

Chapter 11

Language

Language is a system of symbols and rules that enable us to communicate (Harley, 2001). The symbols used in language can include speech sounds as well as writing; while the rules include grammar (e.g. Pronouns, tense), parsing, pragmatics. There is an arbitrary relationship between a linguistic symbol and its referent. Language provides context for symbolic understanding. The use of language is intimately connected to cognition.

Much of the information that we gather comes from either spoken or written language. We also use language to ask questions, explain any conclusions, clarify problems, and so on. Furthermore language processing is affected by other cognitive processes such as perception, attention, and memory; and also is used in other cognitive processes such as thinking, planning, reasoning, and making decisions. Some language processing appears automatic, which is carried out without awareness or intention; while some language processing is performed intentionally and with effort.

There are approximately 3000-6000 distinct languages that are spoken by humans, and approximately 250 language families, such as the Indo European language family, or the Sino-Tibetan language family. 95% of the world's people speak fewer than 100 of the 6000 different languages, whereas the last 5% of the world's people speak thousands discrete languages with few speakers. Mandarin alone accounts for about 1 in every 5 people on earth. If we add English, Hindi, Spanish and Russian the figure jumps to 45%. Some of these languages are disappearing due to various reasons such as hostility and repression from dominant governments, and high speed transportation and communication. Every language has its own way of encoding and expressing human experience, and an entire way of thinking is lost each time a language becomes extinct.

It is important to differentiate between language and communication. Communication is a process whereby there is exchange of information between the sender and the receiver. This information can be transmitted via any of the methods such as a scent, song, gestures, tone, writing, painting, or language. Language is a symbolic form of communication. Although there are other communication systems, but these do not form the true languages. For example, many bees can use elaborate dances to tell other bees where the food is, or birds have different songs or calls to attract mates or broadcast territorial boundaries. But these communication systems can send only such very particular messages, and cannot be considered as a language system. To be considered language, a number of different characteristics should be met.

Characteristics of Language

- **Discrete and Re-combinable elements** – Language is made up of discrete sounds. The number of sounds in a language varies. How these sounds are produced and represented is also an important characteristic of language. For example, English language is an inconsistent language; /s/ and /z/ represented by s as in dogs and cats, /k/ sound represented by k and ck, /j/ sound represented by j (jug), dge(edge, judge), and the like.
- **Arbitrariness** – Language is based on arbitrary symbols. Words have no inherent relation to the objects, people, commands they stand for. Different sounds may convey the same meaning. For example, Water (English), Eau (French), Agua (Spanish). Also, same sounds may convey different meanings; for example, Knee (English), Nie (never in German).
- **Displacement** – This characteristic of language includes being able to talk about time and place other than here and now. It is the ability to talk about objects, people, things and events that are remote in time and space.
- **Productivity and Creativity** – This characteristic of language includes the ability to create sentences never heard or uttered before. Human languages are an open system of communication, whereas the system of communication in animals is closed.

Origin of language

Humans are the only species that has evolved an advanced system of communication between individuals. Whereas other species communicate through ritualized and repetitious songs, calls, or gestures, humans have developed linguistic systems that can express a literally infinite variety of separate and distinct thoughts. This incredible evolutionary leap is what distinguished humans from all other organisms on earth. Language first appeared between 30,000 and 100,000 years ago in the species *Homo sapiens*.

