

## Language

Language is one hallmark of cognitive development, which we talked about last time. Language is particular to humans. Although other species have language too, humans have the most developed and the richest form of language.

### Characteristics of language

Language is **referential**. Language is used to describe objects in the world (like a phone), ideas (like justice), actions (walking, talking), states (hunger). Language is a means by which we know what things are and can refer to them even if they are not in our immediate presence.

Language is **interpersonal**. We use language to communicate with others. Language allows us to imagine states that do not exist now, and to communicate those states to someone else, and together discuss a goal related to those states. For example, we might make a plan with friends to go eat out, discuss where we want to eat and what we want to eat, although the actual event is not in the present. Other species are slaves to their current states. Unlike humans, they tend to lack the cognitive mechanisms that help facilitate communication for none existing states.

There are some **universals** of language. In English, sentences typically have a subject, which is followed by a verb then an object. For example the sentence "Homer chocked Bart" makes sense to us. In Malagasy, the object comes first, then the verb and the subject. The sentence would go "Bart chocked Homer". Despite those differences, all languages have a structure that help us communicate the important information.

Language is **creative** (or novel). We can talk about things that don't exist and understand sentences we have never heard before. For example, in the sentence "Casteen and groh had a midnight rendez vous with a unicorn". We haven't heard this sentence before, yet it makes sense. We are not trapped by language.

Language is **hierarchical**: we have sounds that are used to make words; those words are used to make phrases; phrases are used to make sentences.

### Language structure

Let's take the sentence: "the boy hit the ball". At the base level, there are phonemes, which are put together to produce sounds and words. Phonemes in any given language are a restricted set of the sounds we could use. There are about 40 phonemes to produce the English language. But those phonemes are not the same used in other languages. Because other languages use a different phoneme set, we have a hard time pronouncing words in another language.

**The segmenting problem:** some of the researchers who study language have been interested in how the sounds we hear get to mean what they mean to us. If we were to look at the sound waves produced in speech, it's hard to say where a word starts and stops. However we have no problem understanding where words stop and new words start, our mind does it for us automatically. If we hear "stuffy nose can lead to problems", we can distinguish it from "stuff he knows can lead to problems", although the two sentences sound the same. In fact, those sounds use the same phonemes.

How is it that we make sense of these sounds although they are ambiguous? We use the same processes as in memory and processing. Bottom up processing: the sounds we hear; top down processing: the context we use to understand the ambiguous words immediately and without effort. In some real sense we don't necessarily know what the words are unless we know what is being said, using the context. We need to know the context to find out what people are trying to say. The inference process does not only happen at a low level (with phonemes) it also happens at a higher level (sentences). For example: newspaper headlines can have multiple meanings. In class, we saw among newspaper headlines "deaf school never heard of benefactor". We know that the newspapers are not trying to make fun of deaf people by pointing to the fact that they could not hear, they mean something else. Many times, we make inferences based on what we think newspapers are trying to say.

When we are born, we have the ability to learn any language. Which language we end up speaking depends on the context we are raised in. One thing babies learn very early are the sounds of language, which differ from sounds that are not for language. They start knowing those sounds within 4 days after birth, and they are exposed to those sounds to some extent in the womb. Babies learn to distinguish language specific sounds from sounds that are not relevant to language. As we learn one language, we lose the ability to use phonemes that are not relevant to our particular language. The ability to distinguish sounds in infants decreases with time. In class, we talked about the ability to distinguish "t" sounds in Hindi. "t" is said one way in English, but in different ways in Hindi. At 6-8 months, infants raised in an English speaking environment have a good ability to distinguish "t" sounds in Hindi. By 10-12 months, they are really bad. The ability keeps decreasing further with age. The fact that we lose phonemes that are not in the language we grow up in contributes to why it's difficult to learn a new language as an adult compared when you are young.

### **Language acquisition**

At 7 months, babies start to babble. Babbling is not random noise, it's relevant to language acquisition. At 4-5 months, babies make simple sounds. At 7 months, babies say syllables. The initial sounds babies make are not specifically related to the household language. But babies around one year old in Russia make sounds that are

different from the ones babies about one year old in the US make, although those babies are not able to speak their native language yet.

