'Broca's area'.

– Another area towards the back of the frontal lobe, 'Exner's centre', may be involved in the motor control of writing.
– Part of the left parietal region, close to Wernicke's area, is involved with the control of manual signing.
– The area at the back of the occipital lobe is used mainly for the processing of visual stimulae.

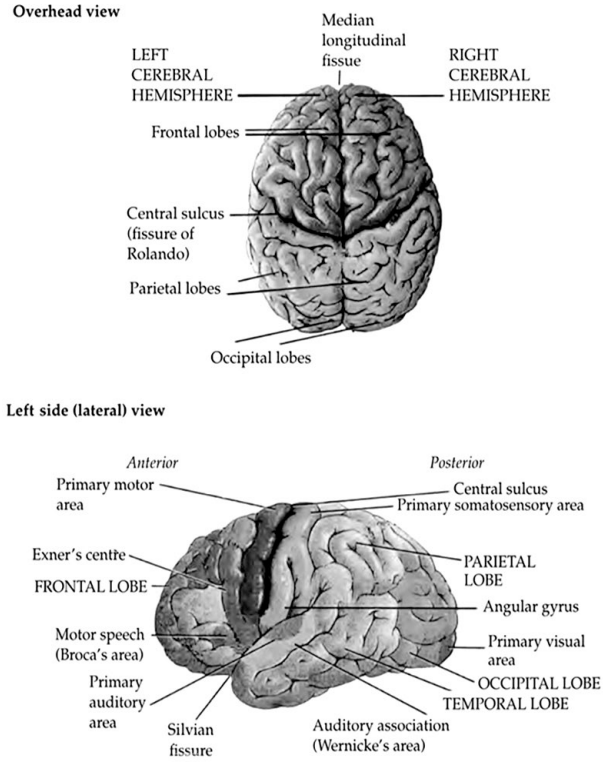

Figure 1. The brain: overhead and side views. Steinberg & Sciarini (2006).

Some of the neural pathways that are considered to be involved in the processing of spoken language:

– *Speech production.* The basic structure of the utterance is thought to be generated in Wernicke's area and is sent to Broca's area for encoding. The motor programme is then passed on to the adjacent motor area, which governs the articulatory organs.

- *Reading aloud.* The written form is first received by the visual cortex, then transmitted via the angular gyrus to Wernicke's area, where it is believed to be associated with the auditory representation. The utterance structure is then sent on to Broca's area.
- *Speech comprehension.* The signals arrive in the auditory cortex from the ear, and are transferred to the adjacent Wernicke's area, where they are interpreted.

1. ii. Hemispheric dominance

Even though the hemispheres of the brain divide the labours of the body, they do not do so evenly. In a sense, we might say that the body cannot serve two masters: one side must take charge. For a human to have the two hemispheres competing over which hand or foot should be used first to fight off an attacker or to jump at an animal in a hunt would not be advantageous for the survival of the species. This phenomenon, where one hemisphere is the controlling one, is called *dominance*.

Generally, animals, including chimps, have not been thought to have a genetic hand/foot preference. Rather, individual animals were thought to develop a personal preference over their lives. However, some recent research seems to indicate there may be left and right hemispheric differences in chimps and that such differences might result in preferences. Clearly, though, such differences are not as striking as in humans.

About 10 percent of the population worldwide are left-handed but, counter to expectations, only about 30 percent of left-handers have right-hemisphere dominance. The majority of left-handers are left-hemisphere dominant but their dominance tends to be much less marked than in natural right-handed persons. The lack of strong dominance for left-handers is believed to be a factor contributing to speech disorders and to various reading and writing dysfunctions, such as stuttering and dyslexia, which includes the reversal or mirror-imaging of letters and words when reading or writing. Such dysfunctions seem to be caused by the two hemispheres vying with one another for dominance.

Because dominance is a congenital condition, the practice of forcing children who are naturally left-handers to use their right hand for writing, etc., will not remedy such problems but may serve to worsen

them and create others. Many countries still force natural left-handers to be right-handers.

Imagine you are sitting in the doctor's office facing the door into the doctor's room. You hear some people talking in the room but you can't make out what they are saying. So you strain to hear. You turn your head slightly towards the door. Which side of your head did you turn? If you are a right-hander, you probably turned your right ear forward. This is because (1) speech sounds are processed in the left hemisphere, (2) the first big impulse of speech sound will be transmitted to the left hemisphere from the right ear, and (3) the first big impulse will precede and dominate any other big impulse. If you are a true left-hander, you probably would have imagined turning your left ear forward.

1. ii. a) Lateralized hemispheric functioning

Besides their general functioning, the hemispheres have some very specialized structures and functions. Some functions occur in one hemisphere while other functions occur in the other hemisphere. This separation of functions is called *lateralization*. Incoming experiences are directed to the left or right hemisphere depending on the nature of those experiences, be they speech, faces, or sensations of touch. We will see that speech production and speech understanding are mainly located in the left hemisphere.

1. ii. b) Left-hemisphere specializations

Research has clearly shown that language centres predominate in one hemisphere or the other. The main language centres are *Broca's area*, in the front part of the brain, *Wernicke's area*, towards the back, and the *angular gyrus*, which is even further back. Broca's area and Wernicke's area are connected by tissue – the *arcuate fasciculus*. For most people, language is in the left hemisphere: for roughly 99 percent of right-handers and about two-thirds of left-handers. Language is located in the right hemisphere in less than 5 percent of the population. For these persons, in addition to language, all other specific left- and right-hemispheric functions are also reversed. In addition to language, the left hemisphere is concerned with logical and analytical operations, and higher mathematics.

1. ii. c) Right-hemisphere specializations

The right hemisphere is involved in recognizing emotions, recognizing faces, and perceiving the structures of things globally without analysis. Unilateral right-hemisphere stroke can lead to problems with both immediate and delayed memory, when patients have trouble learning and remembering individual words. If the area of the brain that deals with faces, for example, is damaged, the person will not be able to recognize the faces of people, even close family, and even that person's own face when looking into a mirror.

The right hemisphere also deals with music and non-linguistic sounds, such as noises and animal sounds. Interestingly, patients with right-hemisphere damage seem to have difficulties in processing pitch as a prosodic syntactic distinction.

New research shows that the right hemisphere has some language functions and can take over the complete language functioning of the left hemisphere when that hemisphere has been surgically removed or damaged.

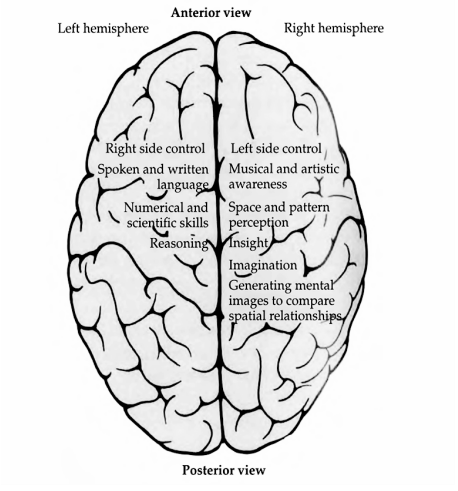

Figure 2.
Lateralized hemispheric functioning.
Steinberg & Sciarini (2006).

1. ii. d) Split-brain effects

Certain aspects of lateralization have been dramatically confirmed by the work of Sperry (1982), who separated the two hemispheres of the brain by severing the connecting tissue, the corpus callosum, of a

number of patients. Such a drastic operation was believed necessary to save the patients, who were suffering from extreme cases of epilepsy. After surgery with the corpus callosum no longer intact, information no longer flowed from hemisphere to hemisphere as it does in normal persons. The functions of the complete brain were no longer integrated. Such being the case, it was possible for Sperry and his group of researchers to test some of the abilities of the separate hemispheres.

In one study of a split-brain patient, she was shown a picture of a spoon in her left visual field and was asked what she saw. She replied, "No, nothing." Then she was asked to select with her left hand the object from an array that was out of sight, and she correctly picked out the spoon from a group of common objects. When asked what she was holding, she responded, "Nothing". When asked to reach for the object with her right hand, she performed at a chance level, as likely to pick up a straw or a pencil as a spoon.

It was found that 'split-brain' persons could still use speech and writing in the disconnected left hemisphere but that their right hemisphere had little such capacity. In normal persons, the right hemisphere has more capability. When tactile (touch) information passed to the left hemisphere, split-brain patients were completely capable of verbally describing objects and talking about things they had just touched. If, however, the touching experience of patients passed only to the right hemisphere, they could not talk about the experience at all; the information could not be passed through the corpus callosum to the left hemisphere for expression in speech because the corpus callosum had been severed. The right hemisphere, in general, was also incapable of imagining the sound of a word, even a familiar one, and patients failed simple rhyming tests, such as determining by reading which word, 'pie' or 'key', rhymes with 'bee'. The right hemisphere was found to be good at spatial tasks such as matching things from their appearance, such as being able to correctly reassemble halves of photographs.

Reports on split-brain patients have also shown that the right hemisphere, although it may possess some abilities to comprehend language, is seriously deficient in language production. However, aphasic patients with damage to the left hemisphere also experience difficulty in making nonverbal oral movements such as retracting the lips, clenching the teeth, and protruding the lips. It may be that the left hemi-

sphere is specialized to perform sequences of motor acts, especially those involving the tongue and jaw, but that such motor specialization is not specific to language production. The emerging picture of right-hemisphere language is that it is organized along different cognitive lines than left-hemisphere language. The right hemisphere is weak in syntactic and expressive skills but less so in terms of semantic processes and comprehension.

1. iii. Broca's area, the motor area, and speech production

Pierre Paul Broca was a French pathologist and neurosurgeon (1824–1880) who made the first great discovery regarding the brain and language. He discovered a certain area of the cortex that is involved with the production of speech; that part of the cortex bears his name: Broca's area. Broca further noted that the speech area is adjacent to the region of the *motor* cortex that controls the movement of the muscles of the articulators of speech: the tongue, lips, jaw, soft palate, vocal cords, etc. He posited that speech is formulated in Broca's area and then articulated via the motor area. The link between Broca's area and the motor area was later shown to be the nerve fibres of the arcuate fasciculus. The speech-production process would begin in Broca's area, pass on through the arcuate fasciculus to the motor area and from there to the articulators of speech for vocalization.

1. iv. Wernicke's area, the auditory area, and speech comprehension

Carl Wernicke, a German neurologist (1848–1905), in considering that Broca's speech area was near the part of the brain that involves areas that control the articulators of speech, investigated whether two other areas of the brain are involved in the process of speech *comprehension*. In his research he discovered, near the part of the cortex in the temporal lobe that receives *auditory* stimuli, an area that was involved in the understanding of speech. Wernicke hypothesized that this area, later named Wernicke's area, must in some way be connected to the auditory area. Later research showed that these areas are indeed connected, by fibres of the arcuate fasciculus.

The model that Wernicke posited over a century ago is still largely the model which most researchers use today in describing how we

understand speech. According to Wernicke, on hearing a word, the sound of a word goes from the ear to the auditory area and then to Wernicke's area. It is from Broca's area that the vocalization of speech would then be activated. When a word is read, according to Wernicke, the information goes from the eyes to the visual area of the cortex in the occipital lobe, from there to the *angular gyrus*, then to Wernicke's area and then to Broca's area, which causes the auditory form of the word to be activated. One can directly recover the meaning of written words without having to access their sound. This must be the case, for example, in rapid reading where speed precludes any such distinctive activation.

1. v. Right-hemisphere language abilities

While the left hemisphere is involved in most language tasks, recent evidence indicates that the right hemisphere too is involved in language processing. Both hemispheres receive similar input and both attempt to process input, for every language process. The hemispheres compute information differently at each level of processing (e.g. semantic processing), so that each hemisphere is most adept at handling particular inputs and producing particular outputs.

There is increasing evidence that the right hemisphere is critical for understanding discourse. Non-literal language processing may draw on right-hemisphere resources, perhaps because the right hemisphere maintains activation of meanings that are more weakly associated with particular words. Both of these capabilities could be useful in the understanding of metaphors, because understanding metaphors often requires looking beyond an obvious literal meaning to a less obvious or more subtle metaphoric meaning. Thus, patients with right-hemisphere damage have impairments concerning narrative script, interpretation, integration of information or conceptualization of the unit as a whole, construction of new conceptual models, and inferences about another person's beliefs and intentions.

The right hemisphere has an ability to use 'knowledge of the world', involved in scripting, where a number of sentences are related to a topic. Patients who have damage in their right hemisphere show structuring problems in story recall, and their speech is disrupted, particularly at the level of discourse, jumping from one topic to another incoherently.

It is important to remember that the brain operates as a whole. Any task is represented by a network of areas. For the brain's overall performance the amount of removed tissue matters more than its location. Therefore, the brain is able to readjust its circuits to process language in case normal processing cannot occur. For example, brain scans revealed that blind persons receive verbal communication help from the brain areas that normally process visual and touch information in sighted people.

Brain plasticity (*neuroplasticity*) accounts for the growing evidence that damage to language areas in the left hemisphere of young children is compensated for, with the right hemisphere taking over the reacquisition of language. This sometimes happens with adults, as well. Recently, MRI scans of stroke patients revealed that about six months after the stroke, the area on the right side of the brain corresponding to the inferior frontal gyrus was heavily used to restore language skills. It suggests that the brain develops previously underused areas and transfers language processing to those areas to help compensate the damage. While the extent of functional plasticity is not yet established, it is clear that the right hemisphere *is capable* of taking over left-hemisphere functions.

1. vi. Language disorder — Broca's aphasia

It was in 1861 that Broca published the first in a series of studies on language and the brain. This was the beginning of the true scientific study of cases of *aphasia*, a term that covers a very broad range of language disorders/impairments that are commonly caused by tissue damage or destruction in the brain, i.e. aphasias are linked to a brain lesion. The study of the representation of language in the brain, and the discovery of aphasias led to the birth of the interdisciplinary field of *neurolinguistics*. War injuries, strokes, and car accidents are frequent causes of such injuries. Broca was one of the first researchers to discover that damage to certain portions of the brain, but not to others, results in speech disorders. One particular condition, now called *Broca's aphasia*, is characterized by meaningful but shortened speech and also occurs in writing. Broca's aphasia, also known as *non-fluent aphasia*, is characterized by halting, effortful speech; it is associated with damage involving Broca's area in the frontal lobe of the left hemisphere. In the condition, gram-

matical inflections are often lacking, such as the third-person present tense '-s' ('Mary want candy' for 'Mary wants candy'), and the auxiliary 'be' ('Joe coming' for 'Joe is coming'), as are articles, prepositions, and other function words. In a way, the speech is similar to that of children at the *telegraphic stage* of speech production.

Although the most noted feature of Broca's aphasia is the fragmentary nature of speech production, it has recently been discovered that speech comprehension is also affected. In one experiment with a patient with Broca's aphasia, when presented with the spoken sentence, 'The apple that the boy is eating is red', the patient was able to understand the sentence, particularly with regard to who was doing the eating (the boy). However, when presented with the sentence, 'The girl that the boy is looking at is tall', the same patient could not figure out who was doing the looking. In the previous sentence, the patient could guess the meaning simply from knowing the vocabulary items 'apple', 'boy', and 'eat', and from knowing what usually happens in the world ('boys eat apples' and not vice versa). But the patient could not guess the meaning of the second sentence simply from the vocabulary, because boys look at girls and girls look at boys. To understand such a sentence, one must be able to analyze its syntactic relations. This patient was not able to.

Thus, there is a loss of syntactic knowledge in both speech production and understanding for those with Broca's aphasia. Interestingly, people with Broca's aphasia can often sing very well, even using words and structures they are unable to utter in conversation. This shows that Broca's aphasia is not simply a breakdown in the muscular control of speech movements, since those with this disorder *can* pronounce words. The loss, therefore, must be due to something of a deeper nature.

1. vii. Language disorder — Wernicke's aphasia

This condition is characterized by speech that often resembles what is called nonsense speech or double-talk. It sounds right and is grammatical but it is meaningless. Wernicke's aphasia, also called *fluent aphasia*, is characterized by fluent meaningless strings; it is caused by damage involving Wernicke's area in the temporal lobe of the left hemisphere. It can seem so normal that the listener thinks that he or she has somehow misheard what was said, as is often the case in ordinary con-

versation. A patient with Wernicke's aphasia may say, 'Before I was in the one here, I was over in the other one. My sister had the department in the other one', 'My wires don't hire right', or 'I'm supposed to take everything from the top so that we do four flashes of four volumes before we get down low'. Patients with Wernicke's aphasia commonly provide substitute words for the proper ones on the basis of similar sounds, associations, or other features. The word 'chair', for example, elicited the following in some patients: 'shair' (similar sound), 'table' (association), 'throne' (related meaning), 'wheel-base' (?) and 'You sit on it. It's a [word loss]'. As with Broca's aphasia, Wernicke's aphasia can also cause a severe loss of speech comprehension, although the hearing of non-verbal sounds and music may be unimpaired.

1. viii. Reading and writing aphasias — dyslexias

One type of aphasia that involves disorders in reading and writing is called *dyslexia*. There are many sorts of dyslexia, one category of which is due to damage to the brain, *after* reading and writing have been acquired. With children, however, dyslexias may be observed while they are in the process of acquiring reading and writing skills. Problems of hemispheric dominance or defects in visual perception, for example, may play some role in causing difficulties in reading and writing. Some children may only be able to write backwards (*deer* as *reed*) or upside down, or in reading they may confuse letters (*b* with *d*, *p* with *q*, *u* with *n*, *m* with *w*) and engage in other anomalies. To help remedy such problems as those with letters, it is best not to present the letters to the child in isolation but in a context with other letters. Thus, *b* and *d* should be shown in words, e.g. tu*b*, *d*og. In this way, the child can see the proper orientation of the letter and the word in which it appears.

Dyslexia may be subdivided into two basic categories: *alexia*, which involves disorders in reading, and *agraphia*, which involves disorders in writing. One may be afflicted by both conditions at the same time, in which case the person is unable to either read or write properly. In *pure agraphia* there is a total loss of the ability to write, even though the hand can be used skilfully for other purposes. Thus, for example, a person who has had a left-hemisphere stroke may be able to read the simple sentence 'How are you?', and yet be unable to write it.

1. ix. Methods of investigating the brain and language

The comparatively limited understanding we have of the neurological basis of language in the brain is the result of the application of a relatively small number of methods. The oldest method, used by Broca himself, is the post-mortem examination of the brains of patients who had displayed language disorders while they were alive. The abnormalities he found in certain areas of their brains in post-mortems correlated with the language symptoms they displayed in life.

Another method involves observing the language of patients who have had brain operations. A person might require – because of an accident or a tumour, for example – the removal of a lobe of the brain (lobectomy) or even of an entire hemisphere (hemispherectomy). Then, too, the study of the language of living patients with severe brain damage caused by accidents or wartime injuries was and still is a useful method of investigation.

Yet another method, pioneered by Penfield in the 1950s (Penfield 1947), involves the electrical stimulation of the cerebral cortex in patients who are conscious during brain surgery. On being stimulated, patients would report, for example, that they remember childhood events or old songs. How to verify what the patient says about the past is a problem with this method. The use of this procedure has been very limited, since it is restricted to the open brain areas of persons who are undergoing surgery.

In recent years, revolutionary new methods have been developed that lend themselves nicely to the study of language and the brain. These involve powerful new techniques in imaging: CT or CAT (Computerized Axial Tomography), PET (Positron Emission Tomography), Magnetic Resonance Imaging (MRI) and Event-Related Potentials (ERPs). All of these techniques involve the brain as it is, without surgery or any other invasive procedure, and indicate the actual functioning of the brain in real time. As such they may be used to explore brain-functioning both when it comes to studying intact brain tissue as well as for observing scans of people living with brain damage.

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2. Garman, M. (1990). *Psycholinguistics.* Cambridge University Press. pp. 416-471.

Traditionally, aphasia has been defined as the (a) *impairment* of (b) *central language abilities* in (c) the *speech* modality following (d) *brain damage.* Taking the italicised elements in this definition in turn, we should note that the impairment may be more or less complete; second, it is differentiated from impairment of both non-verbal cognitive functions (i.e., intellectual vs language abilities) and peripheral functioning (i.e., speech vs language abilities); third, it is not strictly involved in the impairment of written language functions. The terminology that derives from this tradition thus distinguishes, at least in principle, between *aphasia* (total loss) vs *ofysphasia* (some degree of loss); *aphasia* vs *alexia* and *agraphia* (loss of reading and writing functions, respectively – and there are also the terms *dysgraphia, dyslexia*), and between *aphasia* and *agnosia* (literally: loss of knowledge).

There is a growing modern consensus that some of these terms, if strictly interpreted, actually carry undesirable and problematic assumptions regarding the underlying nature of language abilities and hence of their impairment. The distinction between *a-* vs *dys-* terms has long been overridden by practical considerations: thus, e.g., aphasia and dysphasia are used quite interchangeably, usually in the sense of some degree of loss (since total loss is a relatively uncommon and transitory condition), while in many cases one or the other prefix is preferred, depending on usage rather than any meaning distinction. There is asymmetry in the lack of a distinction within aphasia corresponding to that between alexia (input) vs agraphia (output).

It might seem a straightforward matter to localise at least the more focal types of brain damage, but the task is in practice extremely difficult. Differences of about l cm can be significant for establishing an association with language impairment, so the precision of location that is required for neurolinguistic correlations is of a fairly high order.

Autopsy is perhaps the most obvious and certainly the most direct means of inspection, allowing for greatest accuracy of measurement. However, it has some disadvantages, since it is not regularly available for a balanced cross-section of language impairment case-histories – rather, only for those where death occurs while the patient is still sufficiently within reach of sufficiently interested neurological specialists (and

also, of course, where permission of relatives has been obtained). Many patients go on living for years after the onset of impairment, and may die, from delayed or unrelated causes, beyond reach and knowledge of those involved in treatment of the disorder in its acute phase. Even in cases where autopsy is performed, death may have occurred before the nature of the language impairment could be adequately assessed, either because of insufficient testing, or because of changes in the patient's condition. In many cases also, the language-related injury may be difficult to disentangle from early pathological conditions that may not have led to symptoms, and from subsequent strokes or other injuries which may have compounded the original language impairment. In spite of all these difficulties, however, autopsy examination formed the foundation of aphasiology in the last century, and has remained the classic method during the formative phases of aphasiological research.

2. i. Aphasia and intelligence

Debates about the relationship, if any, between aphasia and loss of intelligence have been hampered by the notorious difficulties in defining 'intelligence', and the various, and possibly arbitrary, definitions that have been offered for 'aphasia'. Where the concept of aphasia has been restricted to something like 'auditory comprehension deficit, with greater or less reading comprehension involvement', then the question of a relationship with loss of intelligence seems to arise quite naturally. If, on the other hand, aphasia is defined more widely (as we have argued for), then the issue of the relationship becomes exactly parallel with that between normal language-processing and normal intelligence. At the periphery of the psycholinguistic system, among the sensory and motor components that are involved in signal processing, it is relatively easy to draw a distinction between linguistic vs non-linguistic functions. But, nearer the central domain of language processing, it is much harder to draw a distinction between specifically linguistic and non-linguistic capacities, and it may be that what we want to call 'intelligence' is found in both. It is possible, but not necessary, that brain damage may impair general as well as specific linguistic abilities. Not just damage to the brain, but the aging process, too, presents a challenge to our assessment of the relation between language and intelligence. Cognitive decline associated with normal aging or with early dementia must be taken into

account when asking how age interacts with severity of aphasia and recovery from aphasia. The discrimination between normal cognitive decline and specific dementias may be possible on the basis of associated language abilities. There are numerous dementing illnesses that will each have a range of characteristic language behaviors associated with it. As neurologists and neuropsychologists detail the diverse forms of dementia, neurolinguists will document the associated language disorders, and speech pathologists will explore new modes of treatment. Psycholinguists will be interested in the light such studies shed on the relation between language and intelligence in individuals.

From Pinker (2008: 334-335)

Swearing aloud, like hearing the swear words of others, taps the deeper and older parts of the brain. Aphasia, a loss of articulate language, is typically caused by damage to the cortex and the underlying white matter along the horizontal cleft (the Sylvian fissure) in the brain's left hemisphere. For almost as long as neurologists have studied aphasia, they have noticed that patients can retain the ability to swear. A case study of a British aphasic recorded him as repeatedly saying "Bloody hell", "Fuck off", "Fucking hell blimey", and "Oh you bugger". The neurologist Norman Geschwind studied an American patient whose entire left hemisphere had been removed because of brain cancer. The patient couldn't name pictures, produce or understand sentences, or repeat polysyllabic words, yet in the course of a five-minute interview he said "Goddammit" seven times, and "God" and "Shit" once apiece. The survival of swearing in aphasia suggests that taboo epithets are stored as prefabricated formulas in the right hemisphere. It's not that the right hemisphere contains a profanity module, but that its linguistic abilities are confined to memorized formulas rather than rule-governed combinations.

3. Traxler, M. J. (2012). *Introduction to Psycholinguistics: Understanding Language Science.* Wiley-Blackwell. pp. 515-546.

Most adults are strongly left lateralized for speech and syntax, with prosodic processing abilities being the best and perhaps only candidate for a strongly right-lateralized language process. Infants are born

with some ability to recognize the prosody of their native language, but everything else gets added on later. Thus, infants do not start out with language strongly represented in the left hemisphere. In fact, if anything, word processing during early child development (0–3 years) is more strongly represented in the right hemisphere than the left, and is definitely represented more strongly in the right hemisphere compared to later stages of development. Children as old as 5 or 6 years can experience aphasic symptoms (halting, effortful or loss of speech) following RHD, which suggests that at least up to 5 or 6 years old, children are not yet left lateralized for speech. The presence of aphasia in children with RHD motivated some to believe that children, when they are born, are able to develop language skills to equally high levels of skill in either hemisphere. This *equipotentiality* hypothesis has been the focus of a great deal of research on child language development. Besides the presence of aphasia in children with RHD, what evidence favors equipotentiality?

Children who have undergone a surgical procedure called *hemispherectomy* (or the somewhat less complete procedure called *temporal lobectomy*) have been studied to test the equipotentiality hypothesis. Specifically, researchers wish to know whether both hemispheres are capable of developing language to the same extent. In the hemispherectomy procedure, all, or nearly all, of the cerebral cortex on one side of the brain is removed. In the temporal lobectomy procedure, one of the temporal lobes of the brain is removed, but other cortical tissue in the affected hemisphere is left in place. Radical procedures like hemispherectomy and temporal lobectomy carry substantial risks for the patient, and so they are carried out as a last resort and usually only after significant brain damage has occurred. In many cases, epileptic seizures will be the immediate problem. Children experience brain damage as the result of seizures, and if medication fails to control those seizures, surgery may be the only viable option. The great majority of children who undergo hemispherectomy experience reduced seizure activity, and some are able to stop taking anti-seizure medication. Although the majority of hemispherectomy patients have below average intelligence, this is largely due to brain damage caused by their seizures, and the surgery does not normally lead to further declines in intelligence (Also, hemispherectomy patients represent a cross-section of intellectual ability, and some develop superior intelligence, go on to graduate from college, and have

successful professional careers). Some patients actually experience mild increases in intellectual functioning following the surgery, probably because the healthier hemisphere no longer suffers from interference from the more damaged hemisphere. The vast majority of children who undergo hemispherectomy develop speech production and perception abilities in the normal range, regardless of which hemisphere remains following the surgery, with normal or near normal understanding of even complex language components, such as metaphors and idioms.

How is it possible that children can develop sophisticated language abilities when the hemisphere that is normally dominant for many language functions (the left) is removed? Equipotentiality offers an explanation: Language organization is a function of developmental processes that normally result in left-hemisphere language (perhaps because the left hemisphere is better designed to handle rapidly changing stimuli). But if those developmental processes are disturbed, the right hemisphere, due to its *plasticity* (its ability to reorganize based on experience), can develop functions that the left hemisphere would normally carry out. However, there is a time limit on this ability to reorganize, and correlational studies show that right lateralization of language occurs more often in children who start experiencing neurological problems early; while left lateralization or bilateral organization is more common in children whose neurological problems start later. The ability to use right-hemisphere resources for language also comes with a cost, however, as the presence of "extra" language functions in the right hemisphere occupies neural tissue that would normally be used for other functions, such as spatial processing. The *crowding hypothesis* says that, if the right hemisphere takes over language functions from a damaged left hemisphere, it will be less able to carry out spatial perception tasks (because the usual right hemisphere spatial functions are "crowded out" by interloping language functions). When patients with early onset of neurological symptoms were tested for language laterality, there was a strong negative correlation between right- hemisphere control of speech and performance on tests of spatial ability.

The existence of crowding of right-hemisphere spatial function by speech processes might indicate that the right hemisphere has some trouble accommodating displaced left- hemisphere language processes.

And so, following early reports of successful language development following hemispherectomy, researchers began taking a closer look at language function following hemispherectomy, and they found that language outcomes were not the same following left and right hemispherectomy. To investigate language processing functions in more detail, researchers looked at the comprehension of syntax by children who had undergone right vs. left hemispherectomy. Syntax is generally viewed as being a left-lateralized function in most healthy adults. Syntactic comprehension and production problems are far more common following LHD than RHD, and neuroimaging studies show greater left than right hemisphere response when syntactic structure is manipulated. It might be that way for a reason. Perhaps the left hemisphere is just better than the right hemisphere at processing syntactic structure information.

To try to find out, Maureen Dennis and her colleagues performed a number of tests that required children to use their knowledge of syntax. In some tests, children were presented with sentences, and were asked to judge whether the sentences were "acceptable" or "unacceptable." Children were also asked to correct the sentence when they detected a problem. The sentences had problems with various aspects of syntax. Some of the sentences violated the normal word order that occurs in English sentences. For example, *Cash shouldn't send people through the mail* (although a non-syntactic agent-first semantic strategy might cause people to judge this sentence as being "unacceptable" even if they lacked normal syntactic processing abilities). Other sentences included number agreement violations (*The best cars in Canada is a Ford and some Datsun*). Children who had their left hemisphere removed detected fewer syntactic errors than children who had their right hemisphere removed. Children without a left hemisphere also performed at a lower level than right-hemidecorticate children on a task that required them to repeat a sentence verbatim, and they were less able to produce utterances that required movement of a syntactic constituent from its canonical location in the sentence. Children were also tested for speech perception and production abilities, as well as individual word comprehension and production. Including these latter tests helps to rule out a theory under which left-hemisphere patients perform worse than right-hemisphere patients because they know less about words or have trouble understanding speech. Additional testing involved matching of

auditory sentences to pictures that could be described using either active (*The girl pushed the boy*), passive (*The boy was pushed by the girl*), or *negated passive* form (*The girl was not pushed by the boy*). Left-hemidecorticate children had difficulty comprehending the negated passives (but not the actives or the simple passives), when compared to age- and intelligence-matched right-hemidecorticate children. In addition, some left-hemidecorticate children have trouble with inflections, and so are unable to detect problems with sentences such as **He ated his breakfast*. These syntactic processing problems cannot be blamed on a general lack of intelligence, because even very high-functioning people have problems with some aspects of syntax following left hemispherectomy. One patient with a college degree showed subtle problems comprehending linguistic prosody and passive sentences. Syntactic problems can therefore occur in highly intelligent people who have had ample opportunity to learn. Based on the syntactic processing deficits that follow left but not right hemispherectomy: "Language development in an isolated right hemisphere, even under seizure-free conditions, results in incomplete language acquisition." Thus, equipotentiality does not appear to be an accurate description for spoken language development.

But what about writing and reading? Children are capable of learning to read regardless of which hemisphere is removed, but at least some studies suggest that different forms of dyslexia follow depending on which hemisphere is removed. Thus, the two hemispheres do not appear to be equipotential for reading, in that different reading problems appear to follow when damage occurs to the right versus the left hemisphere. On the whole, then, different outcomes are likely for both spoken and written language processing following left versus right hemispherectomy, with lower overall performance being more common after left hemispherectomy than right hemispherectomy (remember, though, that regardless of which side is operated on, children typically develop language skills that are more than adequate to serve their communication needs). Thus, equipotentiality does not appear to accurately describe language development and the capabilities of the two hemispheres.

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4. Deacon, T. W. (1997). *The Symbolic Species: The Co-Evolution of Language and the Brain.* W. W. Norton & Company. pp. 311-315.

It might seem odd that in a book on language and the brain, whole chapters haven't been devoted to *lateralization* — the difference in functional representation between the two cerebral hemispheres. This is in part merely a stylistic choice. But it is also a reflection of the fact that I consider this to be a side issue that is not an essential feature of language processing, only an incidental feature of the way human brains have adapted to the computation problems of language use. The fact that many specialized language functions are strongly lateralized to the left hemisphere in the vast majority of human brains has been a major impetus for theories suggesting that lateralization might have been a precondition for language evolution. Many argue that this robust side-to-side difference reflects some major organizational logic underlying language. But lateralization is almost certainly an effect and not a cause of brain-language co-evolution. Indeed, I think it is largely an effect of language development in an individual's lifetime. The structure of languages has probably evolved to take advantage of intrinsic subtle biases in developing brains to break up and distribute their component cognitive computations so that they can most easily be processed in parallel, and one important way this can be accomplished is by 'assigning' functions to either side of the cerebral hemispheres.

Unfortunately, the study of lateralization has been afflicted with the problem of being an interesting topic for popular psychology, and of offering an attractive source of analogies for theorizing about almost every aspect of the mind. As a result, everyone's favorite complementary pair of mental functions can be mapped onto a brain whose functions differ on opposite sides. Since the middle of the nineteenth century, physicians and psychologists have argued over whether the left was female and the right male, the left verbal and the right non-verbal, the left linguistic and the right spatial, the left rational and the right irrational, the left differentiated and the right undifferentiated, the left localized and the right holistic, the left positive emotion and the right negative emotion, the left ego and the right id, the left dominant and the right subordinate, and even the left human cognition and the right primate cognition, to describe a few of the more prominent dichotomies. The

attraction of discovering the most elegant way of dividing up the mind into two major complementary cognitive systems is almost irresistible.

The representation of language functions probably develops primarily in response to the need to perform simultaneous, but competing operations when speaking or listening to speech. This is supported by the fact that lateralization is not so much a commitment of one side to language and the other not, but rather a segregation of component language functions to the two sides.

It is important to get one thing straight. The right hemisphere is not the non-language hemisphere. It is critically and intimately involved in language processing at many levels during both development and maturity. Perhaps most importantly, it is critical for the large-scale, semantic processing of language, not word meaning so much as the larger symbolic constructions that words and sentences contribute to: complex ideas, descriptions, narratives, and arguments. Symbol construction and analysis do not end with the end of a sentence, but in many regards begin there. The real power of symbolic communication lies in its creative and constructive power.

The best evidence for this right hemisphere language involvement comes from analysis of how right hemisphere damage affects such abilities as story and joke comprehension. Patients who have suffered extensive damage to their right, but not their left hemisphere are generally able to speak well, without any unusual increase in grammatical errors or mistakes in choice of words; but when required to follow and interpret a short narrative, they seem to fail to grasp the logic of the whole. For example, they do not recognize when important steps in a story have been left out or inappropriate or anomalous events have been included, though they can recount the details. They seem to be unaware of the constraints of the context. Jokes provide another window into this difficulty. Humor depends crucially on understanding both what should ordinarily follow, and how the insidious twist of logic of the punch line undermines our expectations. Assessment of what makes something funny depends on an awareness of two conflicting contexts: an expected, 'appropriate' context, and a logically possible but very odd one. The aptness of the shift in contextual logic, the extent to which it effectively catches us off guard even when we know it is a joke, the way it caricatures what in a 'straight' context might be serious or threatening, all

these are the ingredients of good jokes. Well, anyway, this poses a serious problem for someone unable to construct the appropriate narrative context in the first place. Patients with right hemisphere damage seem to rank jokes as funny based solely on the extent to which the punch line contains material that is different from what preceded it.

As language abilities become progressively more sophisticated with age and experience, the need to analyze symbolic relationships at many levels simultaneously grows. The highly automated interpretation of symbolic relationships encoded in word combinations and sentence structure requires a strategy of one rapid interpretation followed by another. It demands both rapid implementation and an ability to keep previous operations from interfering with subsequent operations. The same neural systems that subserve sentence-length analysis would probably also be critical for maintaining long-term recall of symbolic information. These simultaneous demands would thus likely conflict or interfere with one another, and so limit the efficiency of both processes. But because right- and left-brain structures are paired, it is possible to keep the processes from interfering with one another by compartmentalizing them to opposite hemispheres.

The right hemisphere also subserves another important language function that is non-symbolic, but probably is competitive with phonological analysis and word processing. It is the processing of prosodic features of speech. Prosodic features are the rhythmic and pitch changes that we generally use to convey emotional tone, to direct the listener's attention to the more and less significant elements in a sentence, and in general to indicate how aroused we are about the contents of our speech.

Here again, language production and analysis effectively require that we implement two different modes of phonetic analysis and vocal control simultaneously: prosodic and phonemic processes. These tasks would tend to compete for recruitment of the same brain structures (probably the classic Broca's and Wernicke's areas), and as a result would probably interfere with each other. It would be inefficient to trade off use of the same cortical system for both. The monitoring of prosodic information tends to operate against a foreground attention to specific words and phrases.

[Extending] the representation of this background function to the right hemisphere, and phonemic and word analysis to the left, may

similarly provide a means for processing these sources of information in parallel with minimal cross-interference.

But the right hemisphere may be far more capable of full-scale linguistic functions than we normally imagine. Data from schools that train simultaneous translators suggest that under the special demands of this difficult language task, both hemispheres can to some extent become language hemispheres. The problem for the simultaneous translator is to keep the two languages from getting in each other's way. Listening to one while producing the other is like that old problem of patting your head and rubbing your stomach with opposite hands, and then reversing what each hand is doing but leaving them in place; or chewing gum while playing the drums or dancing or just walking out of sync with each chew. The direct competition of simultaneous similar language functions is often further coupled with a consistent asymmetry of auditory input: most translators develop an ear preference for listening to the source language. Studies before and after training demonstrate that most students begin with a right ear (left hemisphere) preference for both languages, but may develop an opposite ear advantage for each language by the end of their training.

Thus, the two languages can come to be preferentially represented in opposite hemispheres. This is all the more remarkable since the shift can be induced in young adults, not infants. This special case nonetheless demonstrates the general principle: when sensorimotor or cognitive operations tend to compete simultaneously for the same neural substrates, there is strong developmental pressure to segregate the competing operations to counterpart structures in the opposite hemispheres.

In general, then, it is misleading to think of language as though it is all in the left hemisphere. The right side is neither primitive nor mute. Both hemispheres contribute essential and complementary functions. These develop in tandem, and the biases for a particular pattern of asymmetry evolved with respect to this complementarity of functions. Lateralization is not so much an expression of evolutionary adaptation as of adaptation during one's lifetime, biased so as to minimize any neurological 'indecisions' about what should go where.

5. Aitchison, J. (2008). *The Articulate Mammal: An Introduction to Psycholinguistics* (5th ed.). Routledge. pp. 49-69.

The two hemispheres do not function identically. Simpler and less invasive methods for discovering which hemisphere controls language are now the norm. The first was the use of *dichotic listening tests*. The subject wears headphones, and is played two different words simultaneously, one into each ear. For example, he or she might hear 'six' in one ear, and 'two' in the other. Most people can report the word played to the right ear (which is directly linked to the left hemisphere) more accurately than the word played to the left ear (linked to the right hemisphere). It is clear that this is not simply due to an overall preference for sounds heard in the right ear, because for non-linguistic sounds the left ear is better. If different tunes are played simultaneously into each ear, subjects will identify the tune played into the left ear better than the one directed into the right ear. We conclude that the left hemisphere is better at processing linguistic signals – and so is normally the dominant one for speech.

A further technique is *tachistoscopic* (*fast-view*) *presentation*. An image is presented very fast to either the left or right visual field (the area that can be seen to left or right without moving the head or eyes). A linguistic stimulus will normally be processed faster if it is presented to the right visual field, which is then transferred to the left (usually language dominant) hemisphere.

In another twentieth-century technique, electrodes are attached to the skull in order to measure the amount of electrical activity in the area beneath. Spoken words produce a greater response in the left hemisphere, whereas noises such as mechanical clicks arouse a greater response in the right.

The results of the observations and tests described are surprisingly consistent. The majority of normal human beings – perhaps as many as 90 percent – have speech located primarily in the left hemisphere. This cannot be due to chance.

A further related discovery is that the location of speech centres in the left hemisphere seems to be linked to right-handedness. That is, most humans are right-handed, and most people's speech is controlled by the left hemisphere. In the nineteenth century it was commonly assumed

that left-handers must have speech located in the right hemisphere, and this seemed to be confirmed by a report in 1868 by the influential neurologist John Hughlings Jackson that he had discovered loss of speech in a left-hander who had sustained injury to the right side of the brain. But this viewpoint turns out to be false. Surprisingly, most left-handers also have language controlled predominantly by the left hemisphere, though the picture is not completely straightforward. Of the relatively few people who do not have their speech centres located in the right hemisphere, more are left-handed than right-handed.

Other studies suggest that the right hemisphere contains a limited potential for language which is normally latent, but which can be activated if needed. Patients who have had the whole of the left hemisphere removed are at first without speech. But after a while, they are likely to acquire a limited vocabulary, and be able to comprehend a certain amount, though they always have difficulty in producing speech. The right hemisphere is not useless, however. Patients with right hemisphere damage have difficulty with intonation, and in understanding jokes and metaphors.

Perhaps the most widely reported experiments on this topic are those involving 'split brain' patients. In cases of severe epilepsy it is sometimes necessary to sever the major links between the two hemispheres. This means that a patient has virtually two separate brains, each coping with one half of the body independently. A patient's language can be tested by dealing with each hemisphere separately. An object shown to the *left* visual field is relayed only to the *right* (non-language hemisphere). Yet sometimes the patient is able to name such an object. This indicates that the right hemisphere may be able to cope with simple naming problems – but it seems unable to cope with syntax. However, the results of these experiments are disputed. Some people have suggested that the information is being transferred from one hemisphere to the other by a 'back route' after the major links have been severed.