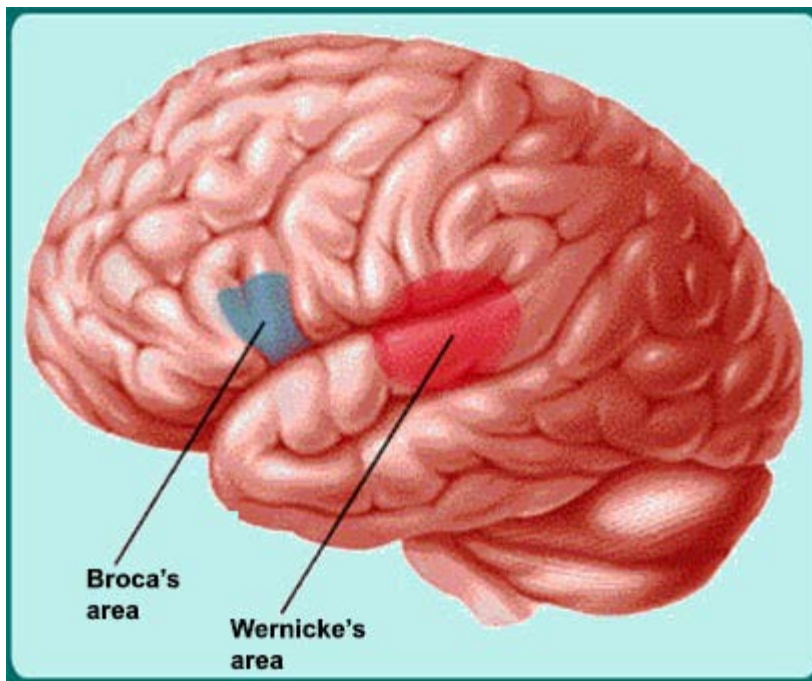
There are two rival answers that were proposed to the question of how the language evolved: the first and more common explanation is that language was an adaptation of some sort; the second is that language is a **spandrel**, a non-adaptive element arising as a byproduct of other processes.

The first view assumes that language is an adaptation, evolved in response to some selection pressure

toward improved communication between humans. Perhaps there was a need for improved communication between hunters at some point in the history of *Homo sapiens*, and oral expressions were simply the optimal way to solve the problem. The second view, however, assumes language to be the byproduct of other evolutionary processes, not a special adaptation that arose by ordinary natural selection acting on mutations. The supporters of this view believe that natural selection made the human brain big, but most of our mental properties and potentials might have been spandrels - that is, non-adaptive side consequences of building a device with such structural complexity. In other words, our ancestors encountered environments which required the type of advanced reasoning only provided by a larger brain; however, language capability was not one of those functions for which the brain was selected. Instead, language may be a result of exapting neural structures formerly used for other functions. This view has been reinforced by the famous linguist Noam Chomsky, who argues that the brain's language capability cannot be explained in terms of natural selection. According to Chomsky, there may be unexpected emergent physical properties associated with the specific structure of the brain that explain language.

Anatomy of Language

Language is a function of the peculiar structures of the human brain. Several areas of the brain have been identified with linguistic skills, such as producing and understanding speech. Furthermore, people with brain damage in specific areas have difficulties with very specific aspects of language, implying that it is a highly compartmentalized process. Furthermore, human brains are functionally asymmetrical, concentrating many areas essential for speech production in one hemisphere. The phenomenon of lateralization is extremely strong in humans, and in the vast majority language areas are concentrated in the left hemisphere. The right hemisphere controls language in only about 3% of right-handers and 19% of left-handers, and another 68% of left-handers have language circuitry in both hemispheres.

