Teaching Materials for Psycholinguistics

Compiled by:

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ENGLISH EDUCATION DEPARTMENT

UNDERGRADUATE PROGRAM

FACULTY OF TEACHER TRAINING AND EDUCATION

HKBP NOMMENSEN UNIVERSITY

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This handout is complemented by related theories to enrich the explanations of psycholinguistics to students. The materials are compiled to 11 subjects of discussion, they are:

1. Introduction: What Is Psycholinguistics?
2. The Biological Basis of Language (Fernández and Cairns 2010:70)
3. Language and Brain
4. Information Flow and Language Ambiguity
5. The Acquisition of Language
6. The Speaker: Producing Speech
7. The Hearer: Structural Processing
8. Remembering Sentences, Processing Discourse, and Having Conversations (Fernández & Cairns, 2011).
9. The Hearer: Speech Perception and Lexical Access (Fernández & Cairns, 2011)
10. The Production of Utterances (Hormann, 1986, p. 201)
11. Understanding Speech, Understanding Speakers (Hormann, 1986)

1. Introduction to Psycholinguistics

Beginning Concepts

What is be like if humans do not have language? Imagine how you will order breakfast, ask someone to do a favor, and ask a friend to drive you to school. Can you imagine where you would be or how you would be now if there was no language in this world? Language serves a central role in our daily lives because no language means no life. Language is everywhere in human society, across every culture. It is an effortless ability that most people acquire before they learn how to dress. Fernández & Cairns (2010) stated that Language is a system that allows people immense creativity. This is not the same creativity as people who write essays, fiction, or poetry. Instead, this is the linguistic creativity that is commonplace to every person who knows a language. Human language's creativity is different from any other animal's communication system in several respects. For one, speakers of a language can create and understand novel sentences for an entire lifetime. Consider the fact that almost every sentence that a person hears every day is a brand-new event not previously experienced, but which can be understood with little difficulty. Similarly, people constantly produce novel sentences with no conscious effort when speaking. This is true for every person who speaks or has ever spoken a language. We can extend this observation to every person who uses signed language to produce and comprehend novel sentences.

As the name implies, psycholinguistics has two important things that are related to each other; psychology and linguistics. Cowles (2011, p. 9) stated that linguistics is the scientific study of language whereas psychology is the scientific study of human behavior and cognition (i.e., how we think). Some people feel that they even think using language, that an important part of their thoughts involves a kind of internal monologue.

Fernández & Cairns (2010) define psycholinguistics as an interdisciplinary field of study in which the goals are to understand how people acquire language, how people use language to speak and understand one another, and how language

is represented and processed in the brain. Psycholinguistics is primarily a sub-discipline of psychology and linguistics, but it is also related to developmental psychology, cognitive psychology, neurolinguistics, and speech science.

Yet, language is not a simple thing—it is quite complex and we need to be able to use it quickly. Its timing is so crucial that even minor delays during the processing of language are thought to have profound consequences. So, by understanding how language works and how we can use it, we can understand a vital yet complex part of our daily lives offer ideas for how to help people with language disorders, and perhaps even shed light on how we think.

Let's start with an analogy—walking around is also pretty easy for most people and it is something that we usually learn to do even before we learn how to talk. But can you explain exactly how it works—how each muscle, bone, and tendon allow us to defy gravity at every step? It's easy to do but hard for a layman to explain how it works—instead, it takes an army of biologists, physiologists, and others to explain this "easy" skill. Language is very much the same—its function is easy to master (when you're young), but hard to explain. And, like walking, we have a lot to gain by understanding it. Language is considered as meaning-making resources (segala sesuatu yang memungkinkan kita untuk bisa berkomunikasi). Haliday:2004, p.4). Language is used to express meanings and perform various functions in different contexts and situations in our daily lives. Grammar is 'how a language is organized.' Furthermore, when we talk about someone's internalized grammar, the term grammar is used in a broader sense than the grammatical meaning we find in various textbooks. System language refers to a person's overall knowledge of the language. Grammar is not only a matter of sentence structure but also phonology and semantics.

The study of the properties of language can be divided up into roughly five, somewhat overlapping categories: sound system, word structure, sentence structure, meaning, and real-world use. We will focus primarily on the first three because in these cases, the insights from linguistics have been directly relevant to

psycholinguistics. However, we will also briefly discuss the meaning and real-world use and the major issues to consider in these areas.

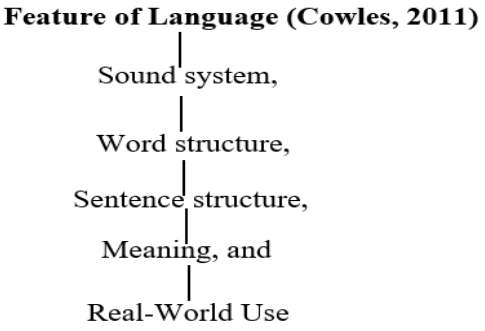


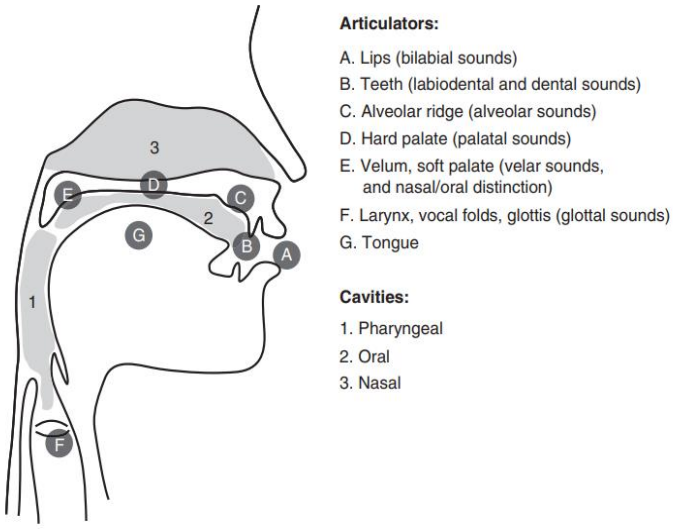
Figure 1.1 Feature of Language

In spoken languages, **segments are sounds**—each language has a set of sounds that are produced by changing the positions of various parts of the vocal tract. There are two important aspects to these segments: first, they have no independent meaning. The second important thing to know about sound segments is that they cannot be combined in any old way—they are governed by rules that are specific to each language. The sound system of language is studied in two main parts: phonetics is the study of the actual sounds in a language and how they are produced, whereas phonology is concerned with how sounds are mentally categorized and the rules that govern how they are combined (Cowles: 2011, p. 19).

Phonetics

It is those sounds associated with speech – also called phones – that are the object of study for phoneticians. Speech sounds are studied from two different general perspectives: articulatory phonetics is concerned with how the vocal tract is configured when a particular speech sound is made; acoustic phonetics is the study of the characteristics of the sound wave associated with a particular speech sound. Hormann (1986, p.52) stated that if one wants to describe speech sounds, one must first establish what one sound is: in the continuous flow of language, where does one sound begin, and where does this sound end? One must also establish which criterion to use to decide that "these two sounds are identical, these two are different." One faces the question of what should be taken as a unit of sound.

To answer this question, we have to decide on what level our description should operate. Theories in this area have at least two levels of representation: a level on which the sounds are described as detailed and as concrete, a fashion as possible (called phonetics), and a more abstract level where the variance encountered on this first level is reduced to "what counts" (called phonology).



Adapted from Fernández & Cairns (2011, p.30)

Figure 1.2 Diagram of the vocal tract, identifying the organs involved in producing speech (articulators) and the spaces in which speech sounds resonate (cavities).

The diagram in Figure 1.2 identifies the key organs in the vocal tract involved in the production of speech sounds. To classify speech sounds based on their articulatory properties, the first characteristic to consider is voicing (also called phonation). An important organ in the production of speech sounds is the larynx, which houses the vocal folds, two folds of flesh around an opening called the glottis. When the vocal folds are brought together and the air is forced through them, they come apart and back together ("vibrate") very rapidly, creating a sound. Sounds produced with vibration of the vocal folds are voiced, compared to voiceless sounds, which involve no such vibration and are produced by drawing apart from the vocal folds. Notice that when you whisper, you are de-voicing all sounds by separating your vocal folds to prevent them from vibrating. Compare the final

sounds in the words hiss and his, or the beginning sounds in sue and zoo. The first in each pair is voiceless, the second is voiced.