This lateralization or localization of language in one half of the brain, then, is a definite, biological characteristic of the human race. At one time, it was thought to develop gradually. But later research indicated that it may be present at birth. Even foetuses have been claimed to show traces of it, with some areas of the left hemisphere being bigger than the right. The issue is an important one for psycholinguists, since it

has sometimes been argued that the period of lateralization coincides with a 'critical period' for language acquisition.

6. Bastiaanse, R., & Ohlerth, A. (2023). Presurgical Language Mapping: What Are We Testing? *Journal of Personalized Medicine, 13*(3).

Gliomas are malignant brain tumors infiltrating healthy and functional cortical and subcortical tissue. When low grade, they grow very slowly, allowing motor and cognitive functions to migrate to other brain areas. During tumor resection, the neurosurgeon aims to save as much of this functional tissue as possible, but cannot rely on classical localization maps, because of this functional plasticity. Therefore, glioma patients with tumors in the so-called 'eloquent areas' are preferably operated while the patient is awake. During surgery, the neurosurgeon stimulates small areas of the cortex or subcortex with *Direct Electrical Stimulation* (*DES*) while the patient performs a task, for example, naming pictures. If, during stimulation, a patient cannot name a picture correctly, it is assumed that the area is involved in speech and language production and should be spared.

Awake surgery is an intense event, both for the patient and for the neurosurgical team. Therefore, neuroscientists are looking for alternative ways to localize critical cognitive func- tions in the affected brain. One of these ways is *navigated Transcranial Magnetic Stimulation* (*nTMS*). Instead of applying an electrical current directly on the cortical and subcortical areas, an electromagnetic current is directed through the skull onto the cortex to inhibit the area right beneath the skull, which is a harmless procedure. The principle of interpreting DES and nTMS is the same: when a cortical area is stimulated, either electrically or electromagnetically, and a picture cannot be named, that area is involved in the language process (note that (n)TMS can also enhance functionality of cortical tissue; in that case, another current is needed).

Of course, it is important that language skills are spared when a tumor is removed: language is the basis of communication, perhaps the most important cognitive function in human beings. While counting backwards and naming the months of the year are considered old-fashioned tests nowadays, naming pictures of objects and animals is quite

a common task. However, this is not quite representative for language in daily life: we do not speak only in nouns, but rather in sentences, and sentences are constructed around verbs and contain many other word classes, such as adjectives and adverbs. Now that we have the opportunity to test glioma patients non-invasively and presurgically with nTMS, a wider range of tasks may be used; although we should realize that tumor patients cannot be tested for protracted periods because of fatigue and lack of concentration. Hence, we developed a test for the production of verbs and noun phrases (including the article) in sentence context, in which the verbs have to be inflected for person, number and time (3rd person singular present; e.g. *he writes*). Inflection of English articles and nouns is limited (only the article *a* has to be changed to *an* when the noun starts with a vowel), but in German, for the language used for the experiments, the article is inflected for number, gender and case. This test is called the *Verb And Noun test for Peri-Operative testing* (VAN-POP). The VAN-POP can be used with both DES and nTMS mapping procedures, hence during pre- and intraoperative language testing.

6. i. The process of picture naming (picture-naming tasks)

A test frequently used presurgically, but also in the operating room is 'picture naming'. A picture of, for example, a cat is shown to the patient. In response, the patient should say 'cat'. If, during stimulation of a certain area, the patient names the picture correctly, the stimulated area is supposed to be not involved in the whole process from recognizing the picture to speaking the word 'cat', and is therefore safe to respect.

In order to name a picture, a few steps need to be carried out, and each step takes place in a different part of the brain:

6. i. a) Picture Recognition and Conceptualization

The first step is recognition of a black-and-white drawing of a cat. The next requires linking that image to the concept of a cat stored in the brain. The concept consists of information from different parts of the brain and includes the following:

– Visual information such as general size, color and shape of a cat, stored in the visual cortex in the occipital lobes bilaterally.

- Auditory information about how a cat sounds, stored in the auditory cortex in the temporal lobes, bilaterally.
- Olfactory information about how a cat smells, stored in the olfactory cortex in the temporal lobes, bilaterally.
- Tactile information about how a cat's fur feels, stored in the sensory cortex in the parietal lobes, bilaterally.
- Information about a cat's predatory nature, diet, etc.; this is stored semantic memory in the hippocampus and, probably, in the frontal and temporal lobes bilaterally.
- Information about personal feelings related to the concept of a cat (cat lovers vs. cat haters), stored in the limbic system, bilaterally.
- Information about personal feelings related to the concept of a cat (cat lovers vs. cat haters), stored in the limbic system, bilaterally.

This bundle of information forms one's concept of a cat and is stored bilaterally. This implies that for matching a picture with a concept, a large part of the cortex in both hemispheres is activated. This process does not yet involve language, it is a 'preverbal stage'.

6. i. b) Lemma Activation

Next, the lemma CAT (lemmas are presented in upper case letters) is activated, which is the first step involving language. A lemma is an abstract word form that contains information about the meaning, the word class, and, in the case of a verb, how many entities are involved. In the verb *to swim*, for example, only an actor is involved, the swimmer, whereas in *to write*, there are two: the writer and what is written. A lemma is not a word. The lemmas for *to swim* and *to read* are similar in English and French, but the words themselves are different (and are only retrieved during the next stage).

Lemmas are stored on the basis of their meaning; that is, when a lemma is activated, lemmas close in meaning are co-activated. Then the co-activated lemma is inhibited and the target lemma 'wins'. This can be illustrated by the fact that the first word that comes to mind when one hears 'cat' is 'dog,' at least for the majority of the people in the Western world, independent of language. When the process of activation, co-ac-

tivation and inhibition is disrupted, for example in aphasia, a semantic paraphasia may be produced: a picture of a table is named as *chair*.

6. i. c) Lexeme Retrieval

Once the lemma CAT has been retrieved, it activates the lexeme /cat/. Lexemes are the underlying word forms and they are stored on the basis of their sound structure. A lemma activates the target lexeme /cat/ and lexemes that are related in sound structure are co-activated: /rat/, /fat/, /cap/. Notice that the co-activated lexemes are always words, because only words are stored as lexemes. Non-words, such as 'dat' or 'rof' cannot be co-activated, because they are not in the mental lexicon that contains the lexemes. The difference between lemmas and lexemes can also be illustrated by tests often used during awake surgery: word fluency. Although it is unclear what these tests actually measure or what is wrong when patients score lower than non-brain-damaged speakers, we do know that 'semantic word fluency' tests ('name as many animals as you can in one minute') tap into lemma retrieval, whereas 'phonological fluency' tests ('name as many words beginning with *b*') tap into lexeme retrieval.

6. i. d) Phonological Encoding

Lexemes activate the process of phonological encoding. When the lexeme has been retrieved, the correct phonemes must be inserted in the correct order. The lexeme /cat/ is phonologically correctly encoded as [kæt] and not as [fæt] or [tæk]. In addition, phonological rules are applied during phonological encoding. The arcuate fasciculus, the superior longitudinal fasciculus and the supramarginal gyrus, all at the left side, have been hypothesized to enable this process. The output of phonological encoding is a string of phonemes. Now articulation can be planned and programmed at the next stage.

6. i. e) Phonetic Encoding

This stage is at the interface of language and speech: the individual phonemes are retrieved and an articulation program is made for a smooth transition from one phoneme to the next and from one syllable to the next. Assimilation of phonemes also takes place at this level. Planning and programming of articulation takes place in Broca's area,

the left inferior frontal gyrus. Still, the word is not pronounced. For this, it needs to be articulated.

6. i. f) Articulation

The final step of the naming process is articulation. The program planned at the former stage needs to be executed for the word to be pronounced. For this, the motor cortices of both hemispheres are used.

7. Čordalija, N., & Kalajdžisalihović, N. (2022). Linguistic Performance in Typical Cognitive Aging and Dementia. *Epiphany: Journal of Transdisciplinary Studies, 15*(2), 74-94.

7. i. On language comprehension and production in typical cognitive aging

In terms of language comprehension at the word level as well as the sentence level, studies show that it is fairly preserved in typical aging. Concerning phonological aspects, using prosodic cues during comprehension seems to be preserved in aging as well. As sensitivity for higher frequency tones declines over the lifespan, it has been asserted that comprehension difficulties of the typically aging elderly seem to arise from hearing problems rather than a cognitive decline or a linguistic impairment.

Concerning language production, a number of difficulties arise which are correlated with factors such as working memory capacity and functions, education and language skills. Such age-related decline occurs in both spoken and written production. Some studies on written language production showed lower accuracy scores in older than in younger adults in spelling tasks despite higher levels of education among older adults. What is frequently reported as the most common symptom of typical cognitive aging are difficulties in word retrieval during spoken language production. Researchers have suggested that lexical knowledge itself is preserved but it is the access to that knowledge that is taxing. More precisely, the locus of retrieval deficit is not to be found at the concept level or the lemma level as conceptualization itself is not troublesome but rather at the lemma-lexeme interface – transla-

ting concepts into actual words and sentences. However, in verbal fluency tasks, the factor of age correlates strongly with education levels as higher fluency scores are found for participants with a higher level of education. Interestingly, studies also report a somewhat increased usage of pronouns and more difficulties in noun retrieval during language production. This tendency for simplification is also present at the syntactic level as the elderly tend to avoid producing complex syntactic structures.

Therefore, whilst retrieving and comprehending the word meaning seems to be rather robust in old age, age-related decline effects are observed in language production which entails mapping of a lexical concept onto a phonological or orthographic form.

7. ii. On language comprehension and production in dementia

In terms of comprehension, it has been shown that individuals with dementia displayed a rather intact ability to translate orthography onto phonology. However, research on how phonological aspects of language are affected in dementia is scarce. At the lexical level, just as typically aging individuals, in priming experiments, patients with dementia show automatic activation of the word meaning with somewhat larger priming effects than younger subjects as patients with dementia are generally slower. Nevertheless, patients with a type of dementia labelled as *semantic dementia* do show severe impairment in word recognition and processing [...].

Language production of individuals with dementia is also characterized by preference for simpler syntactic structures. This was observed in typical cognitive aging too. However, the decrease in using syntactically complex structures is much more rapid in individuals with dementia. Dementia is also characterized by progressively poorer usage of structures that achieve coherence and cohesion in speech.

(B) Further reading and online resources:

1. Åke et al. (2023)
2. Carroll (2008). pp. 354-379
3. Cutler (2005). pp. 57-68; 157-189

4. De Bot & Makoni (2005)
5. Fernández & Cairns (2011). pp. 81-96
6. Fernández & Cairns (2018). pp. 411-437
7. Field (2003). pp. 8-9; 53-57; 96-100
8. Field (2004)
9. Flores d'Arcais & Levelt (1970). pp. 416-426
10. Garman (1990). pp. 181-370
11. Krishna et al. (2023)
12. Lenneberg (1967)
13. Menn (2017). pp. 71-108
14. O'Grady & Archibald (2016). pp. 418-438
15. Pinker (2008). pp. 323-372
16. Steinberg, Nagata & Aline (2001). pp. 309-342
17. The Brain Tumour Charity (2019)
18. Traxler & Gernsbacher (2006). pp. 93-124; 1143-1171

19. Why do some people have 'two brains'?
20. The left brain vs. right brain myth
21. Aphasia: The disorder that makes you lose your words
22. Broca's aphasia (Non-fluent aphasia)
23. Wernicke's aphasia (Fluent aphasia)
24. The Translator's Brain

(C) Key concepts:

aging
aphasia
brain
brain mapping
Broca's area
Broca's aphasia
dementia
disorder
dominance
dyslexia
elderspeak
glioma
hemispheres
impairment
lateralization
neuroplasticity
split-brain
Wernicke's area
Wernicke's aphasia

(D) Discussion questions and activities:

1. Make a distinction between (healthy) aging, dementia, Broca's aphasia, Wernicke's aphasia, and gliomas in regards to the brain's functioning in language comprehension and production. What do they all have in common?

2. What characteristic of the brain does this quote refer to? Also, answer the question at the end of the quote:

> "We continue to have the ability to learn new activities, skills or languages even into old age. Reinforcement or repetitive activities will eventually lead the adult brain to remember the new activity. By the same mechanism, the enriched and stimulating environment offered to the damaged brain will eventually lead to recovery. So if the brain is so flexible, why doesn't everyone who has a stroke recover full function?" (Fernández & Cairns 2011)

3. How do studies of brain mapping demonstrate not only the lateralization of language but also the localization of language function in particular areas of the brain?

4. Why is a person with a "split brain" unable to name an object held in their left hand (assuming their eyes are closed)?

5. What is the right-ear advantage for speech? How do psycholinguists and neurolinguists know that it is not simply a result of a general auditory superiority of the right ear?

6. How do studies of inherited language disorders contribute to the pursuit of the genetic underpinnings for language?

7. What is meant by the lateralization of language? How does the study of aphasia support the view that language is lateralized?

8. Does the age at which a second language is acquired relate to lateralization?

9. Popular psychology would have us believe that there are "left-brained" people and "right-brained" people. Do you think the same thing could apply to language?

10. In response to the question "*What do you do with a telephone?"* a person with one type of brain disorder would reply *"Uh... uh... telephone... uh... call people."* However, in response to the same question,

a person with another type of brain disorder would reply "*It is a pickbox of grey. Lose a telephone to call people. Yes, people.*"

What two types of brain disorders are these? Analyze the given examples as to their specific language characteristics related to each brain disorder.

11. What treatments are available for aphasia? Which are the most effective?

12. Is stuttering a (brain or speech) disease, tumor, illness, disorder, impairment, or injury? Explain in more detail why it is only one of these and not the others.

13. Bastiaanse & Ohlerth (2023) present two glioma patients who underwent presurgical testing with nTMS to illustrate individual (re)organization. Discuss both patients, the noteworthy findings from the case studies (bilateral representation of naming; actions/verbs versus objects/nouns), and the clinical implications. How could these results contribute to psycholinguistics?

14. Quiñones et al. (2021) have stated:

"Recent evidence suggests that the presence of brain tumors (e.g., low-grade gliomas) triggers language reorganization. Neuroplasticity mechanisms called into play can transfer linguistic functions from damaged to healthy areas unaffected by the tumor. This phenomenon has been reported in monolingual patients, but much less is known about the neuroplasticity of language in the bilingual brain."

Discuss the main findings from the clinical cases. How could these results contribute to psycholinguistics?

15. Chance observations showed that people whose right side of the body was paralyzed had experienced loss of speech. Tests that followed were more or less invasive. One of the invasive tests is the Wada test developed in the 1940s. Describe the procedure of the Wada or the sodium amytal test (sse Aitchison 2008).

16. Imagine you are an English as a Foreign Language (EFL) teacher and you have noticed that you had a student suffering from dyslexia in your class. What would you do or change/adapt in your teaching approach to that student?

17. What else might you want to know more about in context of what this Chapter deals with?

Chapter 3
Language comprehension

(A) Readings:

1. Traxler, M. J. (2012). *Introduction to Psycholinguistics: Understanding Language Science.* Wiley-Blackwell. pp. 79-140.

Big questions about words in language science include: How do we mentally represent word forms? How are those representations organized? How are word meanings represented in the mind? When we hear or see a word, how do we go about searching our memories for a matching form? What parts of the brain are involved in storing and accessing word meanings and what are the neural events that support word processing?

To understand how words are represented and processed, we need to subject them to several different kinds of analyses. Separate kinds of analyses are required because we represent information about words in at least two distinct ways. First, we mentally represent the *form* that words take, the way they sound and the way they look. The way they sound is reflected in a *phonetic* or *phonological* code, and the way they look is represented in an *orthographic* code. We also represent the meaning that words convey, which is referred to as a *semantic coding* system. When we talk about how word representations are organized, we can focus on different kinds of mental representation. Words may be related to one another because they sound similar (gave – cave), because they look similar (wow – mow), or because they have similar meanings (horse – donkey). Prominent accounts of word processing propose that word forms are represented in *lexical networks* and word meanings are stored in a separate, but linked, *semantic memory* or *conceptual store*. To understand how words are represented and processed, we have

to be clear whether we are talking about *form* or *meaning*, and we have to recognize that the mind represents these attributes in different ways in separate, but linked systems.

The whole point of having words in the language is that words can convey meaning from speaker to listener. How is that accomplished? To begin the discussion, we have to discriminate between two different definitions of the term *meaning*. When we talk about word meanings, we can differentiate between *sense* and *reference*. *Sense* refers approximately to dictionary-like or encyclopedic knowledge that we have about words. So, for example, the word *cat* maps on to information about generic form and function. When we hear *cat* we can access the information that cats are mammals, they have fur, they are kept as pets, and so forth. When we hear *knife*, we think of metal objects used for cutting things. *Reference* is another form of meaning that words are involved in. When we use words to refer to people, objects, or ideas the words themselves have senses, but their specific meaning in a given context depends on what the words point to — what they *refer* to. So how are word meanings (*senses*, that is) represented in the mental lexicon? And what research tools are appropriate to investigating word representations? One approach to investigating word meaning relies on introspection — thinking about word meanings and drawing conclusions from subjective experience. It seems plausible, based on introspection, that entries in the mental lexicon are close analogs to dictionary entries. If so, the lexical representation of a given word would incorporate information about its grammatical function (what category does it belong to: *verb*, *noun*, *adjective*, etc.), which determines how it can combine with other words (adverbs go with verbs, adjectives with nouns). Using words in this sense involves the assumption that individual words refer to *types* — that the core meaning of a word is a pointer to a completely interchangeable set of objects in the world.

If word meanings are types, how do we represent types? We could represent a given type by making a list of defining, necessary, or core characteristics. Some words seem to be easily represented by a small number of core, necessary features. "Bachelor," for example, seems to be well represented by combining the concepts "human," "adult," "male," and "unmarried". However, this apparent simplicity may be misleading. How about the concept "cat"? We could use its core features (e.g., "cat" =

"cute and furry killing machine"). But we know an awful lot more than that about cats (they have claws, they see well at night, they cough up hairballs, they don't make good doorstops, you can't use them to iron your clothes, etc., etc.). The question then becomes, of all of the millions of things one could include in the dictionary entry under the word *cat*, which things get put in and which things get left out? Does the meaning of *cat* include the fact that it can breathe? Does it include the fact that it is larger than a tomato and smaller than an automobile? Probably not. But where do you draw the line? Which properties are prestored in long-term memory, and which are derived "on the fly"? What we really need to store to represent the meaning of the word *cat* is just its core or essential properties — those things that make up the essence of "cat" and that discriminate between cats and other kinds of things, in which case, we might store just features like "mammal, feline, pet, makes purring sound" and perhaps a visual image of a prototypical cat. This approach runs into trouble very quickly, however, as many fairly easy to understand concepts do not have consistent, core properties across different versions of the concept. These are the kinds of problems that have led many language scientists to abandon the "defining" or "core" features approach to lexical semantics. Until someone comes up with a much better categorization scheme, dictionary-definition-like entries do not seem to be a good way of explaining how word meanings are represented in the mental lexicon.

One way to sidestep problems associated with the dictionary entry theory of semantics is to operationalize word meanings as reflecting collections of associated concepts. According to this type of account, word meaning is defined as "whatever comes to mind when someone says the word". This approach, exemplified by *semantic network theory* (Collins & Loftus, 1975; Collins & Quillian, 1972), has been the dominant theory in artificial intelligence approaches to semantics for the past 30 years. The goal of semantic network theory is to explain how word meanings are encoded in the mental lexicon and to explain certain patterns of behavior that people exhibit when responding to words. Semantic network theory proposes that a word's meaning is represented by a set of *nodes* and the *links* between them (Figure 3).

The nodes represent concepts whose meaning the network is trying to capture, and the links represent relationships between concepts.

For example, the concept *goose* would be represented as an address in memory (a node) connected to other addresses in memory by different kinds of links.

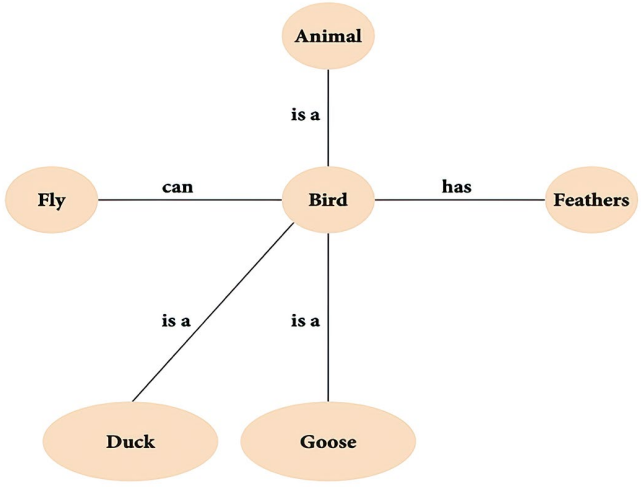

Figure 3. A fragment of a semantic network. Traxler (2012).

One of the important kinds of links in semantic network theory is the "*is a*" type. The *is a* link encodes relationships between general categories and the concepts that fall within the category. So, *goose* would be connected to the *waterfowl* node with a unidirectional *is a* link (representing the concept that *a goose is a waterfowl*). The *waterfowl* category node could be connected to many different instances (*duck*, *goose*, *coot*, *swan*, *seagull*, and so forth), and could in turn be connected to a superordinate category node, like *bird*, with yet another *is a* link. According to this view, subordinate concepts, like *goose*, inherit the properties of superordinate nodes via transitive inference (a goose is a waterfowl, a waterfowl is a bird, therefore a goose is a bird). This means that there is no need to directly connect the specific concept *goose* to the more general concept *bird*, and this helps conserve memory resources. In early work, Collins and Quillian showed that statements such as *A canary can fly* primed responses to statements such as *A canary is a bird*. The explanation for this effect was that reading *A canary can fly* caused activation to spread from *canary is a bird* to *a bird can fly*. So hearing *A*

canary can fly entails implicitly activating the relationship *a canary is a bird*, and that property is already activated when subjects read *a canary is a bird*. Other kinds of nodes and links are used to represent other properties and attributes of individual concepts, like *goose*. For example, *has* links and *can* links connect concepts to components (a *goose has feathers*, *a beak*, and *wings*; a *goose can fly*). The meaning of a word, on this account, is captured by the pattern of activated nodes and links. The meaning of *goose* is based on the concepts that *goose* is connected to, and the kinds of links that form the connections.

From Carroll (2008: 110-112)

A network is hierarchical if some elements stand above or below other members of the network. The research of Collins and Quillian (1969, 1970, 1972) stands as the prototype of this approach. The model used by Collins and Quillian is shown in Figure 3a. Notice that concepts similar to the word are represented as distinct nodes in a network of taxonomic and attributive relations. Taxonomic relations are those that deal with hyponymy, hypernymy, and coordination. Attributive or property relations indicate what characteristics may be attributed to the items at various levels in the network. The most interesting aspect of Collins and Quillian's model is their decision regarding how attributes or properties were stored in the lexicon.

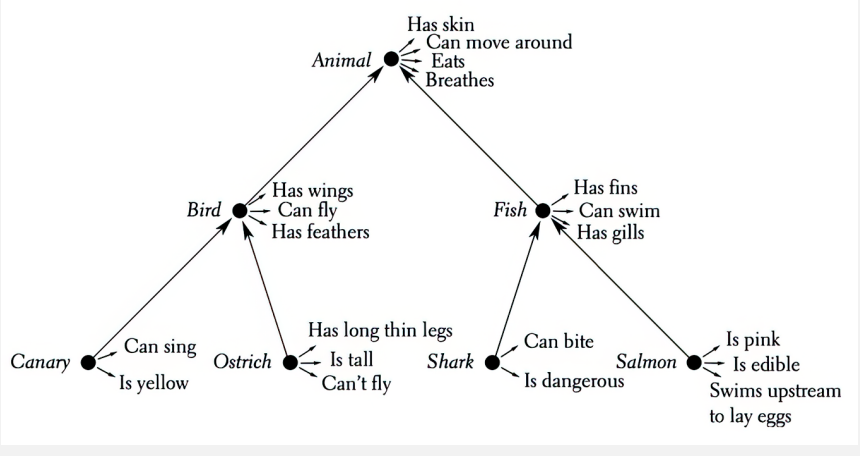

Figure 3a. A hierarchical network model of semantic information related to animals.

Collins and Quillian assumed that the space available for the storage of semantic information was limited, so that it would be beneficial to store information only in one place in the network. This principle is referred to as *cognitive economy*. Furthermore, they assumed that the information would be stored only at the highest possible node. For instance, the information that birds can breathe is stored at the animal level because it is true of all animals. The researchers suggest that rather than store it at all of the nodes, we store the information just once but make it available to other nodes through the network of relations. Because we are capable of drawing inferences, the notion of saving storage space has some merit. This occurs only when the information is redundant; the information that birds can fly would be stored directly at the bird node.

The idea of *spreading activation* is used to explain how information represented in the semantic network is accessed, and why words that are related to one another facilitate access to one another. Spreading activation is a hypothetical mental process that takes place when one of the nodes in the semantic network is activated. So, if someone says, *goose*, the *goose* node is activated by the matching phonological (sound) or orthographic (spelling) information. Activation from the *goose* node then spreads to nodes that are connected to it. So, activating *goose* causes activation to spread to the superordinate node, *bird*, and to the attributes connected to *bird*, *has wings*, *has feathers*, and *can fly*. Spreading activation has two important properties: (a) It is automatic. It happens very fast and we cannot control it. (b) It diminishes the further it has to go. Like ripples in a pond, nodes that are directly connected to *goose* are strongly and quickly activated when you see or hear *goose*; and more distantly connected nodes are less strongly and less quickly activated, and beyond a couple of degrees of separation, no changes in activation should occur.

From Carroll (2008: 115-116)

As a second alternative, we can modify the hierarchical assumption while retaining the idea of a network. This class of models is referred to as *spreading activation models*. As one example, Collins and Loftus (1975) assume that words are represented in the internal lexicon in a network, but

the organization is not strictly hierarchical. In contrast, the organization is closer to a web of interconnecting nodes, with the distance between the nodes determined by both structural characteristics such as taxonomic relations and considerations such as typicality and degree of association between related concepts. Thus, the model incorporates some aspects of both the Collins and Quillian model and the criticisms that the model inspired. The notion that concepts are stored as interconnected links is retained, but the view that all such relations are equal is revised by assuming that some nodes are more accessible than others and that the degree of accessibility is related to factors such as frequency of usage and typicality. The process by which semantic information is retrieved is also revised in this model. Instead of an intersection search throughout the network, Collins and Loftus argue that retrieval occurs by a process of spreading activation: Activation begins at a single node and then spreads in parallel throughout the network. This activation attenuates over distance, thus ensuring that closely related concepts are more likely to be activated than distant concepts. The process of spreading activation has been likened to the effect of dropping a rock into a pool of still water. The disturbance spreads out in all directions from the point of entry, with the magnitude determined by factors such as the intensity of the original stimulus, the distance between a part of the pool and the part the rock was dropped into, and the time elapsed since the rock was dropped.

Spreading activation models in various forms have been popular in cognitive psychology and psycholinguistics. They provide a more flexible way of representing lexical information as well as point to how we might activate such information during lexical access. The Bock and Levelt (1994) model appears to be particularly useful in understanding lexical access in both comprehension and production. Despite their considerable appeal, spreading activation models do not capture all of the aspects of words we are interested in. For example, networks emphasize sense relations and are notably silent on the topic of referential aspects of word meaning. Nonetheless, spreading activation provides a plausible framework within which to think about the concept of lexical organization and lexical access.

The two proposed properties of spreading activation help explain how people respond during *priming* tasks. *Priming* occurs when presenting one stimulus at time 1 helps people respond to another stimulus at time 2. In classic work on word processing, people respond faster in *lexical decision* and *naming* experiments when a target word like *duck* is

preceded by a related word like *goose*, compared to a control condition where *duck* is preceded by an unrelated word like *horse*. This kind of priming is referred to as *semantic priming*. Semantic network theory explains semantic priming as resulting from the spread of activation in the semantic network. Because *duck* and *goose* have many attributes in common, activating one of the concepts necessarily leads to substantial activation in the set of properties that makes up the meaning of the other concept. So, if you hear *goose*, you activate *waterfowl*, *bird*, *feathers*, and *can fly*. When you subsequently hear *duck*, those pre-activated concepts support the naming or lexical decision response (you have to wait for a shorter period of time for the network to activate the parts of the network that represent the concept *duck*). When you hear the prime word *horse*, activation spreads to closely connected nodes, but activation dies away before it reaches the part of the network that represents concepts related to *duck*. So, when you hear *horse* before the target word *duck*, the pattern of activation representing the meaning of the word *duck* starts from zero (or *normal resting activation*), it takes the network longer to activate the appropriate bits, and your behavioral response is correspondingly slower. Faster response time to primed words is also associated with decreased neural activity when a target word is preceded by a related prime word compared to when it is preceded by an unrelated word. Spreading activation is thought to diminish substantially beyond one or two links in the network. According to semantic network theory, what prevents activation spreading all over the network Is that the total amount of activation that can be spread is limited. So, nodes directly connected to the prime word are strongly activated, but less directly connected nodes are less strongly activated, with activation diminishing with increasing distance in the network.

According to semantic network theory, words are related to one another by virtue of having links to shared nodes. *Duck* and *goose* both connect to the *bird* node, the *feathers* node, and so forth. Two words can prime one another because they have similar representations due to shared nodes. This influences what happens to semantic knowledge when the brain is damaged. Two words can also be related to one another, whether they share nodes or not, if the two words co-occur in the language. So *police* and *jail* will prime one another, not because police officers resemble jails or vice versa, but because the two words appear

together often, and so the presence of one of the pair may be used to predict the appearance of the other in the near future. One of the challenges in word-processing research is to determine whether priming effects (like *duck–goose* priming) result from sharing nodes in a network, which is the classical view of semantic priming, or whether priming occurs simply because words co-occur, whether they share features of meaning (like *doctor–nurse*) or not (like *police–jail*).

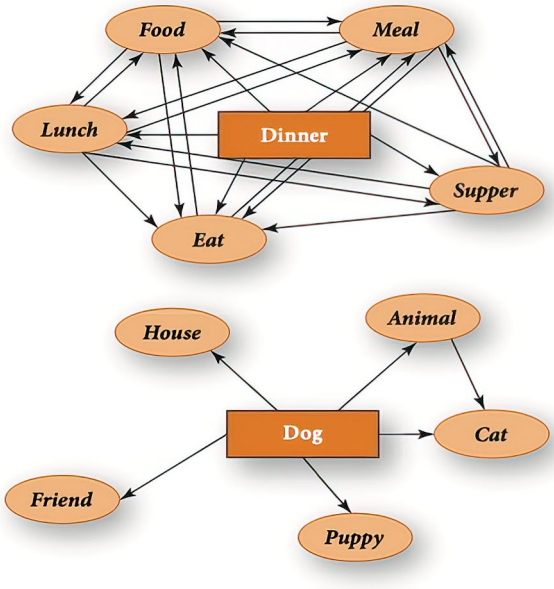

Figure 4. Connectivity for 'dinner' and 'dog'. Traxler (2012).

Concepts that co-occur more often in real life can become more strongly connected in the semantic network. The terms for things frequently connected in experience become themselves connected in the mental lexicon. These patterns of connectivity between different words have been shown to affect how easy it is to remember words. *Connectivity* reflects how many words are associated with a specific target word, and how many connections are shared between that set of words (Figure 4). Some words have few associates, and those associates have few connections between them. Those words have *low connectivity. High connectivity* words have more associates, and those associates have more

connections between them. In Figure 4, *dog* is low in connectivity and *dinner* is high. High connectivity words are easier to remember than low connectivity words in both cued and free recall. High connectivity words also produce different patterns of brain activity in the temporal lobes than low connectivity words. Thus, the structure of the associations in semantic memory affects the degree to which processing one word facilitates processing of a subsequent word, memory for individual words, and the brain's response to different words.

Lexical access refers to the set of mental representations and processes that are involved in identifying which specific words we are hearing (during spoken word processing) or seeing (during visual word processing). Recognizing words leads to the activation of semantic information, but models of lexical access typically deal specifically with the activation of word *form* information (stored representations of how words sound or what they look like), with the activation of semantic information being treated as a consequence of the activation of form. The recognition of familiar words during spoken language processing is so automatic and seemingly effortless, that many people think that there is really nothing there to explain. For many people, but certainly not all, reading seems similarly effortless. This apparent ease and automaticity obscures the fact that lexical access involves complex mental operations and, despite its apparent simplicity, considerable debate continues among language scientists about which exact properties of words are involved in lexical access, what exact mental mechanisms take part, and how the entire process is organized.

1. i. Lexical ambiguity resolution

So far, we have been assuming that each word in the input has one and only one matching representation in the lexicon, and only one meaning. This is not true. Many words have more than one meaning. The word *bank*, for example, can refer to a place where you keep your money or it can refer to a place next to a river where you go fishing. According to some estimates, over 40% of the words that you hear in English have more than one meaning (and this does not include the temporary ambiguities that happen when you hear words with onset-embedded words in them, like *ham* in *hamster*). So what happens when you hear or read a word that has more than one meaning? Do you go straight

to the contextually appropriate or correct meaning? Or do you have to sort through incorrect or contextually inappropriate meanings before you get to the correct one?

According to the *exclusive access* hypothesis, you can use cues from the context to immediately select the correct meaning of an ambiguous word like *bank*. When you hear or see the word *bank* you access only one meaning. If you are listening to a story about money, you access the financial institution meaning; and if the story is about fishing, you access the river-related meaning instead. But as we saw before, early events in word processing seem to involve activation of multiple candidates pretty much all the time. If visual and acoustic stimuli activate multiple word forms that they are associated with, maybe word forms simultaneously activate multiple meanings that they are associated with. This latter hypothesis is called the *exhaustive access* account. Exhaustive access says that you activate all of the meanings that are associated with an individual word like *bank*, even though only one of those meanings will be appropriate in any given situation.

If appropriate and inappropriate meanings are both activated when we hear an ambiguous word, how do we ever figure out the correct meaning of an utterance. Context does affect meaning selection eventually, even though it does not appear to prevent incorrect meanings from being activated in the first place. In follow-on experiments investigating meaning selection for ambiguous words, experimenters manipulated the amount of time that elapsed between the ambiguous word and presentation of the target word. The amount of time that passes between presentation of the ambiguous word and presentation of the target is called *stimulus offset asynchrony* (or SOA). In some studies, target words are presented immediately after the ambiguous word in some conditions, and they are presented at longer SOAs in other conditions. Different patterns of results are observed at different SOAs in experiments looking at ambiguous word processing. If target words are presented immediately after the ambiguous word, all of a word's associated meanings are primed. But if you wait until 250–500 ms after the ambiguous word to present the target word, you get a different pattern of results. At longer SOAs, only meanings that are appropriate in context are primed. This means that, although all of the meanings of *bugs* are activated when you hear the word, context causes you to deactivate

or suppress the inappropriate meaning after a short period of time. Thus, your long-term representation for the utterance will contain only the appropriate meanings, and your interpretation will not be cluttered with inappropriate meanings.

From Field (2003: 102-105)

An alternative view of word meaning comes from the work of a researcher (Rosch 1975) who presented her subjects with a questionnaire containing category names (bird, vegetable, fruit, clothing furniture, transport, etc.) followed by around 50 examples of each one. The task was to rate each item out of 7 as a good example of the category. Over 200 subjects (psychology students in California) performed the task, and there was found to be a very high level of agreement between them as to which items were the most typical. On the basis of this finding, Rosch argued that we determine a category in relation to an ideal exemplar (*a prototype*) of the group, hence the *prototype theory*. We can decide which creatures belong to the category of BIRD on the basis of goodness of fit to the prototypical bird, which (for Rosch's subjects) was a robin. The theory also enables us to account for how we extend the category to a bird that only has one wing or cannot sing. It is simply a less typical bird.

2. Carroll, D. W. (2008). *Psychology of Language* (5th ed.). Thomson Wadsworth. pp. 130-156.

We have to consider a great deal of information during the course of comprehension. Although some debate persists regarding what information is considered at what part of the process, there is agreement that comprehension involves, at some point, a consideration of syntactic, semantic, pragmatic, lexical, and extralinguistic factors. Let us try to tie our discussion of sentence comprehension with what we have already learned about working memory, i.e. the executive controls attention and thus determines what information is attended and what is ignored. Individuals with relatively larger working memories perform better at a variety of complex cognitive tasks, such as reasoning.

Given the complexity of comprehension, we would expect that working memory capacity is also related to individual differences in comprehension performance. It has been found that less skilled comprehenders were less efficient in rejecting the inappropriate meanings of ambiguous words. For example, when presented with sentences such as *He dug with the spade*, less skilled comprehenders were slower to reject the meaning of spade that pertains to playing cards in favor of the meaning that pertains to gardening.

It has been proposed that the mechanism of suppression is a component of general comprehension skill. That is, less skilled comprehenders are less efficient in suppressing irrelevant information, a skill associated with the central executive of working memory. This mechanism is not specific to comprehending written versus spoken language, and similar findings are found with both tasks. Furthermore, similar results occur in a visual, non-language task. Thus, the mechanism of suppression was seen as a component of general comprehension skill.

In regards to individual differences in working memory and how they pertain to language comprehension — for example, individuals with smaller working memories were more likely to show garden path effects in sentences such as *The evidence examined by the lawyer*... Those with larger working memories recognized that the head noun (*evidence*) is not animate, hence is incapable of examining anything. Individuals with larger working memories thus might be better able to identify this pragmatic cue and integrate it with the syntactic information to guide parsing and avoid the garden path effect. The interesting implication of this result is that the ongoing debate — whether all available information is simultaneously considered during sentence comprehension — may not have a single resolution. There may be different answers for individuals with different working memory capacities.

According to the modularity view of parsing, only certain kinds of information may be available to the language processor at a given time. If so, the assumption is that the language processor is hard-wired to handle only certain kinds of input at certain times of the process. By demonstrating that working memory capacity influences parsing performance, it has been suggested that the concept of modularity is not necessary to explain parsing performance.

Similarly, studies of memory load interference in syntactic processing support the conclusion that syntactic processing is not modular but rather influenced by a general working-memory system. Linguists presented participants with a short set of words while they read syntactically simple or complex sentences. In some instances, the words in the set matched those in the sentences; in other cases, they did not. Performance on sentence comprehension was worse for the more complex sentences. Also, more comprehension errors were made when the word set matched the words in the sentences, suggesting interference between the two tasks. Finally, the difference between the two types of sentences was greater when the words matched as opposed to when they didn't. These results indicate that the two tasks drew upon the same set of resources.

Several avenues of research remain. If working memory is related to language comprehension, what determines individual differences in working memory capacity? We know that performance on many tasks improves with practice, and many investigators contend that the amount of working memory capacity needed to perform a task decreases with practice. We do not know much of how language experience influences an individual's language comprehension skill.

To summarize, *parsing* — the process of assigning elements of the surface structure of a sentence to linguistic categories — is the first step in understanding a sentence. As a result of processing limitations, we begin to analyze sentence structure as soon as we see or hear the first words. The modular approach of parsing suggests that the words of a sentence activate syntactic processing strategies that are used to organize the words into a phrase marker. These strategies indicate that we prefer to attach incoming words to the most recent constituent as opposed to attaching them to earlier constituents or developing new ones. Although the strategies are generally useful, they sometimes lead to errors and subsequent re-analyses of syntactic structure. The interactive approach of parsing emphasizes that we use all available information, including lexical, discourse, and contextual factors. Whereas the modular approach insists that syntactically based strategies are used first, with lexical and discourse factors coming in later, the interactive model asserts that we simultaneously use all available information to parse sentences. Current research supports the role of lexical and contextual

factors in parsing, but the role of discourse factors is less evident. Recent research suggests that we sometimes develop incomplete or inaccurate representations of the sentences we encounter. This is more commonly the case when the sentence violates our expectations.

3. Dahan, D., & Magnuson, J. S. (2006). Spoken Word Recognition. In M. J. Traxler, & M. A. Gernsbacher (Eds.), *Handbook of Psycholinguistics* (2nd ed.). (pp. 249-283). Elsevier.

We solve an astounding array of information-processing challenges when we perceive a speaker's intended message. Apparently effortlessly, we accommodate variability in talker characteristics, dialect, speaking rate, and acoustic environment, all of which perturb the mapping between speech and linguistic categories. Without the aid of invariant cues to phonetic categories or word boundaries, we map acoustics onto phonetic categories, phonetic categories onto words in memory, words onto phrases and syntactic structures, words and syntax onto semantics, etc. Or do we?

On this view of language understanding, spoken word recognition is a distinct sub- system providing the interface between low-level perception and cognitive processes of retrieval, parsing, and interpretation. The narrowest conception of the process of recognizing a spoken word is that it starts from a string of phonemes, establishes how these phonemes should be grouped to form words, and passes these words onto the next level of processing. Some theories, though, take a broader view and blur the distinctions between speech perception, spoken word recognition, and sentence processing.

What motivates the narrow and broad conceptions? There are empirical, pragmatic, and theoretical motivations for the narrow view. Empirically, psycholinguistic levels of processing map roughly onto linguistic levels of description. The fact that linguistic knowledge can be described as a hierarchically structured set of levels leads to the reasonable hypothesis that speakers (or signers) and perceivers may represent and operate on those structures. Indeed, this hypothesis is given face validity by the fact that humans can make decisions about levels like phonemes and words and that perception can be influenced by manipu-

lations at those levels (though there is a long history of debate over their psychological reality).

The pragmatic motivation for the narrow view stems from the fact that over a century of concerted study of speech perception has led to a catalog of complex empirical phenomena and candidate cues for speech perception, but little understanding of the specific components of the speech signal that humans use to decode speech and achieve phonetic constancy. Rather than wait for a complete understanding of early perceptual processes, psycholinguists have made significant progress in understanding the processing of words and sentences by making the simplifying assumption that a string of phonemes makes a reasonable proxy for the results of initial perception, and that a series of sound forms associated with lexical entries makes a reasonable proxy for the input to sentence processing.