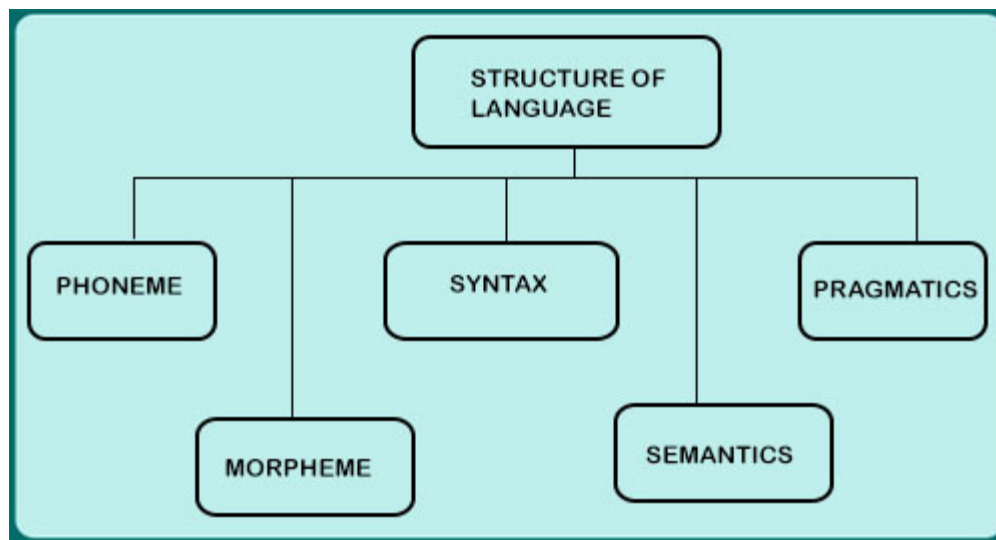


There are two major areas of the human brain that are responsible for language: **Broca's area**, which is thought to be partially responsible for language production (putting together sentences, using proper syntax, etc.) and **Wernicke's area**, which is thought to be partially responsible for language processing (untangling others' sentences and analyzing them for syntax, inflection, etc.). Other areas involved in language are those surrounding the **Sylvian fissure**, a cleavage line separating the portions of the brain that are exclusively human from those we share with other animals. In general, the areas that control language would be adjacent to one another if the human brain was laid out as a flat sheet.

When people experience damage to Broca's area or its surroundings, their disorder is called **Broca's aphasia**. Broca's aphasics produce slow, halting speech that is rarely grammatical. These difficulties experienced by Broca's aphasics reveal that Broca's area is central to correct processing and production of grammatical information.

When people experience damage to Wernicke's area, the result is a disorder called **Wernicke's aphasia**. Wernicke's aphasics are able to produce generally grammatical sentences, but they are often nonsensical and include invented words. Wernicke's aphasics show few signs of understanding others' speech, and have difficulty naming objects; they commonly produce the names of related objects or words that sound similar to the object's name. These symptoms experienced by Wernicke's aphasics seem to support the idea that Wernicke's area is related to the correct processing of others' communication.

Structure of Language



- **Phonemes –**
Phonology is the study of sounds of a language. Phonemes are the smallest distinguishable units in a language. In the English language, many consonants, such as *t*, *p*, and *m*, correspond to single phonemes, while other consonants, such as *c* and *g*, can correspond to more than one phoneme. Vowels typically correspond to more than one phoneme. No human language uses all the sounds humans can make. Moreover, the number of phonemes varies with each language. For example, English has 46; Italian has 27; Hawaiian has 13 and the so on.
- **Morphemes –**
Morphemes are the smallest meaningful units in a language. In the English language, only a few single letters, such as *I* and *a*, are morphemes. Morphemes are usually whole words or meaningful parts of words, such as prefixes, suffixes, and word stems.
- **Syntax –**
Syntax is a system of rules that governs how words can be meaningfully arranged to form phrases and sentences. For example, one rule of syntax is that an article such as “the” must come before a noun, not after: “Read the book,” not “Read book the.”
- **Semantics –**
Semantics concerns the meanings of words, signs, symbols, and the phrases that represent them. More specifically, it is the study of meanings through the relationships of words, how they are used, and how they are said.
- **Pragmatics –**
Pragmatics is concerned with the use of language in social contexts and the ways in which people produce and comprehend meanings through language. Pragmatics is concerned with practical language use and comprehension. It is concerned with **intended** rather than **literal** meaning.

Language and Thought

The Sapir Whorf hypothesis was proposed by Edward Sapir and Benjamin Lee Whorf, which states that language is a shaping force and it predisposes people to see the world in a certain way and so guide their thinking and behavior.

A number of questions have been raised in order to determine the relationship between language and thought such as, Does language determine thought?, or does thought determine language ?, or is the relationship strong or weak ?

The Whorfian Hypothesis (Lee Whorf, 1956) proposes that language determines and influences thinking. There are different versions of the hypothesis making different claims.