Phonology

Phonology sets the limits for how a speaker is permitted to articulate what he has to say and the limits on the sound variations a listener can expect to hear incomprehensible speech. Phonemes signal differences in meaning. They, however, have as yet no meaning. The genius of all human languages is that they take meaningless sound units and combine them in regular ways to produce meaningful units like words and sentences. (There is a parallel to this in signed languages: the gestures that when combined make up a meaningful sign language words and sentences are by themselves essentially meaningless. Even signed languages have something very much like a phonological component, guiding the rhythm and intensity of gestures and providing cues to the information structure of a sentence – like whether the sentence is a question or a statement.) The phonology of a language is the component of the grammar that specifies what sound units the language uses to make words, and how those sound units are combined into syllables, words, and intonational phrases. The phonological component plays four key roles:

- it specifies the language's phonemic inventory;
- it adds predictable phonetic details by the application of phonological rules;
- it specifies the language's phonotactic constraints; and
- it supplies prosody.

2. The Biological Basis of Language (Fernández and Cairns 2010:70)

While physics and chemistry are referred to as the "hard" sciences and psychology and similar fields are considered "soft" sciences, it is quite hard to study almost any aspect of human cognition. we process language on the order of milliseconds and we simply don't have conscious access to the action behind the scenes. In short, we can't just ask people how they do it. We in the "soft" sciences are stuck with the hard job of doing science on something hard to see—a moving target, through a glass darkly.

No other species has a communication system like the language used by humans. There are two ways to approach this claim. One is rather obvious: no other animals talk, nor do any other animals have a gestural system with the organizational structure of human language. The other way to address this issue is to ask whether other animals can be taught a human communication system. You have undoubtedly heard of experiments in which researchers have attempted to teach a form of human language to apes. That sort of experimentation is designed to test the claim that human language is species-specific: if other species could learn human language, then human language would not be species-specific. Primates do not have vocal tracts like those of humans, so the approach has been to teach them communication that involves gestures or manipulated objects. Importantly, no animal has been able to learn a creative syntactic system. For example, Washoe, the chimpanzee, learned more than a hundred individual words and could combine them communicatively to request food or play. She did not, however, order them inconsistent ways to convey meaning, nor was there any evidence that her utterances had any kind of structural organization.

The second criterion--that a biological system must be universal to all members of the species – is met by language in two ways. First, all human babies are born with a brain that is genetically prepared to organize linguistic information; thus, the

psychological processes involved in both acquiring and using language are at play, no matter the person. Secondly, all human languages have universal properties. There are close to 7,000 languages spoken in the world today and, on the surface, they differ greatly. However, there are profound similarities among the languages of the world – so many similarities, in fact, that human language can be thought of as a single entity. Language universals embrace and unify all human languages. These universals do not derive from the social, cultural, or general intellectual characteristics of humans. Instead, they result from the way the human brain organizes and processes linguistic information: language universals are a product of human neurology. Thus, a person's ability to acquire and use language is as natural as a person's ability to walk or a bird's ability to fly. Thinking of language in this way is similar to the way we think about having hair or walking bipedally, two aspects of being human that are rooted in our biology.

The third criterion is about how biological systems consist of processes that are differentiated (develop) spontaneously as the individual matures. This has two correlates in language acquisition: language does not need to be taught, and acquisition cannot be suppressed. Language acquisition in the child is a naturally unfolding process, much like other biologically based behaviors such as walking. Every normal human who experiences language in infancy acquires a linguistic system, and failure to do so is evidence of some sort of pathology. Contrary to the belief of many doting parents, language is not taught to children. The fact that children need to hear language to acquire it must not be confused with the claim that children need specific instruction to learn to speak. It is probably the case, however, that children need to experience social, interactive language to acquire language.

The fact that language learning cannot be suppressed is yet another manifestation of the biological nature of language. If language were more bound to the particular types of linguistic experiences a child has, there would be much greater variation in the speed and quality of language learning than is observed. People acquire language at about the same speed during about the same age span,

no matter what kind of cultural and social situation they grow up in. Children from impoverished circumstances with indifferent parental care eventually acquire a fully rich human language, just as do pampered children of affluent, achievement-oriented parents. The biologically driven processes of language acquisition even drive the creation of new languages.

3. Language and the Brain

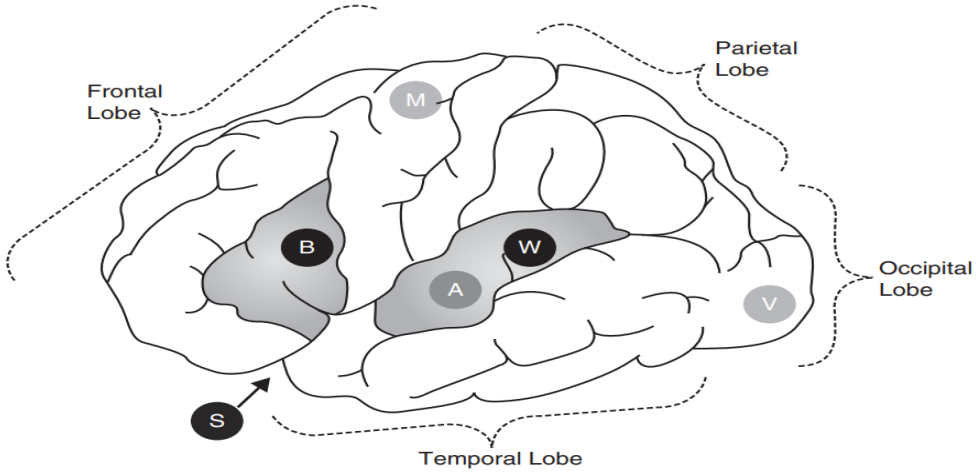
Sedivy (2020) listed that the human brain weighs 1300 to 1400 grams but contains about 100 billion neurons (nerve cells). 'The mind' is a collective activity of parts or regions of the brain. Broadly speaking, the human brain system can be divided into three, namely:

(1) Cerebrum,

(2) Cerebellum,

(3) Brain stem. The most important part of the brain in language activities is the cerebrum.

The part of the cerebrum that is directly involved in language processing is the cerebral cortex. The cerebral cortex is the part that looks like white lumps and is the largest part of the human brain system. This section regulates or manages cognitive processes in humans, and one of them of course is language. Some clues can be gleaned from the more obvious physical structure of the brain. For example, the left and right hemispheres are largely physically separate from each other, so it seems reasonable to ask whether the two sides do different things. More subtle clues can be discerned by looking at brain tissue under a microscope; if two different regions of the brain have a different cellular makeup, this suggests that they may take on somewhat different tasks. But even today, the connection between the structure of brain tissue and the functions those tissues serve is far from clear. The brain poses significant challenges simply because it’s a physical object whose function is not easily understood from its anatomical form. This fact is a big reason why an understanding of the brain has historically lagged far behind our understanding of the other organs in the human body.



(Adapted from Fernández and Cairns, 2011: p.83)

Figure 3.1 Diagram of the left hemisphere of the human cerebral cortex (side view). The diagram indicates the location of the primary language areas (Broca's and Wernicke's areas, 'B' and 'W', and the Sylvian fissure 'S'), as well as the approximate areas recruited for motor (M), auditory (A), and visual (V) processing.

Figure 3.1 provides a sketch of the left hemisphere of the cortex of the brain, with Broca's and Wernicke's areas indicated. Broca's area is located near the motor area of the cortex, while Wernicke's is near the auditory area. Importantly, despite the proximity of these areas to motor and auditory areas, aphasias are purely linked to language, and not to motor abilities or audition. Users of signed languages can also become aphasic if they experience damage to the relevant areas in the left hemisphere. Their signs are non-fluent, halting, and agrammatic. This is true, even though they have no motor disability in their hands and can use them in everyday tasks with no difficulty (Poizner, Klima, and Bellugi 1987). The fact that signers become aphasic is a dramatic confirmation of the fact that signed languages not only have all the formal properties of spoken language but are similarly represented in the brain. It also demonstrates that the neurological damage that produces aphasia impairs language systems, rather than motor systems.

Hemispheric structure and function

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

a connection with one another through a bundle of fibers 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. The cortex 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 denser 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. As we shall see later, other hemispheric-specific functions 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 Steinberg & Sciarini (2006, p.243).

Left and Right Hemispheres Control Opposite Sides of the Body

The brain controls the body by a division of labor, so to speak. The left hemisphere controls the right side of the body, including the right hand, the right arm, and the right side of the face, while the right hemisphere controls the left side of the body. Those who have suffered a cerebral haemorrhage, commonly called a ‘stroke’, provide clear examples of how this kind of cross-over control operates. A stroke in the right hemisphere of the brain will affect victims on the left side of the body. Thus, they can lose control over the muscles in the left hand, left leg, and the

left side of the face (including that side of the tongue and mouth). A stroke to the left part of the brain will similarly affect the right side of the body.