Theoretically, the narrow view is motivated in part by the assumption that the division of labor in staged systems affords significant processing efficiencies. Breaking the problem into distinct stages is argued to provide cognitive economy if the result is a series of mappings that are straightforward relative to the complexity of the full mapping from lowest to highest level. The broader view of spoken word recognition (in the extreme, as the mapping from speech to meaningful units that may be larger than words) has empirical and theoretical motivations. One consideration is that by assuming that the input to spoken word recognition is a string of abstract, phonemic category labels, one implicitly assumes that the non-phonemic variability carried on the speech signal is not relevant for spoken word recognition and higher levels of processing. However, if this variability and detail is not random but is lawfully related (even partially) to linguistic categories, the simplifying assumption that the output of speech perception is a string of phonemes may actually be a complicating assumption. Indeed, there is growing evidence that spoken word recognition is influenced by information in the signal that cannot be captured in a string of phonemes.

What purpose might this fine-grained sensitivity serve? One challenge posed by assuming that words are identified from a string of phonemes is the *embedding problem*; most long words have multiple shorter words embedded within their phonemic transcriptions (e.g., depending on dialect, and neglecting all subphonemic cues, *unitary* con-

tains *you, unit, knit, it, tarry, air,* and *airy*) and conversely, many short words embed in one or more other words. Successful spoken word recognition depends on distinguishing intended words from embeddings. However, the embedding problem is significantly mitigated when subphonemic information in the input is considered. For example, listeners are sensitive to very subtle durational differences (in the range of 15-20 ms) that distinguish *phonemically identical* syllables that occur in short words (*ham*) from those embedded in longer words (*hamster*).

Thus, the bottom-up signal contains vital information that simplifies the mapping from speech to words that would be lost were words identified from a string of phonemes. Might the same be true for subsequent processes? There is increasing evidence that the construction of syntactic and semantic structures relies on more than just a sequence of words. Indeed, a sequence of words is almost always temporarily compatible with multiple structures. For example, the structure associated with the word sequence *John knew the answer* differs whether it is followed by *was wrong* or *to the question*. A growing body of work has documented the role played by the prosodic structure of an utterance (marked by prosodic breaks and intonational prominences) in favoring some structures over others. Information from the speech signal is passed onto higher levels of processing. This supports an integrated view of phonetic, lexical, and sentential processing.

Sentence-level top-down constraints on lexical activation have received some attention in spoken word recognition, but chiefly with respect to how top-down information might constrain the set of activated lexical items. Immediate access to syntactic, semantic, and non-linguistic context could provide significant constraints on spoken word recognition, by influencing the activation of homophones, semantic associates, or context-appropriate lexical items, helping resolve lexical ambiguity resulting from phonological assimilations, or by restricting the set of possible referents.

3. i. Initial contact as input

When someone speaks, the linguistic content and speaker characteristics (e.g., physiology of the vocal tract, gender, regional origin, emotions, identity) simultaneously influence the acoustics of the resulting spoken output. Additional sources of variability include rate of elocu-

tion, prosodic prominence, and the phonetic context in which each word is pronounced. Nonetheless, listeners are able to recognize acoustically different stimuli as instances of the same word, thus extracting the similarity that exists between these different tokens, and perceiving them as members of the same category. How are words mentally represented to allow for this complex categorization?

The traditional (and dominant) view assumes that people represent the form of words as categories that abstract away from variability. Drawing on linguistic theories, the mental representation of a word form is usually conceived as a sequence of phonemes (sometimes themselves decomposed into a bundle of contrastive features). Within this framework, the ease with which a given pronunciation is categorized as a token of a given word is assumed to depend upon the degree to which its components have characteristics typically associated with the word's phonemes. Speaker-specific information is often viewed as a source of noise which does not contribute to the process of identifying the linguistic units present in the signal. The traditional view has influenced much of the research on spoken word recognition. Thus, the recognition of a spoken word is generally viewed as the mapping of the speech input onto abstract lexical representations, with abstract units standing for the word's subcomponents, the phonemes, mediating this mapping.

4. Fernández, E. M., & Cairns, H. S. (2011). *Fundamentals of Psycholinguistics.* John Wiley & Sons. pp. 179-183.

An important property of the speech perception system is that it is constructive. This means that the speech perception system takes information anywhere it can find it to construct a linguistic percept of the acoustic signal. Different phonemes have unique acoustic properties. The hearer also actively uses knowledge of the phonemic inventory, along with internalized information about how speech is produced. Some interesting facts about the constructive nature of the speech perception system come from the study of phonological illusions, much as the study of optical illusions provides insights about visual perception. One such illusion – *the McGurk effect* – illustrates how visual and auditory information together affect the construction of a phonological percept. If

you watch a video of a person mouthing [ga ga ga ...], together with the audio track of a person saying [ba ba ba ...], you will hear neither [ba] nor [ga] – but [da]. Depending on the combinations used, the visual will override the audio, the audio will override the visual, or – as in our example – the audio and the visual will combine into a new "sound." Since it is a true illusion, you will perceive it the same way even if you know that the audio and the video do not match. Most stunning about the version of the illusion described here is that if you close your eyes, you will clearly hear [ba], and if you turn down the volume you will clearly "see" [ga], so it is not the case that the individual signals are inadequate.

The McGurk effect is compelling, but it is not really all that surprising. We all perceive speech better if the speaker is in view. If people are asked to report speech that has been made difficult to understand by embedding it in noise, comprehension is improved if participants can see the speakers. Also, the lip-reading abilities of many deaf people are quite remarkable.

Slips of the ear bear some resemblance to phoneme restoration effects. Consider the person who "heard" *She had on a French suit*, from a signal produced by a speaker who intended to say *She had on a trench suit*. Slips of the ear are also called *mondegreens*. An important difference between slips of the ear and phoneme restoration effects is that the former are often the result of inattentiveness to the signal, while the latter can be truly illusory. Slips of the ear are frequently the result of the hearer being distracted. They are more likely when the signal is noisy (which explains why song lyrics are so susceptible to being misheard) or when the signal is ambiguous (e.g., hearing *traitor* instead of *trader*, since the two words are identical when pronounced with a flap between the vowels, or hearing *fine me* instead of *find me*, since the /d/ in *find* is likely to be elided due to coarticulation). Hearers can be very tolerant of the sometimes rather bizarre meanings that result from slips of the ear. Consider, for instance, the strange but funny mishearing of a Beatles' song lyric: *the girl with colitis goes by* (the original lyric is *the girl with kaleidoscope eyes*). Bizarre meanings aside, slips of the ear, similarly to slips of the tongue, tend to result in "heard" sentences that conform to the grammatical properties of the language.

5. Gluksberg, S. (2003). The psycholinguistics of metaphor. *Trends in Cognitive Sciences, 7*(2), 92-96.

Neuroimaging has become a gold mine. Whether or not you agree with that statement, you had no trouble when reading it in understanding that neuroimaging is a rich source for discoveries in the cognitive sciences and not a hole in the ground. How do people arrive at such understandings? As is usually the case for questions about cognition, we need to understand both representation and process. For the neuroimaging example, what is the mental representation of the words 'gold mine' in the context of the metaphorical assertion? Does it, for example, include an initial representation of the literal gold mine that is replaced by a contextually appropriate representation? Given a particular representation, what processes do people apply to generate a contextually appropriate interpretation? Do we, for example, initially derive a literal interpretation of the sentence, then reject that interpretation because it makes no sense?

As awkward as this process might seem, it is exactly what the standard pragmatic model of metaphor comprehension posits. This model, which has held sway since Aristotle, holds that metaphor requires a discrete three-stage process. For nominal metaphors such as 'neuroimaging is a gold mine', the first step is to derive the literal meaning of the sentence. This yields the nonsensical interpretation that neuroimaging is a hole in the ground. The second step assesses this interpretation against the context of utterance. Because it does not make sense in context, we must then take the third step: a search for a non-literal meaning that does make sense. As has been said, "where an utterance is defective if taken literally, look for an utterance meaning that differs from sentence meaning."

Literal meaning is defective whenever a rule of conversation appears to be violated. One conversational rule is to be truthful, and nominal metaphors like the one above are literally false. Under the three-stage pragmatic model, when false assertions do not make sense in context they are defective. What can be done to repair the damage? According to the model, metaphors are initially recognized as false categorical assertions. The literal false meaning must therefore be rejected, and an alternative non-literal interpretation found. One way to do this is to

convert a false literal assertion, such as 'some roads are snakes' or 'some jobs are jails' into a true assertion, namely, a *simile*. Sentences such as 'some roads are like snakes' and 'some jobs are like jails' are literally true. Indeed, all comparison assertions are true because any two things must always be alike in innumerable ways. 'False' metaphors are thus converted into 'true' similes, and then interpreted just as any literal comparison assertion would be interpreted.

Literal language processing is considered to be automatic: it is triggered by any linguistic input. Figurative language processing, by contrast, is presumably triggered by the failure of a literal interpretation to make sense. This entails that figurative interpretations must take more time than literal, because such interpretations are sought only after a literal interpretation has been generated and found wanting. A moment's reflection should convince you that this cannot always be true, and indeed, psycholinguistic research supports this intuition. Consider, first, idioms such as 'kick the bucket'. This expression is virtually never intended in its literal sense. As a result, the first meaning that comes to mind is the idiomatic one: to die.

5. i. How important is expression familiarity?

One determinant of an expression's comprehensibility is its familiarity, but familiarity alone is insufficient to account for ease of idiom comprehension. Consider novel variants of familiar idioms such as 'he didn't spill a single bean'. Even without a supporting context, most people immediately interpret this expression idiomatically, meaning that he told no secrets whatsoever. We tested this intuition by having people interpret novel variants of familiar idioms and their literal counterparts. For example, given the context of interrogating a prisoner of war, people interpreted either the single-bean idiom or its literal counterpart, telling a single secret. There was no priority of the literal: people understood the novel variant idioms as quickly as their literal counterparts. Even young children can handle, indeed produce, idiom variants. In a class exercise for my psycholinguistics course, one of my students explained to her three-year-old daughter, Stephanie, that 'spilling the beans' meant telling a secret. Later that day, Stephanie cautioned her father: 'Don't throw the beans to Allison, she's not supposed to know!'

Familiarity is also relatively unimportant when understanding well-constructed, apt metaphors. One demonstration that people can understand novel metaphors as quickly as comparable literal expressions was provided in an elegant experiment. The results are consistent with other studies of metaphor comprehension that have found no differences in the time taken to understand metaphorically and literally-intended expressions.

I turn now to a second implication of the view that literal meaning has unconditional priority. Fluent speakers of a language do not have the option of refusing to understand. The language processor is data-driven. Given a linguistic input, that input will be processed – phonologically, lexically and syntactically. This implies that literal meanings are non-optional. They will always be generated, regardless of a person's intentions to understand or not. Are metaphorical meanings also automatically generated, or is metaphor comprehension optional, dependent on context? Counter to the standard three-stage model, metaphor comprehension is not dependent on a failure to find a context-appropriate literal meaning. Like any other kind of language comprehension, metaphor comprehension is non-optional. Instead it is mandatory and automatic.

5. ii. Beyond similarity: metaphors are understood directly

So far we have accepted the assumption that metaphors such as 'my lawyer is a shark' are literally false, whereas in simile form – 'my lawyer is like a shark' – they are true. But let us reconsider. The lawyer-shark class inclusion assertion is literally false, but only if we take the word 'shark' to refer to the marine creature, that is, at the basic level of abstraction. However, the word 'shark' can be understood at a higher level of abstraction to refer to the category of predatory creatures in general, not just to the fish with sharp teeth. Metaphor vehicles such as 'shark' thus have dual reference. They can refer either at a subordinate level or at a superordinate level. In most metaphors, this dual reference function is implicit. In others, the dual reference is explicit, as in 'Cambodia was Vietnam's Vietnam'. The first mention of Vietnam refers to the Asian nation of that name; the second to the superordinate category of disastrous military interventions that the American-Vietnam war has come to exemplify. More generally, when a category has no name of its

own, the names of prototypical category members can be used as a name for that category. Typical literal examples include brand names such as Xerox and Kleenex to refer to the categories of dry paper copiers and tissues, respectively. Typical metaphorical examples, now conventionalized, include 'butcher' for anyone who should be skilled but is incompetent, 'jail' for any unpleasant, confining situation, or 'Enron' for any dramatic accounting scandal.

The communicative strategy of dual reference – using prototypical category member names to name non-lexicalized categories – provides a natural explanation for the major metaphor phenomena. Because metaphors are categorical assertions, they are, unlike literal comparisons, non-reversible. The only circumstance under which a metaphor can be reversed is when the ground of the metaphor changes, as in 'my surgeon was a butcher' (a negative comment) versus 'my butcher is a surgeon' (a positive comment).

Dual reference also accounts for the paraphrasability of metaphors as similes and vice-versa. In simile form, as in 'my lawyer was like a shark', the word 'shark' refers to the literal predatory fish. In metaphor form, it refers to the superordinate category of predatory creatures that is exemplified by the literal shark (Table 2). Literal comparisons cannot be paraphrased in this way; for example, 'coffee is like tea' becomes false in categorical form: 'coffee is tea'. Similarly, literal category assertions become anomalous in comparison form: 'robins are birds' versus 'robins are like birds'.

Metaphorical shark	Literal shark
Vicious	Vicious
Predatory	Predatory
Aggressive	Aggressive
Tenacious	Tenacious
Merciless	Merciless
etc.	Can swim
	Has fins
	Has sharp teeth
	Has leathery skin
	etc.

Table 2. Metaphorical and literal reference for 'shark'. Gluksberg (2003).

6. Gibbs, R. W., & Colston, H. L. (2006). Figurative language. In M. J. Traxler, & M. A. Gernsbacher (Eds.), *Handbook of Psycholinguistics* (2nd ed.) (pp. 835-861). Elsevier.

Figurative language is language that means one thing literally but is taken to mean something different. It is a ubiquitous aspect of language. Figurative language is present in our daily discourse, in our poetry, and in our religious worship. Figurative language is no longer perceived as merely an ornament added to everyday, straightforward literal language, but is instead viewed as a powerful communicative and conceptual tool.

One of the continuing difficulties with the psycholinguistics literature on figurative language understanding is that few scholars ever attempt to define the terms "literal" and "figurative." A traditional assumption in many academic disciplines is that literal meaning is primary and the product of default language comprehension. Thus, in psycholinguistic terms, the human language processor is designed for the analysis of literal meanings. Non-literal, indirect, and figurative meanings are secondary products, and dependent on some prior analysis of what words and expressions literally mean. This general theory implies that non-literal meanings should always take more time to interpret than are literal meanings.

Psycholinguistic research over the past 40 years has struggled to create adequate accounts of sentence parsing and discourse processing. Although there has been significant progress in our understanding of different aspects of sentence processing in regard to specific topics (e.g., the interaction of syntax and semantics in sentence parsing, reference assignment, ambiguity resolution, establishing coherence relations in text), there is no single agreed upon position as to what people ordinarily do as they encounter language word by word in speech and reading. Thus, there is really not a single position on literal meaning processing. This state of affairs highlights the absurdity of theories of figurative speech processing that are often based on unverified assumptions as to how so-called literal language is usually understood. In fact, it is not clear what the operational definition of "literal" meaning is in most psycholinguistic experiments. These studies individually compare metaphoric vs. literal meaning, ironic vs. literal meaning, idiomatic vs. literal mea-

ning, metonymic vs. literal meaning, and so on. But across the vast number of empirical studies that have compared "literal" and "figurative" meaning, the variety of forms for literal utterances is as great as are the differences between metaphors, metonymies, ironies, and so on. Yet scholars continue to assume that the literal meaning they examine empirically somehow is the same variable that other researchers investigate in their respective experiments. A related tendency in research on figurative language has been to note the difficulty in making a principled distinction between literal and figurative language, or meanings, and to suggest, alternatively, that literal and figurative represent different ends of a continuum of meaning. This idea is seen as especially useful in recognizing that some instances of figurative language, such as novel, poetic metaphor seem more nonliteral than are highly conventionalized phrases which almost seem to express literal meanings (e.g., "kick the bucket" has "to die" as one of its literal meanings). Individual word meanings may also vary along this literal vs. figurative continuum. But making these distinctions, even along some graded continuum makes little sense, especially if one is trying to squeeze all aspects of literal and figurative meanings onto a similar scale. There is simply no single dimension along which all instances of literal and nonliteral meanings nicely align.

The results of many psycholinguistic experiments have shown the standard pragmatic view to be incorrect as a psychological theory. Numerous reading-time and phrase classification studies demonstrate that listeners/readers can often understand the figurative interpretations of metaphors, irony/sarcasm, idioms, proverbs, and indirect speech acts without having to first analyze and reject their literal meanings when these expressions are seen in realistic social contexts. For instance, people can read figurative utterances (i.e., "You're a fine friend" meaning "You're a bad friend") as quickly, sometimes even more quickly, as literal uses of the same expressions in different contexts, or equivalent non-figurative expressions. These experimental findings demonstrate that the traditional view of figurative language as *alway*s requiring additional cognitive effort to be understood has little psychological validity.

But the idea that people can use context to infer figurative meaning without a literal analysis of an expression has been criticized on various grounds. First, there has been misunderstanding of the claim that

figurative language can be understood "directly." This suggestion does not imply that people do not process the meanings, literal or otherwise, of the individual words in each expression. The work showing that people can process many instances of figurative language as quickly as they do non-figurative speech only implies that a complete analysis of an expression need not be completed before any interpretation of its intended figurative meaning can begin. Second, some studies have found evidence that people take longer to process figurative language than corresponding literal speech, exactly as would be predicted by the traditional view. Yet in at least some cases, the contexts used in these studies were relatively weak in supporting figurative meanings. For instance, remarks like "You're just in time" took longer to read in ironic context (i.e., when someone was quite late) than in literal ones, especially when the irony was unexpected. But in other studies, the context in which an ironic remark appeared set up an ironic situation so that the speaker's utterance was easily understood as having ironic meaning and took no longer, and occasionally less time, to process than literal statements. Similar effects have been reported in regard to metaphor understanding where some contexts set up metaphorical conceptualizations of topics that make following metaphoric utterances easy to interpret. People may still need to draw complex inferences when understanding some figurative statements, but part of these inferences can occur before one actually encounters a figurative utterance. Listeners may take longer to understand a novel expression because of the difficulty in integrating the figurative meaning with the context and not because listeners are first analyzing and then rejecting the expression's literal meaning. For these reasons, we simply should not infer that the literal meaning for an entire phrase or expression must have been analyzed simply because people take longer to read novel instances of figurative language than to process either familiar figurative expressions or equivalent literal statements.

Scholars often assume within the context of a single set of studies that there are two processes at work during figurative language understanding, such as literal vs. idiomatic, literal vs. metaphoric, or literal vs. ironic. Yet if there are numerous types of meaning, must there be dozens of types of linguistic processes all at work, or potentially at work, when language is understood? Psycholinguists have not addressed this

question primarily because they focus too narrowly on only one kind of figurative meaning against a simple view of literal meaning.

Perhaps the most prominent of these new models is the "graded salience hypothesis". This account specifically claims that context functions to constrain figurative meanings only after salient word or phrase meanings have already been accessed. Salient word or phrase meanings are not necessarily "literal" meanings. Instead, salient meanings reflect the most common, conventional use of a word or phrase. Unlike the standard pragmatic view, however, context may facilitate activation of figurative meanings before people analyze the semantic, or literal, meanings of the entire linguistic expression. For instance, processing familiar metaphors (e.g., "step on someone's toes") should activate both of their literal (e.g., foot) and metaphoric (e.g., offend) meanings, even when these metaphors are seen in appropriate discourse contexts. Processing unfamiliar metaphors (e.g., "Their bone density is not like ours") may, on the other hand, only initially activate their literal meanings, as these are most salient. Different empirical studies, ranging from reading-time to word-fragment completion experiments, support this general idea for how people interpret different kinds of figurative language, in addition to how jokes may be understood.

One difficulty with the graded salience view is that it is unclear what defines a word's, or expression's, salient meaning. It has been suggested that the salient sense of a word, or an expression, is the one directly computable from the mental lexicon irrespective of inferences drawn on the basis of contextual information. Salience is a graded notion, and includes senses that are more frequent, conventional, or prototypical/stereotypical. A different problem with the graded salience view is that it posits automatic activation of both salient word and phrase meanings. The motivation for this facet of the proposal comes from the fact that the conventional meanings of certain phrases, such as "kick the bucket" (meaning "to die"), are automatically activated even when the context specifies a different interpretation (e.g., a dairy farmer striking his foot against a pail). Yet according to the graded salience hypothesis, the salient meanings of individual words should also be automatically activated regardless of context. Thus, the salient meaning of the word "kick" should be quickly accessed. But this salient word meaning differs from the putative salient meaning of the entire phrase (e.g., "to die"). It

is unclear how this conflict is resolved or whether context comes into play to determine contextually appropriate word meanings before conventionalized phrasal meanings are accessed.

A related recent theory of figurative language processing claims that the language processor initially accesses an interpretation that is compatible with both a word's literal and figurative meanings. Consider the verb "disarmed" in "Mrs. Graham is quite certain that they disarmed about every critic who was opposed to spending more money on art." The "underspecification model" assumes, for example, that the initial meaning recovered when reading the verb "disarmed" in any context is underspecified as to whether it refers to removing literal or figurative arms. Over time, however, the language processor uses context to hone in on the word's appropriate meaning, where the honing in process is faster when the preceding context is strong and slower when the preceding context is neutral. Support for the underspecification model comes from several eye-movement studies. One study examined people's processing of ambiguous verbs, such as "disarmed" in the above sentence. The eye-movement data showed that the processing difficulty with the subordinate sense of "disarmed," relative to when the word was used in a literal, dominant sense (e.g., "After the capture of the village, we disarmed about every rebel and sent them to prison"), did not emerge until *after* the critical verb was read. Thus, context reduces processing difficulty, but the difference did not emerge until much after the verb was seen. People did not initially access either a specific sense or several senses for an ambiguous verb. Instead, readers initially recovered a general, underspecified meaning for the verb and then created a further concrete instantiation of its meaning later on. According to the underspecification model, then, context does not operate to judge between different word meanings, but functions to change an underspecified, or highly general meaning, into a specific interpretation.

But similar to the graded salience view, the underspecification model suffers from the problem of not being able to specify what constitutes the initial, underspecified meaning that is accessed when a word is first encountered. Many linguists reject the underspecification view precisely because they have failed to discover senses that are rich enough to capture the wide range of meanings (up to 100 for some polysemous words) many words possess. More generally, both the graded salience

and underspecification views face the challenge of demonstrating consistent bottom-up activation of context-free word meanings even in the presence of strong supporting context.

Finally, a different model of figurative language understanding embraces the notion of "constraint satisfaction", an idea that has gained much support in psycholinguistics and cog- nitive science. When people comprehend a text, or a figurative utterance, they must construct an interpretation that fits the available information (including context) better than alternative interpretations. The best interpretation is one that offers the most coherent account of what people are communicating, which includes meanings that best fits with certain other information and excludes meanings that do not fit this other information. Under this view, understanding a figurative utterance requires people to consider different linguistic and non-linguistic information that best fits together to make sense of what a speaker or writer is saying. Constraint satisfaction models are computationally efficient, and perhaps psychologically plausible, ways of showing how different information is considered and integrated in everyday cognition. A constraint satisfaction model provides the best explanation for experimental data on proverb understanding. Familiar proverbs are understood more easily than unfamiliar expressions, and the speed-up in processing for familiar proverbs occurs as soon as the second word of the expression is read, but the first words of unfamiliar proverbs are read more quickly in contexts supporting their figurative, rather than literal, meanings. These findings support a constraint satisfaction model by positing how different sources of information (i.e., syntactic, lexical, conceptual) compete for activation over time in parallel. Constraints interact to provide probabilistic evidence in support of various alternatives with the competition ending when one alternative fits best. For example, when reading an unfamiliar proverb, people immediately focus on a literal interpretation because there is less competition from other sources of information supporting a figurative meaning. Similarly, familiar proverbs are easier to process than unfamiliar expressions because there is more information available from the context and the words in familiar proverbs to support a figurative interpretation.

The complexities of figurative language processing are such that there may not be a single theory or model that explains how all aspects

of figurative language are understood. Part of the reason for this conclusion is that figurative language does not constitute a homogenous kind of language that is necessarily used and understood in completely distinct ways from nonfigurative, or what some call "literal" speech. Given the long history to provide a theory of literal meaning and the failure to come up with a unified account of this kind of language, we frankly are doubtful whether any such proposal will come forward that is widely embraced by psychologists, linguists, and philosophers.

(B) Further reading and online resources:

1. Aitchison (2008). pp. 205-233
2. Altmann (2001). pp. 135-152
3. Carroll (2008). pp. 102-129
4. Crystal (2005). pp. 39-50; 121-126
5. Cutler (2005). pp. 209-309
6. Drouillet et al. (2018)
7. Erdeljac (2009)
8. Fernández & Cairns (2011). pp. 170-234
9. Fernández & Cairns (2018). pp. 183-456
10. Field (2003)
11. Field (2004)
12. Flores d'Arcais & Levelt (1970). pp. 48-76
13. Garman (1990). pp. 181-370
14. Hatzidaki (2007)
15. Kalajdžisalihović (2022a)
16. Kalajdžisalihović (2022b)
17. Knupsky & Amrhein (2007)
18. O'Grady & Archibald (2016). pp. 391-417
19. Scovel (1998). pp. 50-69
20. Spivey, McRae & Joanisse (2012). pp. 61-405; 465-522
21. Steinberg & Sciarini (2006). pp. 65-90
22. Steinberg, Nagata & Aline (2001). pp. 93-122
23. Traxler (2012). pp. 37-298.
24. Traxler & Gernsbacher (2006). pp. 151-1024
25. Wierzbicka (2009)

26. Research Features: Understanding the mechanisms of language comprehension
27. Encyclopedia.com: Language Comprehension
28. How do our brains process speech?
29. Language Comprehension and Production
30. Hitting the right pitch: A meta-analysis of effect of sentence context on lexical access

(C) Key concepts:

activation
ambiguity
bottom-up
cognitive economy
cognitive load
comprehension
connectivity
constraint satisfact. model
decoding
encoding
figurative language
graded salience hypothesis
interpretation
lexical access
lexical entries
lexical storage
listening
long-term memory
McGurk effect
meaning
metaphor
networks
nodes
perception
priming
processing
prototypes
reading
recognition
representation
retrieval
semantic network theory
sense
short-term memory
slips of the ear
spreading activation model
storage
syntactic parsing
top-down
underspecification model
working memory

(D) Discussion questions and activities:

1. The fundamental problem in speech perception is to understand how the human listener recovers the speaker's intended linguistic message from information encoded in the time-varying acoustic signal. This general problem has been traditionally broken down into a smaller set of more specific questions. Answer these questions:

a) What types of cognitive and linguistic processing operations occur at each stage?

b) What are the primary processing units in speech perception and spoken word recognition?

c) What sensory, perceptual, and neural mechanisms are used in speech perception and spoken language processing?

2. Imagine yourself as a psycholinguist trying to devise experiments to investigate how people comprehend language. What experiments would you make up to address the following questions? Be as specific as possible about how you would interpret the question and what you would do to try to come to conclusions through psycholinguistic experimentation:

a) Are semantically abstract words easier to process than semantically concrete ones?

b) Are simple clauses more difficult to understand than conjoined clauses?

c) Do people read words from beginning to end?

d) Do people with different levels of education process language in fundamentally different ways?

e) Does the way you parse a sentence depend on whether you speak your native tongue or a foreign language?

3. Explain what goes on in the brain when one hears the metaphor: *Life is a highway.*

4. Describe the relationship between sentence structure and sentence meaning. How does the way that we organize words in sentences influence the meanings we assign to those sentences?

5. What factors affect lexical access?

6. How does lexical storage assist lexical access?

7. The TRACE model of lexical access and the COHORT model of lexical access are prominent second-generation accounts. Discuss both models (why are they called so, what are their advantages, etc.).

8. Lexical processing in sentence comprehension involves two operations: retrieval and selection. How are these processes demonstrated with respect to ambiguous lexical items?

9. Regarding factors that affect comprehension, Hatzidaki (2007) has written:

> "With respect to individual differences, comprehension skills may vary from one person to another, due to people's varying degrees of competence and performance. In other words, what makes "good" and "less-good" comprehenders is the fact that some may acquire all the necessary linguistic and extra-linguistic information for understanding, but be unable to apply it because of physiological limitations (e.g., restricted short-term memory capacity due to age or brain damage), or inadequacy of operating under stressful conditions that may disrupt the process of comprehension (e.g., time pressure or noisy environment). On the other hand, others may be capable of dealing with external factors but not possess the required knowledge (e.g., background knowledge and language-specific information) to successfully construct meaning representations. Regarding the factors that are relevant to the to-be-understood material, it is expected that complex structures will be more difficult to understand than simple structures. The former create more relationships among linguistic elements, thus overloading the mind's processing capacity, whereas the latter do not need any extra cognitive abilities to be processed. The nature of a text, for example stylistics, clarity of expressed ideas, and so on, may also determine how successful the process of comprehension can be. Finally, factors such as familiarity and frequency have been found to facilitate comprehension since the more familiar we are with certain structures and the more frequently we use them the easier it is to understand them when we read or hear them."

What are your thoughts concerning this passage? Can you add other factors?

10. Choose one word (any word) from this text and apply the spreading activation model to the word. Explain this model through the chosen word by drawing a network:

> *UK Met Office scientists are forecasting that next year will be a little cooler around the world. The La Niña weather phenomenon will see temperatures edge down but greenhouse gases will remain the*

biggest influence. A La Niña develops when strong winds blow the warm surface waters of the Pacific away from South America and towards the Philippines.

11. What are the advantages and problems of the spreading activation model?

12. What are the main criticisms of the Prototype Theory (see MacLaury 1991)?

13. What is the difference between bottom-up and top-down processing? When do psycholinguists think that top-down processing is used by the hearer? Is this a conscious decision on the part of the hearer?

14. Describe different kinds of inferences. What role do inferences play in discourse comprehension? When and how do comprehenders draw inferences?

15. It may be said that humans need thinking space to let information "sink in". Give an example in which you will briefly compare and contrast two types of text (see Field 2003).

16. What implications for translation does the process of comprehension have?

17. In practice, how would you use the knowledge on sentence processing and comprehension to teach students how to become better speakers, translators or writers?

18. Discuss the Whole-Word vs. Phonics/Decoding controversy. What is your personal opinion? (see Steinberg & Sciarini 2006: 65-90; Steinberg, Nagata & Aline 2001: 93-122)

19. What do all the theories related to word meaning (semantics) tell us about language comprehension?

20. How could you define speed reading?

21. A major issue in studying reading is: To what extent does the spoken word contribute to the process? Obviously it does so in the early stages of reading when we learn to recognize written forms by reference to spoken ones. But is this just a stage leading to the development of an entirely separate visual vocabulary store? Or does reading continue to be mediated through the spoken word, even for an adult reader? Does the role of the spoken word vary from language to language, given that some languages such as English have orthographies which do not depend upon simple one-to-one links between letters and sounds?

22. How would you approach teaching and practicing reading and listening skills in the EFL classroom?

23. Activity (Inner Speech: how phonology contributes to reading)

Study the following sentence; you have three seconds to try to commit it to memory.

It was when he was parking his car that he noticed a long horizontal scratch on the left side of the windscreen.

Close the coursebook and try to write it from memory.

Now ask yourself: In what form did I try to store that sentence in my mind? You will almost certainly report that you rehearsed the sentence in something like a spoken form: an 'inner voice' in your head. You did not try to store it in a visual form. 'Inner speech' appears to be present when we read in normal circumstances. We only become aware of it when we accord it more attention than usual because we are reading a piece of text that is difficult or because we are tired and having

difficulty in concentrating. But you will almost certainly recall at some time reading an email from a friend and hearing their voice in your head as you read.

Why is this a spoken form rather than a visual one? Two explanations often given are:

a. Spoken information in memory is more durable than visual.

b. If we store words in spoken form, they are less likely to interfere with the visual process of decoding words on the page.

There is one confusing aspect of this phenomenon, however. We can read with our eyes much faster than we read with our voices. Silent reading (average: around 300 words per minute) is much faster than reading aloud (average: around 150-200 w.p.m.). However, the 'voice in the head' appears to follow very closely behind the reader's eye. So, inner speech cannot be an exact replica of spoken language. It appears that some kind of phonological encoding of the reading text takes place, but that it must be in a reduced form. It might feature key words only, or parts of words or content words without functors. The precise nature of inner speech has yet to be established. When readers attempt to analyze what the inner voice says, they receive the impression that it encodes in full everything they have read. However, in focusing full attention upon inner speech, they may have resorted to a slower, more controlled and less efficient process than is involved in normal silent reading. What we do know is that inner speech seems to play an important part in supporting the comprehension processes. It enables us to hold a string of words in memory while we impose a syntactic pattern upon them.

24. Activity (Prototype Theory):

Fill in the table with a prototypical exemplar of each category:

Furniture	Bird	Animal	Fruit	Vegetable	Vehicle

Compare your answers with those of other students. Now ask yourself:

a) What kind of criteria did you use in deciding whether an *ostrich* was a good example of the category 'bird'?

b) What kind of criteria did you use in deciding whether a *bat* was a good example of the category 'bird'? Or *tomato* a good example of 'vegetable'?

c) Do you think that factors other than word meaning might have affected your decision about which items were best examples of the category 'fruit'?

d) Look at the items which you chose as most typical of the category 'vegetable'. What do they have in common? Is it easier or more difficult to decide how you chose a good 'vegetable' than to decide how you chose a good 'bird'?

e) In choosing items for 'vegetable', did you experience interference from any other possible category?

Your answers to the questions above should have given you some indications of the strengths and weaknesses of the Prototype Theory. But now consider the theory in relation to the following:

- Armstrong, Gleitman, and Gleitman (1983) asked subjects to choose numbers that were good examples of the category 'odd number' and 'even number'. Subjects realized that it made no sense to talk of a typical even number, but went on to choose examples quite consistently. They found that 2 and 4 were 'good' examples of even numbers but that 34 and 106 were not. They also reported that *mother* and *ballerina* were prototypical exemplars of the category 'female', but *policewoman* and *comedienne* were not.
- In an early prototype experiment, Labov (1973) asked subjects to give names to drawings of vessels which resembled a cup to different degrees. He found that there was no sharp agreement on where a *cup* ended and a *bowl* began. He went on to ask subjects to imagine the vessels full of (a) coffee, (b) flowers and (c) mashed potato. He discovered that the extent to which the vessels were identified as cups was determined not just by how closely they resembled a prototypical cup but also by their suggested use. Thus the switch from *cup* to *bowl* occurred much earlier if subjects were told to imagine the vessel full of mashed potato, as did the shift from *cup* to *vase* if flowers were introduced.

Some conclusions:

- Speakers who share a particular language seem to recognize similar prototypes for at least some of the language's categories. Of course, this does not necessarily mean that we use prototypes to determine what does and does not belong in a category.
- The choice of a prototype is sometimes determined by a set of attributes which are characteristic of the category. Thus, we expect a typical bird to have wings, to sing, to have feathers, to lay eggs. We make allowances for birds which do not meet these requirements but which show at least some family resemblances. The trouble is that not all categories can be explained in terms of physical characteristics (What does a pea have in common with a carrot?).
- Category membership may sometimes be complicated by the fact that an item belongs to two categories. Thus, we might rank a lettuce as a not very typical 'vegetable' because it also falls into the smaller category 'salad'.
- Prototypes may to some extent reflect the culture in which the individual has grown up. We should also recognize that other languages may have fewer or more categories than English. Spanish has three categories for the items that an English speaker groups together as 'vegetable'.
- Category membership may be more flexible than has been assumed. In classifying items, we may be influenced by the context in which we find them and the use to which they are being put.
- It has been argued that we need to make a distinction between conceptual cores and identification functions. The first tells us that an even number is any number that is divisible by 2; but the second makes us aware that some even numbers are easier to recognize than others. We know that our *grandmother* is the mother of one of our parents. But a grandmother with grey hair, wrinkles and twinkly eyes relates more closely to the identification function for the category than a grandmother who dyes her hair, smokes cannabis and drives a sports car. Similarly, your reasons for rejecting *bat* as a 'bird' and *tomato* as a 'vegetable' may have more to do with scientific knowledge than with the way in which you conceptualize these entities.

25. What else might you want to know more about in context of what this Chapter deals with?

Chapter 4
Language production

(A) Readings:

1. Bock, K., & Levelt, W. (1994). Language Production: Grammatical Encoding. In *Handbook of Psycholinguistics* (pp. 945-984). Academic Press Inc.

The processes of language production can be divided into those that create the skeleton of an utterance and those that flesh the skeleton out. *Grammatical encoding* comprises both the selection of appropriate lexical concepts (entries in the speaker's vocabulary) and the assembly of a syntactic framework. It contrasts with *phonological encoding*, which comprises the assembly of sound forms and the generation of intonation. The product of these processes is not speech itself, but a specification of an utterance that is adequate for controlling the processes of articulation or speech production.

The components of grammatical encoding are no more accessible to conscious experience than the corresponding components of comprehension. Just as in comprehension, we typically become aware only of disruptions. But unlike disruptions of comprehension, many disruptions of production are public events: A speaker who intends to say *meals on wheels* and instead says *wheels on meals* usually knows that something has gone wrong, as does anyone within earshot. Because of their ready availability, speech errors are a rich source of clues to how language production works.

Deciphering these clues has been the focus of several pioneering studies. The details of the analyses diverge in important ways, but there is reasonable agreement on the broad outline of production processes

that is sketched in Figure 5. This outline roughly follows proposals by Garrett (1980, 1982, 1988) and, although it is motivated primarily by analyses of speech errors, it is intended to provide an account of normal production. The bridge from errors to normal production is built largely on the existence of strong constraints on the forms of speech errors, which are taken to point to relatively immutable components of the production process.

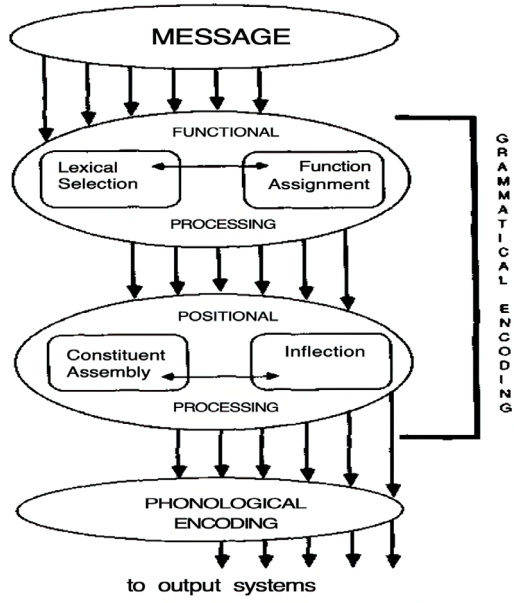

Figure 5. An overview of language production processes. Bock & Levelt (1994).

1. i. Levels of processing

Figure 5 shows four levels of processing: the message level, the functional level, the positional level, and the phonological level. The message captures features of the speaker's intended meaning and provides the raw material for the processes of grammatical encoding. These processes are grouped into two sets: functional and positional. The primary subcomponents of functional processing are lexical selection (which involves the identification of lexical concepts that are suitable for conveying the speaker's meaning), and function assignment (which involves the assignment of grammatical roles or syntactic functions).

Positional processing involves the creation of an ordered set of word slots (constituent assembly) and morphological slots (inflection). Finally, phonological encoding involves spelling out the phonological structure of the utterance, in terms of both the phonological segments of word forms and the prosody of larger units.

The processes of grammatical encoding can be more concretely specified by going through the steps involved in generating a simple utterance and constructing errors that might arise at each step. We number these steps for expository convenience, but the numbers are not intended to denote a strict ordering of implementation. As the target utterance we use *She was handing him some broccoli.* The message behind this utterance presumably includes notions about a past progressive event in which a female action-agent transfers by hand a non-specific object from a certain class of vegetables to a male action-recipient.

The first step, lexical selection, involves identifying the lexical concepts and *lemmas* suitable for conveying the message. Lemmas carry the grammatical information associated with individual lexical concepts, such as their form class (noun, verb, etc.). For conveying the broccoli message, appropriate lemmas include masculine and feminine pronominal indices, a noun (*broccoli*), and a verb (*hand*) that relates the elements or arguments of events involving an agent, a recipient, and a theme. A common type of speech error that appears to reflect a problem of lexical selection is a *semantic substitution*, which would occur if our hypothetical speaker said *She was handing him some cauliflower.* These substitutions preserve general features of the meaning of the intended word and are nearly always members of the same grammatical form class (noun, verb, adjective, adverb, or preposition). There are three major types of lexical selection errors, called substitutions, blends, and exchanges. In all three cases a non-target lemma is activated and an incorrect word form is produced. One potential cause of a substitution error is that an alternative lexical concept is activated along with the target.

The second step is function assignment. This involves assigning syntactic relations or grammatical functions (e.g., subject-nominative, object-dative). During the formulation of *She was handing him some broccoli,* the feminine pronoun lemma should be linked to the nominative (subject) function, the masculine to what we will call the dative function, the argument represented by *broccoli* to the accusative function, and

hand to the main verb function. Errors of function assignment arise when elements are assigned to the wrong functions. For example, if the feminine and masculine pronoun lemmas were linked to the dative and nominative functions respectively, the resulting utterance would most likely be *He was handing her some broccoli.* These *exchange errors*, like other types of exchanges, involve constituents of the same type (both are noun phrases).

The next two steps constitute positional processing, so called because it fixes the order of the elements in an utterance. As this implies, the order may not be imposed during functional processing. One indication comes from a contrast in scope between the features of different types of errors. Adjacency is not a strong conditioning factor.