What is the point of babbling? Researchers used to think that babbling was for babies to practice the motor behaviors needed to produce speech (for example to practice moving lips). In the last 10 years, this explanation for babbling has been challenged. It is now argued that babbling is for learning the workings of language.

Video clip: why do babies babble? When babies babble, they repeat a syllable over and over again. Those syllables do not mean anything. In the video, we learn that the best way to figure out whether babies babble to understanding language or to practice motor behaviors for speech is to compare deaf babies to hearing babies. Deaf babies learn sign language. If hearing babies babble to practice motor behaviors needed for speech, then deaf babies should not need to babble. If on the other hand babbling is to understand how language works, then deaf babies should babble using sign language just like hearing babies babble with vocal sounds. In other words, the researchers are trying to determine if language and speech are as connected as they seem. Language might be an independent part of the brain that could come out even if speech was not there to be the vehicle through which it comes out. To answer these questions, the researchers have to differentiate the gestures that a typical child makes (hearing or not) from the gestures that only deaf children make, which can be considered babbling if they are also different from the gestures that the parents made. The researchers found evidence of babbling in deaf children therefore language does not need speech to express itself. The researchers were also interested in whether speech is a more natural means for language than signing. To study that question, the researchers looked at children who have one parent who speaks to them and another parent who communicates with sign language. It was found that those kids had no difficulty going from sign language to speech, and it makes no difference in their brain. The same happens with children who are raised by parents who speak different languages. Sign language development and speech development were happening at the same time. Kids can learn multiple language if they are exposed to them early. Learning two languages is not confusing, or demanding. The kids can learn multiple languages without effort.

At around 12 months, children say their first words. At first, the lexicon of kids is slow, only single words are used to refer to objects or for social communication: a child might say "dog", "hi". Note that there is some social component early in language. At around 18 months, children are able to combine words, they might say "go car". They usually say the minimum necessary to get their basic idea across.

From 2 to 5 years old, children learn about 10 words a day. That's an astonishing rate, especially given that children don't actively practice those words.

At 7 years, it's the end of the critical period. The mind is suited for learning language early in life. The ability to learn language starts to decline after the critical period and keeps declining into adult life. Our minds work differently once we are adults, which is why adults have a harder time learning a language if for instance they move to a new country. Although those adults might be able to learn the language, they still keep an accent. Children have more malleable skills and can easily pick up new phonemes and intonation styles.

### Language innateness

How does language development happen? Many ideas were proposed. Is it instruction, the idea that parents teach the language to the children? No, it's not through instruction. Children pick up rules of grammar on their own without direct instruction. Another idea that was proposed is that language was learned through reinforcement: BF Skinner (the father of behaviorism) argued that children get reinforced for saying things correctly. That idea is not true either. The fact that we can say things that have never been said before (don't have reinforcement history) shows that reinforcement does not explain language acquisition. It has also been suggested that children acquire language through imitation. This is partly true but rules of language are not a result of imitation only.

Video of children applying rules of grammar to nonsense words: in the video, children are presented with a word and an object that do not exist, for instance "wug". Then the child might be asked, now that there are two of them, what do you say? The children can answer "wugs", although they have never seen this word. So how is it that kids pick up grammar rules (for example, the rule that "s" needs to be added to words to make plurals) without being able to articulate those rules? According to the researcher Steven Pinker, we have a language instinct. He argues that the ability to learn grammar is innate. We are just born with the right tools so just being exposed to language is sufficient to initiate those tools. What is the evidence?

- Language is learned without instruction
- spontaneous invention: we can understand new things that were never said before
- Universal grammar: all languages have rules
- Universality of language: there is no culture without language
- Dedicated neural circuitry: we have brain areas invested in language (broca's area and Wernicke's)

Summary on language:

- Language is organized as a hierarchy of structures
- Context helps us understand what we hear

- Language learning appears to be genetically predisposed

## Emotion

Definition: an **emotion** is a feeling elicited by objects or events, real or imagined, that have significance to the individual. All of what we talked about so far has been about cognition. But emotions are also a fundamental part of the human experience.

### What are emotions for?

There is a popular notion in western culture that emotions are something that gets in the way: if we want to be logical, we need to put aside emotions (star Trek illustrates this by always having logical emotionless characters). There is a belief that emotions get in the way of rationality. Psychologists moved away from that view. They now believe that emotions are informative.