The process of language birth witnessed in the case of Nicaraguan Sign Language resembles the process through which pidgins turn into creole languages. A pidgin is a communication system consisting of elements from more than one language. A pidgin emerges in situations of language contact when people who speak different languages come up with ways to communicate with each other. Pidgins have a simplified structure and a lexicon consisting of words from the various languages of their speakers. Importantly, a pidgin has no native speakers: its users have learned the communication code as adults, and their ability to use it will be uneven. When the pidgin becomes nativized – that is, when children begin to acquire it as their native language – the grammar stabilizes and becomes more complex, the lexicon grows, and the language is on its way to becoming a creole.

Hemispheric Dominance

Typically, the left hemisphere dominates the right Now, even though the hemispheres of the brain divide the labors 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 (p.245).

4. Information Flow and Language Ambiguity

Despite the obvious desire for language to be clear and easy to understand, language is often ambiguous. It is so often ambiguous that this bears repeating: Language is often ambiguous. What does this mean? Take the following sentence:

1. I went down to the bank yesterday. So, where did I go yesterday?

Did I go to a place where money changes hands, or did I go to a place where water flows nearby? Now, you might (correctly) object that this sentence is unfairly out of context and that in any real-world situation the hearer would know exactly which "bank" the speaker meant. Certainly, context can and does help in the final interpretation of the meanings of words, but researchers have been especially interested in the processing of language as it unfolds over time, and so while context is involved in coming to the correct final interpretation of a word (or sentence), a major question concerning information flow has been about what happens in those first moments when you encounter a word. In particular, which meanings immediately become activated? The context might help in this case, but the key question is, when? And what about when there isn't any context? What happens if I come up and just say "bank"? Ambiguity isn't limited to single words, either. As we saw in chapter 2, sentences have structure beyond the linear order of the words in them. And, it turns out that sometimes the same string of words can have more than one possible structure. Take the following:

2. I watched the man with the binoculars.

So, according to this sentence, who had the binoculars? Me? The man? Both are possible. What researchers have wanted to know is how people initially interpret this sentence when there isn't any context and whether this interpretation changes when there is context. Finally, the thing that makes sentences particularly ambiguous is the fact that sentences can have more than one possible syntactic

structure temporarily, for some brief period during the sentence itself, but that by the end of the sentence only one structure is possible. For example:

3. The florist who sent the flowers was very pleased.

Here, the sentence has one and only one syntactic structure by the end—in which the florist is the subject and was very pleased is the predicate. In the middle, we have sent the flowers, which is a clause that gives more detail about the florist (it is a reduced form of "who was sent the flowers"). However, there is a moment in the sentence when this final structure is not the only possible one—for a moment there, sending the flowers could be the predicate of the sentence, not just a clause that gives more detail. The question this kind of ambiguity poses is: Does the language processing system notice the temporary ambiguity? If it does, how does the system handle it?

5. The Acquisition of Language

"Small children learn their language by first determining what the adult means independent of language, and then by working out the relationship between what is meant and what is said" MacNamara (1972). Language acquisition, according to Fernández and Cairns (2010), is one of the most fascinating facets of human development. Children acquire knowledge of the language or languages around them in a relatively brief time, and with little apparent effort. This could not be possible without two crucial ingredients: a biologically based predisposition to acquire language, and experience with language in the environment. All children pass through similar stages of linguistic development as they go from infancy through middle childhood.

Language is a tool, an instrumental auxiliary, by means of which one person can communicate something about something to someone. When someone hears a pattern sound and says to another ‘be aware of the bull”, there are three points which establishes relationship:

• to the one who says it

• to the one who hears it

• to what is being spoken about.

Hormann (1986:82) stated that if we want to understand the conversation of two people in a foreign language, the analysis can follow three "lines of sight": we can place the linguistic patterns in relation to what is happening in the environment (whenever it rains, he produces these sounds); we can place them in relation to the speaker (whenever he is afraid, he produces these sounds); or we can place them in relation to the way the listener reacts (whenever he hears these sounds, he comes over here). In the first case, the pattern of sounds is seen in its representational function, that is, as symbol; in the second case it is taken as an expression or symptom, and in the third case as a signal which makes an appeal to the receiver.

A new function of language is touched on: that of constituting objects. It was emphasized by Humboldt (1963) (and after him by many others): "Language is the producing organ of thought." not the *re*producing. Thus we must now ask. In which way does a sign "have" "its" meaning? Is the word table a name tag, so to speak, which the object table always wears around its neck, and by saying it we can call it up, call it into consciousness? Definitely not, because we can. according to the situation. also call it a "low thing" or "the ugly thing" or the "wooden thing" or only "that thing"-how many meanings does the object wear around its neck like a name? (Hormann, 1986:83).

To answer that question, Hormann (1986) proposed the answer through this example. The word love means something because the speaker means something by it. It develops its function or action as a sign only at the time of its use by the speaker. We cannot separate sign from its use. An utterance is only a sign if and as long as it is intended by the speaker in a certain way. The intention of the speaker, his intentions with respect to the listener, makes the sign a sign. The listener understands what the speaker means if he is successful in realizing that a warning is intended with the spoken words, "Careful, the dog bites." Understanding assumes that we realize that a sound or a combination of sounds is meant, is intended as a sign. Hormann added that the understanding of an utterance in language already assumes a certain preunderstanding-one that is still uncertain, undecided, only a frame, which is not yet completely determined-which is then differentiated and made precise by the meanings of the words actually used, by the structure of the message, and by many other things. This recognition of the intention of the speaker also presents the basis for the acquisition of language by the small child.

Developmental Stages (Fernandez and Cairns, 2010)

From before birth to 12 months

An important accomplishment that takes place over the baby’s first year is the identification of the phonemic inventory for the language being learned. The target set of phonemes will be a subset of all the possible sounds that exist in the

world's languages. Logically, the infant must approach this task by being able to discriminate all sorts of different phonemic contrasts, whether or not they are present in the environment. Studies measuring brain activity by using event-related brain potentials (ERPs) have demonstrated that infants as young as 2 months are able to discriminate many phonemic contrasts, including vowel and consonant duration, and vowel and consonant articulation (Männel and Friederici 2008).

Janet Werker and her colleagues (Werker and Lalonde 1988; Polka and Werker 1994; Werker and Tees 2002) have produced seminal findings regarding the phonemic discrimination abilities of babies in their first year. Werker's research serves as a metaphor for all language acquisition. Infants are born with the ability to acquire any language; then experience with the language of the environment allows them to acquire their target language. Many babies grow up with two or more languages in their environment. Bilingual language acquirers must, therefore, set two or more phonemic inventories. There is a growing body of research demonstrating that, in order to distinguish between the languages in the environment, bilingual infants rely on phonetic information that they extract from the input (Werker and Byers-Heinlein 2008).

Imitation

There is a common statement which tells that the child learns to speak by imitating what he or she hears adults saying. Hormann listed some theories that raised a serius objection to this statement:

• If imitation were the decisive factor, then the words and structures that occur especially frequently in the language of adults would have to be imitated earliest and acquired earliest. This is not the case (Brown 1973).

• The recognizable imitations of a child (the mother says something, the child repeats it) are almost without exception much more primitive than that which was first said. Sometimes a new word is repeated, but seldom is a new sentence structure imitated.

• The child often produces expressions which he could not have heard: *two dogses, come/corned, the mouses*-the child thus uses incorrectly rules that are correct in other instances! This means, though, that the child does not imitate what he has heard but rather forms hypotheses about the way one speaks correctly and then tries out these hypotheses. We will come back to this later.

Babbling

In the first half of the first year of life infants interact in a variety of ways with their caretakers, but their vocalizations are primarily soft coos and gurgles that are not at all like actual language. In the second half of the first year, true babbling begins. Babbling consists of single syllables at first, always consisting of a consonant and a vowel. Usually the consonant is a stop consonant and the vowel is /a/. At first the babbles will be strings of similar syllables, like baba baba. Later, the babbles will become more varied, e.g., baga bada. This type of babbling is called segmental babbling because the vocalizations sound like phonemic segments. The vocalizations also have sentence-like intonation, so the strings of babbles might sound like declarative or interrogative sentences made up of nonsense words. This is a very interesting stage of language development because as far as one can tell the babbles have no content. Hearing such a child, one sometimes has the sense that the child is trying to convey something meaningful, but in fact it is more likely that the child is playing with the sound structures of the language. During this period, children babble as much when they are alone as when they are with other people. Even though babbling is not used for communication, it may play a role in interactive "pretend" conversations.