We consider *constituent assembly* first. This is the creation of a control hierarchy for phrasal constituents that manages the order of word production and captures dependencies among syntactic functions. The basic features of such hierarchies are largely predictable from the types of syntactic functions that have to be represented and from the syntactic features of the selected lemmas.

The last of the grammatical encoding processes, *inflection*, involves the generation of fine-grained details at the lowest levels of this structure. In English, many of these details involve elements that carry information about number, tense, and aspect but are bound to other words. The generation of these details is in no strict sense distinguishable from the rest of constituent assembly. One type of error that is identified with inflection is known as *stranding*. Stranding is illustrated in the utterance of a speaker who intended to say *You ended up ordering some fish dish* and instead said *You ordered up ending some fish dish*. In such errors, the bound suffixes (*-ed, -ing*) show up in their proper locations in the utterance but affixed to the wrong words, arguing that the inflections are positioned separately from their word stems. Another type of error that may arise during inflection is called a *shift* and consists of the mislocation of an affix. Such an error could lead to the utterance of *She was hand himming some broccoli* by our hypothetical speaker. The elements involved in such errors are much more likely to be involved in errors than the final syllables of word stems, such as the *-id* in *morbid*, implying that strandings and shifts are not simple mislocations of syllables but mislocations of pieces of grammatical structure. With all this

done, it still remains necessary to spell out the phonological content of the utterance. That is the province of phonological encoding.

Experimental work makes it possible to explore whether the features of production that are postulated on the basis of error analyses hold equally under the circumstances that lead to normal, error-free production. Errors, by definition, reflect unusual circumstances that cannot straightforwardly be taken to represent the norm. So, any hypothesis that attributes a certain property to the production system in order to account for a particular sort of error is vulnerable to the objection that the property is in fact aberrant.

At the outset, we adopt a very strong position about the nature of these processing systems. It is that each one is influenced only by information represented at the level directly above it. For example, we assume that the processes of lexical selection and function assignment are under the control of information in the message and are unaffected by the sounds or phonological features of words.

We also assume that language production is incremental, so that variations in the order in which information is delivered from one component to the next can readily affect the order in which elements appear in speech. When higher level processing components drive lower level ones, incremental production implies that the higher levels need not complete their work on an utterance before the next level begins. This is illustrated in Figure 5 in terms of hypothetical temporal connections between the processing levels. The implementation of incrementality requires the formulation, at every level, of piecemeal units relevant to the form and content of the developing utterance, so our review touches on the information partitionings within each processing component.

Theories of speech production try to answer questions like: Once you have an idea that you wish to convey, what steps must you take to retrieve the linguistic representations you need to express your idea? How do you organize those representations? How do you translate those representations into a form that the motor system can use to generate the actual, physical gestures that create speech sounds?

Speech production requires at least three kinds of mental operations. First, you have to think of something to say. The processes that ac-

complish that are called *conceptualization*. Once you have something to say, you must figure out a good way to express that idea given the tools that your language provides. This type of processing is called *formulation*. Finally, you need to actually move your muscles to make a sound wave that a listener can perceive. These processes are called *articulation*.

Speech production is viewed as involving a sequence of mental processes. Each mental process accomplishes a subgoal, and the output of one mental process provides the information needed for the next mental process.

1. ii. A network model of lexical access

Our mental store of words and basic information about them is called the *mental lexicon*. It is obviously not the case that all possible words of our language are stored somewhere in our minds because there is an infinity of possible words. Take the numerals. They form an infinite set and a corresponding infinite set of words, including compounds such as *twenty-three thousand two hundred seventy-nine.* This is unlikely to be an entry in the mental lexicon. Rather, such words are constructed when needed. Languages differ greatly in the use their speakers make of this ability: Speakers of Turkish, for instance, produce new words in almost every sentence, whereas speakers of English rarely do so. When we talk about lexical access here, we sidestep this productive lexical encoding to focus on the retrieval of stored words from the mental lexicon.

Our knowledge of words involves three types of information. First, we know a word's meaning. We know that a sheep is a kind of domestic animal, that it has a wool pelt, that it produces milk, etc. These are all properties of our concept *sheep*. Second, a word has syntactic properties. The word *sheep* is a noun. In French *mouton* is also a noun, but in addition it has male syntactic gender, in contrast to *chèvre* 'goat', which has female gender. A word's syntactic properties can be fairly complex. Verbs, in particular, are specified for the optional or obligatory arguments they command. For example, the verb *hit* typically takes a subject and a direct object (i.e., it is a transitive verb), and because this is something that a speaker knows about the verb *hit,* it is part of the mental lexicon. This type of information is called the verb's *subcategorization frame*. The verb *hand* has two subcategorization frames. The first

one, the prepositional frame, includes a direct object position and an oblique (prepositional) object position (as in *She was handing some broccoli to him*), and the second one, the double object frame, maps the dative to the direct object position and the accusative to a so-called second object position (as in *She was handing him some broccoli*). The word as a syntactic entity is technically called a *lemma*.

Lemmas contrast with *lexemes*, which capture the word's form properties. These constitute its morphological and phonological shape. The word *sheep* is monomorphemic and consists of three phonological segments.

In the network model, these different types of information correspond to nodes within three levels of representation: the conceptual level, the lemma level, and the lexeme level. A part of this lexical network is shown in Figure 6. It depicts some of the knowledge we have about the words *sheep* and *goat*.

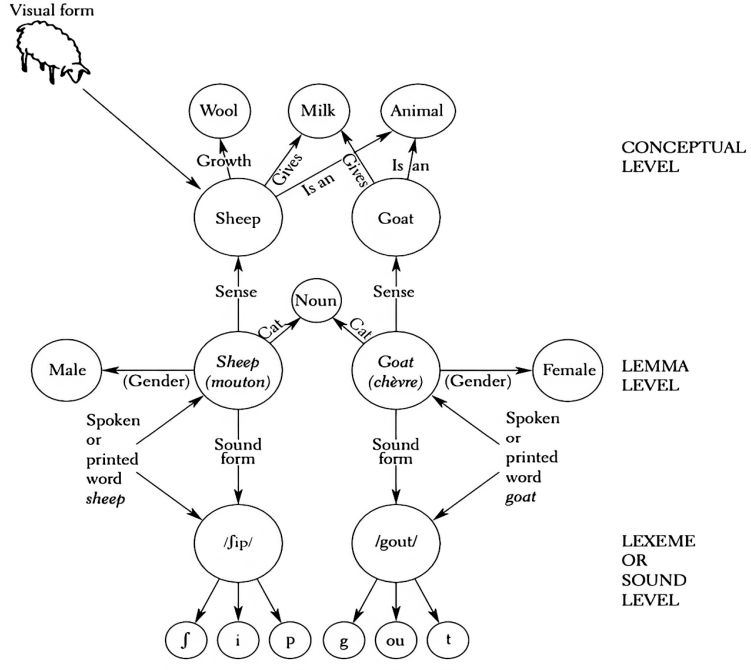

Figure 6. A part of the lexical network. Note that the arrows represent types of connections within the network, not the flow of information during comprehension or production. Bock & Levelt (1994).

At the conceptual level, the nodes represent concepts. They are linked by labeled arcs that represent the nature of relationships. Since a sheep is an animal, this is represented by a connection between the nodes *sheep* and *animal*. A word's meaning as a whole is represented by such a network of relations (as introduced by Collins & Loftus, 1975, and Collins & Quillian, 1969), although individual lexical concepts themselves are represented by unitary nodes. In this respect, the model departs from a compositional representation of word meaning.

Some conceptual nodes have direct connections to nodes at the second, lemma level. This subset of conceptual nodes represents lexical concepts. Not all concepts are lexical: *dead tree* is a perfectly well formed concept, but one without a lexical concept. Yet English has a lexical concept for *dead body* (*corpse*).

The nodes at the lemma level represent syntactic properties. The lemma *sheep* has a category link to the noun node; in French the lemma *mouton* has a gender link to the male node, and so on. At the lexeme level, the network represents the word's form properties.

Lexical access in this model is represented by activation spreading from the conceptual level to the lemma level to the lexeme level (note that Figure 6 does not depict the activation trajectories; the arrows in the figure characterize permanent relationships rather than processing dynamics). The first requirement for lexical selection in normal speech is the existence of an active lexical concept. A concept node can become activated in myriad ways. One simple procedure to induce this is to present a picture for naming. In an experiment, a subject can be given a picture (e.g., one of a sheep, as shown in Figure 6) and asked to name it as fast as possible. The assumption is that the picture activates the concept.

An active lexical concept spreads its activation to all connected concept nodes. So if the *sheep* node is active, the *goat* node will receive some activation as well (either directly, or via mediating nodes such as *animal* or *milk*). In addition, activation will spread from the lexical concept node to the corresponding lemma node. In this framework, lexical selection is selection of the appropriate lemma node. So, if *sheep* is the active lexical concept, the lemma *sheep* should be retrieved. It would be an error of selection if *goat* were retrieved. There is nonetheless a small

chance for such a mishap, because some activation spreads from *sheep* to *goat* and from there to the lemma *goat.*

In Roelofs' (1992) implementation of this model, the probability that any given lemma will be selected during a specified time interval is the ratio of its activation to the total activation of all lemmas in an experimental set. This makes it possible to predict the time course of lexical selection under various experimental conditions. Some of those conditions are designed to directly activate lemma nodes through the presentation of spoken or written words (see Figure 6), creating competitors for other lemmas activated from the conceptual level.

The model as it is depicted deals only with lemmas for lexical concepts. But not all words in fluent speech correspond to lexical concepts. In *listen to the radio, to* does not represent a concept. Rather, the lemma for the transitive verb *listen* requires the preposition *to,* so the lemma *to* must be activated via an indirect route at the lemma level. We refer to this as *indirect election.*

From Field (2004: 113)

Fluency (*fluent speech*) is defined as the ability to speak a language at a natural rate, with appropriate prosody and without disruptive hesitation patterns. The impression of fluency derives partly from predictably placed planning pauses and from a lack of pausing within syntactic or intonational units. Fluency is partly achieved by composing recurrent sequences into memorised chunks which can be produced ready-formed, thus reducing the burden of planning utterances. Foreign language learners who have been resident in target language environments give an impression of increased fluency which derives from reduced pausing and greater average length of run (number of syllables between each pause). Their rate of articulation does not increase markedly, however.

The major joint in the model is between the lemma and lexeme levels of representation. Between lexical concepts and lemmas, there are systematic relations. So, a verb's meaning is regularly related to its subcategorization frame. But between lemmas and lexemes, the relation is highly arbitrary. There is no systematic reason why a sheep should be called *sheep.* Still, there are some statistical relations between the syn-

tactic and phonological properties of words. Nouns, for instance, tend to contain more syllables than verbs; they also contain front vowels more often than verbs.

1. iii. Tip-of-the-tongue phenomenon

The most dramatic reflection of the rift between the lemma and lexeme levels is the so-called *tip-of-the-tongue* (*TOT*) *phenomenon*. It was described by William James in 1890 in one of the most frequently quoted passages in cognitive psychology: "Suppose we try to recall a forgotten name. The state of our consciousness is peculiar. There is a gap therein: but no mere gap. It is a gap that is intensely active. A sort of wraith of the name is in it, beckoning us in a given direction, making us at moments tingle with the sense of our closeness, and then letting us sink back without the longed-for term. If wrong names are proposed to us, this singularly definite gap acts immediately so as to negate them. They do not fit into its mould. And the gap of one word does not feel like the gap of another, all empty of content as both might seem necessarily to be when described as gaps... The rhythm of a lost word may be there without a sound to clothe it; or the evanescent sense of something which is the initial vowel or consonant may mock us fitfully, without growing more distinct" (James 1890: 251).

The TOT phenomenon was later discussed by Woodworth (1938) and systematically studied for the first time by R. Brown and McNeill (1966). R. Brown and McNeill presented the definitions of infrequent words such as *sextant* and asked subjects to produce the defined word. Whenever subjects entered a tip-of-the-tongue state, they reported whatever came to mind about the target word. In many cases the subjects knew the initial consonant or vowel, the number of syllables, and the stress pattern. Related words might come to mind that shared these properties (such as *secant* for *sextant*). These findings have been confirmed and elaborated in many subsequent studies. Most of these studies deal with TOT states in normal speakers, but there are also clinical conditions that persistently arouse TOT states. These are called *anomias*.

In terms of the network model, the TOT phenomenon in lexical retrieval is a failure to access the lexeme from the lemma. The speaker knows the meaning to be expressed (i.e., the concept) and the word's syntax (that it is a plural noun, a transitive verb or whatever; i.e., the

lemma). Only the word form is blocked. The TOT experience happens when you are trying to retrieve a word, you have a strong impression that you know the word, but you are temporarily unable to consciously recall and pronounce the word. Some aspects of the form may surface, revealing something about the process of phonological encoding. Because TOTs appear to arise subsequent to lemma activation, they are not problems of lexical selection, but of lexeme activation, i.e. TOT states occur when you have accessed the correct lemma, but have been unable to fully activate the phonological information that goes along with that lemma. What people experience during a TOT state offers a glimpse into the steps involved in lexical retrieval. Typically, people have access to the meaning-based part of the lexical representation, but experience a TOT state when they fail to find a fully specified form-based representation. However, people typically know something about the word they are unsuccessfully searching for. They can often think of the initial or final sounds or letters, how many syllables it has, where primary stress is located, and even words that sound similar.

There is now an array of experimental methods that strategically target the underlying dynamics of production, most of them relying on techniques (like interference and priming) that transiently sideswipe or enhance specific subcomponents of formulation between messages and articulation. These developments are nonetheless fairly new and narrowly spread over the range of issues in production, in part because of the challenge of manipulating the language production process without disrupting the fundamental features of the underlying communicative intention. Critical observations are therefore sparse at many points, making the research we have reviewed little more than a preliminary step toward the understanding of grammatical encoding.

2. Carroll, D. W. (2008). *Psychology of Language* (5th ed.). Thomson Wadsworth. pp. 194-197.

2. i. Speech errors / slips of the tongue

The scientific analysis of speech errors, commonly called "slips of the tongue", reemerged in the early 1970s with the seminal publication of an article by Fromkin (1971) that examined the way speech errors

may be used in the construction of linguistic arguments. This paper, and those that followed, marked the end of a long period in which speech errors were regarded with suspicion in scientific circles. It has become respectable for investigators to use errors to examine the role of linguistic units in the production of speech. A number of collections of spontaneous speech errors have been made and it is interesting to determine whether there are consistent patterns in when and how they occur. Although these errors are not common, all speakers seem to make them occasionally. Some people are more prone to speech errors than others. The legendary Dr. William Spooner, infamous for his tendency to say such things as the following sentences to an ungrateful college class, gave speech researchers more than his share: *You have hissed my mystery lectures. I saw you fight a liar in the back quad. In fact, you have tasted the whole worm.* The analysis of speech errors has a long and glorious history in psychology in general and psycholinguistics in particular. Sigmund Freud viewed speech errors as a window into the unconscious mind. He believed that speech errors revealed our true inner thoughts — thoughts that we suppressed in order to be polite. Modern psycholinguistic theories view speech errors as reflecting breakdowns in various components of the speech production process. We can use speech errors to inform our understanding of speech production processes because speech errors are *not* random. In particular, slips of the tongue occur in systematic patterns, and those patterns can be related back to aspects of the speech production process. Slips of the tongue can be seen as products of the productivity of language. A slip is an unintended novelty. Word errors create syntactic novelties; morphemic errors create novel words; and sound errors create novel, but phonologically legal, combinations of sounds.

Most of us make similar errors from time to time. Anecdotal evidence indicates that such errors are more common when we are nervous or under stress, as when performers appear on live television and radio shows; programs devoted to television's best "bloopers'" never seem to run out of material. It seems probable that errors are more likely to occur when we are tired, anxious, or drunk. Most research, however, has focused less on the factors that may influence the frequency of speech errors than on the nature of the errors themselves.

Although speech errors cover a wide range of semantic content, there appear to be only a small number of basic types. Examples of the eight types are given in Table 3, with the words that were apparently intended in brackets:

Type	Example
Shift	That's so she'll be ready in case she decide to hits it (decides to hit it).
Exchange	Fancy getting your model renosed (getting your nose remodeled).
Anticipation	Bake my bike (take my bike).
Perseveration	He pulled a pantrum (tantrum).
Addition	I didn't explain this clarefully enough (carefully enough).
Deletion	I'll just get up and mutter intelligibly (unintelligibly).
Substitution	At low speeds it's too light (heavy).
Blend	That child is looking to be spaddled (spanked/paddled).

Table 3. Major types of slips of the tongue. Carroll (2008).

If you have closely examined these examples, you probably have noticed by now that these types of errors occur with a number of linguistic units. In some cases, a single phoneme is added, deleted, or moved, but at other times it may be a sequence of phonemes, morphemic affixes and roots, whole words, or even phrases. As a general rule, errors tend to occur at only one linguistic level per utterance. That is, when a person clearly says the wrong word, as in substitutions, the sentence is syntactically, prosodically, and phonologically intact.

Other patterns in these speech errors deserve a closer look. There have been identified four generalizations about speech errors that reappear with striking regularity. First, elements that interact with one another tend to come from similar linguistic environments. The phonetic segments in the beginning of a word tend to be exchanged with other initial segments; the same is true for middle and final segments. Moreover, exchanges of segments are more common when the segments that precede them are similar. Second, elements that interact with one another tend to be similar to one another. In particular, consonants are invariably exchanged or shifted with other consonants but not with vowels. Along the same line, substitutions tend to be semantically similar to the item for which it is substituted. Third, even when slips produce novel linguistic items, they are generally consistent with the

phonological rules of the language. Speech errors involving phonological segments never create phonemes that are not part of the phonemic inventory of the speaker's language, nor do they create words that violate the phonotactic or phonological rules of the speaker's language. A speaker might slip and say *tips of the slung*, but never **tlips of the sung*, because in the latter a sequence has been created that violates phonotactic constraints for English. Finally, speech errors reveal consistent stress patterns. Segments that are exchanged for one another typically both receive major stress in the word or phrase in which they reside, or both receive minor stress. To sum it up simply, speech errors are hardly random; in fact, they occur in highly regular patterns.

2. i. a) The Freudian explanation

One intriguing idea is that speakers have more than one idea in mind at a time. During the 1992 campaign, President George Bush began his remarks for one speech by saying: *I don't want to run the risk of ruining what is a lovely recession* (*reception*). (Newsweek, 1992) — This, of course, could be construed as simply a sound error, as the two words are similar phonologically. But it could also be evidence that the president was preoccupied with the recession (and its effect on his campaign). Or consider a student who explains that he wants to postpone an exam with the statement: *Last night my grandmother lied* (*died*). (Motley, 1987) — This could be an innocent phonological error, but then again, the slip could reveal the student's thinking more than he wishes.

Freud emphasized the role of psychodynamic factors in making certain types of content more available than others. He argued that these errors "arise from the concurrent action — or perhaps rather, the mutual opposing action – of two different intentions" (Freud, 1916-1917/1963). One of these actions was thought to constitute the conscious intention of the speaker, whereas the other pertained to a more disturbing thought or intention that interfered with the former. Sometimes, the disturbing comment would be censored; but, on other occasions, the outcome of this hypothetical intrapsychic conflict would be a slip of the tongue that expressed some aspects of the less conscious intention. Freud's position was that virtually all speech errors were caused by the intrusion of repressed ideas from the unconscious into one's conscious speech output. Although the Freudian interpretation may be appealing

in cases in which the slip of the tongue results in a word with emotional significance, many slips seem to reflect simpler processes, such as anticipation (a *meal mystery* instead of a *real mystery*). It seems to be unnecessarily complicated and unconvincing to claim that the error originated from intrapsychic conflicts. Still, these more common speech errors demand an explanation.

2. i. b) A psycholinguistic explanation

Most recent psycholinguistic and linguistic thinking has focused on the insights gained in understanding language mechanisms (not unconscious motivations) from the study of speech errors. In this respect, errors of linguistic performance occupy a role in psycholinguistic theories similar to that played by aphasic disorders. The types of language breakdowns that occur in each case provide important insights for normal language functioning. Fromkin (1971), for example, has shown that many of the segments that change and move in speech errors are precisely those postulated by linguistic theories, lending support to the notion that linguistic units such as phonetic features, phonemes, and morphemes constitute planning units during the production of an utterance.

3. Field, J. (2003). *Psycholinguistics: A resource book for students.* Routledge.

3. i. Pausing

Although speech appears to be effortless, it actually requires planning and the components (clauses, words, phonemes) have to be assembled. Many of the pauses in informal speech reflect this planning operation. They tend to come at or near clause boundaries, when the speaker has delivered one clause and is preparing the next one. There is a great deal of evidence that the clause is the major unit of planning in speech. For example, the vast majority of speech errors occur within a clause. An exchange of words within a clause ('a catful of houses') is much more likely than one which crosses clause boundaries ('I don't know that I'd hear one if I knew it').

What are the functions of pauses? It is usual to recognize three functions: (a) physiological – to allow the speaker to inhale; (b) cognitive

– to allow the speaker to plan ahead; and (c) communicative – to allow the speaker to signal certain demarcations in the speech stream to the listener.

At the end of a clause, we need to remove what is in our speech buffer (i.e. the group of words we have just produced) and to replace it with a new chunk of speech for the next stage of the utterance. Pausing seems to be vital to this process. When experimenters have forced speakers to suppress pausing, it has resulted in confused and sometimes incoherent discourse. A second reason for pausing is because the speaker finds difficulty in retrieving an item from the lexicon. This may be because of the item itself: it might be an infrequent word or a word that is quite complex in form. Or it may be because of the circumstances of the speaker: they might be tired or ill or simply not concentrating very well. One can identify this kind of hesitation pause because it occurs irregularly and is often just before an infrequent lexical item. (But be careful: speakers also sometimes pause before unusual words in order to draw attention to them). The situation can be explained in terms of demands upon working memory. Retrieving a difficult word makes demands that are heavier than usual, requiring that the speaker focus attention on the task. Or tiredness may restrict the capacity of working memory and the speaker's powers of attention, making the retrieval task more challenging than usual.

Pauses serve two other important purposes. At the end of an utterance, they may indicate that the speaker is prepared to hand over the turn to the listener. They can also be used rhetorically to indicate that what comes next is of importance.

It is important to keep in mind the distinction between speaking rate (reflecting the overall quantity of speech produced) and articulation rate (reflecting how rapidly the speaker formed the syllables). Average articulation rate varies between languages because it partly reflects the types of syllable that a language contains. A typical rate for English is 4.4 to 5.9 syllables a second. The absolute maximum that the human articulators are capable of is probably about eight syllables per second. People listening to speech in a foreign language often comment that it is 'too fast' to understand. In fact, it is often normal in terms of articulation. What gives the impression of speed may be a lack of pausing. You can understand why this might be problematic. Remember that

there are no regular gaps between words in connected speech. A speaker who hesitates and inserts a lot of pauses assists the non-native listener because they mark proportionately more word beginnings and endings.

John Laver in his major study of phonetics (1994) suggests that there are three main types of speech. He defines them in relation to the phonological phrase, a small chunk of speech, consisting of words which seem to cluster together:

- In *continuous fluent speech*, a speaking turn of several phonological phrases is produced without pauses.
- In *non-continuous fluent speech*, a speaking turn of several phonological phrases has pauses between the phrases but they coincide with clause boundaries.
- In *non-continuous hesitant speech*, there are hesitation pauses which fall within phonological phrases.

Research (by Beattie 1983) has suggested that speech proceeds in phases: a hesitant phase of about nine clauses is followed by a fluent one of about nine clauses. If this is the case, it suggests that speech planning may take place on two levels. There may be short-term planning, marked by relatively regular planning pauses, and longer-term planning marked by a period of hesitant speech.

4. Paolieri, D., Morales, L., & Bajo, T. (2018). Production in Bilingual and Multilingual Speakers. In E. M. Fernández, & H. S. Cairns (Eds.), *The Handbook of Psycholinguistics* (pp. 82-110). John Wiley & Sons.

4. i. Bilingual lexical processing

The question of how different languages interact at the cognitive and behavioral levels has been of long-standing interest to psycholinguists as well as to neurologists, clinicians, and educators. Moreover, in our view, a deep knowledge of the cognitive and brain mechanisms involved in language processing can only be achieved if they are also explored from the perspective of bilingual speakers. Additionally, the way in which the mind of a bilingual copes with different languages may shed some light on the processes that otherwise might remain hidden in monolinguals.

Preparing words in speech production is normally a fast and accurate process, although the underlying structure is exceedingly complex. A range of linguistic stages are involved in speech production. Speech is the final expression of concepts and sensations, translated into a linguistic form that involves lexical, syntactic, morphological, phonological and phonetic encoding before the beginning of articulation. According to most accounts, the activated semantic representations spread activation to the corresponding lexical representations. Because of this assumption, most models of word production have the shared assumption that lexical selection is a competitive process that is necessary to decide which lexical representations should be selected for further processing.

Several theories of bilingual lexical processing assume a parallel activation of the lexicons of the two languages during reading, speaking and listening. Despite the growing interest in bilingual language processing, some questions are still unsettled. Which linguistic levels of the two languages are activated during bilingual lexical selection and how do these levels interact? How does a bilingual control their two languages during speech processing, selecting the lexical items he/she intends to produce, in the language in which he/she wants to communicate? Thus, one of the central issues regarding bilingual speech production can be formulated in the following way: How do bilinguals retrieve words from one of the two languages selectively when both words express the same conceptual content? For example, how does an English-Spanish bilingual employ the word *mariposa* in one situation and *butterfly* in another situation, even though both words have the same meaning?

4. ii. Language-selective activation models

Language-selective activation models suggest that the selection of a lexical entry uniquely affects the lexical entry corresponding to the intended language. According to this view, lexical access in bilinguals should entail similar processes to those involved in monolingual speakers during lexical selection. The intention to speak in one language determines which candidates become active and the two languages are considered as being functionally separate. From this view, there may be activation of words within the language not in use, but the activation of

those words does not make them candidates for selection. One viewpoint of the language-selective model is that it serves as a "mental firewall" where the language cue effectively signals the correct activated alternatives. In this context, the language cue acts to set the activation level higher for candidates in the target language, avoiding potential competition between them at the point where selection occurs. From another viewpoint the locus of the bilingual's hard problem is shifted up to the level of concept selection, and not at the lexical level, suggesting that only selected concepts, or, more appropriately, preverbal messages, activate their corresponding lexical nodes. This process should be similar to what happens when monolinguals need to choose between seemingly equivalent words to express a concept with subtle differences in meaning. In this way, the selection of one of two translations equivalent lexical nodes will be similar to the selection of words used in different registers carrying similar meanings. No additional activation or inhibition processes at the lexical level are needed, because the preverbal message contains a language cue that ensures that the word in the intended language reaches the highest activation level.

Most of the evidence supporting these models (and others) generally comes from psycholinguistic paradigms, which allow for the study of language processing and the mental processes involved while producing words in real time. In the picture–word naming interference task, participants are usually instructed to name a picture as quickly and accurately as possible while ignoring a superimposed distractor word. Since naming latencies are affected by the relationship between the picture's name and the distractor word, this paradigm became a useful tool to study the processes involved during lexical access. In the bilingual version of this task, distractor words can be presented in one of the languages, in order to see how naming in one language is altered by the presence of the other.

4. iii. Bilingual cognitive control

The advantage held by bilinguals in communicative competence relative to mono- linguals is evident. However, bilingualism also entails a number of disadvantages in language production, such as reduced verbal fluency scores and more retrieval failures than monolinguals. Importantly, these disadvantages are found even when bilinguals are

tested in their L1. Experimental evidence has shown that in bilinguals, conceptual activation spreads not only to the lexical entries corresponding to the language in use, but also to the lexical system of the alternative language, thus causing interference during selection of the intended lexical entries. Hence, it is important to identify which cognitive processes are involved in the control of languages in bilinguals and how people speaking several languages select the appropriate lexical entries, given the interference caused by the simultaneous activation of the two languages.

Spontaneous slips of the tongue are interesting sources of information when testing theories of speech production. It is generally agreed that semantically related lexical errors reflect co-activation of semantically related lexical candidates during a conceptually driven retrieval process. In the context of a bilingual's production, the presence of L1 intrusions in L2 production has been considered to support the parallel activation of the two languages activated from the same semantic system. This activation may lead to a malfunction of the lexical selection mechanism, thus selecting the translation in the non-intended language instead of the target word from the proposed language. Language errors might be particularly expected in multilinguals, not least because considering that already monolinguals must be able to quickly select a word from a lexicon composed of more than 50,000 words, whilst proficient bilinguals must have at least 10,000 additional L2 words to select from.

This means that, during language production, several different words may be the possible targets. It is surprising, however, given the large amount of lexical competition during bilingual production, that the costs associated with the capacity of processing more than one language seems to be relatively mild. High-proficient bilinguals seem to be able to master the control of the two languages in a very natural and efficient way. This would require the existence of a language control mechanism that monitors lexical selection. Moreover, the importance of a control mechanism has also been recognized in cases of aphasia: bilingual speakers who suffered neurological damage cannot properly control language selection, leading to pathological language mixing.

Indeed, recent evidence suggests that bilinguals use general mechanisms of control to achieve errorless language-selective production that are thought to share some features with the more general executive

control system. In relation to this issue, failures in language control increase with aging-related declines in executive control, providing robust evidence for the role of executive control in maintaining language selection.

The most important model proposed to explain mechanisms of language control in bilinguals is the Inhibitory Control model (IC) proposed by Green (1998). In the IC model, language processing involves different levels of control or regulation by modifying levels of activation of the items in the language networks. A key concept in the IC model is the language task schema. The language task schema allows bilinguals to select the appropriate task by suppressing the non-intended task. A language task schema regulates the output from the word identification system by altering the activation levels of representations in that system and by inhibiting outputs from the system. In addition, an internal lexical-semantic mechanism exerts control by inhibiting the competing lexical representations from the non-intended language. The locus of word selection is the lemma level and selection involves the use of language tags, and resolution of the competition from the non-intended language requires attentional resources. Cognitive control allows the correct selection of the lexical item in the target language and to keep it free from non-target language interferences with the integration of separable neural systems. A variety of evidence supporting the importance of the inhibitory control process comes from studies using the language switching paradigm, where the response language varies in an unpredictable manner during the task. These studies usually reveal asymmetric language switching costs, since bilinguals take longer to switch into L1 – the dominant language – than to L2 – their non-dominant language.

4. iv. The role of language immersion

The notion that learning a second language can lead to a loss of access to the native language has also been explored in the context of language immersion. L2 immersion facilitates the learning of a second language as a result of the suppression of the native language. Consequently, the activation of the more dominant L1 is reduced, and its negative influence on L2 becomes attenuated. Results from a study showed that immersed learners inhibited their L1 while living in the L2 context, supporting the notion that bilinguals must launch inhibitory processes

to suppress one of the languages when using the other. Immersion experience modulates the activation of the more dominant language during spoken production, in congruency with the inhibitory account and the IC model, which further suggests that bilinguals need to inhibit the language not in use to enable selective language access. Therefore, although initially lexical entries of both languages are active, inhibitory control would be exerted on the more dominant and competing language (i.e., L1, usually), which in turn leads to a greater cost in reactivating the native language when it is again needed.

4. v. Translation and expertise in translation

Another task that bilinguals accomplish in daily life is rephrasing a message from one language into another — the translation task. This task is one of the most employed paradigms to study the dynamics of the activation of lexical information in bilinguals, including both the L2 to L1 "backward" translation and the translation from L1 to L2 that has been labeled "forward" translation. Although it is possible to distinguish different types of translation tasks (depending on the modality of the input, output or temporal parameters; for example, simultaneous, consecutive, or self-paced translation), most theories of translation agree that there are three common processes: analysis and understanding of the message source, language switching between the two linguistic codes, and production of the message in the target language. Therefore, the translator has to analyze the source message at the lexical, syntactic and discourse level, and then perform planning and lexical selection to correctly produce the message in the target language.

The *Revised Hierarchical Model* (RHM; Kroll & Stewart, 1994) assumes that the conceptual representations are shared among the languages, while the lexical representations are language-specific. This model was initially proposed to account for asymmetries in translation by late bilinguals for whom the L1 is still the dominant language. The L1 was hypothesized to have privileged access to meaning, whereas the L2 was thought to require mediation of the L1 translation equivalent until the bilingual acquired sufficient skill in the L2 to access meaning directly. Recent evidence suggests that semantic mediation can also be involved in backward translation from L2 to L1 despite the fact that forward

translation, from L1 to L2, was more likely to engage semantics than backwards translation.

It seems to be generally accepted that translation is conceptually mediated in proficient bilinguals. Research was done to investigate the temporal course of translation production in Dutch-English bilinguals, a task in which a word is presented in one language and participants have to produce the translation equivalent in the other language. This task has high ecological validity, since it combines word comprehension and word production in two different languages, requiring a considerable amount of language control. In order to increase the need for cognitive control during translation production, the researchers presented participants with interlingual homographs (IH) or "false friends," stimuli in which the same orthographical form has different meanings in two languages, (e.g., *room* in Dutch means *cream* in English). These results suggest that participants were not able to prevent the activation of the irrelevant meaning, and they are interpreted in terms of an increased lexical-semantic competition with these stimuli. Similar conclusions were reached by other researchers in a study using bilinguals and professional translators. In this study, it was showed that when participants read for translation, global comprehension was affected by lexical ambiguity, cognate status of the words, and memory load. However, when participants were asked to understand and repeat the sentences, these manipulations did not have any effect.

Translation involves establishing semantic matches between the lexical and syntactic entries in the two languages in a continuous parallel manner, so that the two languages of the bilinguals start to interact very early in the translation process from the moment in which comprehension starts. This view contrasts with the proposal of a "vertical view," in which comprehension and reformulation are independent processes that proceed in a sequential manner, and therefore they should impose similar demands on resources.

Experience in simultaneous (verbal) interpretation also seems to modulate language co-activation. The role of expertise in translation has previously been explored in relation to the linguistic and cognitive processes involved in translation and interpreting tasks. Translators are a special type of multilingual individual not only because they usually master three or more languages at a very proficient level, but also because

language use of each of these languages differs from that of other types of bilinguals. Despite differences among the existing varieties of translation tasks, the main characteristic of the translation performance is that the translator has not only to understand and reformulate a message from one language to another, but also she/he has to maintain the two relevant languages active and to switch continually between them. Therefore, translators have to manage the activation of two languages and be continuously coping with the interference coming from the parallel activation of the two languages in the translation task. Although the evidence suggests that translators and bilinguals activate the two relevant languages during comprehension for later translation, results suggest that bilinguals may differ in the way they negotiate their two (or more) languages.

Translators differ from bilinguals in the way they control their languages during comprehension, in that they kept them both active (cognate effects) and show no evidence of inhibition. Translators do not use inhibitory processes to control for the concurrent activation of their two languages. Results concerning the cognitive abilities of professional translators seem to suggest that language control in translators is of a proactive nature and more related to monitoring and updating.

To conclude, the joint activation of the two languages in bilinguals requires an active mechanism that negotiates cross-language activation and facilitates language selection. Evidence suggests that the act of planning speech in a second language requires the inhibition of the native language, which then has negative consequences for speech planning in L1. This idea has also received support from studies using functional magnetic resonance imaging (fMRI). Being immersed in a second language country can constrain the activation of the native language by inhibiting its level of activation. Overall, from this perspective it is not surprising that bilinguals develop abilities for negotiating cross-language competition that confers them enhanced cognitive control, since brain areas associated with inhibitory processing function seem to be recruited by bilinguals to select the appropriate language.

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5. Kroll, J. F., Dussias, P. E., Bice, K., & Perrotti, L. (2015). Bilingualism, Mind, and Brain. *Annual Review of Linguistics, 1,* 377-394.

Bilinguals are individuals who actively use more than one language, but bilingualism arises in many different ways. Some individuals are exposed to two languages from birth and continue to use both languages throughout their lives. Early bilinguals may live in a bilingual environment where they are the majority-language users or in a context in which only one of the two languages is used by most speakers. Other bilinguals acquire the second language (L2) only after early childhood, once a native language has been firmly established. Like early bilinguals, these late bilinguals may live in a range of different environments in which most individuals become bilingual or in which only some become bilingual. In the research we review, we consider anyone who actively uses two languages to be bilingual, but we also acknowledge that not all bilinguals are the same. The differences among bilinguals that result as a function of learning history and the context of language use are important, but so too are differences in the languages themselves and the proficiency and relative dominance with which each language is used.

5. i. The parallel activation of the bilingual's two languages

A widely replicated finding is that a bilingual's two languages are simultaneously active during language use. Intuitively, the native and more dominant language, L1, remains active when using the less dominant second language, L2. However, the converse is also true, such that bilinguals using their L1 also demonstrate concurrent L2 activation. Furthermore, this parallel activation, or cross-language activation, appears to be present in all bilinguals regardless of the languages they speak, including bilinguals whose languages use different written scripts, as with Chinese and English, or different modalities, as with American Sign Language (ASL) and English.

The evidence revealing parallel activation across the bilingual's two languages comes from a diverse set of tasks and methods. A common technique for measuring the activity of the non-target language is to compare the processing of language-ambiguous cognates and homographs with words that unambiguously belong to one of the bilingual's

two languages alone. Cognates are words that have similar form and meaning across a bilingual's two languages (e.g., *piano* in English and Spanish). The convergence in lexical form and meaning for cognates tends to facilitate processing on word recognition and word production tasks. In contrast, homographs, which have similar lexical form but conflicting meaning across the bilingual's two languages (e.g., Spanish *carpeta* means 'folder,' not 'carpet'), typically produce interference in processing. In theory, monolingual speakers should process cognates and homographs no differently than other words that are matched on lexical properties such as word length and frequency. Therefore, when bilinguals demonstrate sensitivity (i.e., facilitation or interference) to language-ambiguous cognates and homographs compared with matched unambiguous control words, we can infer that the heightened activity of their non-target language facilitates processing when form and meaning agree (cognates) or that the heightened activity competes with the target language when there is conflict between form and meaning (homographs). Studies have reported that a bilingual's non-target language is active in a range of tasks that require only one of the two languages to be used. Cognate facilitation has been found for isolated word reading in both the L1 and the L2, as well as for sentence reading in the L1 and L2. Bilinguals also demonstrate parallel activation of the two languages while listening to speech in either language. Most surprisingly, both languages appear to be active when bilinguals plan to speak in one language alone, even though initiation of speech planning lies within the control of the speaker. The pervasive presence of parallel activation at all levels of language processing is further confirmed by the diversity of bilinguals for whom these findings hold true.

Parallel activation appears to be a product of knowing two languages, independent of what those languages are or how they are used. The fact that cross-language activation is found in language comprehension and production, and for both written and spoken or signed language, suggests that the L1 and L2 are interconnected. The fact that it is found in bilinguals that differ so widely in their two languages suggests that there are at least some common, shared language storage or processing mechanisms that support both languages regardless of what they are. Critically, the parallel activation of the two languages has consequences, both for language use and for cognition in general.

In a well-known paper, Grosjean (1989) claimed that a bilingual is not two monolinguals in one. The context for this claim was a debate about whether language switching is a normal or pathological feature of bilingual language use. We now know that code-switching and language mixing are not only normal features of bilingualism but also skills that may effectively enhance cognitive abilities in bilinguals. But it is also important to note that the pervasive parallel activation of the bilingual's two languages is likely to be a primary mechanism that contributes to language change and that differentiates bilingual and monolingual language use. When a bilingual is using the less dominant L2, the concurrent L1 activation is pervasive. Given the choice between using two words or two structures, one of which shares overlap with the L1, the simultaneous L1 activation will promote that alternative over a word or structure that appears in the L2 only. Choosing common structures across languages when using the L2 is not that surprising; however, the same process applies to a bilingual using his or her L1, although processing in the L1 may be sufficiently skilled and automatic as to mask the influence of the L2. These small, incremental changes accumulate with increasing L2 proficiency and with time; continuing to select language-similar structures over language-dissimilar structures changes the way both languages are used. If the bilingual's two languages are always active, to be able to use the target language there must be regulation to control the influence of the language not in use. The fact that bilinguals rarely produce erroneous language intrusions suggests that they develop an effective means to control the language they do not intend to use. Although there is debate about the means by which bilinguals control the use of each language, there is evidence in both comprehension and production that the activation of the language not in use must be reduced and that, at least under some circumstances, there is active suppression of the dominant language to enable the processing of the less dominant language.

5. ii. The cognitive and neural consequences of bilingualism

Recently there has been widespread media coverage on the provocative claims about the ability of bilingualism to protect individuals against the deleterious consequences of cognitive aging. Elderly bilinguals have been reported to be better able to switch between tasks, to

ignore irrelevant information, and to resolve conflicting cognitive alternatives. But most striking is the evidence on the consequences of bilingualism when some pathology is present, as in the case of Alzheimer's-type dementia. Individuals with Alzheimer's disease were diagnosed with the disease an average of four to five years later if they were bilingual rather than monolingual. The active use of two languages protects bilinguals from the symptoms of the disease. The areas of the brain that enable cognitive control are hypothesized to have benefited from bilingual experience. Under conditions of pathology and stress, the skill developed as a function of juggling two languages over the course of a person's life provides a level of cognitive reserve to enable individuals to continue to function, despite the presence of disease. Bilingualism itself does not directly affect Alzheimer's disease but instead enables functional cognition for a longer period of time, relative to monolingualism, following the onset of the disease.

But what aspect of bilingualism is responsible for these benefits? Past research claimed that a life spent resolving cross-language competition, of the sort we have documented at the level of the lexicon and the level of grammar, creates skill more generally in resolving conflict. The hypothesis is that the same cognitive networks that enable selection and decision-making in the rest of life outside of language are also engaged when language is used. Bilingualism is then thought to provide a rich foundation for developing these control skills because language is so prevalent in cognitive life. Other activities (e.g., playing video games, becoming a skilled musician, driving a taxi cab through a maze of city streets) will also tune cognitive networks, but important as they are, it is unlikely that these activities will be used as frequently as language.