**Affect as information** hypothesis: this idea explains how emotions can be informative. Good emotions act as a green light, they tell us that all is working, and that we need to keep doing whatever we are doing. Bad emotions act as a red light, they inform us that something is wrong and that we need to watch out and try something different. This idea does not imply that emotions are always correct, but it says that emotions can be helpful.

Emotions are also useful in the social domain. They allow us to:

- Communicate internal states and desires: we can infer that someone is angry by looking at their face
- Coordinate behaviors in a group: if one person shows different emotions from the rest of the group, we need to attend to that person so that everything runs smoothly
- Elicit behaviors and emotions in others to manage relationships. If I look sad, someone else might want to care for me
- To synchronize our emotions (**emotional contagion**): if emotions are synchronized, the relationships can run more smoothly. If I am angry you are happy, the conversation will not go smoothly

### How is it that we have emotions?

Several theories have been proposed to explain how it is that we have emotions.

**Common sense theory of emotion:** we see a stimulus (we have a perception of a stimulus), we have some emotion activated, and our body responds (sweating, racing heart). That view of emotional experience is logical but not necessarily true.

**William James' theory of emotion:** From William James' theory, physical reactions don't follow but precede emotions. The emotion comes from bodily reactions. That's not an intuitive way of thinking of emotions, but there is some evidence to support it. The evidence comes from **the facial feedback hypothesis** of Paul Ekman. The idea is that humans have a set of basic emotions that are linked to facial expressions. All other emotions are combinations of those basic emotions. Each basic emotion has a specific facial expression and people in all cultures have and recognize the same basic facial expressions. The basic emotions are happiness, surprise, fear, sadness, anger, and disgust. Another prediction of the facial feedback hypothesis is that adopting the facial expression associated with a basic emotion might make us feel that basic emotion. In one study, participants were either asked to hold a pencil with their teeth which made them look like they were smiling, or to hold a pencil with their lips, which made them look like they were frowning. While holding the pencils in their mouth, participants read cartoons. Participants who were "smiling" reported feeling happier than participants who were in "frowning".

**Schachter's theory of emotion** was a middle ground between James' theory and the common sense theory of emotion. According to Schachter, we have our perception, then we have bodily arousal, then we have appraisal. Our making sense of the event is a separate process. We have reactions, but we don't know what they are about until we know what in the environment caused the emotion.

**Current/modern theory of emotion:** emotions have a strong relation to the brain. The current theory is a path theory. We have multiple routes to feelings. We have an immediate reaction, but we also have thinking. What's quick is our perception of

whether something is good or bad, that's our quick interpreter. The thoughtful interpreter tries to identify what is going on, and it might modify the feedback provided by the quick process. For example, if someone comes to class with an ax on Halloween week, the quick process will say "it's dangerous". This quick process quickly determines for us whether fast action is needed, before we have time to fully think about the situation. The slow process will reinterpret the situation and say "no, it's part of a Halloween costume". Quick and fast interpreters are associated with different brain regions. The amygdala is very sensitive to fear, and quickly processes information without us thinking. The thalamus is the gateway to sensory information. It sends information to the cortex for processing, but sends that information also to the amygdala for quick processing. The amygdala is the fast route; the frontal areas of the brain are the slow route.

### **Misattribution of emotions**

We don't always know where our emotions come from. Sometimes we miss the information as to where our emotions come from, and we might make the wrong decision based on the wrong information. In one study, an attractive young woman experimenter walked to male participants either right after they had crossed a really high bridge in Vancouver, or right after they had crossed a low bridge. She asked participants if they wanted to fill out a questionnaire. Then she told them that if they wanted more information, they could call her, and she gave them her number. The researchers were interested in how many participants called in both conditions. Participants who had just crossed the high bridge were more likely to call the experimenter than participants who had crossed the low bridge. They had experienced arousal from crossing the high bridge, but since they were done crossing and they were approached by an attractive experimenter, they attributed the arousal to the experimenter when in fact it came from the bridge. The fast route might indicate that the arousal comes from the fear of the bridge, but the slow route reinterprets it as being due to the woman.

#### Summary

- Emotion provides information about how things are going
- Emotions serve important social functions
- Emotions give good and bad advice
- The amygdala is for a fast and simple evaluation, the cortex is for a slow and complex evaluation
- We don't necessarily know why we feel what we feel