From 12 to 24 months

Infants as young as 9 months can segment individual words from a string of speech and recognize them later (Aslin et al. 1996). However, it is not until between 12 and 18 months that children produce their first word. The first word is often indistinguishable phonologically from babble, but it is identifiable as a word because it has a consistent referent. The child will spend a few months in the one-

word stage of language, also called the holophrastic period, because each word conveys as much meaning as an entire phrase. The word milk, for instance, will not only be used to refer to milk, but it will also be used to request milk, to observe that the cat is drinking milk, that milk has been spilled, and so forth. Early vocabulary items tend to be those things that are very salient for the child, like toys and articles of clothing. Rarely would an early word be a large, stationary object like a refrigerator. Nor would the words be function words, except for perhaps up and down. The vast majority of early words are nouns. During this early one-word period, the twin phenomena of underextension and overextension are features of word use. Underextension is a case in which the child will acquire a word for a particular thing and fail to extend it to other objects in the same category. For example, if a child learned the word flower in connection with a rose and did not extend its meaning to other kinds of flowers, this would be an example of underextension. Overextension is more common, or perhaps it's just more noticeable. Overextension is when the child will extend a word incorrectly to other similar things. For example, a child might call all four-legged animals doggie, or everything that is bright light. This behavior is almost certainly not because children are unable to discriminate cats from dogs or light bulbs from lightning. It is because children just do not have a big enough vocabulary to use words very precisely.

A study by Fremgen and Fay (1980) demonstrated that children's overextensions in production do not carry over into a receptive task. Children who called all four-legged animals doggie were perfectly able to discriminate between dogs and cats in a picture-selection task. This suggests that such children have both cat and dog in their lexicons but have difficulty retrieving cat in speech production. When the child's vocabulary approaches about 50 words, two interesting things happen. The child starts putting words together to form rudimentary sentences. Words are learned more rapidly than before, so much so that most children are said to go through a vocabulary spurt, and the rate of acquisition of vocabulary increases dramatically. It has been estimated that a 6-year-old child has a vocabulary of about 8,000 to 14,000 words. Beginning with one word at 12 months, this means that the

child must acquire an average of four to eight new words every day during the preschool years (Carey 1978). This rapid acquisition of lexical items begins with the vocabulary spurt. A very interesting characteristic of spurting is fast mapping (Carey 1978), which occurs when a child hears a word once or twice, learns its grammatical class, but has only a vague sense of what it means. The child will then use the word in sentences, while gradually acquiring the full meaning of the word. For example, one of us has a stone cat in her living room, and a visiting child who was spurting said that the cat was shy. She had no doubt heard the word shy, probably applied to quiet children at her nursery school. The immobile cat, therefore, fit her fast-mapped meaning of shy. The result was a grammatical but amusing sentence.

The preschool years

As the child leaves the one-word stage, vocabulary development speeds up and children begin to combine words to form small sentences. Even at the earliest stages of combinatorial speech, it is obvious that syntactic principles govern the creation of the child's sentences. When children begin combining words, the resulting rudimentary sentences reflect the structure of the child's target language. English-speaking children obey word order very strictly, with subjects preceding verbs and verbs preceding objects (e.g., *Mommy push*, *Pull car*). Sentences can also consist of just a subject and an object (e.g., *Baby cookie*), but they always get the order right. Adjectives precede nouns (e.g., *Big doggie*), and the rare function word is correctly placed (e.g., *That kitty*).

Later Language Development

As children grow older, they develop much more proficiency with language. Their processing capacity increases and their ability to produce and interpret longer and more syntactically complex sentences improves. In fact, the ability to process difficult sentences, such as those with relative clauses described in the previous section, is related to reading ability in the early school years. Lexical learning

continues at a rapid rate, and around school age, children begin using derivational morphemes and the word combinations provided by derivational morphemes.

A child's interpretation of sentences also changes in later childhood, making it appear that there are changes in the child's syntactic knowledge. It is probably the case, however, that much of this change is due to increased knowledge about the grammatical characteristics of lexical items and an enhanced ability to create grammatical structures. Both these factors probably account for the observation that it is not until later childhood that children develop adult interpretations for sentences that contain clauses that appear to be missing subjects, like the following examples:

a. John met Mary before seeing the show.

b. John invited Mary to see the show.

In both sentences, the subject of see is not stated and must be inferred from the sentence structure. In (8a), John will see the show; in (8b), Mary will see the show. Young children, however, interpret both sentences as meaning that Mary will see the show. The adult interpretation of such sentences depends on detailed knowledge of the properties of verbs and subordinating conjunctions, and of the structures those properties require. It is such knowledge that probably develops in later childhood.

6. The Speaker: Producing Speech

The processes that underlie the production and comprehension of speech are information processing activities. The speaker's job is to encode an idea into an utterance. The utterance carries information the hearer will use to decode the speech signal, by building the linguistic representations that will lead to recovering the intended message. Encoding and decoding are essentially mirror images of one another. The speaker, on the one hand, knows what she intends to say; her task is to formulate the message into a set of words with a structural organization appropriate to convey that meaning, then transform the structured message into intelligible speech. The hearer, on the other hand, must reconstruct the intended meaning from the speech produced by the speaker, starting with the information available in the signal.

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 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 suitable prosody. There are several steps to this process, each associated with a distinct type of linguistic analysis and each carrying its particular type of information. The figure below summarizes, from left to right, the processing operations performed by the speaker.

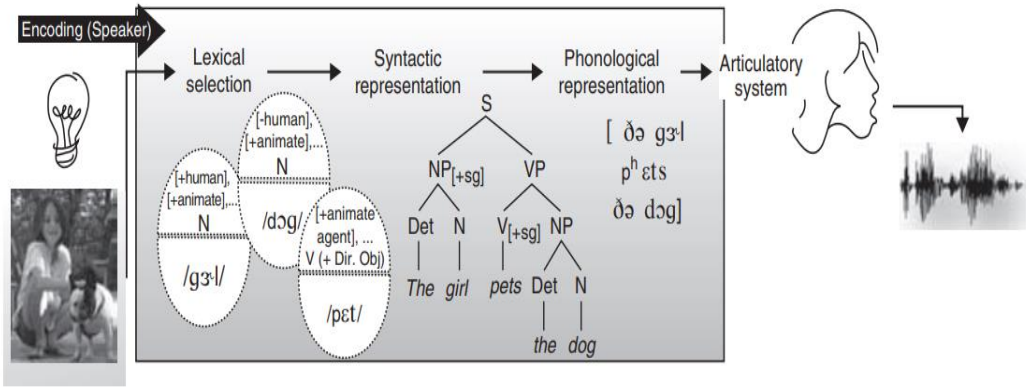


Figure 6.1 Diagram of some processing operations, ordered left to right, performed by the speaker when producing the sentence "*The girl pets the dog"*. (Fernández, 2011: 136).

The first step is to create a representation of a sentence's meaning that will convey the speaker's intended message. This semantic representation triggers a lexical search for the words that can convey this meaning. (In Figure 5.1, the words girl, dog, and pet are activated). The meaning of a sentence is a function of both its words and their structural organization (The girl pets the dog does not mean the same thing as "The dog pets the girl"), so another encoding stage involves assigning syntactic structure to the words retrieved from the lexicon. This process places the words into hierarchically organized constituents. Morphosyntactic rules add morphemes to satisfy grammatical requirements – for example, the requirement that a verb and its subject must agree in number. A phonological representation can then be created, "spelling out" the words as phonemes. Phonological and morphophonological rules then apply to produce a final string of phonological elements. This phonological representation will specify the way the sentence is to be uttered, including its prosodic characteristics. The final representation incorporates all the phonetic detail necessary for the actual production of the sentence. In this representation phonological segments are arranged in a linear sequence, one after the other, as if they were waiting in the wings of a theatre preparing to enter the stage.

■ Planning Speech Before It Is Produced

Producing a sentence involves a series of distinct operations and representations: lexical, syntactic, morphological, and phonological. The following sections discuss some of the evidence that has led researchers to posit these different levels of production planning.

As mentioned above, the process of language production begins with an idea that is encoded into a semantic representation. This sets in motion a process called lexical retrieval. Remember that a lexicon is a dictionary of all the words a speaker knows. A lexical entry carries information about the meaning of the word, its grammatical class, the syntactic structures into which it can enter, and the sounds it contains (its phonemic representation). A word can be retrieved using two different kinds of information: meaning and sound. The speaker retrieves words based on the meaning to be communicated and has the task of selecting a word that will be appropriate for the desired message. The word must also be of the appropriate grammatical class (noun, verb, etc.) and must be compatible with the structure that is being constructed. It is most certainly not the case that the structure is constructed before the words are selected, nor are all the words selected before the structure is constructed. The words and the structure are so closely related that the two processes take place practically simultaneously. Ultimately, the speaker must retrieve a lexical item that will convey the correct meaning and fit the intended structure. This means that a speaker must enter the lexicon via information about meaning, grammatical class, and structure, only later to retrieve the phonological form of the required word. The hearer's task, which will be discussed in detail in the next chapter, is the mirror image of the speaker. The hearer must process information about the sound of the word and enter his lexicon to discover its form class, structural requirements, and meaning. Important psycholinguistic questions concern the organization of the lexicon and how it is accessed for both production and comprehension.