Until recently, the account for the consequences of bilingualism was that the constant activity of the two languages produces competition that then requires resolution. Bilinguals therefore become expert in resolving competition and then reveal that expertise when a task, linguistic or not, presents similar conflict. The problem with this simple story, elegant as it may seem, is that not all bilinguals reveal precisely the same benefits, nor benefits in every conflict task, nor benefits at every point across the life span. There are many different types of bilinguals, and even bilinguals who are similar with respect to the languages

they speak may use those languages in different contexts and with different interlocutors. A goal in recent research has been to identify the critical features of bilingual experience, including learning history and the context in which the two languages are used, and the critical aspects of cognitive control that are required to enable proficient language performance under a range of circumstances.

Other support for the notion that there is a wide range of cognitive consequences of bilingualism comes from studies of infants who are exposed to more than one language from birth. These "crib bilinguals" are not speaking either of the two languages to which they are exposed, but the multiple exposure has critical consequences for the way in which their representation of speech is tuned and furthermore imposes a range of consequences for attention and for language discrimination.

A goal for future research is to begin to identify the constellation of control mechanisms that are engaged by bilingualism. The evidence on language processing suggests a dynamic system in which regulation among competing alternatives is necessary to enable the intended language to be used.

6. Traxler, M. J. (2012). *Introduction to Psycholinguistics: Understanding Language Science.* Wiley-Blackwell. pp. 415-478.

6. i. Potter and the Revised Hierarchical Model

One fundamental issue in bilingual research involves the question of how bilingual speakers represent knowledge about words. Lexical knowledge (stored information about words) can be subdivided into different components relating to word meanings (concepts), and phonological form (sounds). Most theories of bilingualism propose that learning a second language does not entail learning an entirely new set of concepts, but does obviously involve learning an entirely new set of phonological forms or labels for concepts. Having two labels for a given concept creates the possibility of translating from one label to the other.

But how are the two sets of labels related to one another in memory, and what processes do you undertake to translate from one to the other? The modern study of lexical representation in bilingual speakers and the process of translation traces its roots to a study by Mary Potter

and her colleagues (Potter, So, Von Eckardt, & Feldman, 1984). In that study, the process of translating from a person's first language (L1) to a second language (L2) was compared to the process of naming pictures in the L2. The researchers were testing two ideas about how words in the L1 relate to words in the L2.

Potter and colleagues' (1984) ideas about how concepts and labels are related to one another, and how labels in different languages are related to one another indirectly via concepts, have been characterized as being a *hierarchical model*, because knowledge related to words is distributed across different subcomponent systems, L1 labels, L2 labels, and concepts. Research conducted after Potter and colleagues' groundbreaking experiments on the way bilingual speakers organize knowledge about words in their two languages showed that life is somewhat more complicated than thought.

For one thing, bilinguals are able to translate in both directions. *Forward translation* involves starting with L1 and speaking in L2. *Backward translation* involves starting with an L2 word and speaking the L1 equivalent. Kroll and her colleagues (1994) proposed a new version of the hierarchical model, which is known as the *Revised Hierarchical Model* (*RHM*). According to RHM, L1 labels connect directly to L2 labels (as in Figure 7), but those connections are weaker in the L1–L2 direction than in the L2–L1 direction. As a result, It should be possible to translate from L2 into L1 without passing through the store of conceptual representations. In fact, across a range of different degrees of proficiency and fluency in L2, bilingual speakers generally translate from their L2 into their L1 faster than they translate from their L1 into their L2 (as RHM predicts).

Additional evidence for the RHM comes from experiments that investigate whether semantic (meaning) factors influence translation in different directions. According to the RHM, L2 to L1 translation is different, because the conceptual representations are bypassed due to the existence of direct L2–L1 *lexical* connections. Because of the asymmetry between L1–L2 connections and L2–L1 connections, coming up with a word in your L2 should be more affected by semantic (meaning) factors than should translating from your L2 into your L1. That is because getting to L2 from L1 involves a detour through the concept (semantic) system, but you can go straight from L2 to L1 via direct lexical connections.

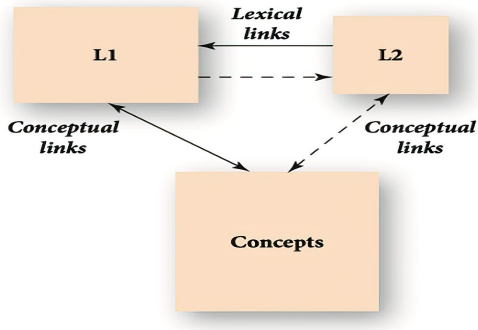

Figure 7. The Revised Hierarchical Model. Traxler (2012).

This hypothesis has been tested in different ways. In one kind of experiment, subjects are given lists of words to translate. Sometimes the words are in their L1, sometimes they are in their L2. Sometimes, a block of words all comes from the same semantic category (like *fruits*). Sometimes a block of words switches back and forth between different categories (like *fruits* and types of *furniture*). Because different examples of fruits are associated with one another, activating the concept for *banana* will also activate related concepts, such as *apple*, *orange*, and *pear*. This creates the possibility of semantic interference, as the different concepts compete to be expressed. The possibility for this kind of competition would be lessened if you could bypass the conceptual memory system in which that semantic competition takes place. The RHM predicts that you will get more semantic interference in forward translation (L1–L2) than in backward translation (L2–L1), because forward translation leads to activation of conceptual memory more than backward translation does. In fact, presenting a whole list of fruits as a block slowed bilinguals down when they were translating from L1 to L2 (compared to the condition where different categories were intermixed). When bilinguals performed backward translation, they were just as fast when the list of words-to-be-translated was presented with all the fruits together as when the fruits were interwoven with other categories of things. Forward translation involves accessing concepts (because pre-activating the appropriate concepts helps) and backward translation does not involve accessing concepts, because pre-activating a matching concept did not affect backward translation.

6. ii. Sign language

The vast majority of people use spoken language to communicate, but significant numbers of deaf individuals around the world use sign languages instead. On the surface, sign languages appear to differ radically from spoken languages. Most obviously, spoken languages make use of auditory channels, while sign languages make use of visual channels. But this difference in form between sign and spoken languages disguises substantial similarities between the two types of language. In fact, sign languages have all of the fundamental properties of spoken languages (e.g., phonology, morphology, grammar and syntax). Sign languages combine meaningless sublexical units into larger components that do carry meaning, the same way spoken languages combine meaningless phonetic features, phonemes, and syllables into meaningful expressions. Sign languages, just like spoken languages, have grammatical principles that determine how units of the language can combine. In both sign and spoken languages, the store of sublexical units could produce an infinite set of combinations, but only a subset of these combinations occurs. Because sign languages share the fundamental characteristics of spoken languages, but express them in a different set of physical forms, researchers can use the contrast between the two language types to investigate which aspects of language processing occur regardless of modality (visual vs. auditory), and which are determined by the specific manner in which the language conveys meaning.

At an abstract level of description, sign languages work just like spoken languages. Sign and spoken languages combine separately stored meaningless subcomponents to express complex meanings. A grammar governs how the subcomponents can be combined to produce meaningful expressions. Sign languages have gestures that are the equivalent of root morphemes in spoken languages, and the collection of gestures in sign language comprises a lexicon. The sign language lexicon is divided into subcomponents that reflect different sign classes, such as noun and verb. Some signs are produced with one hand, and some are produced with both, but for one-handed signs, the meaning remains the same no matter which hand is used. This categorical organization of signs in the sign language lexicon is one of the aspects of sign languages that distinguishes them from non-language gestural systems, such as pantomime. While both sign languages and pantomime make use of manual gestures,

and people can use pantomime to express a subset of the things that they could express using sign language, the gestures in pantomime do not have the categorical organization that is present in signed languages. Nothing in pantomime differentiates between "verb" gestures and "noun" gestures, for example. Pantomime also lacks the means to express fine-grained aspects of meaning, such as tense and aspect. Sign languages use tense and aspectual morphemes to express precisely those details of the intended meaning (unless the speaker purposefully leaves that information unspecified).

Sign language is not a complex form of pantomime, but how are sign language gestures formed and how do they express meaning? The modern study of sign languages traces its origins to William Stokoe's research in the 1960s. Stokoe suggested that sign language gestures could be broken down into three basic components or parameters: *hand shape* (or *hand configuration*), *location*, and *movement* (or *path*). (Later on, other researchers suggested that a fourth parameter, *orientation* should be added.)

Hand shape (or *hand configuration*) reflects the way the fingers and thumb are held in relation to the rest of the hand and how the hand is oriented toward the rest of the arm. Finger-spelling is often used when American Sign Language (ASL) does not have a sign for a specific concept. This occurs frequently for proper names and technical terms, as well as for some types of animals (e.g., ASL has a sign for *elephant*, but it does not have a sign for *bee*). Hand shape is considered a *phonological feature* because the meanings of different signs can be differentiated on the basis of hand shape. For example, if you spread your fingers and thumb apart and hold them out straight (sometimes called the "five" hand shape), then touch your thumb to your head near your temple, you have just made the ASL sign for *father*. If you change the shape of your hand to the ASL finger-spelling "Y" hand configuration, and touch your thumb to the same spot, you have just made the ASL sign for *cow*. The "five" and "Y" handshapes in ASL represent a kind of *minimal pair*. The minimal change that differentiates between *father* and *cow* in ASL should remind you of the minimal differences between speech sounds (phonemes) that similarly differentiate between spoken words (as in *pat* and *bat*).

Location refers to the place in space where the sign is articulated. *Signing space* includes the region in close proximity to the upper body and face. Members of minimal pairs of signs can be distinguished by where in space they are articulated. Eye level and chin level are two locations where signs can be articulated. If a particular hand shape and pattern of movement are articulated at eye level, the corresponding sign means "summer." If the hand shape and pattern of movement remain the same, but the sign is articulated in the vicinity of the chin, the corresponding sign means "dry." Thus, location is a characteristic that produces minimal pairs and hence qualifies as a phonological feature in ASL.

Movement qualifies as a phonological feature because it, too, participates in minimal pairs, but movement also serves morphological and syntactic functions as well. One commonly cited example of morphological function involves the verb "give". The hand shape for the base (stem) uninflected form of the verb "give" is formed by turning the palm upward, holding all the fingers parallel to one another, and touching the tip of the index finger with the tip of the thumb. The motion of the base form starts near the signer's shoulder and proceeds in the direction away from the body. To change from the base form to a different form, such as *give to each*, the hand shape stays the same, and the motion occurs in the same plane as the base form, but the trajectory of the movement changes. Instead of being a simple linear motion, the signer makes a series of back-and-forth movements, starting at one side of the plane and progressing horizontally toward the other. To change from the base form to a different inflected form, a different pattern of motion can be used. To express "give continually," a circular motion along the vertical axis is added to the base form. The motion begins in the same place, but the hand drops down as it circles back after the outward part of the movement. Notably, the two forms of motion can be combined and recombined to produce even more complex meanings, such as "give to each in turn repeatedly." Native signers can identify these patterns of movement and indicate their implications for meaning even under conditions where hand shape and location information have been deleted from the signal. Thus, movement really does represent a separate and independent layer of representation in sign language.

Movement is also used in verb agreement. In spoken languages such as English, verbs agree with their subjects in number and not much

else. Other languages, such as French and Spanish, have more complex systems of agreement, including gender. In all of these systems, the form of the verb changes (from *give* to *gives* for example) as the characteristics of the subject noun change. In ASL, verbs agree with their subject and object nouns spatially, and some verbs agree with the semantic category of the argument nouns.

6. iii. Sign language acquisition and language evolution

Children are the fastest language learners. They acquire new words at an amazing rate after the first 18 months or so and are able to determine the complex features of their native language's grammar and syntax without any formal instruction at all. Phenomena like these have persuaded some language scientists that humans are specially adapted for language learning and are born with a *language bioprogram* that includes a genetically installed *language acquisition device*. The language bioprogram hypothesis was built chiefly on the basis of studying hearing and speaking children, but to show that a human characteristic is truly universal, the language bioprogram hypothesis needs to work equally well for hearing-impaired children learning sign language. Language scientists have therefore begun to study sign language in an attempt to gather new evidence about universal characteristics of language acquisition. Such studies show that the acquisition of signed languages in infancy closely resembles the acquisition of spoken languages. Some studies suggest that signing children may acquire their first 10 signs faster than hearing infants acquire their first 10 words, but the differences in timing of the one-word, two-word, and multi-word stages are about the same in both groups.

Additionally, signed language acquisition appears to be constrained by critical or sensitive periods, just like spoken language. A minority of signers learn the language from birth, while many are exposed to standard ASL only after reaching school age or beyond. In fact, only 3-7% of ASL users are native signers. Even though deaf signers who are raised in a hearing environment will tend to communicate with their hearing parents and siblings using self-generated systems of signs, called *home sign*, those home sign systems generally lack complex morphology and syntax, and so do not qualify as full-blown languages. One outcome of this state of affairs is that many hearing-impaired children experience

language delay and lack of communication during infancy and early childhood. However, deaf children are not normally otherwise deprived or abused, which distinguishes them from other cases of language input delay, such as "Genie" and *feral children*. Therefore, language outcomes for non-native hearing-impaired signers reflect the delayed onset of learning, rather than deprivation or other physical and cognitive deficits that result from neglect and abuse. By studying hearing-impaired signers who begin to learn sign language at different ages, researchers can test the critical period hypothesis without worrying too much about factors other than age of acquisition.

Such studies support the conclusion that at least some aspects of language are subject to critical or sensitive phases, because individuals who begin learning the language before the end of the critical period develop normal language skills, but individuals who begin learning the language later do not. Studies of sign language learners indicate that different aspects of the language are subject to different critical periods. The acquisition of the meaning of signs appears to occur normally throughout the lifespan, which is similar to the pattern that holds for spoken languages. Although some aspects of grammar, such as word order conventions, also appear to develop fairly normally regardless of when people begin to use sign language, other aspects of ASL grammar suffer when learning starts after puberty. The morphological structure of ASL presents much greater challenges to older learners, and is mastered to the highest levels of accuracy only by native signers who begin to learn sign language in infancy or early childhood. As in spoken language learning, people who begin to learn the language early tend to make grammatical errors that preserve the meaning of the intended utterance, while late learners tend to make errors that preserve the physical form of the intended utterance, even though those errors lead to substantial changes in intended meaning. Further, differences in the control of ASL grammar remain even after the effects of experience are taken into account, which suggests that age, rather than total amount of practice using the language, determines how proficient an individual will become. Groups of signers who have an equal number of years using the language still differ in proficiency when one group started learning the language younger than the other group.

Why are younger children better learners than older children and adults? Some theorists suggest that younger children lack the working-memory capacity necessary to retain large amounts of uninterpreted information. As a result, younger children may need to rapidly break down complex stimuli into their component parts to get at the essence of the intended message, which can then be retained in a more stable form. Older individuals may instead store morphologically complex signs as unanalyzed wholes and therefore may not recognize that complex signs can be broken down into subcomponents, and that those subcomponents can recombine in regular ways to compose new messages. Alternatively, the language bioprogram may require specific kinds of inputs at specific developmental stages for learning to progress along the normal path. According to this hypothesis, infants and young children are attuned to the linguistic environment, and can glean cues from that environment to figure out how their native language works, but only for so long. Researchers who favor the bioprogram hypothesis point to critical period phenomena to support the time limit aspect of the theory, and they point to other kinds of data to support the idea that infants are attuned to linguistic input.

Such support can be found in studies showing that infants prefer speech over other complex auditory stimuli. The fact that infants prefer speech suggests that humans are adapted to acquire language, but is that preference universal and is it driven by the physical characteristics of speech, or is it instead driven by more abstract properties of language?

Children's innate drive to learn language can also be seen in the creation and development of new languages. Nicaraguan Sign Language (LSN) provides a case study of the formation of a new language. Before the Sandinista movement took control of Nicaragua in the 1980s, there was no formal system of education for hearing-impaired Nicaraguans, and they tended to be isolated from one another. Shortly after the Sandinistas took over the government, they established a school for the hearing-impaired in the capital, Managua. Hearing-impaired students from around the country came to this school and started to communicate with each other for the first time. In the early days of the school, the sign language that was used in the school most closely resembled a *pidgin*. Children in the school spontaneously adopted the same signs for common objects and actions, but their signing lacked grammatical fea-

tures, such as tense and aspect marking on verbs, and agreement between subjects and verbs, that appear in full-blown languages such as ASL. However, within a few years, and without being exposed to other sign languages, the children themselves introduced complex grammatical features, and NSL is now recognized as a language on par with ASL, BSL, English, and so forth.

The LSN studies point toward a special role of children in the creation and development of new languages. Bringing hearing-impaired children into contact led to a sign language pidgin, which in turn led to a spontaneous increase in the regularization of sign language forms and the introduction of more complex morphology and syntax. LSN provides a documented case of children spontaneously inventing the language forms that they need to communicate complex ideas when the language environment did not naturally provide those forms. This outcome demonstrates that children learning language are not like parrots. They do not merely repeat the forms that they see and so their language output goes beyond the input they are given.

The left hemisphere responds to sign language much the same way it responds to spoken language. But what does the right hemisphere do? The right hemisphere plays a vital role in the processing of visuospatial information. People who experience right-hemisphere brain damage often perceive space differently than other people. For example, right-hemisphere brain damage can lead to *hemifield neglect*, a disorder in which people appear to be unaware of the left side of the visual world. Because sign languages depend on visuospatial perception, and because the right hemisphere is heavily involved in visuospatial perception, some theorists have suggested that the right hemisphere is more heavily involved in sign language than in spoken language. However, the idea that signed languages activate right-hemisphere regions that do not normally participate in spoken language processing remains controversial.

(B) Further reading and online resources:

1. Aitchison (2008). pp. 234-256
2. Bock & Levelt (1994)
3. Carroll (2008). pp. 191-248

4. Crystal (2005). pp. 159-170; 409-422
5. Dell (1995)
6. Erard (2012)
7. Fernández & Cairns (2011). pp. 134-169
8. Fernández & Cairns (2018). pp. 3-182
9. Field (2003)
10. Field (2004)
11. Garman (1990). pp. 109-177; 370-415
12. Pinker (1995). pp. 190-230
13. Scovel (1998). pp. 26-49
14. Shariatmadari (2019). pp. 55-78; 136-159
15. Spivey, McRae & Joanisse (2012). pp. 409-465
16. Steinberg, Nagata & Aline (2001). pp. 218-241
17. Steinberg & Sciarini (2006). pp. 160-175
18. Traxler (2012). pp. 37-78
19. Traxler & Gernsbacher (2006). pp. 19-150
20. Warren (2013). pp. 19-97

21. Speech Impediment Guide: Definition, Causes, and Resources
22. Why do we, like, hesitate when we, um, speak?
23. How the Brain Produces Language — And What Can Go Wrong
24. Why you lose words on the tip of your tongue
25. The Benefits of a Bilingual Brain
26. What your handwriting says about you
27. Cursive: Why It Should Be Taught Today & the Science Behind It

(C) Key concepts:

access	grammatical encoding	RHM
articulation	hesitation	sign language
bilingualism	immersion	slip of the tongue
chunks	lemma	speech error
code-switching	lexeme	speaking rate

concept	malapropism	spoonerism
disfluencies	mental lexicon	stuttering
false friends	pausing	substitution error
fillers	planning	TOT
fluency	production	translation
Freudian slip	retrieve	utterance

(D) Discussion questions and activities:

1. Describe the difference between *a concept* and *a lexicalized concept*. What roles do they play in language production?

2. Describe how all these terms are related to one another for speech production: *planning, retrieve, speech sound, working memory, speaking rate, hesitant speech, fluent speech, pausing, typical disfluencies.*

3. Match each term (1-6) to its explanation/definition (a-f):

1. lexical access	a. an abstract representation, encompassing all the formal lexical variations which may apply.
2. lexical storage	b. The way in which lexical items are organised in the lexicon so as to ensure rapid retrieval.
3. input	c. The retrieval of a lexical entry from the lexicon, containing stored information about a word's form and its meaning.
4. nodes	d. The process of producing and using the speech sounds required for intelligible and meaningful speech.
5. lemma	e. The language to which a listener or reader is exposed.
6. articulation	f. Interconnected elements in the organization of the mental lexicon: connected to one another by virtue of having various relations with one another.

4. What sources of evidence does empirical research in lexical selection rely on?

5. The production of a sentence begins with the speaker's intention to communicate an idea or some item of information. This has been referred to by Levelt (1989) as a *preverbal message* because at this

point the idea has not yet been cast into a linguistic form. Turning an idea into a linguistic representation involves mental operations that require consulting both the lexicon and the grammar shared by the speaker and hearer. Eventually, the mental representation must be transformed into a speech signal that will be produced fluently, at an appropriate rate, with a suitable prosody. There are a number of steps to this process, each associated with a distinct type of linguistic analysis and each carrying its own particular type of information. Analyze Figure 8 by summarizing, from left to right, the steps and processing operations performed by the speaker:

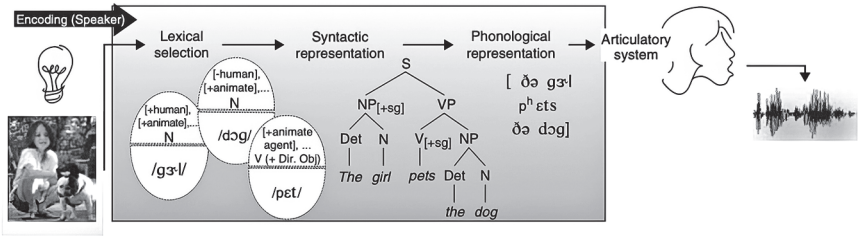

Figure 8. From encoding to articulation. Fernández & Cairns (2011): 135-138.

6. What do you think is more difficult to investigate: language comprehension or language production? Why?

7. Traxler (2012: 38-43) mentions Willem Levelt's production theory as one influential approach to speech production, which has been adapted as a mathematical model called WEAVER++. One of its goals is to describe the intermediate steps between activating an idea and activating the sounds that you need to express the idea. Draw a schematic representation of Levelt's speech production model and discuss it:

8. How can the study of speech errors demonstrate that speech consists of segmented words and phonemes before it is produced?

9. What do speech errors tell us about the speaker's mental processes?

10. Match each type of speech error (1-8) to its example (a-i). The correct form is in brackets:

1. spoonerism	a. I got into *this guy* with *a discussion*. (I got into a discussion with this guy.)
2. exchange error (articulatory)	b. Our national interest should be to encourage the *breast* and brightest. (Our national interest should be to encourage the best and brightest.)
3. shift	c. *I scream* (ice cream); *neck spring* (next spring)
4. malapropism	d. Do you have something *to better* do? (Do you have something better to do?)
5. Freudian slip	f. You noble *tons of soil*! (You noble sons of toil!)
6. slip of the tongue (assembly process involving morphology)	g. I'm *naming* a *wear* tag. (I'm wearing a name tag.)
7. chunking (assimilation and elision)	h. She's the *pineapple* of politeness. (She's the pinnacle of politeness.)
8. exchange error (grammatical)	i. cu*ck* ca*pe* (cupcake)

Which of these above is a borderline speech error?

11. Freud suggested that word retrieval errors were a result of repressed feelings. Consider the following spoonerism: *Work is the curse of the drinking classes.* What is the psycholinguistic view of this error?

12. At some point before an utterance is produced it is represented in a form to which phonological and morphophonological rules have not yet applied. What characteristics of speech errors support this claim?

13. In this example — *You might beel fetter if you go to the doctor's for a shu flot.* — what specific kind of speech error does this senten-

ce contain? Correct the error. Explain this experience in more detail and why it occurs.

14. Phonological slips happen only rarely in function words; some possible reasons being that function words are members of closed categories and are highly frequent. What are some other reasons why function words are relatively immune to their sounds slipping?

15. What does the acronym TOT stand for? How can a TOT experience inform us about the nature of the speech production process, specifically lexical retrieval? Identify the precise point in the speech production process where the TOT state occurs.

16. It is commonly believed that alcohol, medication, and other drugs increase the frequency of slips of the tongue. Do you think they would increase all types of slips across the board, or would certain types of slips be more likely when a person is intoxicated? Explain.

17. Discuss how the word *like* is used in each example. In which example is it used as a filler (typical disfluency)?

a) I just painted my walls in a peach-like orange color.
b) So she enters and is like, "Where's everybody?"
c) I often stay up late, until, like, three in the morning.

18. Do a search on definitions of the term *bilingualism* (i.e. look it up in dictionaries). What similarities and differences in defining the term can you notice?

19. Explain why "a bilingual is not two monolinguals in one." (Grosjean, 1989)

20. How do we know that bilinguals' two languages compete and interfere with one another? Why can they not stop it?

21. What processes take place when doing simultaneous translation and consecutive translation (from preverbal stage to articulation)? How can you apply the RHM in understanding these processes? How could one practice and improve their translation skills?

22. Some computer programs can translate words and phrases from one language to another. How do you think these programs work? Will computers ever fully replace human translators?

23. What is a *cochlear implant*, who is it intended for, and how does it work? (see Fernández & Cairns 2018: 205-207; Traxler 2012: 469-472)

24. How do sign languages compare to spoken languages? In what ways are they similar or identical? In what ways are they different?

25. What else might you want to know more about in context of what this Chapter deals with?

Chapter 5
Language acquisition and language learning

(A) Readings:

1. Steinberg, D. D., Nagata, H., & Aline, D. P. (2001). *Psycholinguistics: Language, Mind and World* (2nd ed.). Routledge. pp. 3-49.

We have minds and in our minds we have the means for producing and comprehending speech. But how did we learn to produce and comprehend speech? At birth we cannot comprehend speech, nor can we produce speech. Yet, by the age of 4 years we all learn the basics of our language. We acquire vocabulary and grammatical rules for creating a variety of sentence structures including negatives, questions, and relative clauses. And although 4-year-olds still have passives and some other elaborate syntactic structures to learn, along with a never-ending stock of vocabulary items, by that age they will have overcome the most difficult obstacles in language learning. This is true of children the world over, whatever the language may be.

Indeed, the language proficiency of the 4- or 5-year-old is often the envy of the adult second language learner, who has been struggling for years to master the language. It is one of the fundamental tasks of psycholinguists to explain how children learn language.

1. i. Vocalization to babbling

Prior to uttering speech sounds, infants make a variety of sounds, crying, cooing, gurgling. Infants everywhere seem to make the same variety of sounds, even children who are hearing-impaired. The ability and propensity to utter such sounds thus appear to be unlearned.

Later, around the seventh month, children ordinarily begin to babble, to produce what may be described as repeated syllabies ('syllabic reduplication'), e.g. 'baba', 'gigi', 'panpan'. While most of the syllables are of the basic *consonant + vowel* type ('baba' and 'momo'), some consist of dosed syllables of the simple *consonant + vowel + consonant* variety ('panpan'). This structure of babbling has been found to be produced by children in all studied languages.

The sounds which infants make involve many but not all of the speech sounds which occur in the languages of the world. For example, English sounds like the 'th' in *'though'* and the 'th' in *'thin'* are rare, as are the click sounds common in various African languages such as Zulu. In time, however, such vocalizations take on the character of speech. From as early as 6 months of age, even before they utter words in the language, infants from different language communities begin to babble somewhat distinctively, using some of the intonation of the language to which they have been exposed. Although this has not been firmly established, research does indicate that in languages where the intonation contours are quite distinctive, native speakers could tell the difference between the babble of infants who were learning their (the native speakers') language as opposed to the babble of infants learning other languages.

The production of sounds using the intonation contours of the first language is obviously a learned phenomenon because when infants babble they follow the intonation contours of the language which they hear. This is something that infants deprived of hearing speech do not do. While such infants are able to vocalize and cry, they do not progress to babbling. Interestingly, hearing-impaired infants who have been exposed to sign language from birth do the equivalent of babbling with their hands.

1. ii. Babbling to speech

It is from the advanced stage of babbling that children move into uttering their first words. Often this occurs at around one year of age but can occur much earlier or much later. When children begin to utter words, somewhat surprisingly only some of the sounds which they have uttered in babbling appear in speech. The other sounds must be reacquired. And there may be some order to the acquisition of speech

sounds. While vowels which occurred more frequently in babbling were related to the frequency of those vowels in the infants' native language, these sounds were not strongly related to the infants' subsequent meaningful speech. As babbling progresses to meaningful speech, though, the relationship seems to get stronger.

Why is there some degree of discontinuity from babbling to the production of speech sounds? In our view, the discontinuity issue involves, as the eminent linguist Jesperson (1933) noted many years ago, the distinction between intentional and non-intentional vocalization. Babbling is non-intentional in the sense that particular sounds are not under central cognitive control; the infant does not intentionally make the particular babbling sounds which occur. They seem to happen by the chance coordination of speech articulators.

The case of meaningful speech is quite different, however. Here, sounds must not be uttered at random but must match previously heard sounds which are conventionally associated with certain objects, needs, and so forth. In order to accomplish this feat, it is necessary that the child discover which sound is created by which speech articulators (mouth, tongue, vocal cords, etc.). It is this knowledge that the child must acquire in order to speak meaningfully. While babbling is different from speech with respect to intentionality, nevertheless speech *is* dependent to some degree on babbling. In babbling, the child will chance on many of the various articulatory mechanisms for producing speech and give practice to the use of those articulators. The connections established by such exercise of the articulatory mechanisms undoubtedly aid the child later in acquiring speech when intentional connections to the articulators for the purpose of activating speech must be firmly established.

1. iii. Early Speech Stages: Naming, Holophrastic, Telegraphic, Morphemic:

1. iii. a) Naming: one-word utterances

When do children start to say their first words? It may surprise you to learn that research on this basic question is not at all conclusive. Actually this is not only because there is a very wide range of individual differences but also because the precise determination of just when a word has been learned is not easy to make and is not standardized. The

mere utterance of speech sounds, e.g. 'mama', may or may not indicate word knowledge. Children can be said to have learned their first word when (1) they are able to utter a recognizable speech form, and when this is done (2) in conjunction with some object or event in the environment. The speech form may be imperfect, e.g. 'da'for 'daddy', and the associated meaning may be incorrect, e.g. all people are called 'da', but, as long as the child uses the speech form reliably, it may be concluded that the child has acquired some sort of word knowledge.

First words have been reported as appearing in children from as young as 4 months to as old as 18 months, or even older. On the average, it would seem that children utter their first word around the age of 10 months. Some of this variability has to do with physical development, such as the musculature of the mouth, which is essential for the proper articulation of sounds. Certain brain development is also involved since the creation of speech sounds must come under the control of speech areas in the cerebral cortex.

The naming of objects is one of the first uses to which children put words, e.g. 'mama' is said by the child when the mother walks into the room. However, naming may be preceded by words which accompany actions, such as 'bye bye' in leave-taking. It appears that children first use nouns as proper nouns to refer to specific objects, after which they may or may not extend the meaning correctly for common nouns. For example, while 'dada' may first be used to identify one particular person, it may or may not be extended to include all men or all people. In time, of course, the proper restrictions and extensions are learned.

1. iii. b) Holophrastic functions: one-word utterances

However, children do not only use single words to refer to objects; they also use single words to express complex thoughts which involve those objects. A young child who has lost its mother in a department store may cry out 'mama' meaning 'I want mama'. Or a child may point to a shoe and say 'mama', meaning 'The shoe belongs to mama'. Research has shown that the young child can express a variety of semantic functions and complex ideas by the use of single words. In such cases, the child uses a single word to express the thought for which mature speakers will use a whole sentence. It is because of this whole sentence function that this aspect of one-word speech is often referred to as

'holophrastic', where 'holo-' indicates whole, and '-phras' indicates phrase or sentence.

Actually, it is quite remarkable how inventive children can be in the use of single words. Researchers have noted that children may describe a complex situation by using a series of single-word holophrases. For example, 'peach, Daddy, spoon' was used to describe a situation where Daddy had cut a piece of peach that was in a spoon, and 'car, go, bus' was used to describe a situation in which hearing the sound of a car reminded the child that she had been on a bus the day before. These strings of words are not yet sentences, because at the end of each word the child pauses slightly and uses a falling intonation of the sort that is used by mature speakers to signal the completion of a sentence.

It is often not easy, of course, to interpret what a child is intending to convey by the single word. And, while knowing the child, the child's previous experiences, and elements of the present situation will serve to aid in the interpretation of an utterance, even the most attentive parents are frequently unable to interpret utterances which their children produce. Such failures in communication may provide children with an impetus to improving their communicative language ability. They will discover that longer, more elaborate constructions will better serve their communicative needs, needs which become more varied and complex as they grow older. Incidentally, we often use the traditional term 'utterance' rather than 'sentence' in order to avoid disputes as to whether what the child says is truly a sentence or whether it is grammatical. The advantage of the term 'utterance' is that it describes what the child says without having to worry about the assignment of sentencehood or grammaticality to what was said.

1. iii. c) Telegraphic speech: two- and three-word utterances

Children do not proceed as rapidly to two-word utterances as one might expect. Why this should be the case is a matter of conjecture, although it is our view that children must first become aware that adding more words will improve communication, e.g. 'tummy hurt' is more effective than just 'hurt' or 'tummy'. In any case, around 2 years of age or so children begin to produce two- and three-word utterances.

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1. iii. d) Morpheme acquisition

Once two- and three-word utterances have been acquired, children have something on which to elaborate. They start to add function words and inflections to their utterances. Function words like the prepositions 'in' and 'on', the articles 'the', 'a', and 'an', the modals 'can', and 'will', and the auxiliaries 'do', 'be', and 'have', begin to appear, together with inflections such as the plural -s on 'cats', and /z/ on 'dogs', and *tense* markings such as the past tense form on 'worked'.

2. Levine, D., et al. (2011). Names for Things… and Actions and Events: Following in the Footsteps of Roger Brown. In E. M. Fernández & H. S. Cairns (Eds.), *Fundamentals of Psycholinguistics* (pp. 536-566). John Wiley & Sons.

As Paul Bloom (2002) noted in *How Children Learn the Meanings of Words*, word learning seems like it should be strikingly simple. Say the word *dog* in the presence of a dog and a child is sure to associate the word with its referent. Pilley and Reid (2011) demonstrated that their border collie, Chaser, could do precisely the same thing. Chaser correctly identified 1,022 objects by name. If a dog can learn over 1,000 words in three years, why is it any surprise that human children learn 14,000 words by the age of six? Obviously, children—and dogs—associate words they hear with the objects, actions, or events that are most salient at the time. Or is it so obvious?

As it turns out, *associationistic* learning supports the beginnings of word learning, but this mechanism alone cannot cleanly explain lexical development. Even a seasoned linguist could be thrown by the ambiguity in the *dog* scene. Might the word refer to the dog's ears or the dog's panting rather than the whole dog? Quine (1960) suggested that, given the vast number of options, there must be some way to resolve the indeterminacy of reference. Indeed, the problem is even more staggering: children do not merely learn perceptually salient object names – they also learn words for categories like *furniture*, abstract concepts like *truth*, relations like *connection*, and actions like *poking*. Words like *savage* are rooted in a cultural context of social and linguistic information above and beyond simple associative cues. The resulting variety in word

types is necessary to achieve the level of complexity found in human language, but it makes the task of discovering a word's meaning that much harder for the child. Might word learning be influenced by constraints that bias the child toward certain interpretations (e.g., assuming a novel label refers to a *whole object* rather than a part or property of it), or perhaps a set of guiding social cues, or even the use of statistical computations that support the kinds of cross-situational learning that enables lexical acquisition?

2. i. The process of word learning

Children are highly efficient word learners. As Paul Bloom notes (2000: 26), "They achieve this feat without any explicit training or feedback." Segmenting fluent speech into word-sized chunks of sound gets infants going on the road to mastering their first language, but before they can start to communicate effectively, they need to associate concepts with packages of sound (words) that they pull out of the speech stream. Children as old as 14 months who are still trying to master the phonological system of their native language have difficulty associating sounds and meanings, but children get better at learning words the longer they spend learning the language and the more skill they develop at discriminating between similar speech sounds. It takes most infants about 18 months to learn their first 50 words (as measured by how many different words they say in daily life), but after that children experience a *vocabulary spurt*, during which time the rate at which children learn new word meanings increases dramatically. What is most amazing about children's word-learning abilities is that they are able to deduce new word meanings simply by hearing the word used a couple of times. Older children can deduce a word's meaning after hearing it used only once.

Children must first segment units of speech from strings of sounds, which are not well punctuated with stops and starts. That is, they have to isolate the phrases and individual words. Second, they have to segment a continuous stream of events into the objects, actions and event units that will be labeled by those words and phrases. Third, children must map linguistic units onto the objects, actions and events they refer to — often called the *mapping problem*. This latter challenge has turned out to be somewhat intractable and is the subject of most theoretical debates on word learning today.

2. i. a) Speech segmentation

If you have ever listened to an unfamiliar foreign language, you will have an idea of how difficult it is to identify individual words in fluent streams of speech. The places where people perceive boundaries between words do not correspond to silent parts of the speech signal. Speech does not have the equivalent of the white space in between words that helps us identify individual words when we read, so babies cannot rely on silence marking the beginnings and ends of words. Natural speech, therefore, presents infants with the *segmentation problem*: The message consists of collections of words, but the speech signal does not provide obvious cues as to where one word ends and the next one starts. Before an infant can start to learn words, that is to identify collections of sounds that make up a word and then associate meanings with those collections of sounds, the infant must *segment* the stream of speech, mentally chopping it up into word-sized chunks.

Though this segmentation seems obvious to adults, there are actually no pauses or reliable acoustic signals to indicate word boundaries in natural speech. So how do infants begin to parse the speech stream? Shortly after birth, sleeping neonates' brain responses to speech reveal a precocious sensitivity to the statistical structure underlying language. Statistical cues, such as the likelihood of certain syllables being adjacent, are crucial for early word segmentation. As infants gain experience with the language(s) they are exposed to, they develop language-specific biases that facilitate a more fine-tuned approach to word segmentation. Given the consistency of prosodic changes at clause boundaries in English (e.g., rises and falls in fundamental frequency), infants rapidly develop a sensitivity to phrase boundaries. By seven to nine months, infants show a listening preference for speech with pauses inserted at clausal boundaries relative to speech containing pauses within syntactic units. This demonstrates infants' remarkable ability to hone in on important linguistic structures before they can understand what the words that form these structures actually mean. In this way, infants identify linguistic patterns early on that will help them learn words later in development.

Statistical segmentation of speech also matures with language experience. As early as eight months, infants use statistical regularities to distinguish coherent syllabic units from non-units in a monotone,

nonsense speech sample. Seventeen-month-olds capitalize on this ability for word learning; they learn a word-referent mapping if the label was previously presented in fluid speech, but not if the label is a novel syllabic sequence.

The fact that older infants but not younger infants show evidence of segmentation ability suggests that this ability is not innate, and is instead built from the infants' experience listening to the native language. If segmentation ability is not innate, there must be some pre-existing abilities (precursors) that the infant capitalizes on to develop segmentation ability. Researchers have identified two major classes of precursors that may provide the tools that infants need to solve the segmentation problem: Prosodic cues and phonotactic knowledge (phonotactic knowledge refers to the patterns of phonemes that occur in the language).

Prosody can support segmentation of the speech signal because prosodic features correlate with word boundaries. Although this correspondence is not perfect, it may be consistent enough for infants to start identifying candidate words from the speech signal. The *prosodic bootstrapping hypothesis* proposes that infants pay attention to prosodic features of their native language, and that they use those features to identify candidate words. Prosody is plausible as the entry point to segmentation because newborn infants can detect the difference between native and non-native utterances on the basis of prosodic differences, and because infants as young as 2 months old can detect differences between prosodic patterns, even when the phonological content of two utterances is identical, or nearly so. In a study, 2-month-old infants listened to someone saying *nitrates* or *night rates* (if you say those two things, and listen carefully, you may be able to hear slight differences in the way you pronounce them), which have the same phonological content, but different prosodic qualities. When infants habituated to (or got bored with) one of the utterances, they dishabituated when the other one was played.

Although young infants are sensitive to differences in prosody between different utterances, it takes them some time to learn about some of the basic prosodic patterns that occur frequently in their native language. For example, about 90% of the *bisyllabic* (two-syllable) words in English have a *trochaic stress pattern*. In trochaic stress, the first syllable is spoken a little bit louder than the second syllable. The English words *cookie*, *baby*, and *bottle* all have trochaic stress (try pronouncing

them with the second syllable louder than the first – that will sound strange). Some English words have *iambic stress*, where the second syllable is louder than the first. *Guitar*, *debate*, and *pursuit*, all have iambic stress. If babies pay attention to stress, and if they assume that a stressed syllable is an important unit in the language, they will be able to identify the beginnings of many words in the language by assuming that a stressed syllable is the beginning (or *onset*) of a word. Researchers have labeled this version of prosodic bootstrapping the *metrical segmentation strategy*.

2. ii. What it takes to learn a word — Quantity and quality of input

On a fundamental level, infants must receive input to learn, through their exposure to a language (i.e., perceptual input that is symbolic and communicative) and non-linguistic information (i.e., all other perceptual input as well as action experiences).

2. ii. a) Language input

Receiving some type of language input is a guarantee for almost every infant. Thus, the vast majority of children become competent users of their native language. Despite the near universality of lexical acquisition, there is a great deal of variation in language input that is reflected in children's vocabulary outcomes. While a child from a family on welfare hears 616 words per hour, a child brought up by a professional family hears more than three times that amount. Considering the fact that 86% to 98% of the words in children's vocabularies at age three are words used by their parents, language input stands as a major determinant of children's lexical store. Input quantity affects not only which words children acquire, but also how rapidly they understand the words they hear.

2. ii. b) Infant-directed speech

The acoustic properties of language input also make a difference for vocabulary development. Originally called *motherese* (*parentese* or *infant-directed speech/IDS*), it describes a particular register used by adults and even by children when addressing infants and younger children. This register involves slower rates of speaking, longer vowels and

pauses, shorter phrases, and higher and more variable pitches as compared to adult-directed speech. IDS is also characterized by certain sentence structures: in English, the label of a referent often occurs in the final position of the sentence and that label is typically preceded by a frequently used article (e.g., "Look at *the balloon*").