- **Strong hypothesis:** The strong hypothesis states that language determines thought and that linguistic categories limit and determine cognitive categories
- **Medium hypothesis:** The medium hypothesis states that language constrains thought
- **Weak hypothesis:** The weak hypothesis states that language influences memory of events, and the linguistic categories and usage influence thought and certain kinds of non-linguistic behavior.

For example, there are hundreds of camel related words in Arabic. So does this influence how an Arabic speaker thinks about camels; clearly it must. However, it is less clear if it is because of the various camel words that Arabic speakers think differently. It seems more plausible that the environment results in the need for more words and expressions. At the same time the environment causes people

from Arabic speaking countries to think more about camels.

Other Evidence for the hypothesis include the study that showed bilingual children sometimes make errors in cognitive tasks involving relational judgments (e.g. "more than", "less than") in one language but not in the other language (Slobin, 1973). Other famous examples include Hanunoo people in Philippines have 92 different expressions for rice.

One popular topic of research relates to the number of colour expressions that languages have. Every known language has expressions equating to **black** and **white** (dark/light). Other highly common terms relate to **red, blue, green, yellow**. Languages that have fewer terms than English generally do not have words corresponding to **purple, pink, orange, and grey**.

Roberson et al. (2000) studied colour perception and language, which was based on the assumption that it is easier to discriminate between colours that belong to a different linguistic category. The findings obtained suggested that both groups showed categorical perception based on their own language. It was also seen that the colour judgements were influenced by vocabulary.

In a second experiment Roberson et al. studied how language affects memory for colours. The participants were shown a colour and then later shown two test stimuli together. They then had to indicate which of the two they had seen before. The results of this experiment showed that both sets of speakers found it easier if the two test stimuli belonged to different categories within their own language.

Language Development and Acquisition

Language acquisition is the process by which humans acquire the capacity to perceive and comprehend language, as well as to produce and use words and sentences to communicate. It can be said to be the process of attaining a specific variant of human language, or the process of learning a native or a second language.

It has been assumed that inside the womb, the fetus does not understand the language; the phonetic information is not clear inside the womb, but the rhythm and melody of speech is perceived. Fetal studies that included measuring modifications in fetal movements showed an effects on kicking rate , and heart rate. They can identify the difference between language and other sounds, and also differentiate between features within language and music (e.g. classical to pop; maternal voice vs other voices)

Studies indicate that the newborn prefers intra-uterus muffled version of the maternal voice to the mother's ex-utero voice, and the latter to other women's voices. At 4 days, they prefer to listen to their mother tongue over certain other languages, they do not discriminate between different unknown languages. In one such study it was observed that babies born to French-speaking mothers will suck harder to hear French over Russian, they do not change a sucking rate in response to a change from Russian to English.

Further studies have indicated that 5-months-old children can make a distinction between languages within the same rhythmic group. From Birth to 2 months, the infants process basic rhythmic characteristics of the language. From 5 months onward, they focus on their native tongue traits

In the process of language acquisition and development, the child goes through a number of stages of phonological, semantic and grammatical development. From shortly after birth to around one year, the baby starts to make speech sounds. At around two months, the baby will engage in cooing, which mostly consists of vowel sounds. At around four months, cooing turns into babbling which is the repetitive consonant-vowel combination. Babies understand more than they are able to say. Children know far more about the phonology of their language than their own pronunciation suggests. They actually know about the sounds of their language long time before they can produce them fluently. The emergence of consonants includes the place of articulation and also the manner of articulation. Moreover, the pitch of vowels of young children is much higher. For infants, it is from 400 to 800 Hz; whereas for adult females it is from 150 to 350Hz, and for adult males it is from 75 to 200Hz. Formant frequencies of children also tend to be higher because of a shorter vocal tract which has higher resonance frequencies. There is no difference between male and female infants according to pitch and formants as it would be with grown-ups.

From birth to one year, comprehension (the language we understand) develops before production (the language we use). There is about a 5 month lag in between the two. Babies have an innate preference to listen to their mother's voice. Babies can also recognize familiar words and use preverbal gestures. Furthermore, between 12 & 18 months, the children learn one word utterances. From 18 months, they start with two word sentences; and from 2 years onwards, they start making use of three and more word sentences.