The speed of conversational speech varies by many factors, including age (younger people speak faster than older people), sex (men speak faster than women), nativeness (native speakers are faster than second-language speakers), topic (familiar topics are talked

about faster than unfamiliar ones), and utterance length (longer utterances have shorter segment durations than shorter ones); on average, though, people produce 100 to 300 words per minute (Yuan, Liberman, and Cieri 2006), which, at the lower end, is between 1 and 5 words (or 10 to 15 phonetic elements) per second. (Notice that this includes the time it takes to build syntactic and phonological representations and to move the articulators, not just time spent in lexical retrieval.) The process of accessing words is extremely rapid.

Words are also organized by their meaning, so close associates are stored near one another. Speech errors can give some insight into this meaning-based organization. It is extremely common for a word retrieval error to result in the selection of a semantically and structurally similar word.

■ Building simple sentence structure

A mind is exquisitely adept at relating syntactic structure to meaning, able to compute the meanings of long, complex sentences, even those containing numerous clauses nested within each other, and encoding intricate relationships among their elements, of which this particular sentence is an excellent example (Sedivy, 2020).

sentence processing happens in two stages: an initial structure building stage in which the only information that is used is syntactic, and then a second stage in which the structure is checked against semantic and pragmatic information. Importantly, only one structure is constructed in the first stage, even if others are possible. Then, if the structure is subsequently incompatible with further syntactic information, or semantic or pragmatic information, the structure is revised in the second stage. The crucial part of this model, and what distinguishes it from other models, is this first stage. If the words coming in came from more than one structure, but the processing system (or parser) only builds one structure, a good question is what structure does the parser build, particularly because according to the model, no semantic or pragmatic information is available at this point during processing. The garden path model has two key principles that apply to how words are initially attached to the sentence structure: minimal attachment and late closure. Let’s start with minimal attachment first.

Very simply put, minimal attachment says “keep it simple.” This means that incoming words should be attached to the current sentence structure using as few “nodes” as possible. This is an excellent time to remember that linguists don’t agree yet on the best way to characterize syntactic structures, and so this part of the model is somewhat tricky if one tries to apply current syntactic theory to it. But, using a simplified version of syntactic structure building, we can see how this principle can apply during processing. Let’s take the beginning of the following sentence shown with two possible structures in Figures:

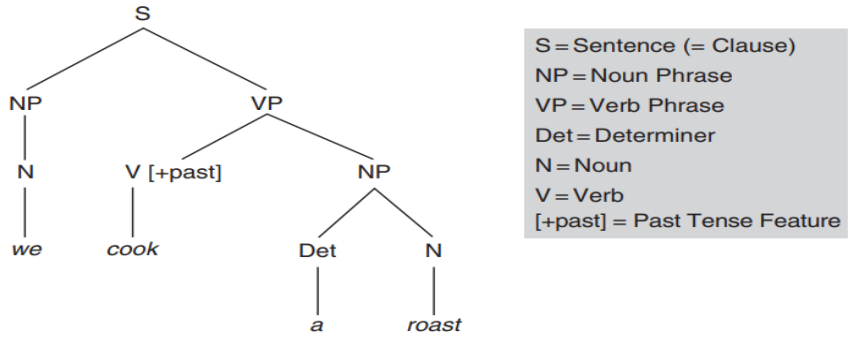


Figure 6.2. Representation of a past tense morpheme before the application of morphophonological rules (Fernández and Cairn, 2020:146).

7. The Hearer: Structural Processing

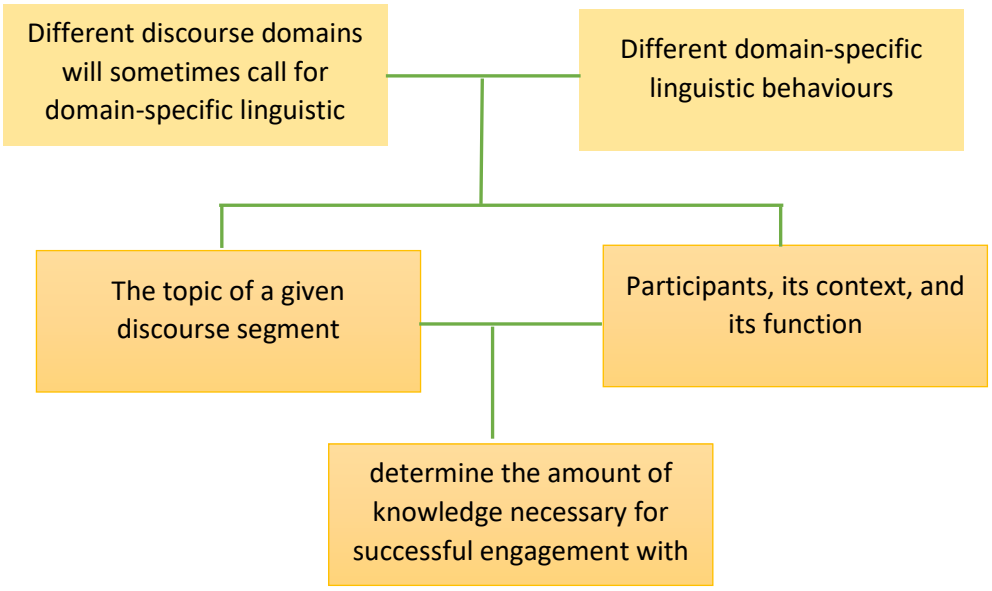
Sentence comprehension is considered from a syntactic point of view means that readers and listeners work out the grammatical structures of the sentences they read or hear, without reference to meaning. It was noted that the explicit marking of grammatical structure through function words and grammatical endings facilitates sentence comprehension.

Identifying the syntactic relations between the perceived set of words is the essential next step, which eventually leads to recovering the basic meaning the speaker intended. Reconstructing the structure of a sentence, the focus of this chapter is a job undertaken by the structural processor or parser. Recall the parsing strategies approach is fundamentally syntax-driven. Some proponents of this approach are that syntax (sentence constituent structure) is logically independent of semantics (meaning, including sentence meaning). Fernández and Cairns (2010:205) stated that a review of the basic operations of the syntax will assist in understanding the operation of the parser:

- it creates basic structures;
- it combines simple sentences into complex ones; and
- it moves elements of sentences from one structural position to another.

The parser needs to identify the basic components of sentences (elements like subjects and predicates, prepositional phrases, relative clauses, and so on). It can only do this if it is able to dismantle complex sentences into simple clauses. And it must also be able to identify elements that have been moved and link them up with the gaps they left behind in their original structural positions. In the sections that follow, we explore what psycholinguists have discovered about the way the parser builds structure during sentence processing. We first take on the question of the psychological reality of sentence structure and provide evidence for the claim that the clauses that make up complex sentences are processed as individual units. We then discuss how studying structural ambiguities has shed light on how the parser operates, examining some of the basic strategies the parser follows when building syntactic structure. We then consider the different types of information that the parser can exploit to determine the syntactic relations among words.

8. Remembering Sentences, Processing Discourse, and Having Conversations (Fernández & Cairns, 2011. p. 235)



The figure above can be explained as this: in both semantics and pragmatics, the term discourse is used to refer to sets of sentences that have some sort of connection to each other. Other terms used to refer to the same concept (by linguists, psycholinguists, and scholars in a number of other fields) include text and narrative. When people engage in sustained linguistic interaction, they are creating discourse. Letters, emails, stories, lectures, meetings, debates, instant messaging sessions, and face-to-face conversations are all examples of types of discourse. The primary objective in such exchanges is usually to communicate, to transmit information; we will see later in this chapter that sometimes the primary objective is to socialize or bond.

Different discourse domains will sometimes call for domain-specific linguistic behaviours. For example, you probably talk to your friends differently than the way you talk to your professors. If you speak more than one language, you also probably have a very good sense about which of your languages is the best one to use, depending on your interlocutor (i.e., the person you are talking to), the topic

of the conversation, the reason for your interaction, and so on. The discourse domain will also dictate the way to express certain elements within a discourse that might not be domain specific.

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Discourses are different based on the domains, the topics, the participants, contexts, and function. Different discourse domains will sometimes call for domain-specific linguistic behaviors. For example, you probably talk to your friends or to your parents differently than the way you talk to your professors or to your manager. If you speak more than one language, you also probably have a very good sense about which of your languages is the best one to use, depending on your interlocutor (i.e., the person you are talking to), the topic of the conversation, the reason for your interaction, and so on. The discourse domain will also dictate the way to express certain elements within a discourse that might not be domain specific. For example, both an instant messaging session and a business letter are expected to have elements to indicate when the discourse is coming to a close, but it would be very strange to close an instant messaging session with *My beloved professor*, and it would be equally odd to close a business letter with an abbreviation (something like TTYL with emoticon :).