From Traxler (2012: 338)

Why do adults use IDS when they address infants? One reason is that babies like it. Newborn infants prefer to hear the sound of a female voice speaking motherese over the same voice speaking adult-directed speech, and it helps infants stay in a good mood. Beyond mood effects, IDS may help infants solve the segmentation problem. Because IDS has exaggerated prosodic features, it may provide clearer indications of important boundaries between words, phrases, and clauses. Further, IDS utterances are relatively short, which lightens the memory load that utterances impose on infants. Critical topic words also tend to appear in highly prominent positions within IDS utterances, often at the end, and topic words tend to be marked with special prosodic features. IDS utterances also engage infants' attention, boosting even further the salience of speech stimuli that infants appear to have an innate drive to attend to. Thus, exposure to more clearly enunciated IDS appears to instill in infants the phonological contrasts that are important in their native language. In one direct test of segmentation skill, infants (6½–8½ months old) exposed to IDS in English outperformed infants who were exposed to adult-directed versions of the exact same test materials. Research on IDS indicates that, although IDS may not be necessary for children to learn their first language, it helps them master some aspects of speech comprehension and word learning, and it certainly does no harm.

2. ii. c) Non-linguistic input

Perhaps less intuitively, non-linguistic information is also critical for lexical development. One important clue to word meaning is where the speaker is looking – their *eye gaze*. As early as 12 months, infants attend to a speaker's eye gaze for substantially longer periods of time when the word learning situation is ambiguous than when it is unambiguous. Infants at this stage also show a developing sensitivity to gestural cues; dynamic gestures synchronized with object labeling promote

greater attention to the labeled object than asynchronous dynamic gestures or static gestures. Beginning in the second year of life, visually available social cues affect the success of word-referent mapping. For example, 18- to 20-month-old infants can map a label to an object only if the adult labeling the referent is observed attending to the object; if the adult is out of sight, the mapping fails. This illustrates the importance of *joint attention* — or the situation in which a child and her caretaker are both focused on the same object or event. Mothers and children speak more during episodes of joint attention, and mothers' frequency of object labeling during these episodes predicts later vocabulary. Additionally, more novel words are learned if parents simultaneously look at and label the object their child is focused on rather than looking at other objects during labeling.

Lexical acquisition is most often discussed in terms of spoken language, but speech and hearing are not necessary for language development, either. Children learn signed languages just as easily as spoken languages (with the right input), regardless of whether they can hear or not. Indeed, hearing infants of hearing parents come prepared to find the "phonemes" in infant-directed *sign* at four months of age, an ability they lose by 14 months of age. Remarkably, the milestones for lexical acquisition are very similar for children learning sign languages and spoken languages.

2. iii. The timeline of lexical acquisition

Across the globe, children reach major vocabulary milestones at the same time and show similar patterns in learning words. Whether children are learning French or Chinese, they tend to comprehend more words than they can produce. Furthermore, children show a tendency to learn nouns before they learn verbs; even in what are termed *verb-friendly* languages, in which verbs can appear alone or at the ends of sentences.

2. iii. a) Major milestones

Although there is some variation among individuals and among languages, children typically experience a remarkably similar trajectory of lexical growth. It takes about 12 months for children to produce their first word, but from then onward, their expressive vocabulary grows to approximately 50 words in the following six months. The lexicon rapidly

expands after this point, during a period often referred to as the *vocabulary spurt*. Some research suggests this spurt may simply be a by-product of learning words, of varying difficulty, in parallel. However, specialized learning processes do emerge, and a large body of evidence suggests that word learning accelerates across development because children discover regularities in referential mappings and increasingly make use of a variety of information when learning new words. This growth continues into adulthood, by which point most people know about 60,000 words.

2. iii. b) The noun bias

Children have been observed to learn more nouns than other types of words, but there has been some debate about the potential universality of this tendency. Children learning Spanish, Dutch, French, Hebrew, Italian, and Korean tend to exhibit a noun bias in expressive vocabulary. Still, certain environmental factors that vary substantially around the world may affect the strength of the noun bias in different linguistic communities. Goldfield (2000) reports, for example, that parents in New England elicit more nouns from their children than verbs and use verbs to elicit actions rather than speech. This suggests that children may understand many more verbs than they produce, and that the way parents use speech to interact with their children influences what types of words children tend to produce. Despite these differences, the noun bias is retained in these so-called *verb-friendly* languages, suggesting that nouns have a universally privileged status in lexical acquisition.

What causes nouns to be learned earlier and more easily? Gentner (1982) suggested that nouns are learned first because their meanings are easier to carve from the ever-changing world. All words lie on a continuum of abstractness, termed the SICI (shape, individuation, concreteness, and imageability) continuum. SICI scores reflect the difficulty of learning a word based on four factors that have been discussed in the literature: the consistency of the referent's *shape*, the ease with which the referent concept can be *individuated*, the extent to which the referent is *concrete* to the senses, and the facility with which the word evokes a mental *image*. Although some verbs, such as *jump*, involve a consistent 'shape' of motion and are easily imageable, and although some nouns are extremely opaque (e.g., *peace*), the average verb is more abstract (i.e., has a higher SICI score) than the average noun.

Is there a critical period?

Critical Period Hypothesis (CPH) is an ongoing debate in linguistics of whether or not the ability to acquire language is biologically linked to age. The current hypothesis is that there is a critical period of time to acquire language: the first (formative) years of life.

- Language acquisition must occur by the age of puberty, before cerebral lateralization is completed. If language is not acquired in this time frame, language acquisition becomes very difficult and the individual will never achieve the full understanding of language, especially grammatical structures.
- Lenneberg (1967) argued that humans have a narrow 'critical period' set aside by nature for the acquisition of language. In his view, it lasts from toddler time to adolescence. Between the ages of two and three, language emerges by an interaction of maturation and self-programmed learning. Between the ages of three and the early teens the possibility for primary language acquisition continues. After puberty, the ability for self-organization and adjustment to the physiological demands of verbal behaviour quickly declines. The brain behaves as if it had become set in its ways and primary, basic skills not acquired by that time usually remain deficient for life.
- Lenneberg appears to be right in outline, but wrong in some details. The early part of life is indeed important for language, though it all starts earlier than he assumed. Lenneberg is right though that a huge language surge (spurt) occurs at around the age of two. But does language come to a shuddering halt around adolescence, as Lenneberg believed?
- All the arguments for a sudden onset or final endpoint of the supposed critical period are unconvincing. It may be better to speak of a 'sensitive period' – a time early in life when acquiring language is easiest, and which tails off gradually, though never entirely. Early exposure to language is therefore important.
- Older children hardly ever sound like native-born speakers, even when they are talking the same language.
- The period between age two and the onset of puberty is one of extreme neural plasticity. There is, however, little that suggests a specifically linguistic type of mechanism.
- How does child sensitivity to language work, given how difficult language learning seems to be for most adults? A 'natural sieve' hypothesis is one idea. Very young children may be able to extract only certain limited features from what they hear, and may automatically filter out many complexities. Later learners may have lost this in-built filter, and be less able to cope as everything pours over them simultaneously. A 'tuning-in' hypothesis is another, overlapping possibility.
- At each age, a child may be attuned to some particular aspect of language. Infants may be tuned in to the sounds, older children to the syntax, and after age ten, the vocabulary remains a major concern.
- Acquisition follows a regular sequence of milestones which can be loosely correlated with other aspects of the child's development. In other words, there is an internal mechanism both to trigger it off and to regulate it. There is a sensitive period for acquiring it, with early exposure a strong advantage, since younger brains have more plasticity. However, it would be wrong to think of language as something which is governed only by internal mechanisms. These mechanisms require external stimulation in order to work properly. The child needs a rich verbal environment during the acquisition period.
- Nature or nurture? Nature triggers off the behaviour, and lays down the framework, but careful nurture is needed for it to reach its full potential. Language is natural behaviour, but it still has to be carefully nurtured in order to reach its full potential.

2. iii. c) Early word learning

Although children eventually make use of complex social and linguistic cues to disambiguate word meaning, research suggests that they might not be able to recruit all these types of input from the outset. At first, they focus on perceptual salience as the main source of word

meaning. Even with this narrow focus, two competing theoretical models propose distinct mechanisms for the acquisition of first words: cross-situational models and single-hypothesis models. We know that children, as master statisticians, can segment the fluid stream of sounds and events into coherent units. We even have some purchase on the mapping problem, which is compounded in the case of verbs and other relational and abstract words. Future research will surely continue to explore the mapping problem, but must do so in a way that nests the problem in a developmental and ecological framework. Gone are the days when researchers could seek simplistic single-mechanism answers to the 'how' of lexical development. Any future solutions must embrace the complexity of the problem, including multiple inputs (i.e., linguistic and non-linguistic), as well as the child's contribution in segmentation, symbolization, and the changes to mapping processes that occur over time. In short, the problems that plagued Plato remain contentious today; and P. Bloom was right – word learning is not a simple matching of word to world, but rather a window onto a multipronged cognitive problem.

3. Abello-Contesse, C. (2009). Age and the critical period hypothesis. *ELT Journal, 63*(2), 170-172.

In the field of second language acquisition (SLA), how specific aspects of learning a non-native language (L2) may be affected by when the process begins is referred to as the 'age factor'. Because of the way age intersects with a range of social, affective, educational, and experiential variables, clarifying its relationship with learning rate and/or success is a major challenge.

There is a popular belief that children as L2 learners are 'superior' to adults, that is, the younger the learner, the quicker the learning process and the better the outcomes. Nevertheless, a closer examination of the ways in which age combines with other variables reveals a more complex picture, with both favourable and unfavourable age-related differences being associated with early- and late-starting L2 learners.

The CPH is a particularly relevant case in point. This is the claim that there is, indeed, an optimal period for language acquisition, ending at puberty. However, in its original formulation (Lenneberg 1967), eviden-

ce for its existence was based on the relearning of impaired L1 skills, rather than the learning of a second language under normal circumstances. Furthermore, although the age factor is an uncontroversial research variable extending from birth to death, and the CPH is a narrowly focused proposal subject to recurrent debate, ironically, it is the latter that tends to dominate SLA discussions, resulting in a number of competing conceptualizations. Thus, in the current literature on the subject, references can be found to (i) multiple critical periods (each based on a specific language component, such as age six for L2 phonology), (ii) the nonexistence of one or more critical periods for L2 versus L1 acquisition, (iii) a 'sensitive' yet not 'critical' period, and (iv) a gradual and continual decline from childhood to adulthood.

It therefore needs to be recognized that there is a marked contrast between the CPH as an issue of continuing dispute in SLA, on the one hand, and, on the other, the popular view that it is an invariable 'law', equally applicable to any L2 acquisition context or situation. In fact, research indicates that age effects of all kinds depend largely on the actual opportunities for learning which are available within overall contexts of L2 acquisition and particular learning situations, notably the extent to which initial exposure is substantial and sustained.

Thus, most classroom-based studies have shown not only a lack of direct correlation between an earlier start and more successful/rapid L2 development but also a strong tendency for older children and teenagers to be more efficient learners. For example, in research conducted in the context of conventional school programmes, Cenoz (2003) and Muñoz (2006) have shown that learners whose exposure to the L2 began at age 11 consistently displayed higher levels of proficiency than those for whom it began at 4 or 8. Furthermore, comparable limitations have been reported for young learners in school settings involving innovative, immersion-type programmes, where exposure to the target language is significantly increased through subject-matter teaching in the L2.

In sum, more mature learners are usually capable of making faster initial progress in acquiring the grammatical and lexical components of an L2 due to their higher level of cognitive development and greater analytical abilities.

In terms of language pedagogy, it can therefore be concluded that (i) there is no single 'magic' age for L2 learning, (ii) both older and

younger learners are able to achieve advanced levels of proficiency in an L2, and (iii) the general and specific characteristics of the learning environment are also likely to be variables of equal or greater importance.

4. Bylund, E. et al. (2021). Age of acquisition – not bilingualism – is the primary determinant of less than nativelike L2 ultimate attainment. *Bilingualism: Language and Cognition, 24,* 18-30.

A classic topic in the field of SLA, and the cognitive sciences at large, concerns the role of age of acquisition for nativelike attainment in a second language (L2). Since Lenneberg's (1967) formulation of the Critical Period Hypothesis (CPH), well over a hundred studies have sought to ferret out the effects that timing of exposure exerts on L2 acquisition, showing that those who start learning the L2 in childhood in the long run outperform those who start in adulthood. As classic a topic as age of acquisition effects is, it is also highly controversial, having instigated vigorous discussions throughout the decades. The debate has largely focused on the ultimate cause of age effects – that is, whether they are biological, experiential, socio-psychological, cognitive, etc. in nature – rather than on their actual existence.

Recently, however, the finding that individuals who acquired the L2 during childhood do not always converge fully with native speakers has called into question age of acquisition as the cause of such near-native (rather than fully nativelike) attainment. As an alternative explanation, it has been suggested that, rather than age of acquisition, bilingualism – in the sense of either bilingual acquisition, bilingual use, or both – accounts for the subtle non-native features in early-learner ultimate attainment, and, by inference, also the near-nativeness of exceptionally advanced adult L2 learners. This suggestion relates to the fact that most studies on nativelike attainment compare L2 speakers who have retained their first language (L1), and therefore are functionally bilingual, with native speakers who are functionally monolingual, thus effectively confounding age of acquisition effects with bilingualism effects.

The methodological practice of comparing bilingual L2 speakers with monolingual L1 speakers becomes particularly problematic in the

light of frameworks suggesting that the linguistic behavior of bilinguals inherently differs from that of monolinguals, as this may ultimately render any observations on age effects inconclusive. However, despite various iterations of the notion of bilingualism effects on L2 ultimate attainment, few studies have actually attempted to address this question empirically. Thus, while it is indeed an intriguing possibility that bilingualism, rather than age of acquisition, underlies the subtle non-nativelikeness of many childhood (as well as exceptionally advanced adult) learners, this suggestion largely remains at the level of speculation due to the absence of solid empirical data.

4. i. The nativelikeness paradigm in CPH research

The notion that biologically scheduled changes in brain plasticity underlie child-adult differences in L2 ultimate attainment would seem to find support in research showing that non-maturational variables such as length of L2 exposure, educational level, and motivation, while important in (especially adult) L2 acquisition, only exert marginal impact compared to age of acquisition (AoA). Indeed, studies have repeatedly shown that the contributions of experiential and socio-psychological variables drop considerably (often to non-significant levels) when the AoA variable is partialled out, whereas the impact of AoA remains strong and relatively unaffected when the contributions from these variables are removed. To this end, then, the maturation of the brain would still seem a strong explanatory candidate for AoA effects. However, despite some promising explanatory frameworks, such as the scheduled process of myelination of language-related cortical areas or the age-related switch from (predominantly) implicit/procedural memory to (predominantly) explicit/declarative memory in language development, any operationalizable neurophysiological correlates to maturation that can be closely associated with AoA are still lacking.

Therefore, an alternative way of addressing the impact of maturational constraints has been to look exclusively for individual counterexamples to the hypothesis that only child learners are capable of attaining nativelike L2 proficiency and behavior. We refer to this approach as the 'nativelikeness paradigm'. If at least one such individual post-critical period learner could be identified who, even after broad and detailed

scrutiny, can be shown to exhibit the same linguistic knowledge and behavior as native speakers, then the CPH can be safely rejected, and the well-documented average adult disadvantage should instead be ascribed to factors other than neurobiology.

Long (1990, 1993) moreover recommended that researchers should use only linguistic tasks and structures that highly advanced learners potentially do not command; that the level of cognitive demand, item difficulty, and linguistic scrutiny in nativelikeness studies should be significantly higher than in studies of beginner or intermediate L2 proficiencies; and that a broad range of language abilities (rather than narrowly selected linguistic features of a limited language domain) should be scrutinized in these learners' ultimate attainment.

A project from the Stockholm lab aimed to follow Long's (1990, 1993) recommendations as closely as possible. The focus was set exclusively on L2 speakers who passed for native speakers in everyday oral interaction, the rationale being that there is no point in subjecting obviously non-nativelike speakers to extensive linguistic scrutiny just to declare them non-nativelike. A total of 195 candidates, who self-reported as potentially nativelike L2 speakers of Swedish (AoA 1–47 y/o), were first screened through naïve native listener judgments of their spontaneous speech. Out of these, 41 speakers were eventually selected, all of whom were perceived as native speakers by a majority of the judges (minimally 6 out of 10), and were subjected to detailed linguistic scrutiny through a challenging test battery. Thirty-one of these were early learners (AoA 1–11 y/o), and ten were late learners (AoA 13–19 y/o).

The results revealed that every late (seemingly nativelike) learner, and many of the early learners, were in fact near-native (as opposed to nativelike) when scrutinized in detail.

That brain maturation is a potential cause of childhood learners' less than nativelike L2 ultimate attainment, is not, however, an interpretation that has been embraced by everyone. Instead, results have been reinterpreted by several scholars as evidence that bilingualism, not maturation, is what lies behind the less than nativelike ultimate attainment of both early and exceptionally advanced late learners.

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4. ii. Monolingual bias, bilingualism effects, and the 'bi/multilingual turn' in CPH research

The status of the L2 learner's L1, and the role of cross-linguistic influence generally, has fluctuated considerably over time in SLA theory building. From having been given an absolute role under the behaviorist (pre-modern SLA) era, via a next to negligent role during the first decades of interlanguage theory development and (mainly) nativist SLA, learners' L1 and their bilingualism at large have been gradually resurrected as central components in recent (notably, connectionist/emergentist) SLA theorizing. Several modern-day cognitivist theorists would argue that the successive, age-related entrenchment of the L1 and/or the active use of two languages are the major reasons why nativelike L2 competence and behavior are not attained.

Accordingly, the theoretical account currently gaining interpretative prerogative in the CPH debate holds that less than nativelike ultimate attainment is to be expected even in very advanced (be it early or late) L2 learners, simply because non-monolingual-likeness in terms of proficiency /.../ is a defining characteristic of bilingualism. In line with Grosjean's (1989) statement that the bilingual is not two monolinguals in one person, various theoretical approaches to SLA, such as the Multicompetence framework (e.g., Cook, 1991, 2003, 2016), the Competition Model (e.g., MacWhinney, 1999, 2016), the Speech Learning Model (e.g., Flege, 1999), and the Interference Hypothesis (Pallier, Dehaene, Poline, LeBihan, Argenti, Dupoux & Mehler, 2003; Ventureyra, Pallier & Yoo, 2004), all point to the inherent difference between monolingual competence and the unique linguistic competence that emerges from the existence of two language systems in one mind.

Because of coactivation and bidirectional effects, neither the first nor the second language of bilinguals can be expected to resemble under scrutiny that of monolinguals in either language, thus making it unreasonable to hold up a standard of 'across-the-board monolingual nativelikeness' in the L2 as a criterion for falsifying the CPH". In a similar fashion, it is held that the linguistic repertoires of mono- and bilinguals differ by definition and differences in the behavioural outcome will necessarily be found, if only one digs deep enough.

Consequently, and in line with what has been launched as "the bi/multilingual turn in SLA", the very comparison with monolingual

speakers has been deemed theoretically misguided and it has been recommended that it should be abandoned in CPH (or, even, all SLA) research; since 'nativelike' is considered synonymous with 'monolingual-like', the expected maximal 'bilingual-like' ultimate attainment should be equivalent to what has hitherto been (mis)taken for 'near-native' proficiency, regardless of learners' AoA. Accordingly, it has been suggested that the comparative standard should be shifted from monolingual language proficiency to the simultaneously acquired bilingual ultimate attainment of 'crib bilinguals'.

That bilingualism, rather than brain maturation, might be the best candidate for explaining any subtle differences between native and near-native ultimate attainment is indeed a theoretically intriguing hypothesis that, in our view, merits thorough empirical testing. When considering the past decades' explosion of research suggesting that bilingualism brings about cognitive advantages (in terms of divergent thinking, enhanced executive control, delayed symptoms of dementia, etc.), as well as linguistic costs (particularly in terms of a so-called bilingual lexical deficit), the hypothesis seems well-motivated. However, the widespread reliance on this research is actually what constitutes the core problem of the current CPH debate, as the bilingualism-effects argument largely rests on indirect inferencing from non-CPH/non-ultimate attainment research.

To begin with, it should be noted that the bilingual cognitive advantage has been seriously challenged, showing that there is no robust evidence of enhanced executive functioning in bilinguals. Secondly, and more importantly for the current argument, the majority of studies claiming to show a lexical deficit in bilinguals have actually ignored the AoA dimension or disregarded the crucial distinction between simultaneous and sequential bilingualism. Because of this, it is notoriously difficult to tell whether the lexical behavior attested in those bilingual samples is an artefact of bilingualism or L2 status.

Indeed, a recent study showed that when AoA is taken carefully into account, the alleged bilingual lexical deficit turns out to predominantly be an L2 effect. Taken together, these findings seriously undermine several assumptions on which arguments of bilingualism effects rest.

From O'Grady & Archibald (2016: 371)

There have been several documented cases of what has become known as *foreign accent syndrome*, in which people have been known to suddenly acquire what sounds like a non-native accent. A British English speaker, for example, may start to sound as if they have a Spanish accent. Or an American English speaker may acquire a British accent. The cases all result from underlying brain damage (from a stroke or some sort of cerebral trauma), but it appears that there is no one brain area that is related to this syndrome. In 2006, the *Journal of Neurolinguistics* (vol. 19, no. 5) devoted an entire issue to this subject.

5. Carroll, D. W. (2008). *Psychology of Language* (5th ed.). Thomson Wadsworth. pp. 326-329.

The effect of experience on human nature has been a source of fascination for philosophers, psychologists, and laypeople for centuries. It is most commonly expressed nowadays in terms of the familiar heredity-versus-environment or nature-versus-nurture arguments. What is most responsible for our knowledge and behavior: our biological predispositions or the shaping done by our environments? These arguments have typically evoked passionate reactions and, not uncommonly, extreme positions, and this is no less true of language than of other aspects of behavior.

Rather than pit nature against nurture, however, it might be more productive to begin by looking at the language environment into which children are born and then assess to what extent the acquisitions can be accounted for in environmental terms. Many questions are related to the role of the environment in language acquisition: Is exposure to language needed for language acquisition? Does the exposure have to be within a particular time frame? What types of language input are most useful?

5. i. Feral and isolated children

5. i. a) Victor

The first question has been addressed through studies of feral and isolated children. Feral children are those who have grown up in the

wild. Lane (1976) presents a detailed description and analysis of a boy named Victor, who was found in the woods of France in 1797. Peasants spotted the boy running naked through the woods, searching for potatoes and nuts, and he was subsequently captured by some hunters and brought to civilization. They called him the Wild Boy of Aveyron, after the province in which he was found.

The Wild Boy came to the attention of Jean-Marc-Gaspard Itard, a young physician. At the time of his capture, Victor was thought to be about 12 or 13 years old. He had no speech, although his hearing was normal and he uttered some sounds. Other physicians thought that Victor was hearing-impaired and disabled, but Itard was optimistic that he could be trained to be socialized and to use language. Itard worked intensively with Victor for 5 years, using techniques of language training and behavior modification similar to those used by modern researchers (Skinner, 1957). For example, he taught Victor to name objects such as milk by presenting the object and then the French word for it. Victor would name objects that were presented but would not request them by using their names.

Victor had other problems with language. One was that he developed a gestural communication system that interfered with the language training. Lane (1976) suggests that the signs might have supplanted his need to acquire spoken language. Another problem was Victor's understanding of words. Victor associated a particular name with a particular object, rather than with a class of objects. For instance, when taught the word for *book*, he initially applied it to only one book. Only with considerable effort could Itard teach Victor to generalize names for classes of objects.

Itard devoted five years to Victor. Near the end of that period, he tried once again to teach the boy to speak. These attempts failed too; soon afterwards Itard decided to end his work with Victor. He arranged for Victor to live in a house with Madame Guérin. Victor lived there for 18 years, continuing to be mute until his death in 1828 at the age of about 38. The excellent movie, *The Wild Child*, (its original French title is *L'Enfant Sauvage*), made by François Truffault in 1969, portrays the story of Itard and Victor.

In general, Victor's language progress was poor. There are several competing explanations for this fact. Some observers believed that

Itard's techniques were defective and that Victor might have acquired more language if given better instruction. Others embraced the hypothesis that Victor was past the critical period for language acquisition. This view holds that exposure to language must occur within a specified time period (for example, by puberty) in order for language to be acquired normally. Although no one is sure, Victor was believed to be about 16 years old when Itard's training began. Finally, some scholars believe that Victor was either disabled or autistic from the beginning and that he was perhaps abandoned in the woods for that reason. Lane (1976) disputes the latter point, tending to agree with Itard's analysis that Victor was normal when born and that the symptoms he displayed were a consequence of his isolation in the wild.

5. i. b) Genie

Isolated children are those who grow up with extremely limited human contact. The best-documented case is of a child who experienced extreme social and physical isolation from 20 months of age until about age 13.5 years. The child is referred to in the scientific literature as Genie. At the time of her discovery, Genie was in a pitiful physical condition and appeared to have no language. Based on the information later provided by her mother, the girl had started to acquire language just prior to her confinement, when she was around 20 months of age. If Genie had learned to comprehend some basic elements of speech, she would have likely lost them after 12 years of living in silence.

Some understanding of Genie's family background is helpful. Despite the fact that her father was adamant about not having children, Genie's mother became pregnant 5 months into their marriage. Late in the pregnancy, the father-to-be viciously beat and tried to kill his wife. Later, after the child was born, the father kept her in the garage to avoid hearing her cry. The child died at 2.5 months of pneumonia and overexposure. A second child, a boy, was born the following year and died within 2 days. Another son was born 3 years later. The child's development was slow, and eventually his paternal grandmother took him into her home. Three years later Genie was born. She was average in birth weight but suffered from a congenital hip dislocation that required a splint. Pediatric check-ups for the next few months indicated essentially normal development, but by the 11th month – 6 months after the last checkup –

she weighed only 17 pounds. Shortly after that, she developed an acute illness that required her to be brought to another pediatrician, who indicated that she showed signs of possible retardation. This statement had tragic consequences, for it was used by Genie's father to justify extreme neglect and isolation on the grounds that he believed the child was profoundly disabled.

Curtiss (1977) reports the conditions under which Genie lived: "Genie was confined to a small bedroom, harnessed to an infant's potty seat. Genie's father sewed the harness himself; unclad except for the harness, Genie was left to sit on that chair. Unable to move anything except her fingers and hands, feet and toes, Genie was left to sit, tied-up, hour after hour, often into the night, day after day, month after month, year after year. At night, when Genie was not forgotten, she was removed from her harness only to be placed into another restraining garment – a sleeping bag which her father had fashioned to hold Genie's arms stationary (allegedly to prevent her from taking it off). In effect, it was a straitjacket. Therein constrained, Genie was put into an infant's crib with wire mesh sides and a wire mesh cover overhead. Caged by night, harnessed by day, Genie was left to somehow endure the hours and years of her life."

Genie had very little exposure to language during her imprisonment. Her father apparently did not speak to her, and he prevented other family members from entering the room. There was no TV or radio. The room was in the back of the house, so that Genie probably heard very little speech or noise from the street. Her father responded to her few sounds by beating her. Eventually she learned to suppress all vocalizations.

Genie was ultimately rescued, when she was 13.5 years old, by accident. After a violent argument with her husband, Genie's mother took Genie and escaped to her own mother's home. Shortly afterward, Genie's mother, who was almost blind, went to a family aid building to check into services for the blind. She brought Genie with her, and a worker noticed the frail child and alerted her supervisor. After questioning the mother, they called the police, who took Genie into custody. After charges were filed against the family, Genie's father committed suicide.

At this point, Genie was severely undernourished and displayed almost no social skills. She had no language skills at all. After being pla-

ced in a program of language remediation, Genie began to show some language gains, but her development was uneven. Phonologically, she showed signs of using intonation appropriately but also many substitutions of speech sounds. Her semantic development was rapid and extensive. She began acquiring vocabulary within 2 months of entering the hospital, and her first words included a wider variety of concepts than that typically found early in language development (for example, words for colors and numbers). Once she began putting words together, she used semantic relations similar to those found in normal children. However, her syntactic development was slow. She displayed few grammatical morphemes and no complex syntactic devices (for example, relative clauses). What she did was to string together content words with little grammatical structure, albeit with relatively clear meaning, as in the sentence: *I like hear music ice cream truck*. Her cognitive development appeared to be well in advance of her language development, because she sometimes expressed subtle or complex ideas with rudimentary syntax, as in the sentence: *Think about Mama love Genie*. A puzzling aspect of Genie's language development was that she appeared to process language in the right hemisphere, even though she was right-handed and had no discernible damage to the left hemisphere. Ordinarily, right-handed individuals process language principally in the left hemisphere. Curtiss and her colleagues (1974) speculate that Genie's left hemisphere might have suffered "functional atrophy" from lack of use, forcing her to acquire language with the right hemisphere.

Genie's language learning was studied for about eight years, after which time she made little progress. Her language ability, both in terms of understanding and production, remained well below normal and her speech continued to be ungrammatical. Genie, like Victor, was not able to acquire a normal level of language despite receiving a great amount of care, attention, instruction, and linguistic input. Genie was finally placed in a nursing facility. This was the end of the scientific collection of data on Genie's linguistic or other development.

Although there are many other reports of feral or isolated children, the cases of Genie and Victor are representative. It is clear from these two instances that the overall prognosis for acquiring language after prolonged isolation from other humans is quite bleak. Given the

extreme circumstances of their early years, it is perhaps remarkable that they were able to do as well as they did.

5. ii. Two major factors governing language learning

In reviewing the details of the cases of Victor and Genie (and other such cases) we can identify two major factors that could have operated to influence their varying success in language learning. These relate to exposure to language and the extent of non-linguistic trauma: (1) the age at which exposure to language began, and (2) the extent of any physical, psychological, and social trauma prior to exposure to language.

As far as Victor is concerned, we do not know why he had been roaming alone in the wild, nor do we know whether he had experienced any language prior to his capture. It may be that for most, or all, of the estimated 11 or so years of his life, his exposure to language and to ordinary human life had been minimal. However, he could have had some exposure to language before his abandonment. But why he was abandoned will never be known, although there is the possibility that he could have been regarded as disabled. He could not have been, for, at least average or better intelligence is necessary for one to be able to survive in the wild. Barring the unlikelihood of his being raised by animals, Victor must have been raised by humans, at least in infancy, for some period of time. Because we have no information regarding such crucial circumstances, there is no way we can state with any assurance why Victor was not able to attain full competence in speech or written language. Whether Victor was or was not normal at birth is something that we shall never know.

Lenneberg (1967: 142) was undoubtedly correct when he said, "In the absence of information on such a point, virtually no generalization may be made with regard to human development".

5. iii. Why did Genie not progress more than she did?

Genie, at 13 years, was about Victor's age (11 or 12 years) before she was exposed to language. Nevertheless, despite over 11 years of isolation, she was able to develop a much higher level of language than Victor; her achievement was mainly in the area of speech comprehension. Genie's accomplishment in this respect establishes that, if there is a critical

age for acquiring the fundamentals of a first language, i.e. grammatical structures, grammatical rules, and vocabulary, the limiting age cannot be very young, for Genie was over 13 years old when she began to learn language.

However, there is still some controversy over Genie's accomplishments. Although Curtiss, after years of collecting data on Genie, concludes, "She had a clear semantic ability but could not learn syntax," other researchers disagree. Jones (1995) argues that inconsistencies in the presentation of the data on Genie call into question the exact extent of her progress in acquiring English syntax. Yet Genie's attained level of speech comprehension was significant. It is certainly beyond that which would be expected if there really were a critical age for the learning of syntax.

That Genie's speech production ability was faulty in terms of pronunciation may be related to factors that operate in the learning of second-language pronunciation by ordinary people, where it has been found that the ability to control certain muscles of the body, in particular the articulators of speech (the tongue, mouth, vocal cords, etc.), generally begins to decline around 10 to 12 years of age. The fact that Genie had not used speech from infancy until she was 13 years old probably put her at a greater disadvantage than would be the case for a typical second-language learner of the same age. At least the ordinary second-language learner would, in using his or her first language, have had the benefit of exercising the articulators of speech for over a decade. Then, too, we cannot be sure that Genie's poor speech ability was not the result of some negative psychological influence due to her long mistreatment.

In any case, to rely only on the cases of Victor and Genie to make a case for critical age is surely not warranted. There are too many unknown factors. Clearly, the ideal experimental situation for studying the problem of a critical age for first language learning has not presented itself. Language deprivation experiments have been claimed to have been attempted at least four times through history, isolating infants from the normal use of spoken or sign language in an attempt to discover the fundamental character of human nature or the origin of language. This kind of research study is called the "forbidden experiment" because of the exceptional deprivation of ordinary human contact it requires. Although not designed to study language, similar experiments on

non-human primates (labelled the "the pit of despair") utilising complete social deprivation resulted in serious psychological disturbances. Let us hope for the sake of some poor child that a language deprivation experiment will not be conducted.

6. Lightbown, P. M., & Spada, N. (2021). *How Languages are Learned* (5th ed.). Oxford University Press. pp. 38-45.

6. i. Learner characteristics

By definition, all second language learners, regardless of age, have already acquired at least one language. This prior knowledge may be an advantage in the sense that they have an idea of how languages work. On the other hand, knowledge of other languages can lead learners to make incorrect guesses about how the second language works, and this may result in errors that first language learners would not make.

Very young language learners begin the task of first language acquisition without the cognitive maturity or metalinguistic awareness that older second language learners have. Although young second language learners have begun to develop these characteristics, they will still have far to go in these areas, as well as in the area of world knowledge, before they reach the levels already attained by adults and adolescents. On the one hand, cognitive maturity and metalinguistic awareness allow older learners to solve problems and engage in discussions about language. This is particularly important for those who are learning language in a classroom, with limited time in contact with the language. On the other hand, some theorists have suggested that the use of these cognitive skills — so valuable for many kinds of tasks — actually interfere with language acquisition. They argue that successful language acquisition draws on different mental abilities, abilities that are specific to language learning. It has been suggested that older learners draw on their problem-solving and metalinguistic abilities precisely because they can no longer access the innate language acquisition ability they had as young children.

In addition to possible cognitive differences, there are also attitudinal and cultural differences between children and adults. Most child learners are willing to try to use the language – even when their proficiency is quite limited. Many adults and adolescents find it stressful when

they are unable to express themselves clearly and correctly. Nevertheless, even very young (pre-school) children differ in their willingness to speak a language they do not know well. Some children happily chatter away in their new language; others prefer to listen and participate silently in social interaction with their peers.

6. ii. Learning conditions

Young second language learners are often allowed to be silent until they are ready to speak. They may also practice their second language in songs and games that allow them to blend their voices with those of other children. Older second language learners are often forced to speak from the earliest days of their learning, whether to meet the requirements of classroom instruction or to carry out everyday tasks such as shopping, medical visits, or job interviews.

Another way in which younger and older learners may differ is in the amount of time they can actually spend learning a second language. We know that first language learners spend thousands of hours in contact with the language or languages spoken around them. Young second language learners may also be exposed to their second language for many hours every day — in the classroom, on the playground, or in front of the television. Older learners, especially students in foreign language classrooms, receive far less exposure — perhaps only a few hours a week. Indeed, a typical foreign language student will have no more than a few hundred hours of exposure, spread out over a number of years. Adult learners who are immigrants or minority language speakers often continue to use the language they already know as they fulfill their daily responsibilities for work and family, and they may use the second language only in limited situations.

Classroom learners not only spend less time in contact with the new language, they also tend to be exposed to a far smaller range of discourse types. For example, classroom learners are often taught language that is somewhat formal in comparison to the language as it is used in most social settings. In many foreign language classes, teachers may even switch to their students' first language for discipline or classroom management, thus depriving learners of opportunities to experience uses of the language in real communication.

Parents tend to respond to the meaning rather than to the grammatical accuracy of their children's language. Similarly, in second language learning outside classrooms, errors that do not interfere with meaning are usually overlooked. Most people would feel they were being impolite if they interrupted and corrected someone who was trying to have a conversation with them. Nevertheless, interlocutors may react to an error if they cannot understand what the speaker is trying to say. Thus, errors of grammar and pronunciation may not be remarked on, but the wrong word choice may receive comment from a puzzled interlocutor. In a situation where a second language speaker appears to use inappropriate language, interlocutors may feel uncomfortable, not knowing whether the speaker intends to be rude or simply does not know the polite way to say what is intended. In this case too, especially between adults, it is unlikely that the second language speaker would be told that something had gone wrong. The only place where feedback on error is typically present with high frequency is the language classroom. Even there, it is not always provided consistently.

One condition that appears to be common to learners of all ages is exposure to modified or adapted input. This adjusted speech style has sometimes been called *foreigner talk* or *teacher talk* depending on the contexts of second language acquisition. Some people who interact regularly with language learners seem to have an intuitive sense of what adjustments they need to make to help learners understand. Of course, not everyone knows what adjustments will be most helpful.

6. iii. Studying the language of second language learners

We have seen that children's knowledge of the grammatical system of their first language is built up in predictable sequences. For example, grammatical morphemes such as the *-ing* of the present progressive or the *-ed* of the simple past are not acquired at the same time, but in a sequence. Are there developmental sequences for second language acquisition? How does the prior knowledge of the first language affect the acquisition of the second (or third) language? How does instruction affect second language acquisition? Are there differences in the development of learners whose only contact with the new language is in a classroom and those who use the language in daily life? These are some of the questions researchers have sought to answer.

Knowing more about the development of learner language helps teachers to assess teaching procedures in the light of what they can reasonably expect to accomplish in the classroom. Some characteristics of learner language can be quite perplexing if one does not have an overall picture of the steps learners go through in acquiring the second language. Of course, teachers analyse learner language all the time. They try to determine whether students have learned what has been taught and how closely their language matches the target language. But progress cannot always be measured in these terms. Sometimes language acquisition progress is reflected in a decrease in the use of a correct form that was based on rote memorization or chunk learning. New errors may be based on an emerging ability to generalize a particular grammatical form beyond the specific items with which it was first learned. In this sense, an increase in error may be an indication of progress.

Teachers and researchers cannot read learners' minds, so they must infer what learners know by observing what they do. Like those who study first language acquisition, we observe learners' spontaneous language use, but we also design procedures that help to reveal more about the knowledge underlying their observable use of language. Without these procedures, it is often difficult to determine whether a particular behaviour is representative of something systematic in a learner's current language knowledge or simply an isolated item, learned as a chunk.

Like first language learners, second language learners do not learn language simply through imitation and practice. They produce sentences that are not exactly like those they have heard. These new sentences appear to be based on internal cognitive processes and prior knowledge that interact with the language they hear around them. Both first and second language acquisition are best described as developing systems with their own evolving rules and patterns, not simply as imperfect versions of the target language.

6. iv. Contrastive analysis, error analysis, and interlanguage

Until the late 1960s, people tended to see second language learners' speech simply as an incorrect version of the target language. According to the *contrastive analysis hypothesis* (*CAH*), errors were assumed to be the result of transfer from learners' first language. Detailed

analysis of learners' errors revealed, however, that not all errors made by second language learners can be explained in terms of first language transfer alone. A number of studies show that many errors can be explained better in terms of learners' developing knowledge of the structure of the target language rather than an attempt to transfer patterns of their first language. Furthermore, some of the errors are remarkably similar to those made by young first language learners.

The finding that many aspects of learners' language could not be explained by the CAH led a number of researchers to take a different approach to analysing learners' errors. This approach, which developed during the 1970s, became known as *error analysis* and involved detailed descriptions of the errors second language learners made.

The goal of this research was to discover what learners really knew about the language. When learners produce correct sentences, they may simply be repeating something they have already heard; when they produce sentences that differ from the target language, we may assume that these sentences reflect the learners' current understanding of the rules and patterns of that language. Error analysis differed from contrastive analysis in that it did not set out to predict errors. Rather, it sought to discover and describe different kinds of errors in an effort to understand how learners process second language data. Error analysis was based on the hypothesis that, like child language, second language learner language is a system in its own right – one that is rule-governed and predictable.

Larry Selinker (1972) gave the name *interlanguage* to learners' developing second language knowledge. Analysis of a learner's interlanguage shows that it has some characteristics influenced by previously learned languages, some characteristics of the second language, and some characteristics, such as the omission of function words and grammatical morphemes, that seem to be general and to occur in all interlanguage systems.

Interlanguages have been found to be systematic, but they are also dynamic, continually evolving as learners receive more input and revise their hypotheses about the second language. The path through language acquisition is not necessarily smooth and even. Learners have bursts of progress, then reach a plateau for a while before something stimulates further progress.

Selinker also coined the term *fossilization* to refer to the fact that some features in a learner's language seem to stop changing. This may be especially true for learners whose exposure to the second language does not include instruction or the kind of feedback that would help them to recognize differences between their interlanguage and the target language.

(B) Further reading and online resources:

1. Aitchison (2008). pp. 70-95; 115-169
2. Carroll (2008). pp. 249-351
3. Erard (2012)
4. Fernández & Cairns (2011). pp. 97-133
5. Fernández & Cairns (2018). pp. 457-705
6. Hartshorne, Tenenbaum & Pinker (2018)
7. Hulstijn (2006)
8. Lenneberg (1967)
9. Lightbown & Spada (2021)
10. Marinis (2003)
11. Menn (2017). pp. 263-315; 357-389
12. O'Grady & Archibald (2016). pp. 323-390
13. Purba (2018)
14. Scovel (1998). pp. 8-27
15. Spivey, McRae & Joanisse (2012). pp. 573-589
16. Steinberg, Nagata & Aline (2001). pp. 3-50; 124-144; 167-190
17. Steinberg & Sciarini (2006). pp. 3-37; 91-104; 121-138
18. Thomas (2010)
19. Traxler (2012). pp. 325-360

20. Psycholinguistics and Language Acquisition: Do They Correlate?
21. The linguistic genius of babies
22. Stephen Krashen's Theory of Second Language Acquisition
23. Starved, tortured, forgotten: Genie, the feral child who left a mark on researchers

(C) Key concepts:

acquisition	input	parentese
babbling	interlanguage	segmentation
CPH	isolated children	SLA
error analysis	L2	SLL
exposure	learning	telegraphic stage
feral children	morphemic stage	utterance
FLA	naming stage	vocabulary spurt
holophrastic stage	nature	vocalization
IDS	nurture	wug

(D) Discussion questions and activities:

1. What is the 'wug test'? What conclusions can be drawn from it? (see Aitchison 2008: 128-131; Carroll 2008: 288-290)

2. What is a child who has said the two-word utterance *"Joe see!"* trying to actually say (purpose of utterance)? In what developmental period would a child say such a thing? In what early speech stage would a child say such a thing?