The stages the children go through while language development can be described as follows –

- **Stage I – 0 to 8 weeks**

This stage lasts from about 0 to 8 weeks, and is concerned with the Basic biological noises. These sounds directly reflect the baby's biological state and activities: breathing, eating, excreting, sucking, swallowing, coughing, burping, etc. Also, the other sounds included are the crying sounds such as hunger cries, pain cries, and discomfort cries, etc.

- **Stage II – 8 to 20 weeks**

This is the Cooing stage in which the vowel like sounds of rather indeterminate character with nasal quality which are often accompanied by a preceding consonant like sound, are produced towards the back of the vocal tract.

- **Stage III – 20 to 30 weeks**

This stage includes Vocal Play on the part of the child. Longer segments with higher pitch variation are produced. This stage also includes higher absolute pitch, as well as consonant+ vowel like sequence.

- **Stage IV – 25 to 50 weeks**

At this stage the child begins to engage in Babbling. Smaller set of sounds start to be repeated more often than in vocal play. The sounds become highly reiterative [babababa, dadadada, gagaga], and there is no clear boundary between babbling and spoken language.

- **Stage V**

At this stage, Melodic Utterances start to occur. There is closest imitation of real speech with no meaning. Also, there is high use of different sound segments (consonants& vowels), and suprasegmental features are already being imitated

Speech Perception and Comprehension

Speech perception includes a number of steps that need to be followed in order to correctly perceive it. First, the speech signal are extracted from other irrelevant background noise, and then these speech signal are decoded into its constituent **phonemes**. Phonemes are discrete segments in the speech signal, and represent the smallest unit of encoding of human speech. E.g the word "apple" consists of 4 phonemes in sequence: the "ah" sound, the "p" sound the "eh" sound and the "l" sound. About 40 phonemes are used in English speech. Then the syllables and word are identified, and after that an interpretation is constructed for the meaning of the utterance

Speech perception thus includes segmentation. There are no gaps between spoken words as there are in writing. A number of methods such as eye tracking data, phonological loop studies etc. can be used understand the systems involved in perceiving language. Also, it has been seen that people are very good at identifying spoken & written words in their native language. But very little is known as to what process is involved once those words have been identified, and also what processes underlie comprehension

Speech is produced when vocal cords & mouth used to produce sound wave. These sound waves are collected by ear and then translated into neural signal. The brain then translates neural signal into phonemes, which are the basic components of speech. Phonemes are combined to form words. Changing a phoneme changes the meaning of a word. The listener processes sound waves to identify phoneme components. Listeners then access phonemes corresponding to output from auditory analysis, and accesses words formed by combining phonemes.

- **Parsing –**

Parsing involves the analysis of the syntactical structure of each sentence.

For example, "The old men and women sat on the bench". Parsing involves syntactic and semantic information. Syntactic information includes word order & sentence construction, and the semantic information includes meaning analysis. Normally people analyse the meanings of sentences so quickly that it is difficult to study parsing. How parsing works can be explained through two models, namely.

- **One stage models:** Syntactic and semantic information used at the same time to construct a model of the sentence. E.g. Constraint based theory
- **Two stage models:** Syntactic information used first. Then semantic in the second stage. E.g. Garden path model

- **Discourse Processing –**

Discourse Processing is the cognitive process that investigates the structures, patterns, mental representations, and processes that underlie the written and spoken unit of connected speech or writing longer than a sentence. Sentences typically appear as part of a discourse. They have a context based on the conversation/story that they are part of. In order to understand a given discourse a person must draw inferences. This can be explained through the following example-

Mary heard the ice cream van coming; she remembered the pocket money; she ran into the house. In this example, it can be inferred that Mary wanted to buy ice cream, and buying ice cream costs money. Mary had pocket money in the house and she only had a certain amount of time to buy ice cream. The Logical inferences here is assuming ice cream van sells ice cream. Bridging inferences suggest that 'She' refers to Mary; and the elaborative inferences add detail,

such as the van will only be outside for a short time.