The topic of a given discourse segment – as well as its participants, its context, and its function – will determine the amount of knowledge necessary for successful engagement with it. Think of the types of sentences you are likely to encounter while reading a passage about particle physics, or the current baseball season, or phonological representations. The sentences in each passage will necessarily include domain-specific terminology (e.g., gluon, shortstop, phoneme), and will likely use or allude to domain-specific extra-linguistic symbols (e.g.,

diagrams of sub-atomic particles, hand gestures used by umpires, syllable structure trees).

Understanding discourse – be it written or spoken – is linked only minimally to the words we might be looking at or listening to, though it goes without saying that being able to process individual words and individual sentences is an absolutely necessary prerequisite for the type of processing we will discuss in this chapter. The information we extract from those printed or spoken words becomes represented mentally in an elaborate matrix of existing knowledge, attitudes, and emotional biases we might have about the topic, the writer or speaker, the reason we are reading or conversing, and so on. To understand discourse, we take the basic meanings of the individual sentences and integrate them into a coherent framework by discovering the links between and among the meanings of the sentences that make up the discourse. This goal requires an intricate orchestration of a number of different processes, which include committing elements of the preceding sentences to memory, finding references for anaphoric elements in current or upcoming sentences, and building inferences. The sections that follow address each of these processes in turn.

Memory for sentences

Three important things happen to sentences when they get stored in long-term memory. First, information about structure and even individual lexical items is lost, while meaning is retained. Second, meanings of many sentences are combined, so individual sentences no longer have independent representations. Third, inferences are added to representations of meaning. Any human-to-computer analogy for memory stops working at this point. Here is the analogy: when you save a word processing document, or a sound clip, or an image file on your computer's hard drive – its long-term memory – it is saved in an intact form, and it does not change while it is in long-term storage (unless malware corrupts or destroys your files). If computers worked like human long-term memory, a document you saved yesterday and will not open until tomorrow could be altered by a document you create today. A well-known early experiment on memory for sentences demonstrated that information about form (structure) is not retained, while

information about content (meaning) is. Participants listened to a narrative containing the sentence in (3), followed by a probe sentence, one of the three sentences in (4); participants were to judge whether they had heard the probe sentence in the narrative.

(3) He sent a letter about it to Galileo, the great Italian scientist.

(4) a. He sent a letter about it to Galileo, the great Italian scientist.

b. He sent Galileo, the great Italian scientist, a letter about it.

c. Galileo, the great Italian scientist, sent him a letter about it.

To respond to the probes, participants in the experiment would have to search their memory representation of the narrative, attempting to match the probe with part of that representation. Notice that the first probe is identical to the sentence that actually appeared in the passage; the second probe changes the structure, but not the meaning; the third probe changes both the structure and the meaning. Participants tested immediately after hearing the sentence in the passage were very accurate at identifying only (4a) as having been heard in the passage. However, participants who were tested after a brief time interval (less than a minute) would report having heard both (4a) and (4b), suggesting that they did not retain the exact form of the sentence in memory, but held on to the meaning.

The conclusion is that there is compelling evidence that, when people are asked to recall a sentence heard just a few moments before, the sentence is regenerated rather than merely recalled verbatim; in other words, people use active lexical representations plus sentence production mechanisms to reconstruct the syntax of the recalled sentence.

Discourse Processing

The goal of discourse integration requires at least two major processes: anaphoric reference and inference. An anaphor is a linguistic device that refers to someone or something that has been mentioned in the previous context (to avoid repetition). Pronouns are anaphors because they cannot be interpreted without locating an antecedent for them; they have no independent meaning, except as indicated by their gender, number, or case, all given by their grammatical form. Yule (1989:19) stated that it is tempting to think of anaphoric reference as a process

of continuing to identify exactly the same entity as denoted by the antecedent. In many cases, that assumption makes little difference to the interpretation, but in those cases where some change or effect is described, the anaphoric reference must be interpreted differently. In example 95), from a recipe, the initial referring expression ‘six potatoes’ identifies something different from the anaphoric pronoun ‘them’ which must be interpreted as ‘the six peeled and sliced potatoes.’

(5) Peel and Slice six potatoes. Put them in cold salted water.

There is also a reversal of the antecedent-anaphor pattern sometimes found at the beginning of stories, as in example (6).

(6) I turned the corner and almost stepped on it. There was a large snake in the middle of the path.

Note that the pronoun ‘it’ is used first and is difficult to interpret until the full noun phrase is presented in the next line. This pattern is technically called as cataphora, and is much less common than anaphora.

Another major process to the goal of discourse integration requires at least: inference. Memory for sentences – and memory for just about everything else – is enhanced by inferences, which are stored in memory alongside information extracted directly from sentences that were actually experienced. The formation and storage of inferences is a central feature of discourse processing. Even the shortest stretches of discourse require the reader to make inferences in order to connect the sentences into a coherent structure. Inferences are also involved in the location of referents for anaphors. Reference is clearly tied to the speaker’s goals (for example, to identify something) and the speaker’s belief (e.g., can listener be expected to know that particular something?) in the use of language. Reference is an act in which a speaker, or writer, uses linguistic forms to enable a listener, or reader, to identify something. For successful reference to occur, we must also recognize the role of inference. Because there is no direct relationship between entities and words, the listener’s task to infer correctly which entity the speaker intends to identify by using a particular expression. This type of inference is illustrated in the following example, which requires an inference about the beer being part of the picnic supplies for coherent comprehension:

(7) We checked the picnic supplies. The beer was warm. Processing is facilitated or impaired depending upon the ease with which hearers will be able to make such inferences, and if too many inferences are required, the discourse can sound decidedly odd.

The bridging inference in (7) is easier than the one required to find the referent for the fire in (8), for him in (9), or for the woman in (10):

(8) A careless tourist threw a lighted match out of his car window.
The fire destroyed several acres of virgin forest.

(9) A: My daughter just got engaged.
B: Do you like him?

(10) We went to a wedding. The woman wore white.

Notice that sociocultural norms and the real-world knowledge of the interlocutors clearly impinge on the success (or failure) of inference making. This is evident for the discourse in (10), since not all brides wear white, and not all weddings have brides.

Inferences can do more than locate referents for definite noun phrases. They can also enhance their meaning. Consider the meaning of a noun phrase such as *the container*, which is a very general term with a non-specific meaning. When used in a sentence, though, the container can take on more specific meaning. Compare, for instance, '*The container held the soup*' with '*The container held the gas'*. By inference, the former is an open small bowl or cup whereas the latter is a closed large metal cylinder. In this example, participants heard a list of sentences, which included either (11a) or (11b):

(11) a. The woman was outstanding in the theatre.
b. The woman worked near the theatre.

Participants' memory was probed using either *the woman* or *the actress*. *The woman* was an equally good memory probe for both sentences, and *the actress* was no better for participants who had heard (11b). However, the actress as a probe enabled the participants who had heard (11a) to recall it twice as often as they did follow the probe *the woman*. This finding is particularly important because it illustrates that instantiation is not simply the result of a simple association between,

in this case, the woman and the theater. The inferences that allowed the actress (which had not even appeared in the sentence) to be a good memory probe were very specific to the participants' real-world knowledge Bridging inferences are backward inferences in the sense that they require the hearer to review previous information in a discourse to provide coherence with a current item. For example, it is not until one encounter the beer in (12) that one infers that the picnic supplies contained beer. Forward or elaborative inferences are those made immediately after a piece of text is encountered, whether or not it is needed for coherence. We would make a different elaborative inference about what happened next for each of the following two sentences:

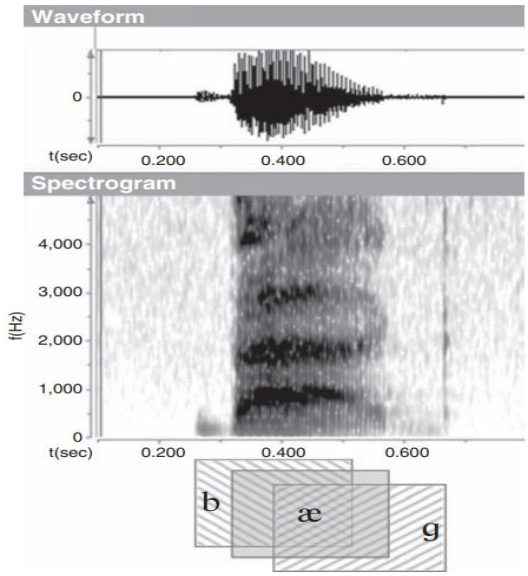
(12) a. Alex accidentally dropped his wine glass on the carpet.

b. Alex accidentally dropped his wine glass on the stone patio.

The inferences that lead to the instantiation of general terms are examples of elaborative inferences. It is unclear under what circumstances people create elaborative inferences, but it is almost certain that they do so often. Since elaborative inferences are not necessary for discourse coherence, they are not as vital to text comprehension as bridging inferences are.