3. Which concept is the odd one out? Explain:
a) naming b) holophrastic c) babbling d) morphemic

4. What are *holophrases*? Which stage of language production is this term relevant for and who used the term to explain the stage in question?

5. Would it be a mistake to say that children everywhere around the world seem to produce roughly comparable utterances at the two-word stage?

6. Which sentence would a child utter first in their life: *"She wanted a slice of bread."*; *"My horse fell."* or *"I streamed a movie yesterday."*? According to what three variables can the general order of acquisition be explained here? (see Steinberg & Sciarini 2006: 11-13).

7. What does this paragraph summarize?

> "Children who wish to talk about events need to be able to analyze what they observe to decompose scenes into constituent parts relevant to linguistic expressions in the language they happen to be learning. They have to work out ... how to talk about agent versus patient, location versus instrument, or beneficiary versus recipient. They must find out how to mark grammatical relations such as subject and object. And they must also learn how to indicate that the elements in a constituent (a noun phrase or predicate for instance) belong together, through agreement, adjacency, or both, depending on the language." (Traxler 2012: 356)

8. Chomsky compares the child to a miniature scientist who makes successive hypotheses to account for the data. What would be a major difference between a scientist and a child in terms of discarding hypotheses? Answer briefly using the following terms (not necessarily in this order): *residue*, *selective attention* and *inconsistency* (see Aitchison 2008).

9. How is it possible for children with low vision to acquire vocabulary? How do you think their vocabulary acquisition process compares to sighted children? How do you think it compares to hard of hearing children?

10. There are individual differences in language acquisition among children learning the same language, as well as among children acquiring different languages. What kinds of variation would one expect to observe? What kinds of variation would one not expect to observe?

11. What characteristics of the child's linguistic environment are important for language acquisition? What aspects are not important?

12. How might the language development of a child exposed to two languages in the home differ from that of a monolingual child? In what ways might their development be similar?

13. Explain the CPH in one sentence using the following terms (not necessarily in this order): *years, exposure, nurture, deficient, sensitive*.

14. Is the existence of feral children an argument for or against CPH?

15. Why have some feral children achieved the feat of speaking in a given language (although it might not be perfect) and some have

not at all? Can children deprived of language at a young age ever achieve target-like speaking abilities? (see Steinberg & Sciarini 2006: 91-103)

16. Are there any known cases of twins or siblings that may be considered relevant for answering the previous question?

17. Is there indeed a critical period? If so, is it the same for acquisition of phonology (target-like pronunciation), vocabulary, and syntax?

18. How would you summarize the differences between *language acquisition* and *language learning*?

19. What are the five hypotheses of Krashen's Theory of SLA? Discuss each one.

20. In which aspects are adults better language learners than children?

21. How would you approach errors made by learners in the EFL classroom?

22. Circle the correct option:

The behaviorist perspective of FLA states that:

a) there is an interplay between the innate learning ability of children and the correction they receive when making an error.

b) language acquisition requires a separate 'module' of the mind.

c) the quality and quantity of the language the child hears in the environment, as well as the reinforcement offered by others, shapes the child's language.

d) children are biologically programmed for language, and their language develops in the same way as any other biological function.

23. Lightbown & Spada (2021) revisit some popular ideas about language learning:

a) Language is mainly learned through imitation.

b) Parents should correct young children when they make grammatical errors.

c) Some people have a special talent for learning languages.

d) The most important predictor of success in SLA is motivation.

e) The earlier a second language is introduced in school programs, the greater the likelihood of success in learning.

f) Most of the mistakes that second language learners make are due to interference from their first language.

g) The best way to learn new vocabulary is through reading.
h) It is essential for learners to be able to pronounce all the individual sounds in the second language.
i) Teachers should present grammatical rules one at a time, and learners should practice each one before going on to another.
j) Learners' errors should be corrected as soon as they are made in order to prevent the formation of bad habits.
k) Classrooms are good places to learn about language but not for learning how to use language.

What are your thoughts on each idea? Read pp. 219-231 to compare your answers.

24. Activity (Lightbown & Spada 2021: 6-12; Steinberg, Nagata & Aline 2001: 11-27):

Grammatical morphemes

In the 1960s, several researchers focused on how children acquire grammatical morphemes in English. One of the best-known studies was carried out by Roger Brown and his colleagues and students. In a longitudinal study of language development, they found that grammatical morphemes were acquired in a similar sequence.

Task 1: Following the reading on this topic, put these grammatical morphemes in order of acquisition:

a) regular past *-ed* (she walk*ed*)
b) plural *-s* (two book*s*)
c) auxiliary *be* (he *is* playing)
d) present progressive *-ing* (Mommy runn*ing*)
e) *be* as copula (Mommy *is* happy)
f) irregular past forms (Baby *went*) — *baby goed
g) third person singular present simple *-s* (she run*s*)
h) possessive *-s* (Daddy*'s* hat)
i) articles *the/a*

In the context of the theory of three variables, why are progressive and the prepositions 'in' and 'on' learned earliest? Why is past irregular learned before past regular?

Negation

Children learn the functions of negation very early. That is, they learn to comment on the disappearance of objects, to refuse a suggestion, or to reject an assertion, even at the single word stage. However, as Lois Bloom's (1991) longitudinal studies show, it takes time for children to express them in sentences, using the appropriate words and word order.

Task 2: Following the reading on this topic, put these sentences in order of acquisition of negation in four stages:

a) I can't do it. He don't want it.

b) No. No cookie. No comb hair.

c) You didn't have supper. She doesn't want it. I don't have no more candies.

d) Daddy no comb hair. Don't touch that!

Questions

There is a remarkable consistency in the way children learn to form questions in English. For one thing, there is a predictable order in which the *wh*-words emerge. 'What' is generally the first *wh*-word to be used for questions. It is often learned as part of a chunk ('Whassat?') and it is some time before the child learns that there are variations of the form, such as 'What is that?' and 'What are these?' There is consistency in the sequence of acquisition of question words. Perhaps more surprising is the consistency in the acquisition of word order in questions. This development is not based on learning new meanings, but rather on learning different linguistic patterns to express new meanings that are already understood.

Task 3: Following the reading on this topic, put these questions in order of acquisition in five stages:

a) Can I go? Are you happy? Is the teddy is tired? Do I can have a cookie? Why you don't have one? Why you catched it?

b) Cookie? Mommy book? Where's Daddy? What's that?

c) Are these your boots? Why did you do that? Does Daddy have a box? Why the teddy bear can't go outside?

d) You like this? I have some?

e) Are you going to play with me? Do dogs like ice-cream?

25. Based on what you have read in this chapter, what can you conclude regarding whether environmental, cognitive, or innate factors are necessary or sufficient? Explain your answer.

26. What else might you want to know more about in context of what this Chapter deals with?

Chapter 6
Language, thought, and culture

(A) Readings:

1. Sapir, E. (1929). The Status of Linguistics as a Science. *Language, 5*(4), 207-214.

Language is becoming increasingly valuable as a guide to the scientific study of a given culture. In a sense, the network of cultural patterns of a civilization is indexed in the language which expresses that civilization. It is an illusion to think that we can understand the significant outlines of a culture through sheer observation and without the guide of the linguistic symbolism which makes these outlines significant and intelligible to society. Some day the attempt to master a primitive culture without the help of the language of its society will seem as amateurish as the labors of a historian who cannot handle the original documents of the civilization which he is describing.

Language is a guide to 'social reality'. Though language is not ordinarily thought of as of essential interest to the students of social science, it powerfully conditions all our thinking about social problems and processes. Human beings do not live in the objective world alone, nor alone in the world of social activity as ordinarily understood, but are very much at the mercy of the particular language which has become the medium of expression for their society. It is quite an illusion to imagine that one adjusts to reality essentially without the use of language and that language is merely an incidental means of solving specific problems of communication or reflection. The fact of the matter is that the 'real world' is to a large extent unconsciously built up on the language habits of the group. No two languages are ever sufficiently similar to be consi-

dered as representing the same social reality. The worlds in which different societies live are distinct worlds, not merely the same world with different labels attached.

The understanding of a simple poem, for instance, involves not merely an understanding of the single words in their average significance, but a full comprehension of the whole life of the community as it is mirrored in the words, or as it is suggested by their overtones. Even comparatively simple acts of perception are very much at the mercy of the social patterns called words than we might suppose. If one draws some dozen lines, for instance, of different shapes, one perceives them as divisible into such categories as 'straight', 'crooked', 'curved', 'zigzag' because of the classificatory suggestiveness of the linguistic terms themselves. We see and hear and otherwise experience very largely as we do because the language habits of our community predispose certain choices of interpretation.

For the more fundamental problems of the student of human culture, therefore, a knowledge of linguistic mechanisms and historical developments is certain to become more and more important as our analysis of social behavior becomes more refined. From this standpoint we may think of language as the *symbolic guide to culture.* In another sense too, linguistics is of great assistance in the study of cultural phenomena. Many cultural objects and ideas have been diffused in connection with their terminology, so that a study of the distribution of culturally significant terms often throws unexpected light on the history of inventions and ideas.

It is very encouraging that the psychologist has been concerning himself more and more with linguistic data. So far it is doubtful if he has been able to contribute very much to the understanding of language behavior beyond what the linguist has himself been able to formulate on the basis of his data. But the feeling is growing rapidly, and justly, that the psychological explanations of the linguists themselves need to be restated in more general terms, so that purely linguistic facts may be seen as specialized forms of symbolic behavior. The psychologists have perhaps too narrowly concerned themselves with the simple psycho-physical bases of speech and have not penetrated very deeply into the study of its symbolic nature. This is probably due to the fact that psychologists in general are as yet too little aware of the fundamental importance of

symbolism in behavior. It is not unlikely that it is precisely in the field of symbolism that linguistic forms and processes will contribute most to the enrichment of psychology.

It is very notable that philosophy in recent years has concerned itself with problems of language as never before. The time is long past when grammatical forms and processes can be naïvely translated by philosophers into metaphysical entities. The philosopher needs to understand language if only to protect himself against his own language habits, and so it is not surprising that philosophy, in attempting to free logic from the trammels of grammar and to understand knowledge and the meaning of symbolism, is compelled to make a preliminary critique of the linguistic process itself. Linguists should be in an excellent position to assist in the process of making clear to ourselves the implications of our terms and linguistic procedures. Of all students of human behavior, the linguist should by the very nature of his subject matter be the most relativist in feeling, the least taken in by the forms of his own speech.

All in all, it is clear that the interest in language has in recent years been transcending the strictly linguistic circles. This is inevitable, for an understanding of language mechanisms is necessary for the study of both historical problems and problems of human behavior. One can only hope that linguists will become increasingly aware of the significance of their subject in the general field of science and will not stand aloof behind a tradition that threatens to become scholastic when not vitalized by interests which lie beyond the formal interest in language itself.

Where, finally, does linguistics stand as a science? Does it belong to the natural sciences, with biology, or to the social sciences? There seem to be two facts which are responsible for the persistent tendency to view linguistic data from a biological point of view. In the first place, there is the obvious fact that the actual technique of language behavior involves very specific adjustments of a physiological sort. In the second place, the regularity and typicality of linguistic processes leads to a quasi-romantic feeling of contrast with the apparently free and undetermined behavior of human beings studied from the standpoint of culture. But the regularity of sound change is only superficially analogous to a biological automatism. It is precisely because language is as strictly socialized a type of human behavior as anything else in culture and yet be-

trays in its outlines and tendencies such regularities as only the natural scientist is in the habit of formulating, that linguistics is of strategic importance for the methodology of social science. Behind the apparent lawlessness of social phenomena there is a regularity of configuration and tendency which is just as real as the regularity of physical processes in a mechanical world, though it is a regularity of infinitely less apparent rigidity and of another mode of apprehension on our part. Language is primarily a cultural and social product and must be understood as such. Its regularity and formal development rest on considerations of a biological and psychological nature, to be sure. But this regularity and our underlying unconsciousness of its typical forms do not make of linguistics a mere adjunct to either biology or psychology. Better than any other social science, linguistics shows by its data and methods, necessarily more easily defined than the data and methods of any other type of discipline dealing with socialized behavior, the possibility of a truly scientific study of society which does not ape the methods nor attempt to adopt unrevised the concepts of the natural sciences. It is peculiarly important that linguists, who are often accused, and accused justly, of failure to look beyond the pretty patterns of their subject matter, should become aware of what their science may mean for the interpretation of human conduct in general. Whether they like it or not, they must become increasingly concerned with the many anthropological, sociological, and psychological problems which invade the field of language.

2. Whorf, B. L. (1959). *Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf.* The Technology Press of Massachusetts Institute of Technology and John Wiley & Sons. pp. 134-159.

There will probably be general assent to the proposition that an accepted pattern of using words is often prior to certain lines of thinking and forms of behavior, but he who assents often sees in such a statement nothing more than a platitudinous recognition of the hypnotic power of philosophical and learned terminology on the one hand or of catchwords, slogans, and rallying cries on the other. To see only thus far is to miss the point of one of the important interconnections which Sapir saw between language, culture, and psychology. It is not so much in these special uses of language as in its constant ways of arranging data

and its most ordinary everyday analysis of phenomena that we need to recognize the influence it has on other activities, cultural and personal.

One cannot study the behavioral compulsiveness of linguistic material without suspecting a much more far-reaching compulsion from large-scale patterning of grammatical categories, such as plurality, gender and similar classifications (animate, inanimate, etc.), tenses, voices, and other verb forms, classifications of the type of "parts of speech", and the matter of whether a given experience is denoted by a unit morpheme, an inflected word, or a syntactical combination. A category such as number (singular vs. plural) is an attempted interpretation of a whole large order of experience, virtually of the world or of nature; it attempts to say how experience is to be segmented, what experience is to be called "one" and what "several". But the difficulty of appraising such a far-reaching influence is great because of its background character, because of the difficulty of standing aside from our own language, which is a habit and a cultural *non est disputandum*, and scrutinizing it objectively. And if we take a very dissimilar language, this language becomes a part of nature, and we even do to it what we have already done to nature. We tend to think in our own language in order to examine the exotic language. Or we find the task of unraveling the purely morphological intricacies so gigantic that it seems to absorb all else. Yet the problem, though difficult, is feasible; and the best approach is through an exotic language, for in its study we are at long last pushed willy-nilly out of our ruts. Then we find that the exotic language is a mirror held up to our own.

In my study of the Hopi language, what I now see as an opportunity to work on this problem was first thrust upon me before I was clearly aware of the problem. The seemingly endless task of describing the morphology did finally end. Yet it was evident, especially in the light of Sapir's lectures on Navaho, that the description of the language was far from complete. I knew for example the morphological formation of plurals, but not how to use plurals. It was evident that the category of plural in Hopi was not the same thing as in English, French, or German. Certain things that were plural in these languages were singular in Hopi. The phase of investigation which now began consumed nearly two more years.

The work began to assume the character of a comparison between Hopi and western European languages. It also became evident that

even the grammar of Hopi bore a relation to Hopi culture, and the grammar of European tongues to our own "Western" or "European" culture. And it appeared that the interrelation brought in those large subsummations of experience by language, such as our own terms 'time','space', 'substance', and 'matter'. Since, with respect to the traits compared, there is little difference between English, French, German, or other European languages with the possible (but doubtful) exception of Balto-Slavic and non-Indo-European, I have lumped these languages into one group called SAE, or "Standard Average European".

That portion of the whole investigation here to be reported may be summed up in two questions: (1) Are our own concepts of 'time', 'space', and 'matter' given in substantially the same form by experience to all men, or are they in part conditioned by the structure of particular languages? (2) Are there traceable affinities between (*a*) cultural and behavioral norms and (*b*) large-scale linguistic patterns? I should be the last to pretend that there is anything so definite as "a correlation" between culture and language, and especially between ethnological rubrics such as 'agricultural, hunting', etc., and linguistic ones like 'inflected', 'synthetic', or 'isolating'. When I began the study, the problem was by no means so clearly formulated, and I had little notion that the answers would turn out as they did.

2. i. Plurality and numeration in SAE and Hopi

In our language, that is SAE, plurality and cardinal numbers are applied in two ways: to real plurals and imaginary plurals. Or more exactly if less tersely: perceptible spatial aggregates and metaphorical aggregates. We say 'ten men' and also 'ten days'. Ten men either are or could be objectively perceived as ten, ten in one group perception — ten men on a street corner, for instance. But 'ten days' cannot be objectively experienced. We experience only one day, today; the other nine (or even all ten) are something conjured up from memory or imagination. If 'ten days' be regarded as a group it must be as an "imaginary", mentally constructed group. Whence comes this mental pattern? From the fact that our language confuses the two different situations, has but one pattern for both. When we speak of 'ten steps forward, ten strokes on a bell', or any similarly described cyclic sequence, "times" of any sort, we are doing the same thing as with 'days'. Cyclicity brings the response of imaginary

plurals. But a likeness of cyclicity to aggregates is not unmistakably given by experience prior to language, or it would be found in all languages, and it is not.

Our awareness of time and cyclicity does contain something immediate and subjective: the basic sense of "becoming later and later". But, in the habitual thought of us SAE people, this is covered under something quite different, which though mental should not be called subjective. I call it objectified, or imaginary, because it is patterned on the outer world. It is this that reflects our linguistic usage. Our tongue makes no distinction between numbers counted on discrete entities and numbers that are simply "counting itself". Habitual thought then assumes that in the latter the numbers are just as much counted on "something" as in the former. This is objectification. Concepts of time lose contact with the subjective experience of "becoming later" and are objectified as counted quantities, especially as lengths, made up of units as a length can be visibly marked off into inches. A 'length of time' is envisioned as a row of similar units, like a row of bottles.

In Hopi there is a different linguistic situation. Plurals and cardinals are used only for entities that form or can form an objective group. There are no imaginary plurals, but instead ordinals used with singulars. Such an expression as 'ten days' is not used. The equivalent statement is an operational one that reaches one day by a suitable count. 'They stayed ten days' becomes 'they stayed until the eleventh day' or 'they left after the tenth day'. 'Ten days is greater than nine days' becomes 'the tenth day is later than the ninth'. Our "length of time" is not regarded as a length but as a relation between two events in lateness. Instead of our linguistically promoted objectification of that datum of consciousness we call 'time', the Hopi language has not laid down any pattern that would cloak the subjective "becoming later" that is the essence of time.

How does such a network of language, culture, and behavior come about historically? Which was first: the language patterns or the cultural norms? In main they have grown up together, constantly influencing each other. But in this partnership the nature of the language is the factor that limits free plasticity and rigidifies channels of development in the more autocratic way. This is so because a language is a system, not just an assemblage of norms. Large systematic outlines can change to something really new only very slowly, while many other cultural inno-

vations are made with comparative quickness. Language thus represents the mass mind; it is affected by inventions and innovations, but affected little and slowly, whereas to inventors and innovators it legislates with the decree immediate.

3. Traxler, M. J. (2012). *Introduction to Psycholinguistics: Understanding Language Science.* Wiley-Blackwell. pp. 21-27.

Although language and thought are not identical, that does not mean that they cannot influence each other. One of language's chief purposes is to express our thoughts; and the language we speak may also affect the way we think about and perceive the world. Before we had Commander Worf from Star Trek, psycholinguists, linguists, and philosophers looked to Benjamin Lee Whorf for inspiration. Whorf and his linguistics advisor, Edward Sapir, developed the idea that the language we speak influences the way we think. Their theory goes by different names, but let's call it *linguistic determinism*, which helps to highlight the idea that language drives thought, that the way we think is determined by the language we speak. This attitude is exhibited in social norms against using racist or sexist terms or expressions, the idea being that eliminating such expressions from the language will make the accompanying thoughts less likely to occur in people who hear the language. If a language lacks terms that refer in a derogatory way to classes of people, it will be difficult for speakers of that language to express those thoughts, so they will express other, more acceptable thoughts instead.

One of Whorf 's chief motivations in proposing linguistic determinism was an analysis of Eskimo-language vocabulary. Possibly based on Franz Boas' (1911) analysis of Eskimo, Whorf concluded that, where English has a single word *snow*, Eskimo languages have multiple words. Why does Eskimo have multiple words, where English has one? Whorf argued that Eskimos had more words for snow because they carved up the concept "snow" into multiple, distinct sub-concepts, assigning a different word to each different sub-concept. They would do this for the same reason that, if you have more than one child, you give them each a different name. You conceive of them as being separate individuals, and it would be unthinkable to call them all by the same name. But linguistic determinism really says more than this. It says that if your language

has many words for snow, you will be able to perceive differences between different kinds of snow that people whose language lacks those distinctions will *not* be able to see. That is, because you speak Eskimo, you see more different kinds of snow. Because I speak English, I cannot see the differences that you can.

In a devastating critique, Geoffrey Pullum, a linguist from Edinburgh, Scotland, knocked down two pillars of linguistic determinism: the contents of Eskimo vocabulary and the relationship between vocabulary and perception. First, Eskimo languages do *not* appear to have more words for snow than English does. "Eskimo has about as much differentiation as English does for 'snow' at the mono-lexemic [single-word] level: *snow* and *flake*. That these roots and others may be modified to reflect semantic distinctions not present in English is a result of gross features of Eskimo morphology [word form] and syntax [language structure] and not of lexicon [vocabulary]." He notes, "C. W. Schultz-Lorentzen's *Dictionary of the West Greenlandic Eskimo Language* (1927) gives just two possibly relevant roots: *qanik*, meaning 'snow in the air' or 'snowflake', and *aput*, meaning 'snow on the ground'". If Eskimo and English carve up the universe of snow into roughly the same number and kinds of categories, then language cannot be the source of any differences in the way speakers of Eskimo languages (Aleuts, Inuits, and Yupik) and speakers of other languages perceive the world. But even more seriously for linguistic determinism, there is no actual evidence one way or the other regarding the abilities of Eskimo-speakers and members of other language groups to perceive differences between different kinds of snow. We don't know for a fact that Aleuts, Inuits, and Yupik people have better or more sophisticated snow perception than the average New Yorker. Even if we assume that Eskimos have more words for snow, this language difference has not been shown to lead to a difference in perception. Both parts of linguistic determinism are in trouble.

Whorf provided no evidence that different groups of people perceive the world differently. Subsequent to Whorf, a number of researchers looked for evidence that speakers of different languages perceive the world in similar ways. They found some degree of success in the areas of emotion and color perception. In studies of emotion perception, people all over the world, from both industrialized and primitive cultures, recognize the same basic emotions in pictures that show happiness,

anger, and disgust. Different languages also characterize emotion using similar terminology, organized in analogous ways. Languages can have as few as two terms for emotions, and if they have only two, they will be the equivalents of *anger* and *guilt*. The next terms that will appear will be *amusement*, *alarm*, *adoration*, and *depression*. Languages that have more terms than these six will have all six. That is, no language has a word for *lonely* but not a word for *guilt*. Similar perception of emotional expressions (in pictures) and a consistent organization of emotional vocabulary across languages both point toward a shared conceptualization of human emotion across cultures, despite vast differences in both language and culture across speakers of different languages.

Color perception and color words work similarly to emotion. Most languages have seven or fewer basic color terms. Languages that have only two color terms will have rough equivalents to the English words *black* and *white*. The next term to appear will be *red*, followed by *yellow*, *green*, or both yellow and green. After that group, *blue*, *brown*, *purple*, *pink*, *orange*, and *gray* show up. No language has a term for *orange* that does not also have a term for *red*, just as no language has a term for *confused* unless it also has a word for *happy*. These similarities in color classification may reflect the fact that all people (minus the color-blind) have the same underlying physical mechanisms and processes for color perception. We all have three cone types that react to light, and these three cone types are connected into neural systems that place dark in opposition to light, yellow in opposition to blue, and green in opposition to red. Given identical anatomy and physiology across language groups, it is not surprising that we all perceive color in similar, if not identical, ways. Thus, in at least two areas of perception, the language a person speaks does not appear to dictate the way that person perceives the world.

As a result of concerns like those raised by Pullum, as well as studies showing that speakers of different languages perceive the world similarly, many language scientists have viewed linguistic determinism as being dead on arrival. Many of them would argue that language serves thought, rather than dictating to it. If we ask the question, what is language good for? — one of the most obvious answers is that language allows us to communicate our thoughts to other people. That being the case, we would expect language to adapt to the needs of thought, rather

than the other way around. If an individual or a culture discovers something new to say, the language will expand to fit the new idea (as opposed to preventing the new idea from being hatched, as the Whorfian hypothesis suggests). This anti-Whorfian position does enjoy a certain degree of support from the vocabularies of different languages, and different subcultures within individual languages. For example, the class of words that refer to objects and events (*open class*) changes rapidly in cultures where there are rapid technological or social changes (such as most Western cultures). The word *internet* did not exist when I was in college. The word *Google* did not exist 10 years ago. When it first came into the language, it was a noun referring to a particular web-browser. Soon after, it became a verb that meant "to search the internet for information." In this case, technological, cultural, and social developments caused the language to change. Thought drove language. But did language also drive thought? Certainly. If you hear people saying "Google," you are going to want to know what they mean. You are likely to engage with other speakers of your language until this new concept becomes clear to you. Members of subcultures, such as birdwatchers or dog breeders, have many specialist terms that make their communication more efficient, but there is no reason to believe that you need to know the names for different types of birds before you can perceive the differences between them.

3. i. Whorf makes a comeback

If my language does not have a ready-made word for a concept, perhaps my thought processes will be channeled toward concepts that are easily expressible. Alternatively, if my language has a ready-made word for a concept, I am more likely to be reminded of that concept as it appears in conversation. I am also less likely to be distracted or otherwise prevented from attending to a particular concept when my language has a ready-made label for that concept, compared to when reference to the concept has to be built up from other concepts that my language has labels for.

Linguistic determinism – the idea that the language you speak strongly limits the thoughts you are capable of thinking – has fallen out of favor in psychology and linguistics, but the idea that language affects thinking in less drastic ways has actually gained traction in the last de-

cade or so. Many theorists now believe that language can affect non-linguistic (non-language) perceptual and thought processes, so that speakers of one language may perform differently than speakers of other languages on a variety of perceptual and cognitive tasks. Chinese offers two such examples: counting skill and counterfactual reasoning. Consider the counting skill first.

Different languages express numbers in different ways, so language could influence the way children in a given culture acquire number concepts. Chinese number words differ from English and some other languages (e.g., Russian) because the number words for 11–19 are more transparent in Chinese than in English. In particular, Chinese number words for the teens are the equivalent of "ten-one," "ten-two," "ten-three" and so forth. This makes the relationship between the teens and the single digits more obvious than equivalent English terms, such as *twelve*. As a result, children who speak Chinese learn to count through the teens faster than children who speak English. This greater accuracy at producing number words leads to greater accuracy when children are given sets of objects and are asked to say how many objects are in the set. Chinese-speaking children performed this task more accurately than their English-speaking peers, largely because they made very few errors in producing number words while counting up the objects. One way to interpret these results is to propose that the Chinese language makes certain relationships more obvious (that numbers come in groups of ten; that there's a relationship between different numbers that end in the word "one"), and making those relationships more obvious makes the counting system easier to learn.

Pirahã offers a potentially more dramatic case of number terminology affecting cognitive abilities. Pirahã has no words that correspond to Arabic numerals (*one*, *two*, *three*, etc.). The terms that they do have for quantifying objects (*hói*, *hoí*, and *baágiso*; the little accent marks indicate vowels pronounced with a high tone) appear to be relational terms along the lines of "fewer" and "more." The lack of number words in the language does not prevent Pirahã speakers from perceiving that different sets of objects have different quantities of individual objects. Pirahã are able to match sets of different objects, such as spools of thread and balloons, based on the number of objects in each set. However, the lack of number terms does appear to affect Pirahã speakers' ability

to remember the exact quantity of different sets of items. If, for example, a number of objects is placed in a can, and objects are drawn from the can one at a time, Pirahã speakers are likely to make errors when they are asked to indicate when the can is empty. The likelihood of these errors increases as the number of objects in the can increases. So, when the task involves the direct perception of the objects involved, and does not require any type of memory, Pirahã do as well as anyone else. But when memory for objects is required, Pirahã speakers are at a disadvantage. Results like these may favor a "weak" form of linguistic determinism. Language does not affect perception directly, but language allows speakers to encode knowledge in a form that is relatively easy to maintain (it's easier to remember the sound "eight" than it is to maintain a picture in your head of exactly eight objects).

Despite their superior arithmetic abilities, it's not all sunshine and light for speakers of Chinese. They may have more difficulty than English speakers with counterfactual statements, again potentially because of characteristics of the Chinese language. Counterfactual statements are ways to express things that might have been, but did not happen. "Counterfactuals are thoughts of what might have been, of how the past might have turned out differently." Counterfactual reasoning is a useful tool in reasoning about events. Considering what might have happened had we acted differently is an important aspect of avoiding similar mistakes in the future. English has direct means of expressing counterfactuals (If x, ... would y ...), but Chinese does not. Chinese counterfactuals are expressed using less direct means. A Chinese speaker might state explicitly "John did not take linguistics" and then follow that statement by the past implicational statement "If he did, then he was excited about it" and the remark would again be accorded a counterfactual interpretation – i.e., be interpreted as roughly equivalent to the English "If he had taken linguistics, he would have been excited about it."

More recent research provides evidence that some aspects of color perception may not be present universally in the human species, contrary to claims made by members of the universalist school, such as Berlin and Kay. One recent study tested the ability of different groups of speakers to discriminate (notice the difference between) different shades of the color blue. In English, we can call royal blue, robin's egg blue, powder blue, sky blue, and midnight blue all "blue." While plain old

"blue" is less specific than any of these other terms, it is not *wrong* to call any of them blue. Russian works differently. Russian draws a mandatory distinction between light shades of blue, such as robin's egg blue and true blue, and dark shades of blue, such as royal blue. Lighter shades of blue are called голубой ("goluboy"). Darker shades of blue are called синий ("siniy"). It is wrong if you are speaking Russian to call powder blue "siniy" or to call royal blue "goluboy." As a result, when a Russian-speaker wishes to communicate about a blue-colored object, she must decide before she speaks whether the object falls into the light blue or dark blue category. Because color (hue) is a continuously varying characteristic, Russian speakers must impose a categorical organization on the world of blue things in order to talk about them. Different Russian speakers have slightly different boundaries between the "goluboy" and "siniy" categories, but they all make the distinction.

Does this language-imposed need to carve up blue into subcategories affect the way Russian speakers perceive the color blue? Some recent data suggest that it does. In previous experiments, researchers had shown that people can remember a particular color better if their language has a specific term for that color. These experiments were intended to show an effect of language on color perception and categorization, as per the Whorfian hypothesis. However, Pinker and others have criticized these experiments on the following grounds: They do not show that different languages cause people to perceive or categorize the world differently. Instead, they show that, if your language has a word for a color, you remember the word rather than the color, because verbal information is more stable and durable than visual information.

To summarize, research on the relationship between language and thought shows that the way your language works does not change the way you perceive the world — that is, it does not give you super-human perceptual abilities that other people can not have unless they speak your language — but it may make some cognitive tasks easier.

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4. Boroditsky, L. (2012). How the Languages We Speak Shape the Ways We Think: The FAQs. In M. J. Spivey et al. (Eds.), *The Cambridge Handbook of Psycholinguistics* (pp. 615-632). Cambridge University Press.

4. i. Why might the languages we speak shape the ways we think?

Humans communicate with one another using a dazzling array of languages, and each language differs from the next in innumerable ways (from obvious differences in pronunciation and vocabulary to more subtle differences in grammar). For example, I can tell you in English that "my brother and his seven children live in the blue house to the left of the big tree". In some languages it would be impossible for me to tell you about my brother without revealing whether he is older or younger than me (because there are only words for older brother and younger brother, not a generic word for brother). In other languages it would be most natural to specify simply that the person is a sibling, without revealing gender. In many languages there is no word meaning exactly seven, so instead one might say several or many. Some languages don't have a color word for blue: some distinguish only between dark and light, some have a color word that includes both blue and green, and others would require one to specify necessarily whether the house was dark blue or light blue. Many languages don't have words like *left*, and instead might require you to locate the house as southwest or volcanoward or uphill from the tree. And some languages don't have a generic superordinate word like *tree*, instead requiring speakers to specify the type of tree in each instance. And on and on.

In addition to these kinds of wide differences in vocabulary, languages differ in what kind of information is grammatically required. Let's take a (very) hypothetical example. Suppose you want to say, "Bush read Chomsky's latest book." Let's focus on just the verb, *read*. To say this sentence in English, we have to mark the verb for tense; in this case, we have to pronounce it like *red* and not like *reed*. In Indonesian you need not (in fact, you can't) alter the verb to mark tense. In Russian, you would have to alter the verb to indicate tense and gender. So, if it was Laura Bush who did the reading, you'd use a different form of the verb than if it was George. In Russian, you would also have to include in the verb information about completion. If George read only part of the book,

you would use a different form of the verb than if he had diligently plowed through the whole thing. In Turkish, you would have to include in the verb how you acquired this information. For example, if you had witnessed this unlikely event with your own two eyes, you'd use one form of the verb, but if you had simply read or heard about it, or inferred it from something Bush said, you'd use a different form of the verb.

Observations like these have led scholars to wonder whether speakers of different languages have to attend to and encode strikingly different aspects of the world in order to use their language properly. Do these quirks of languages affect the way their speakers think about the world? Do English, Mandarin, Russian, and Turkish speakers end up attending to, partitioning, and remembering their experiences differently simply because they speak different languages?

The idea that thought is shaped by language is most commonly associated with the writings of Benjamin Lee Whorf. Whorf, impressed by linguistic diversity, proposed that the categories and distinctions of each language enshrine a way of perceiving, analyzing, and acting in the world. Whorf asked, "are our own concepts of time, space, and matter given in substantially the same form by experience to all men, or are they partly conditioned by the structure of particular languages?" This question, often called the Whorfian question, has attracted much attention and controversy throughout the years. Some scholars have found the idea that different languages encapsulate different world views intuitive and compelling and have been happy to accept it without need of empirical evidence. Long before Whorf, Charlemagne the Holy Roman emperor proclaimed that "to have a second language is to have a second soul." One of his successors, Frederick the Great of Prussia, quipped, "I speak French to my ambassadors, English to my accountant, Italian to my mistress, Latin to my God and German to my horse." Others, however, have been much less enthusiastic about the idea of linguistic relativity.

There are, of course, many powerful and noncontroversial ways in which language acts on our thoughts and actions. With a few well-chosen syllables, it is possible to make a complete stranger laugh, blush, or give one a good solid sock on the nose. In its perfected form language can uplift, educate, and inspire. In more turbulent times, poignant words can incite revolutions and loose lips can sink ships. Other times we may

just want to say "pass the salt". In all of these cases, language causes real conceptual and physical outcomes, be they revolutions, broken noses, soggy ships, or seasoning. Further, an overwhelming proportion of what we know about the world outside of our direct physical experience we learn through the medium of language. The importance of these rather obvious influences of language on thought is generally overlooked in the literature, so it is worth spelling them out at least briefly.

Consider an analogy with visual perception. Our experience of aspects of the visual world like color and motion are fundamentally constrained by the physiology of the visual system. For example, humans generally have only three types of cones for perceiving color. This means that many physically different surfaces in the world will reflect light in a way that produces the same relative levels of excitation in our three cone types, and so will look the same to us. If our knowledge of these surfaces is limited to our visual experience with them, then our knowledge of their reflective properties will be fundamentally limited by the physiology of the color perception system.

The same is true in the case of language. Language, like the physiological underpinnings of visual perception, is a limited input channel. A very large proportion of what we know is communicated to us through language. Language is the main way in which contents of individual minds are transmitted across individuals, between groups and cultures, and through time. What information gets transmitted (or even what information can be transmitted) is necessarily constrained by the particular properties of the language being used.

As we saw in the examples cited earlier, different languages will incidentally communicate very different information about the world. In some languages, you would often learn more about the birth order of siblings, in others more specifics about numbers, colors, gender, local arborous species, or locations with respect to nearby volcanoes. Because so much of our knowledge of the world is learned through language (and often only through language), the particular aspects of the languages we use for communication can potentially exert a tremendous influence over the contents of our minds.

Of course, language is not the only source of information we have. We also receive tremendously rich streams of information from the

physical world, through our perceptual and motor systems, and we come to the learning problem equipped with some important skills and predispositions. Still, accompanying this rich stream of perceptual information is an ever-present stream of language. By the time infants are born, they have already learned a great deal about the sound properties and regularities of their language from the sound patterns that reached them in the womb. From the very beginning of life, linguistic and other perceptual information occurs concurrently and children are avidly learning and processing both at the same time.

Further, though the information we receive from the physical world is incredibly rich, we are able to attend to and process only a small fraction of that information. While we have the feeling of always having a complete and clear picture of the visual world, decades of research on attention have shown that this feeling is a grand illusion. We are really able to attend to only a very small number of elements at any given time. One way to think about language in this context is as an attentional guide. The aspects of the world encoded by language are those that generations of people before us have found useful to pay attention to. On this conception, each language functions as a culturally created guide to attention, a way of highlighting certain aspects of the world important within a culture. This suggests that if languages differ in interesting ways, then speakers of different languages may learn to attend to and encode different aspects of the world, even when confronted with the same physical stimuli.

There is, of course, an alternative view. Just because speakers of different languages talk differently, doesn't necessarily mean they think differently. It is possible for example, that speakers of all languages attend to and encode all the same things. Then, each language chooses some subset of those universally attended things to talk about. After all, just because speakers don't habitually encode some aspect of the world in their linguistic utterances doesn't mean that they don't attend to it non-linguistically. In this view, speakers of all languages attend to all the same things (logically, this would mean that all people attend to the set of all distinctions made by all the world's languages), and differ only in how they talk. This leads us to the second question: do speakers of different languages actually perceive, attend to, encode, and represent their worlds differently?

4. ii. Do people who speak different languages think differently?

In recent years, research on linguistic relativity has enjoyed a remarkable resurgence, and much new evidence regarding the effects of language on thought has become available. Some studies have been successful in finding cross-linguistic differences in thought, while others have failed to find differences. Cross-linguistic differences have been found in many of the most fundamental domains of thought including color perception, object categories, conceptions of shape, substance, events, and people's representations of motion, space, causality, time, and number.

I will draw on examples from space, color, and grammatical gender to illustrate three important ways in which languages shape thinking. First, I will describe work on spatial reference frames. This work reveals a remarkably deep set of cross-linguistic differences in spatial thinking, showing that practice with a particular language can equip one with cognitive abilities that seem amazing to speakers of other languages. Then I will describe work on the role of language in color discrimination. This work reveals that patterns in language are involved not only in very complex or high-level domains of thought, but also meddle in the very nuts and bolts of perceptual experience. Finally, I will describe work showing the influence of grammatical gender on representations of objects and other entities. This work demonstrates that grammatical features, even the seemingly arbitrary mandatory mechanics of language like grammatical gender, also have the power to shape people's thinking.

4. ii. a) Do speakers of different languages really think all that differently?

One example of really striking cross-linguistic differences comes from the domain of spatial reference. Languages differ dramatically in how they describe spatial relations. For example, in English, terms like *left* and *right* that define space relative to an observer are common (e.g., "the salad fork is to the left of the dinner fork"). Unlike English, some languages do not make use of terms like *left* and *right*, and instead rely on an absolute reference frame system to describe such relations. For example, Guugu Yimithirr (an Australian Aboriginal language), uses cardinal direction terms – roughly aligned with north, south, east, and west – to

define space. While English speakers also sometimes use cardinal direction terms, our use of them is restricted to large spatial scales. For example, English speakers do not say "the salad fork is to the east of the dinner fork". In languages like Guugu Yimithirr, no words like *left* and *right* are available, and absolute spatial reference is used at all scales. This means that Guugu Yimithirr speakers say things like "There's an ant on your southeast leg" or "The boy standing to the south of Mary is my brother". One obvious consequence of speaking such a language is that you have to stay oriented at all times, else you cannot speak the language properly. For example, the normal greeting in Kuuk Thaayorre (an Australian Aboriginal language with a roughly N/S/E/W absolute direction system) is "Where are you going?" and the answer ought to be something like "South-southeast, in the middle distance." If you don't know which way you're facing at all times, you can't even get past "hello".

To demonstrate the big difference between this way of being oriented in space and what English speakers usually do, I often have the whole English-speaking audience in a lecture hall close its eyes. I then give the audience members a surprise quiz: Point southeast. People's responses are informative on many levels. First, many people laugh because they think it's a ridiculous and unfair question. How are they supposed to know which way southeast is? Then, it takes people a while to start pointing. There is an effortful computation to be done: This isn't information that is readily available for most English speakers. Finally, when people do point, they point in all possible directions. I don't generally know which way southeast is myself, so I cannot tell who is right and who is wrong, but given that in any group of English speakers most directions are pointed to about equally often, I infer that the accuracy is not very high. A task like this is trivial for speakers of absolute languages.

Because space is such a fundamental domain of thought, differences in how people think about space don't end there. People rely on their spatial knowledge to build other, more abstract representations. Representations of such things as time, number, musical pitch, kinship relations, morality, and emotions have been shown to depend on how we think about space. So if speakers of different languages think differently about space, do they also think differently about other things, like time?