9. The Hearer: Speech Perception and Lexical Access (Book 1, p. 169)

This chapter dealt with the operations the speaker performs, using knowledge of language, when encoding a mental message into a physical signal accessible to the hearer. There are three features of the speech signal that the speech perception system must deal with: the signal is continuous, it transmits information in parallel, and it is highly variable. The speech signal is continuous: there are no spaces between consonants and vowels, or even between words.



Figur. Illustration of parallel transmission of phonetic information. The figure is an adaptation of Figure in Liberman (1970: 309).

Figure illustrates how information about the three phonological units in the word bag is distributed across the word. In the recording whose waveform and spectrogram appear in the figure, the vowel has a duration of approximately 250 milliseconds, of which approximately 50 to 75 milliseconds carry information about all three phonological units. Properties of the word-initial /b/ spill into the vowel and persist through the beginning of the word-final /g/. Properties of /g/ begin at the offset of /b/ and continue through the second half of the vowel. The vowel /æ/ influences the pronunciation of the entire word, and carries acoustic information about both of the consonants in the word. This is an example of parallel transmission, of how the speech signal transmits information about more than one phonological unit simultaneously. The speech perception system must sort out all that information and figure out what the units are.

A third feature of the speech signal is its variability, or lack of invariance. The abstract mental representation of a phonological element does not vary. However, a speech sound may vary greatly each time it is actually produced. Many factors contribute to the fact that the same consonant or vowel, the same syllable, and even the same word is never pronounced exactly the same.

First, there is variability among speakers. Human anatomy is broadly similar, but there is individual variation in every aspect of our physique, which includes the organs involved in speech production. As a consequence, many aspects of the signal are intrinsically different for different speakers, including fundamental frequency and the spectral properties of consonants and vowels. In fact, a person's voice is as unique an identifier as are the person's fingerprints or retinas.

Second, there is variability within speakers. People sometimes speak fast, and other times slowly; they sometimes speak with chewing gum in their mouths; they mumble; they shout; they speak while being overcome with feelings of sadness or joy. All these variables affect the speech signal, and can make the acoustic signal associated with a single word very different each time it is uttered, even by the same speaker.

A third factor that makes the signal variable is ambient noise. Rarely do we speak to each other in noise-free environments. Other voices and other sounds (like music or traffic) can alter the speech signal dramatically. The same utterance will sound different in a small quiet room, in a large loud room, or coming from the room next door. The same voice could sound very different in person and on the telephone, and telephone transmissions will vary further depending on the connection and the equipment being used. A fourth factor affecting variability in the signal is the context. The articulation of phonemes is affected by the phonemes around them, and as just described with respect to parallel transmission. In addition to effects caused by coarticulation of phonological units, sentence context and neighbouring words can also affect the pronunciation of individual lexical items.

10. The Production of Utterances (Hormann, 1986, p. 201)

Speaking is a particular accomplishment but speakers probably do not think of it. People think that it seems to be fairly an automatic process that there is a good deal of planning and organization when a speaker speaks. Warren (2013) stated that in everyday contexts people are only likely to become aware of this planning under certain circumstances, such as when people are unable to find the word or phrase that people would like to use to express some idea, or when people make some kind of an error or 'slip of the tongue'. When people speak means that people make choices. These choices include deciding which words best express the ideas that the speaker wants to convey and which types of sentence structure are the best vehicles for sharing the ideas. They also include decisions about the very ideas that should be expressed.

Producing language considers an automatic process, however, the task of producing language involves several processes and as well the sources of knowledge. The figure given by Garret (1980) below shows the processes and their outcomes on the left and the right some of the required knowledge and skills.

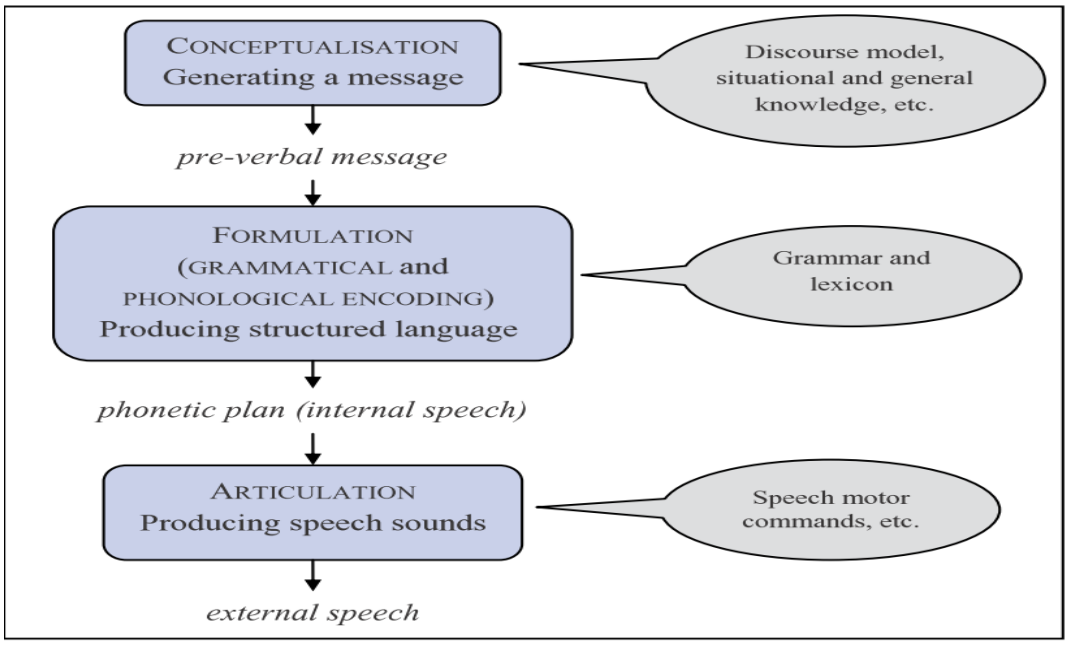


Figure. Processes and knowledge types are involved in utterances production (Garret, 1980).

Warren (2013: 16) explained that the first process of utterance processing is conceptualization. This is the process in which we use what we know about the world, about the current situation, etc., to sort ideas, we then need to put together the elements of language that will express this idea, drawing on our knowledge of our language, including grammar and the lexicon (vocabulary). This involves a process of formulation, involving our speech apparatus. Brain activity was compared in tasks that required syntactic from the lexical process. The brain areas that can be activated during narrative production were determined and compared with those used in prompted sentences production. This situation indicates that aspects of language production are distinguishable in terms of brain activity, which supports their separation as stages in the production process.

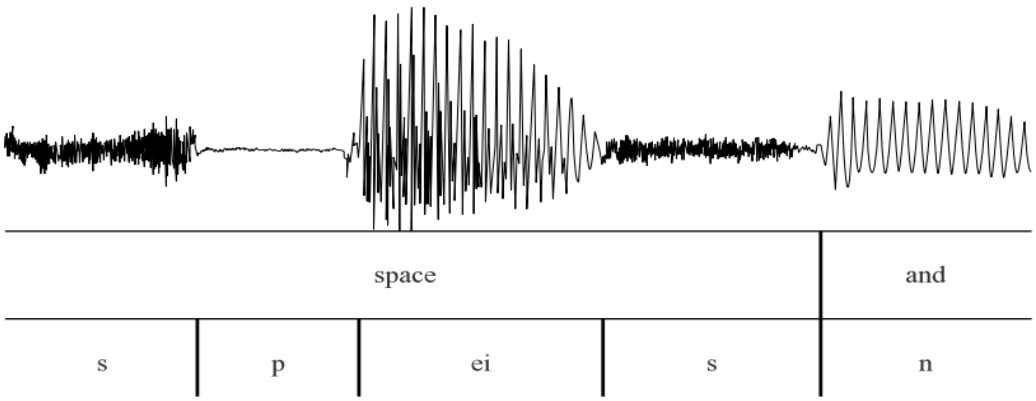


Figure. Speech waveform and text annotation of '…space and…'. Note the period of silence in the waveform during the /p/ sound. In this case, the silence lasts approximately 65 msec (Warren, 2013:18).

A key source of information about the process of conceptualization and planning in producing spoken output is the pattern of pausing that speaker produces. The argument is that planning involves mental activity that competes for our attention resources with the actual process of speaking. The more planning, we need to do, the less easy it is for us to continue speaking and the more likely it is that we will hesitate.

11. Understanding Speech, Understanding Speakers (Hormann, 1981)

Our capacity to endow language with meaning must be recognized as a particular instance of our sense-giving powers. We must realize that to use language is a performance of the same kind as our integration of visual clues for perceiving an object, or as the viewing of a stereo picture, or our integration of muscular contractions in walking or driving a motor car. or as the conducting of a game of chess-all of which are performed by relying on our subsidiary awareness of some things for the purpose of attending focally to a matter on which they bear. These are exercises of an integrative power which can comprehend a triad in which the person A sees a B as bearing on a C, or else uses a B for the purpose C, and these Integrations can be seen to be essentially tacit (Polanyi, 1966).

Understanding does not seem to be an all-or-nothing affair; perhaps there are levels or stages of understanding-we will come back to this. And second: what is actually a criterion for whether something is understood or not? When the listener can repeat the utterance, he heard word for word? Or when he behaves in accordance with the utterance? (But what would "in accordance" be here?) Does the listener understand what the speaker says, or what the utterance means, or even what the speaker means? We do not want to and are not able to distinguish precisely between these different formulations now, but it is perhaps appropriate to recall the thesis which runs through this whole book: the speaker makes an utterance in order to change the listener's consciousness. With this thesis in mind, we see that, after all, it is not so much the question of what the object of our understanding is (whether the sounds, the words, the sentences ...) and what the relationships between these objects are, but rather that these are, on different levels, all means to an end. (Hormann, 1981. P. 242).

Horman (1981) stated that it is difficult to determine where language understanding *ends*. It is just as difficult to say exactly where it *begins*. As long as

we make no attempt to avoid these difficulties. we must grapple with two facts: (a) in order to understand an utterance a person must (always?) recognize at least several of the words or lexemes or sounds produced by the speaker; (b) the recognition of individual words or lexemes. on the other hand. is highly dependent on the understanding of the entire utterance.

The process of understanding. therefore. cannot be a one-way street (like "from the elements to the whole"); whoever wants to analyse it must know that bottom-up processes-the input that comes from outside-interact with top-down processes. with whatever comes from the knowledge. ability. and expectations of the listener. (Let us make it clear right away that these two terms provide no substantial information but at best a direction for the investigator's search.)

If in the course of understanding, these bottom-up and top-down processes work together, and if we do not want to limit understanding only to the understanding of sentences, then what suggests itself is that we might have a theoretical discussion of the process of understanding begin with those very units from which linguistics puts together lexemes, words, and sentences, that is, with the phonemes, the smallest units which signal meaning in language. But we are no longer so naive as to formulate our basic question thus: Is understanding based on the recognition of phonemes? We will. in a more careful way. try to find out something about the role which phonemes play in this entire process.

The prosodic structure of an utterance (Le., intonation, accent, stress, number and location of pauses, ...) contains information which is important for understanding. Probably early in an utterance a pattern is begun which rouses certain expectations as to the temporal locations at which some stimuli will happen in the very near future. The weight of this factor is shown in an experiment of Bosshardt (1980). His subjects hear sentences like the following:

(8.1) The student writes his thesis in the cold attic.

(8.2) In the cold attic writes the student his thesis.

(8.3) His thesis writes the student in the cold attic.

The task of the subjects is to repeat the sentences immediately after hearing them; achieving this aim is made a little bit more difficult by mixing the speech signal with white noise. All three versions are found to be of about equal difficulty. In a next step, versions (8.2) and (8.3) were cut into pieces at the three points indicated by the vertical lines, and then the pieces were pasted together in the sequence given by (8.1). When these new versions were presented, the subjects had very great difficulties in understanding the sentences. Even the perception of the verb constituent ("writes") suffers, although this constituent is at the same position in all three versions and therefore was not moved or exchanged in the cut-and-pasted versions. Similarly. even though the constituent "the student" is now presented always in first position. it is much more difficult to comprehend than it was in the uncut. original version of (8.1). These findings show that when generating prosodic expectations from the first words of an utterance. the listener not only takes into consideration what sounds are produced here but also allows for the fact that these sound the particular way they do because they are produced at this particular position in the sequence of the utterance. In hearing the cut-and-pasted versions. the listener is misled in this respect: he hears something in, say, position 1 which has actually been pronounced in position 3, and so the listener generates false expectations which then impede comprehension even of the constituent "writes," which was produced at the very place (in time) that it is heard.

Clark (1974: 13) stated that “the linguistic deep structure represents exactly what the people who have understood a sentence know." This is a theory of independence of sentence comprehension because it postulates, as the essence of the understanding process, recovery of the (linguistic deep) structure which permeates the sentence and because both this structure and the process of recovering it are thought to be independent of all other factors. According to this theory, understanding "ends" with the attainment of this linguistically defined condition. On the basis of this condition, a further processing of what has been understood-a processing perhaps in part not linguistically determined-could then possibly begin.

The achievements and the weaknesses of this theory can best be shown if we juxtapose its opposite. We will do this with an example. Let us assume that two people are working or reading in an overheated room. One says to the other, who is sitting near the Window,

(8.4) Could you open the window?

When has the listener understood this sentence? According to the theory of independence, it is at the moment when he successfully grasps the linguistic deep structure of the sentence (predicate verb "can" ... object "window" ... question form ...).

What the listener can do with this. after he grasps the linguistic structure. has something to do with the further processing of the sentence. possibly. but nothing to do with the understanding of the sentence. Sentence (8.4) would thus be understood if the listener answered.

(8.5) Probably. if I pulled hard enough and then resumed working.

The opponents of the thesis of independence would say that this answer is evidence of a misunderstanding. According to their view. the listener would have understood sentence (8.4) if he had stood up and opened the window-or also if he had said.

(8.6) I'd rather not; there would be a draft.

For this alternative theory understanding is achieved if the intention of the speaker is grasped. In contrast to the theory of independence. we call this the theory of intention. In this second theory understanding involves. in many cases. going beyond the linguistic structure of the sentence. Understanding. for instance. (8.4) implies that the question form is seen as a request. For followers of this theory. the listener has understood an utterance when he grasps what the speaker means (Clark, 1978).

If understanding was defined linguistically for the theory of independence, namely, as grasping the linguistic structure of the utterance. then for the representatives of the intention theory it is defined communicatively, namely, as grasping what the speaker means.

Strategies of Understanding

In recognizing the linguistic structure inherent in an utterance. it will always be necessary. as we have said before. to use knowledge of various kinds; bottom-up processes must interact with top-down processes. The decision as to which top-down processes to apply will very often be made under conditions of insufficient information.

Cowles (2011, p. 18) stated that in a strictly bottom-up processing model, only information from the input is considered—processing is entirely stimulus-driven. For example, when you hear a language sound, you must decide what it is. A strictly bottom-up processing model would say that you use information from the sound itself to determine the linguistic identity. For example, to understand the word "file," you would need to process the details of the sound waves as they come in—which frequencies are louder, which are quieter, how long certain frequencies are loud, and the like.

A top-down processing model, on the other hand, adds additional information from "higher" processes. Clearly, we use bottom-up information when processing language—we need to pay at least some attention to the actual input, otherwise we wouldn't actually be listening to people talking to us. However, in experimental conditions that mimic the real-world example earlier, the results show that people also use "top-down" processing to fill in the blanks—they report hearing sounds that are physically just not present in the speech stream (because the experimenters removed them) or are deliberately ambiguous (because the experimenters made them so), and further, they "hear" sounds that are consistent with interpretation from higher processes (e.g., Warren & Warren, 1970). So, both top-down and bottom-up processes are important. The bigger picture here is

whether and to what extent information from later or higher processes can influence early or lower processes. This is a recurring theme because it is applicable not only to how we process sounds, but also to how we build and interpret sentence structures.

When bottom-up information inadequately specifies a word or phrase, top-down information can allow the hearer to select among a range of possibilities. If bottom-up information is adequate, however, top-down information will not be necessary. Let us illustrate with an example. Suppose a friend walks up to you and says "Cat food," clearly and distinctly. You will, effortlessly, be able to decode the acoustic signal and retrieve the uttered words from your lexicon. In this situation, bottom-up information guides your processing: details of the acoustic signal help you build a phonological representation. Once you have retrieved the words, you might think that your friend saying Cat food out of the blue is a bit odd – or not. Consider a different scenario: you and your roommate have a cat, and you are headed to the supermarket. Your roommate hollers from the kitchen (where the dishwasher is running noisily), "*Fluffy's bowl is empty! Be sure to buy some cat food!"* The acoustic information that reaches your ear is highly degraded; maybe you catch *Fluffy, bowl, buy*. You guess that cat food is somewhere in the sentence. You have understood this version of cat food (which you didn't even really hear) by using top-down information. This is information that is not part of the acoustic signal – contextual information that helps you understand what your roommate said absent a clear acoustic signal. In this case, part of the information guiding your processing was carried by the signal – the words you did catch, especially your cat's name. But other information well beyond the signal helped you too: usually, you're the one who buys Fluffy's food and your roommate knew that you were going shopping. All of this conspires to allow you to understand *cat food* as a likely candidate for what your roommate might have been saying.

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