To test this idea, I compared speakers of English and Kuuk Thaayorre. Participants received sets of pictures that showed some kind of temporal progression (e.g., pictures of a man aging, or a crocodile growing, or a banana being eaten). Their job was to arrange the shuffled photos on the ground to show the correct temporal order. Each person was tested in two separate sittings, each time facing in a different cardinal direction. When English speakers are asked to do this, they arrange the cards so that time proceeds from left to right. Hebrew speakers tend to lay out the cards from right to left, showing that writing direction in a language plays a role. So what about folks like the Kuuk Thaayorre, who don't use words like *left* and *right*? What do they do? The Kuuk Thaayorre did not arrange the cards more often from left to right than from right to left, or more toward or away from the body. But their arrangements were not random: There was a beautiful pattern, just a different one from that of English speakers. Instead of arranging time from left to right, they arranged it from east to west. That is, when they were seated facing south, the cards went left to right. When they faced north, the cards went from right to left. When they faced east, the cards came toward the body, and so on. This was true even though participants were never told which direction they were facing. The Kuuk Thaayorre not only knew that already, they also spontaneously used this spatial information to construct their representations of time. Important, these results demonstrate that cross-linguistic differences, at least in some cases, are not simply a matter of degree – they can constitute qualitatively different ways of organizing the world. Most of the English speakers tested on these tasks simply could not have done what the Kuuk Thaayorre did, because they did not know which way they were facing (even in a highly familiar environment). And even those English speakers who could figure out which way was which would never have thought to use that information to organize time.

To summarize, there are profound differences in navigational ability and spatial knowledge between speakers of languages that rely primarily on absolute reference frames and languages that rely on relative reference frames. Simply put, speakers of languages like Guugu Yimithirr are much better than English speakers at staying oriented and keeping track of where they are, even in unfamiliar landscapes (or inside unfamiliar buildings). The constant practice of paying attention to and

tracking orientation in order to speak their language enables them (in fact, forces them) to be able to perform navigational feats once thought beyond human capabilities. Further, cross-linguistic differences in spatial reference frames profoundly shape not only people's reasoning about space, but also their representations of other domains that are typically scaffolded on top of spatial representations (e.g., time).

4. ii. b) Does language just shape the way we construe or remember our experiences, or does it shape how we actually perceive things?

Language divides the continuous spectrum of color into discrete categories (e.g., in English: yellow, green, blue, etc.). Different languages divide up the color continuum differently: Some make many more distinctions between colors than others, and the boundaries often don't line up across languages. Do these linguistic categories play a role in how people perceptually experience colors? Can language play a role in even such low-level perceptual decisions as judging whether two squares of color are exactly the same?

Recent research on color language and color perception has demonstrated that languages meddle even in surprisingly basic perceptual tasks. For example, in Russian, there is no single word that covers all the colors English speakers call *blue*. Russian makes an obligatory distinction between light blue (*goluboy*) and dark blue (*siniy*). Does having to make a distinction between lighter and darker blues in language cause Russian speakers to perceive lighter and darker blues as being more different from one another than they would appear to an English speaker? To test this, Russian and English speakers' ability to discriminate shades of blue were compared. On each trial of the task, English and Russian speakers were shown three color chips on the screen at the same time: one above, and two below. One of the bottom color chips was identical to the top chip. The subjects' task was to indicate which of the bottom two chips was the same as the chip on top (they did so by pressing a button on the right or left side of the keyboard). All of the color chips in the study fell into the English category *blue*, spanning the *goluboy*/*siniy* border in Russian. The results showed a clear cross-linguistic difference. Russian speakers were faster to respond when the two bottom color chips they had to distinguish between were from different linguistic cate-

gories in Russian (one would be called *siniy* and one *goluboy* in Russian) than if they were from the same linguistic category (both were *siniy* or both were *goluboy*). For English speakers, of course, all of these colors are called by the same basic color term – *blue* – so there should be no such differences. And indeed, English speakers tested on the same stimuli showed no such differences: They were not faster when the two colors to compare crossed the Russian *goluboy*/*siniy* boundary than when they didn't. Both in language and in perception, these colors were all *blue* to English speakers.

Further, the Russian linguistic boundary effect disappeared when subjects were asked to perform a verbal interference task (verbally rehearsing a string of digits), while making color judgments – but not when they were asked to perform an equally difficult spatial interference task (keeping a novel visual pattern in memory). Neither verbal interference nor spatial interference had any effect on the English speakers' pattern of results. The fact that verbal (and not spatial) interference had an effect and only on the language group that makes the relevant linguistic distinction demonstrates that it is language per se that creates this difference in perception between Russian and English speakers. It appears that under normal viewing conditions (without verbal interference) linguistic processes meddle in Russian speakers' perceptual decisions. When Russian speakers are blocked from their normal access to language by a verbal interference task, the differences between Russian speakers and English speakers disappear. These results demonstrate that language is involved in even surprisingly basic perceptual judgments. Importantly, these cross-linguistic differences were observed in an objective perceptual discrimination task. All stimuli were present on the screen and available to perception while people were making their judgments: They did not need to be retrieved from long-term memory. There was no ambiguity in how to interpret the task. On all trials there was an objective correct answer (one of the bottom chips was identical to the chip on top and the other chip was different), and subjects knew the correct answer and performed the task with high accuracy. Further, the task was entirely nonlinguistic: subjects were not asked to name the colors or to produce or understand language at all. Still, the amount of time people required to arrive at these simple perceptual decisions (even in the presence of all the necessary perceptual stimuli) depended on their

native language. The fact that cross-linguistic differences can be found even in such basic perceptual tasks suggests that linguistic processes get involved not just in higher-level cognition, but in relatively low-level perceptual processes as well.

4. ii. c) Do aspects of grammar shape thinking?

One important aspect of the debate on language and thought centers on the question of what to count as language. On some views of language, only aspects of grammar, the very mechanics of constructing utterances, are at the very core of language. Correspondingly, some scholars wonder whether grammatical differences (i.e., not what you say, but how you have to say it) play any role in shaping people's thinking.

Aspects of grammar make for a very exciting test case of linguistic relativity because grammatical markers can be so pervasive in language. For example, in some languages grammatical markers like tense or aspect will need to be attached to all verbs, and categories like grammatical gender may affect all nouns. If it can be shown that grammatical markers that attach to all verbs or all nouns have an effect on how people think about objects or events, then that means language might affect how people think about anything that can be named by a noun or a verb. This would indeed be a very pervasive effect of language on thought.

It turns out that even what might be deemed frivolous aspects of grammar can have far-reaching subconscious effects on how we see the world. Take grammatical gender. In Spanish and other Romance languages, all nouns are either masculine or feminine. In many other languages, nouns are divided into many more genders (*gender* in this context meaning class or kind). For example, some Australian Aboriginal languages have up to sixteen genders, including grammatical classes for hunting weapons, canines, things that are shiny, or, as George Lakoff (1987) made famous, "women, fire, and dangerous things." What it means for a language to have grammatical gender is that words belonging to different genders get treated differently grammatically and words that belong to the same grammatical gender get treated the same grammatically. Languages can require speakers to change pronouns, adjective and verb endings, possessives, numerals, and so on, depending on the noun's gender. For example, to say something like "my chair was old" in Russian (*moy stul bil stariy*), you would need to make every word in the sen-

tence agree in gender with *chair* (*stul*), which is masculine in Russian. So you'd use the masculine form of *my*, the masculine form of *was*, and the masculine form of *old*. These are the same forms that you would use if speaking about a biological male, for example to say "my grandfather was old." If, instead of speaking of a chair, you were speaking of a *bed* (*krovat*), which is feminine in Russian, you would use the feminine form of *my*, the feminine form of *was*, and the feminine form of *old*. These are the same feminine forms that you would use if speaking of a biological female (e.g., "my grandmother was old"). Does treating chairs similarly to biological males and beds similarly to biological females in grammar make Russian speakers think of chairs as being more like men and beds as more like women in some way?

To find out, an experiment was done in which German and Spanish speakers were asked to describe objects that have opposite grammatical gender assignment in the two languages. The descriptions people gave differed in a way predicted by grammatical gender. For example, when asked to describe a *key* – a word that is masculine in German and feminine in Spanish – German speakers were more likely to use words like "hard," "heavy," "jagged," "metal," "serrated," and "useful," whereas Spanish speakers were more likely to say "golden," "intricate," "little," "lovely," "shiny," and "tiny." To describe a *bridge*, a word that is feminine in German and masculine in Spanish, German speakers said "beautiful," "elegant," "fragile," "peaceful," "pretty," and "slender," and Spanish speakers said "big," "dangerous," "long," "strong," "sturdy," and "towering". This was true even though all testing was done in English (a language without grammatical gender). The same pattern of results also emerged in entirely nonlinguistic tasks. For example, Spanish and German speakers were asked to rate similarities between pictures of people (males or females) and pictures of objects (the names of which had opposite genders in Spanish and German). Both groups rated grammatically feminine objects to be more similar to females and grammatically masculine objects more similar to males. This was true even though all objects had opposite genders in Spanish and German, the test was completely nonlinguistic (conducted entirely in pictures with instructions given in English), and even when subjects performed the task during a verbal suppression manipulation (which would interfere with their ability to sub-vocally name the objects in any language).

Further studies showed that aspects of language *per se* can create these kinds of cognitive differences. For example, teaching English speakers new grammatical gender categories in a novel language produced the same kinds of biases in their mental representations of objects as were observed with German and Spanish speakers. It appears that even small flukes of grammar, like the seemingly arbitrary assignment of gender to a noun, can have an effect on people's conceptions of concrete objects.

In fact, one doesn't even need to go into the lab to see these kinds of effects of grammar; it is possible to literally see them at an art gallery. Consider the case of personification in art: the ways that abstract entities such as death, sin, victory, or time are given human form. How does an artist decide whether death, say, or time should be painted as a man or a woman? It turns out that in eighty-five percent of such personifications, whether a male or female figure is chosen is predicted by the grammatical gender of the word in the artist's native language. So, for example, German painters are more likely to paint death as a man, while Russian painters are more likely to paint death as a woman.

The fact that even seeming flukes of grammar like grammatical gender can have an effect on our thinking is exciting because grammatical features can be so pervasive in language. A small quirk of grammar like grammatical gender for example applies to all nouns. That means that this quirk of grammar can subtly shape how we think about anything that can be named by a noun.

4. iii. Does learning new languages change the way one thinks?

Many of us endeavor to learn languages other than our native tongue. When we try to learn a new language, are we simply learning a new way of talking, or are we also learning a new way of thinking? Results from language training studies show that learning to talk in a new way does also lead one to think in a new way. Studies with bilinguals also support this idea. For example, studies comparing Indonesian speakers who have and have not learned English as a second language show that those who have learned English at some point in their lives show more English-like attentional patterns in nonlinguistic tasks than Indonesian speakers who have not learned English. This is true even though both groups are tested in Indonesian in Indonesia, by a native Indonesi-

an speaker, and are never asked about their proficiency in English until after the end of the experiment. This pattern of findings signals that in addition to online effects of language (as found in the case of color), language can also have a long-term effect on thinking. Even when a particular language is not being used, simply having learned that language at some point in life has created an attentional habit, tuned one's attentional system to the distinctions encoded in that language. It appears that when we learn a new language, we're not simply learning a new way of talking; we are also inadvertently learning a new way of thinking, a new way of partitioning, organizing, and construing the world.

4. iv. Do bilinguals think differently when speaking different languages?

Another approach to establishing the causal role that language plays in cognition is to study bilingual populations. For example, in a group of bilinguals, it is possible to randomly assign subjects to be tested in one language or another, and then see whether the linguistic context in which the test is conducted has an effect on the results. In one such study, I tested a group of Indonesian–English bilinguals on a set of nonlinguistic tasks designed to assess attention to temporal frames in events (an aspect that English cares more about than Indonesian). Half of the participants were greeted and given instructions in Indonesian, and half in English. Being tested in an English or an Indonesian linguistic context had an influence on how people performed the tasks. Bilinguals who were tested in the English linguistic context showed attentional patterns that were more like those of English speakers, while bilinguals tested in the Indonesian linguistic context showed a more Indonesian attentional pattern. This was true even though the tasks themselves were nonlinguistic (e.g., remembering sets of photographs, or rating photographs for similarity), and the linguistic context was established simply by the language that the experimenter used to give instructions.

It appears that bilinguals do sometimes show different cognitive patterns when tested in one language versus another. However, it is also the case that the patterns one has learned in a language are somewhat active even when that particular language is not being spoken. The extent to which two languages are integrated in daily use will undoubtedly serve to shift these results. For example, if a person is a perfectly balan-

ced bilingual and both languages are used in very similar and interrelated contexts, then one might expect more integration in cognitive patterns as well: less difference as a function of language of test and a stronger effect of the language not currently being used on the patterns in behavior. If the two languages are not well integrated in daily use, then there may be a bigger difference in behavior when tested in different languages. And of course, as languages go into disuse and start to fade from memory, so may their cognitive influence.

Does language only shape thinking when you're speaking or does it also shape nonlinguistic thought? We have already seen that languages can exert influence even when people are not being tested in the language of interest. For example, Spanish and German speakers show effects of grammatical gender categories in their native language even when tested in English, a language without grammatical gender. We have also seen that cross-linguistic differences surface even when people are tested in tasks that do not require them to produce or understand language. In some cases these cross-linguistic differences in behavior persist despite verbal interference, suggesting that language has influenced the underlying representations and is not involved online.

In all of these cases, however, it is possible that people do somehow rely on language in the task. They may not be asked to speak out loud, or they may even be somewhat inhibited by verbal interference, but it is possible that they still manage to bring up some information from the linguistic system. What does this mean for the claim that language is shaping nonlinguistic thought?

The question of whether experience with a language affects nonlinguistic thought is central to the Whorfian debate. But what should be counted as nonlinguistic thought? The argument that language and thought are entirely separate (such that language doesn't affect thought) is only meaningful if a sufficiently large number of cognitive tasks are normally accomplished without the involvement of language. A good candidate for this set of tasks would be tasks that do not require participants to produce or understand language.

But what then of all the cross-linguistic differences found even in such tasks? It could be argued that the tasks were not truly nonlinguistic, that language is automatically or involuntarily recruited for these tasks even though subjects are not overtly required to use language (and

even overtly discouraged from using language by a concurrent verbal suppression task). For example, one might argue that people implicitly name pictures as soon as they see them and this cannot be wiped out entirely by verbal suppression. However, taking this line of argument runs counter to the original premise one would be trying to defend – namely that language and thought are entirely separate (such that language does not affect thought).

If language is indeed involuntarily recruited for most cognitive tasks (even ones that do not overtly require language use), then language *is* having a profound effect on thought by being an involuntary component of the processes we call thinking. In fact, if this is the case, then what we colloquially call "thought" is indeed a complex set of collaborations between linguistic and non-linguistic representations and processes. The evidence available so far suggests that language affects thought both by being involved in a variety of cognitive processes online and by effecting long-term change in nonlinguistic representations.

4. v. Are some thoughts unthinkable without language?

In *1984*, George Orwell describes a dystopian society in which the Party meticulously controls and manipulates language to create a new dialect – *Newspeak*. The purpose of *Newspeak* is to make thoughts of freedom and rebellion impossible by removing any words or phrases that could express these ideas. The suggestion is that thoughts that are impossible to express in language become unthinkable.

4. v. a) Are some thoughts unthinkable without the right words to express them? Is language necessary for thought?

Language, of course, is not our sole source of information. We can learn about the world in many other ways. Just because some information or some distinction is missing from language doesn't mean it will be impossible to discover it or acquire it in some other way. It may take much longer to discover that particular feature of the world, and many people may never come across it at all, but that doesn't mean it's impossible. Language, after all, is developed by humans. We are constantly inventing new words and expressions, adjusting the structures, and staking out new uses for elements in our language. We use our languages as tools to achieve many goals, and as our goals develop and

change, we often develop and change the tools of language. This is a laborious process, but through cultural time humans are clearly developing new knowledge as well as new ways of talking about it.

Language is also not the sole cognitive tool we have. Language is extremely useful for many types of thinking and in practical terms greatly expands our repertoire of cognitive skills. Language can act as a crutch in memory, serve as an external placeholder, and encourage us to schematize, categorize, abstract, and build knowledge through analogical inferences. But is it the only way we can possibly achieve these things? Could other forms of representation that share some of the virtues of language also do the job?

Let's take this question up in a particular example domain: number. The domain of number has recently been championed as the star case in which language, and in particular the system of exact number words (e.g., *one*, *two*, *three*, *four*, *five*, *six*, *seven*, etc.) is necessary to be able to keep track of exact quantities above three. If there was really no other way to keep track of exact quantities except by learning exact number words, then this would indeed be a very strong case for the idea that some thoughts are unthinkable without language.

However, there are other ways of keeping track of exact quantities. For example, the Arrernte (Central Australia) do not have exact number words above two, but are still able to keep track of large exact quantities. Arrernte, like many Australian languages, has terms roughly corresponding to *one*, *two*, *few*, and *many*. There are no everyday language terms for *three*, *four*, *five*, and so on. However, there is a term which means *thus many*. This term shifts the expression of number quantification out of the language system and into other external representation systems, like gestures (holding up the correct number of fingers for example) or to a form of conventional tallying in the sand (e.g., with dots). The Arrernte use these two external systems to keep track of exact quantities far beyond the number words available in their language.

It appears that people's number vocabulary is neither a direct reflection of their numerical abilities nor does it impose a hard limit on numerical cognition. While number words are undoubtedly extremely useful for keeping track of exact quantities, other systems of external placeholders (in this case gestures, sand drawings, etc.) can also be used to accomplish the job.

That said, languages have built into them thousands of years of cultural knowledge and invention. Each language is an incredibly useful guidebook to the world: It comes with ways of categorizing, differentiating, organizing, and making sense of objects, actions, events, internal states, dimensions of perceptual experience, useful analogies for conceiving of entities that are beyond perception, and so on. The process of learning a language and becoming enculturated in a particular society teaches us a way of understanding, compartmentalizing, and managing the very rich and complicated physical world we inhabit. While it is not technically impossible to create and think thoughts for which there are not ready linguistic forms in one's language, without the benefit of cultural learning, a great many of the thoughts we take for granted would go unthunk. How many of us would independently invent a system for keeping track of exact quantities if number words were not already available in our language? While it may not be strictly impossible, the probability of any given individual independently arriving at such an idea is vanishingly small.

4. v. b) Is language a straitjacket for thought?

The Whorfian hypothesis has often been either misrepresented or misunderstood as claiming that language is a straitjacket for thought. In this construal, language binds us into a particular way of viewing the world, and we cannot conceive of things outside of the bounds of our language. This construal of the role that language plays in cognition is problematic because it is self-contradictory. On the one hand, it states that language importantly shapes thinking, which suggests that thinking is something pliable, something that can be changed with experience. On the other hand, it claims that language locks us into a particular way of thinking, and nothing can be done to change it. If language is indeed a powerful tool for shaping thought, and (by implication) thought is a shapeable entity, then why couldn't we learn a new way of thinking simply by learning a new way of talking?

Rather than conceiving of language as a straitjacket, let us consider experience with language as simply part of the history of the human organism. Experiences with a particular language, just as all other experiences, leave a trace. Each experience subtly tweaks and nudges the complex internal state of the organism. The full history of these changes

over time leads us to our current state, our current set of ideas and dispositions. We can no more unlearn the effects of the structures and patterns of our languages than we can willfully unexperience any other event from our past. While language is not a straitjacket, it is an ever-present part of the fabric of human experience. To the extent that we cannot fully escape the effects that any other experiences have had on us, we also cannot fully escape the effects of our experiences with language. Importantly, this does not mean that we can't learn things that are outside of the bounds of our language. What it does mean is that whenever we do endeavor to learn something new, we are doing so from a particular point of view. We are not starting from a blank or a neutral state; our starting point is the place we have arrived as a result of all of our life experiences, including those with language.

Each of us has an idiosyncratic set of experiences, and through these we collect a vast idiosyncratic knowledge base. We certainly manage to use language to achieve cooperative goals with each other, some of the time. But this does not mean that the underlying representations we have (either linguistic or conceptual) are identical or even very similar. While it is not impossible to learn things outside of the bounds of one's language, what is highly improbable is being able to achieve the same mental states as the monolingual speaker of another language. For example, it is extremely unlikely that I can arrive at a conception of time that is exactly the same as that of a monolingual Indonesian speaker because my starting point for learning Indonesian is that of a Russian, English, and sort-of French speaker. I cannot unlearn the conceptions of time that I have learned through my experiences with these other languages. At best, I may arrive at an idea of time that may *include* the way monolingual Indonesian speakers conceive of time, but even this would be very different from really seeing the world as a monolingual Indonesian speaker does.

To summarize, structures that exist in languages serve many useful functions both in individual cognition and in communication. Languages do not place a hard limit on what is learnable, but they do exert profound influences on the contents of our minds, making some ideas tremendously easier and some harder to use and acquire. Beyond showing that speakers of different languages think differently, these results suggest that linguistic processes are pervasive in most fundamental

domains of thought. That is, it appears that what we normally call "thinking" is in fact a complex set of collaborations between linguistic and nonlinguistic representations and processes. Unbeknownst to us, linguistic processes meddle in and subconsciously influence our thinking from the very basics of perception to the loftiest abstract notions and the most major life decisions. Language is central to our experience of being human and the languages we speak profoundly shape the way we think, the way we see the world, and the way we live our lives.

(B) Further reading and online resources:

1. Bulić (2020)
2. Carroll (2008). pp. 394-420
3. Crystal (2000)
4. Everett (2009)
5. Everett (2013)
6. Field (2004)
7. Gleitman & Papafragou (2012)
8. Osgood & Sebeok (1954). pp. 192-203
9. Pinker (2008). pp. 89-151; 323-372
10. Shariatmadari (2019). pp. 95-119; 160-177
11. Spivey, McRae & Joanisse (2012). pp. 653-692
12. Steinberg, Nagata & Aline (2001). pp. 243-275
13. Steinberg & Sciarini (2006). pp. 177-198

14. Lera Boroditsky: How language shapes the way we think
15. Does the language I speak influence the way I think?
16. The weird way language affects our sense of time and space
17. The subtle ways language shapes us
18. Do we think differently in different languages?
19. How the language we choose to use impacts how we think
20. Can language slow down time?
21. The Pirahã language: The Story of Language with Dan Everett
22. Daniel Everett: 'There is no such thing as universal grammar'
23. The Magic of "Untranslatable" Words

(C) Key concepts:

categories	gender	perception
cognition	language death	Sapir-Whorf hypothesis
color terms	linguistic determinism	spatial terms
counterfactuals	linguistic relativity	thought
culture	number terms	

(D) Discussion questions and activities:

1. Distinguish between the strong and weak versions of the linguistic determinism view.

2. What evidence suggests that spatial terms influence our thinking?

3. What conclusions can be drawn regarding the influence of grammatical gender on cognition? Why is research on grammatical gender important for psycholinguistics?

4. Do aspects of grammar in a language shape the thought process?

5. Read Everett (2013), with a focus on pp. 255-272, and discuss the ideas about language that he rethinks in the context of Pirahã. Why is his work pioneering?

6. In Steinberg, Nagata & Aline (2001), and Steinberg & Sciarini (2006) it is stated that over the centuries there have been expressed four principal formulations concerning the relationship of language, thought and culture:

- *Theory 1: Speech is essential for thought.* We must learn how to speak aloud, otherwise we cannot develop thinking.
- *Theory 2: Language is essential for thought.* We must learn language, how to produce or understand speech, otherwise we cannot develop thinking.
- *Theory 3: Language determines or shapes our perception of nature.* The learning of language will determine or influence the way we perceive the physical world, visually, auditorily, etc.

– *Theory 4: Language determines or shapes our world view.* The learning of language will determine or influence the way we understand our culture and the cultures around the world.

Discuss the inadequacies of each theory.

7. How does the existence of multilinguals go against the theory of linguistic determinism?

8. Are there some things that you cannot do if your language lacks the proper vocabulary? Are some thoughts unthinkable without language?

9. Why do "untranslatable" words exist? Give examples of such words in English and your native tongue. How would you deal with them when translating or interpreting?

10. The publication manual of the American Psychological Association (APA) and other style manuals endorse the elimination of sexist language (bias-free language). Do you think that the reduction of sexist language will influence the thoughts or attitudes of individuals who comply with these standards?

11. Do you think speakers of cultures whose languages have a grammatical gender system are likely to be more sexist than speakers of languages that do not? Why or why not?

12. In the chapter titled *The Seven Words You Can't Say on Television*, Pinker (2008: 325-327) has stated:

> "Whether they are referred to as swearing, cursing, cussing, profanity, obscenity, indecency, vulgarity, blasphemy, expletives, oaths, or epithets; as dirty, four-letter, or taboo words; or as bad, coarse, crude, foul, raunchy, or off-color language, these expressions raise many puzzles for anyone interested in language as a window into human nature. The fear and loathing are not triggered by the concepts themselves. Nor are they triggered by the words' sounds because many of them have respectable homonyms. The unprintable can become printable with a hyphen or asterisk, and the unsayable sayable with the flip of a vowel or consonant. Something about the pairing of certain meanings and sounds has a potent effect on people's emotions."

Why are these words felt to be not just unpleasant but taboo? Why is merely hearing or reading them felt to be corrupting?

13. How are newly coined COVID-19 words/phrases connected to the theories from this chapter?

14. Why do linguists care about language death? Why and how do languages die? What do linguists do to keep an endangered language from dying?

15. Textbooks for EFL learners contain sections on culture. If you were to teach EFL, how would you include aspects of culture in your lessons?

16. Do you think that language holds a mirror to society or society holds a mirror to language? Justify your opinion.

17. What else might you want to know more about in context of what this Chapter deals with?

References

Abello-Contesse, C. (2009). Age and the critical period hypothesis. *ELT Journal, 63*(2), 170-172.

Aitchison, J. (2008). *The Articulate Mammal: An Introduction to Psycholinguistics* (5th ed.). Routledge.

Åke, S., Hartelius, L., Jakola, A. S., & Antonsson, M. (2023). Experiences of language and communication after brain-tumour treatment: A long-term follow-up after glioma surgery. *Neuropsychological Rehabilitation, 33*(7), 1225-1261.

Altmann, G. T. M. (2001). The language machine: Psycholinguistics in review. *British Journal of Psychology, 92,* 129-170.

Altmann, G. T. M. (2006). History of Psycholinguistics. *The Encyclopedia of Language and Linguistics.* Elsevier.

Ammari, E. H. (2011). Prodigious Polyglot Savants: The Enigmatic Adjoining of Language Acquisition and Emaciated Potentials. *International Journal of Business and Social Science, 2*(7), 158-173.

Armstrong, S. L., Gleitman, L. R., & Gleitman, H. (1983). What some concepts might not be. *Cognition, 13*(3), 263-308.

Asoulin, E. (2016). Language as an instrument of thought. *Glossa: A journal of general linguistics, 1*(1): 46, 1-23.

Bastiaanse, R., & Ohlerth, A. (2023). Presurgical Language Mapping: What Are We Testing? *Journal of Personalized Medicine, 13*(3).

Beattie, G. (1983). *Talk: An Analysis of Speech and Non-Verbal Behaviour in Conversation*. Open University Press.

Bloom, P. (2000). *How Do Children Learn the Meanings of Words*. MIT Press.

Blumenthal, A. L. (1987). The Emergence of Psycholinguistics. *Synthese, 72*(3), 313-323.

Bock, K., & Levelt, W. (1994). Language Production: Grammatical Encoding. In *Handbook of Psycholinguistics* (pp. 945-984). Academic Press Inc.

Bulić, H. (2020). Eskimi i njihovi nazivi za snijeg. *Lingvazin Magazin za jezik i književnost, VIII*(1), 16-18.

Bylund, E., Hyltenstam, K., & Abrahamsson, N. (2021). Age of acquisition – not bilingualism – is the primary determinant of less than nativelike L2 ultimate attainment. *Bilingualism: Language and Cognition, 24,* 18-30.

Carroll, D. W. (2008). *Psychology of Language* (5th ed.). Thomson Wadsworth.

Cenoz, J. (2003). The additive effect of bilingualism on third language acquisition: A review. *International Journal of Bilingualism, 7*, 71-87.

Chomsky, N. (1969). Knowledge of Language. *London Times Literary Supplement,* 299-320.

Chomsky, N. (2006). *Language and Mind* (3rd ed.). Cambridge University Press.

Cook, V. J. (1991). The poverty-of-the-stimulus argument and multi-competence. *Second Language Research*, 7(2), 103-117.

Čordalija, N., & Kalajdžisalihović, N. (2022). Linguistic Performance in Typical Cognitive Aging and Dementia. *Epiphany: Journal of Transdisciplinary Studies, 15*(2), 74-94.

Crystal, D. (2000). *Language Death.* Cambridge University Press.

Crystal, D. (2005). *How Language Works: How Babies Babble, Words Change Meaning, and Languages Live or Die.* Penguin Books.

Curtiss, S. (1977). *A Psycholinguistic Study of a Modern-Day Wild Child.* Academic Press.

Cutler, A. (Ed.). (2005). *Twenty-First Century Psycholinguistics*. Lawrence Erlbaum Associates.

De Bot, K., & Makoni, S. (2005). *Language and Aging in Multilingual Contexts.* Multilingual Matters.

Deacon, T. W. (1997). *The Symbolic Species: The Co-Evolution of Language and the Brain.* W. W. Norton & Company.

Dell, G. (1995). Speaking and misspeaking. In L. Gleitman, & M. Lieberman (Eds.), *Language: An Invitation to Cognitive Science, Vol 1* (pp. 183-208). MIT Press.

Drouillet, L., Stefaniak, N., Declercq, C., & Obert, A. (2018). Role of implicit learning abilities in metaphor understanding. *Consciousness and Cognition, 61,* 13-23.

Ellington, H., & Race, P. (1985). *Producing Teaching Materials: A Handbook for Teachers and Trainers*. Kogan Page Ltd.

Erard, M. (2012). *Babel No More: The Search for the World's Most Extraordinary Language Learners.* Free Press.

Erdeljac, V. (2009). Mentalni leksikon: modeli i činjenice. Ibis grafika.

Everett, D. (2009). *Don't Sleep, There Are Snakes: Life and Language in the Amazonian Jungle.* Vintage.

Everett, D. (2013). *Language: The Cultural Tool.* Profile Books.

Fernández, E. M., & Cairns, H. S. (2011). *Fundamentals of Psycholinguistics.* John Wiley & Sons.

Fernández, E. M., & Cairns, H. S. (Eds.). (2018). *The Handbook of Psycholinguistics.* John Wiley & Sons.

Field, J. (2003). *Psycholinguistics: A Resource Book for Students.* Routledge.

Field, J. (2004). *Psycholinguistics: The Key Concepts.* Routledge.

Flores d'Arcais, G. B., & Levelt, W. J. M. (Eds.). (1970). *Advances in Psycholinguistics.* North-Holland Publishing Company.

Garman, M. (1990). *Psycholinguistics.* Cambridge University Press.

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. *Language, 2*, 301-334.

Gleitman, L., & Papafragou, A. (2012). New perspectives on language and thought. In K. J. Hollyoak, & R. G. Morrison (Eds.), *The Oxford Handbook of Thinking and Reasoning* (pp. 543-568). Oxford University Press.

Gluksberg, S. (2003). The psycholinguistics of metaphor. *Trends in Cognitive Sciences, 7*(2), 92-96.

Goldfield, B. A. (2000). Nouns before verbs in comprehension vs. production: The view from pragmatics. *Journal of Child Language*, *27*(3), 501-520.

Goodman, K. S., & Wayne State University. (1968). *The Psycholinguistic Nature of the Reading Process*. Wayne State University Press.

Green, D. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition.* 67-81.

Greenberg, J. (1963). Some Universals of Grammar with Particular Reference to the Order of Meaningful Elements. In J. Greenberg (Ed.), *Universals of Language* (pp. 73-113). MIT Press.

Grosjean, F. (1989). Neurolinguists, beware! The bilingual is not two monolinguals in one person. *Brain Lang*, 36 (1): 3-15.

Hartshorne, J. K., Tenenbaum, J. B., & Pinker, S. (2018). A critical period for second language acquisition: Evidence from 2/3 million English speakers. *Cognition, 177*, 263-277.

Hatzidaki, A. (2007). The Process of Comprehension from a Psycholinguistic Approach – Implications for Translation. *Meta*, *52*(1), 13-21.

Hauser, M. D., Chomsky, N., & Fitch, W. T. (2002). The faculty of language: What is it, who has it, and how did it evolve? *Science, 298*(5598), 1569-1579.

Hockett, C. F. (1963). The Problem of Universals in Language. In J. Greenberg (Ed.), *Universals of Language* (pp. 1-22). MIT Press.

Hulstijn, J. H. (2006). Psycholinguistic perspectives on second language acquisition. In J. Cummins, & C. Davison (Eds.), *The International Handbook on English Language Teaching* (pp. 701-713). Springer.

James, W. (1890). *The Principles of Psychology, Vol 1.* Henry Holt and Co.

Jesperson, O. (1933). *Essentials of English Grammar*. Allen & Unwin.

Jonassen, D., & Carr, C. (2000). Mindtools: Affording multiple knowledge representations for learning. In S. Lajoie (Ed.), *Computers as Cognitive Tools, Vol II: No More Walls* (pp. 165-196). Lawrence Erlbaum Inc.

Kalajdžisalihović, N. (2022a). Reading as a Productive Skill and Visual Response as a Reading Strategy. *Journal of the Faculty of Humanities and Social Sciences University of Tuzla, 7*(4): 21, 307-318.

Kalajdžisalihović, N. (2022b). Applications of Speech-to-Text Assistive Technologies in Language Processing. *Proceedings from the Fourth International Conference on English Language, Literature, Teaching and Translation Studies: Re-Examining Gender Concepts and Identities in Discourse(s) and Practice(s) Across Periods and Disciplines, Sarajevo* (October 2021), 81-94.

Kirk, S. A., & Kirk, W. D. (1971). *Psycholinguistic Learning Disabilities: Diagnosis and Remediation*. University of Illinois Press.

Knupsky, A. C., & Amrhein, P. C. (2007). Phonological facilitation through translation in a bilingual picture-naming task. *Bilingualism: Language and Cognition 10*(3), 211-223.

Kress, G. (1994). *Linguistic Processes in Sociocultural Practice*. Deakin University.

Krishna, S., Choudhury, A., Keough, M. B., et al. (2023). Glioblastoma remodelling of human neural circuits decreases survival. *Nature, 617,* 599-607.

Kroll, J. F., Dussias, P. E., Bice, K., & Perrotti, L. (2015). Bilingualism, Mind, and Brain. *Annual Review of Linguistics, 1,* 377-394.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, 33, 149-174.

Labov, W. (1973). The boundaries of words and their meanings. In C.-J. N. Bailey, & R. W. Shuy (Eds.), *New Ways of Analyzing Variation in English* (pp. 340-373). Georgetown University Press.

Lane, H. (1976). *The Wild Boy of Aveyron*. Harvard University Press.

Lashley, K. S. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral Mechanisms in Behavior* (pp. 112-136). John Wiley and Sons.

Laver, J. (1994). *Principles of Phonetics*. Cambridge University Press.

Lenneberg, E. H. (1967). *Biological Foundations of Language.* Wiley.

Levelt, W. (1989). *Speaking: From Intention to Articulation*. MIT Press.

Lidz, J., & Gagliardi, A. (2015). How Nature Meets Nurture: Universal Grammar and Statistical Learning. *Annual Review of Linguistics, 1,* 333-353.

Lightbown, P. M., & Spada, N. (2021). *How Languages are Learned* (5th ed.). Oxford University Press.

MacLaury, R. E. (1991). Prototypes Revisited. *Annual Review of Anthropology*, *20*, 55-74.

MacWhinney, B. (2015). Psycholinguistics: Overview. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences, 2nd ed.* (pp. 353-358). Elsevier.

Marinis, T. (2003). Psycholinguistic techniques in second language acquisition research. *Second Language Research, 19*(2), 144-161.

McFee, M. (1990). Wilder Brain Collection, Cornell University. *The Hudson Review*, *43*(1), 77-80.

Menn, L. (2017). *Psycholinguistics: Introduction and Applications* (2nd ed.). Plural Publishing.

Miller, G. A. (1967). *The Psychology of Communication: Seven Essays.* Basic Books Inc.

Miller, G. A. (1991). The Place of Language in a Scientific Psychology. *National Student Speech Language Hearing Association Journal, 18,* 66-72.

Muñoz, C. (Ed.). (2006). *Age and the Rate of Foreign Language Learning*. Multilingual Matters Ltd.

Newmeyer, F. J. (1988). *Linguistics: The Cambridge Survey, Vol III: Language: Psychological and Biological Aspects.* Cambridge University Press.

Noble, C. E., & McNeely, D. A. (1957). The role of meaningfulness (m) in paired-associate verbal learning. *Journal of Experimental Psychology, 53*(1), 16-22.

O'Grady, W., & Archibald, J. (Eds.). (2016). *Contemporary Linguistic Analysis: An Introduction* (8th ed.). Pearson.

Osgood, C. E., & Sebeok, T. A. (Eds.). (1954). *Psycholinguistics: A Survey of Theory and Research Problems.* Waverly Press, Inc.

Penfield, W. (1947). Some observations on the cerebral cortex of man. *Proceedings of the Royal Society of London. Series B, Biological sciences*, *134*(876), 329-347.

Pennebaker, J. W. (2011). *The Secret Life of Pronouns: What Our Words Say About Us.* Bloomsbury Press.

Pilley, J. W., & Reid, A. K. (2011). Border collie comprehends object names as verbal referents. *Behavioural Processes, 86*, 184-195.

Pinker, S. (1995). *The Language Instinct.* Harper Perennial.

Pinker, S. (2008). *The Stuff of Thought: Language as a Window into Human Nature.* Penguin Books.

Pinker, S. (2011). *Words and Rules: The Ingredients of Language.* Harper Perennial.

Pinker, S., & Jackendoff, R. (2005). The faculty of language: What's special about it? *Cognition, 95,* 201-236.

Potter, M. C., So, K.-F., von Eckardt, B., & Feldman, L. B. (1984). Lexical and conceptual representation in beginning and proficient bilinguals. *Journal of Verbal Learning & Verbal Behavior, 23*(1), 23-38.

Purba, N. (2018). The Role of Psycholinguistics in Language Learning and Teaching. *Tell Journal, 6*(1), 47-53.

Reber, A. S. (1987). The rise and (surprisingly rapid) fall of psycholinguistics. *Synthese,* 72, 325-339.

Quine, W. V. O. (1960). *Word and Object*. MIT Press.

Quiñones, I., Amoruso, L., Gastelu, I. C. P., Gil-Robles, S., & Carreiras, M. (2021). What Can Glioma Patients Teach Us about Language (Re)Organization in the Bilingual Brain: Evidence from fMRI and MEG. *Cancers, 13*(11).

Sapir, E. (1929). The Status of Linguistics as a Science. *Language, 5*(4), 207-214.

Scovel, T. (1998). *Psycholinguistics*. Oxford University Press.

Selinker, L. (1972). *Interlanguage*. IRAL International Review of Applied Linguistics in Language Teaching, 10, 209-231.

Shariatmadari, D. (2019). *Don't Believe a Word: The Surprising Truth About Language.* W. W. Norton & Company.

Skinner, B. F. (1957). *Verbal Behavior*. Appleton-Century-Crofts.

Slobin, D. I. (1971). *Psycholinguistics*. Scott, Foresman.

Sperry, R. W. (1982). Some effects of disconnecting the cerebral hemispheres. *Science, 217*, 1223-1226.

Spivey, M. J., McRae, K., & Joanisse, M. F. (Eds.). (2012). *The Cambridge Handbook of Psycholinguistics*. Cambridge University Press.

Steinberg, D. D., Nagata, H., & Aline, D. P. (2001). *Psycholinguistics: Language, Mind and World* (2nd ed.). Routledge.

Steinberg, D. D., & Sciarini, N. V. (2006). *An Introduction to Psycholinguistics* (2nd ed.). Pearson Education Limited.

The Brain Tumour Charity. (2019). *Speech and language difficulties: Living with a brain tumour.*

Thomas, M. (2010). Names, Epithets, and Pseudonyms in Linguistic Case Studies: A Historical Overview. *Names, 58*(1), 13-23.

Traxler, M. J. (2012). *Introduction to Psycholinguistics: Understanding Language Science.* Wiley-Blackwell.

Traxler, M. J., & Gernsbacher, M. A. (Eds.). (2006). *Handbook of Psycholinguistics* (2nd ed.). Elsevier.

Warren, P. (2013). *Introducing Psycholinguistics.* Cambridge University Press.

Whorf, B. L. (1959). *Language, Thought, and Reality: Selected Writings of Benjamin Lee Whorf.* The Technology Press of Massachusetts Institute of Technology and John Wiley & Sons.

Wierzbicka, A. (2009). The theory of the mental lexicon. In S. Kempgen, P. Kosta, T. Berger, & K. Gutschmidt (Eds.), *Die slavischen Sprachen/The Slavic Languages: An International Handbook of their Structure, their History and their Investigation*. (pp. 848-863). Mouton de Gruyter.

Wray, A. (2002). *Formulaic Language and the Lexicon*. Cambridge University Press.

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By the end of the course employing this textbook as an essential resource, the students will have gained substantial knowledge related to a number of linguistic, psychological, neurobiological, cultural, and pedagogical issues related to the human faculty for language. For these reasons, alongside numerous other benefits the book offers, I wholeheartedly recommend this manuscript for publication as it will undoubtedly benefit the intended audience in a number of ways.

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Reading this coursebook carefully, dedicated readers will benefit from its content in the way that it may serve as a guide towards a learning outcome: turning a reader who may know little or even nothing about psycholinguistics into a researcher enthusiastic about psycholinguistic research, ready to notice an important topic, set a hypothesis, test it by means of valid methods and come to a valid interpretation. Even to readers who might be less interested in a more in-depth study of psycholinguistics, reading this coursebook will help in the way that they may discuss issues raised by psycholinguistics in a competent manner.

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