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Assignment - 4

What are the **possible processes** involved in learning "Word Meanings"? **How** do **children pick up** meanings of different words they are exposed to? What are **mechanisms** they use to rule out **competing interpretations** of words and learn the different word categories such as **nouns** and **verbs**?

Answer these questions mainly based on "journal articles". You can find such articles on "Google scholar" by using keywords, such as "word meaning acquisition" etc. You can refer to the—works of lev Vygotsky, Jean Piaget, Paul Bloom etc.

> Do not try to copy-paste the whole article(s) you read. Make your estimate after reading the article(s) and frame your answer according to that.

How do newborn babies and infants acquire word meaning? The adult speech is really a complex stream of sounds, it is definitely a daunting task for an infant and infants to pick up words meaning naturally from those sets of sounds and input.

To show how complicated is this task. Let me start by giving an example :p, let me teach you german by the process through which babies learn it, I hope you may get at least some of it :p.

Lesson number one:-

“*Wir werden jetzt anfangen, Deutsch zu lernen.*

Und ich möchte im Voraus sagen, das nach meiner Meinung:

Deutsch ist eine sehr schöne Sprache.

Und ich hoffe, dass Sie alle sehr viel Erfolg mit Deutsch haben werden.”

Translation:- “We're going to start learning German now.

And I want to say in advance that in my opinion:

German is a beautiful language.

And I hope that you will all have great success with German.
”

The translation was just for your curiosity in case you failed in understanding that german sentence :p
What do you think? This was a good lesson?
Do you think if I kept talking to you like that, you'd pick up German?
Not very likely.

How about if I repeated it? Would that help?
Probably not.
How about if I said it louder, would that help?
Probably not.

How about if I said it and you repeated it back?
Again, I don't think that would help.

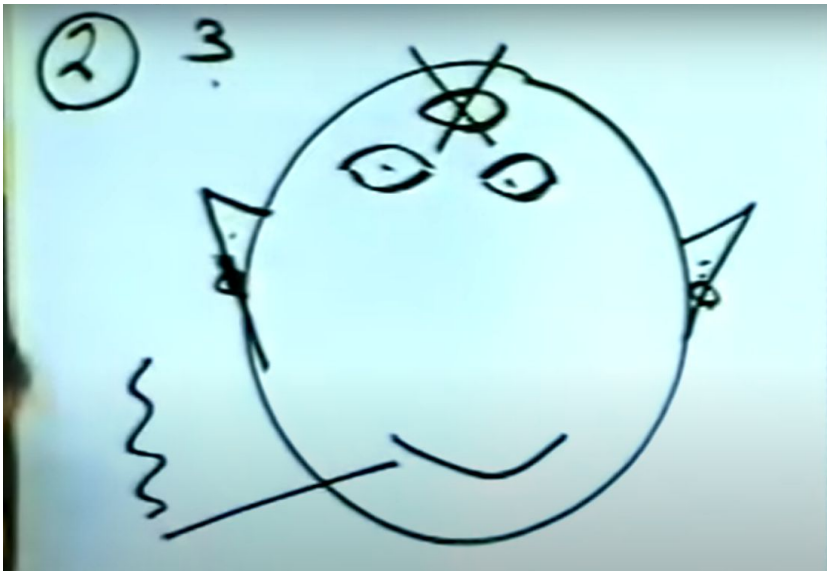
How about if I wrote it out for you, and you could see it on your television screen?
That wouldn't help either.

How about if I wrote it out for you, and you copied it down?
How about if I read it out for you and deleted every fifth word, and you try to guess what the word is?
Then how do babies learn like this :p
The truth is that none of these things will help now.

None of these things means anything. And I hope you can see that now.

Let me try again, but now with slide modification:- with the while giving you the different pictures of what those words mean and basically making my speech as understandable or relatable speech, just like how we talk to a baby. While pointing to different objects.

Focus on this picture!



“Kopf.
Ist gut, ja?
Schön.
Kopf.
Das ist Mr. Spock. Ja?
Mr. Spock hat zwei Ohren.
Ohren, verstehen Sie Ohren?
Er hat zwei Ohren.
Ok, Mr. Spock, ja ach nein, Entschuldigung.
Augen.
Verstehen Sie Augen? Augen.
Wie viele Augen? Eins, zwei, drei Augen.
Drei Augen.
Ist das richtig, drei Augen?
Nein! Wir haben nur zwei Augen.
Mund.
Verstehen Sie Mund?
Und dann: hier ist eine Zigarette, ja?
Nein!
Zigaretten sind nicht gut.”

Translation (just for your curiosity :p) :-

”Head. Is good, yes?Nice.
Head.
This is Mr. Spock. Yes?
Mr. Spock has two ears.
Ears, do you understand ears?
He has two ears.
Ok, Mr. Spock, yes oh no, sorry.
Eyes.
Do you understand eyes? Eyes.
How many eyes? One, two, three eyes.
Three eyes.
Is that right, three eyes?
No! We only have two eyes.
Mouth.
Do you understand your mouth?
And then: here's a cigarette, okay?
No!
Cigarettes are not good.
”

This time also, you must have failed, but I can assure you that you must have learned at least somewhat more than the last lesson, due to the presence of the **figure**.
I gave this long exciting(I hope :p) and challenging task to you, just to make you feel, that when it is so weird for us to do this, how difficult would it be for babies to acquire language only by listening to it :p
Now, I am even more excited to learn this mysterious phenomenon of extracting word meaning.

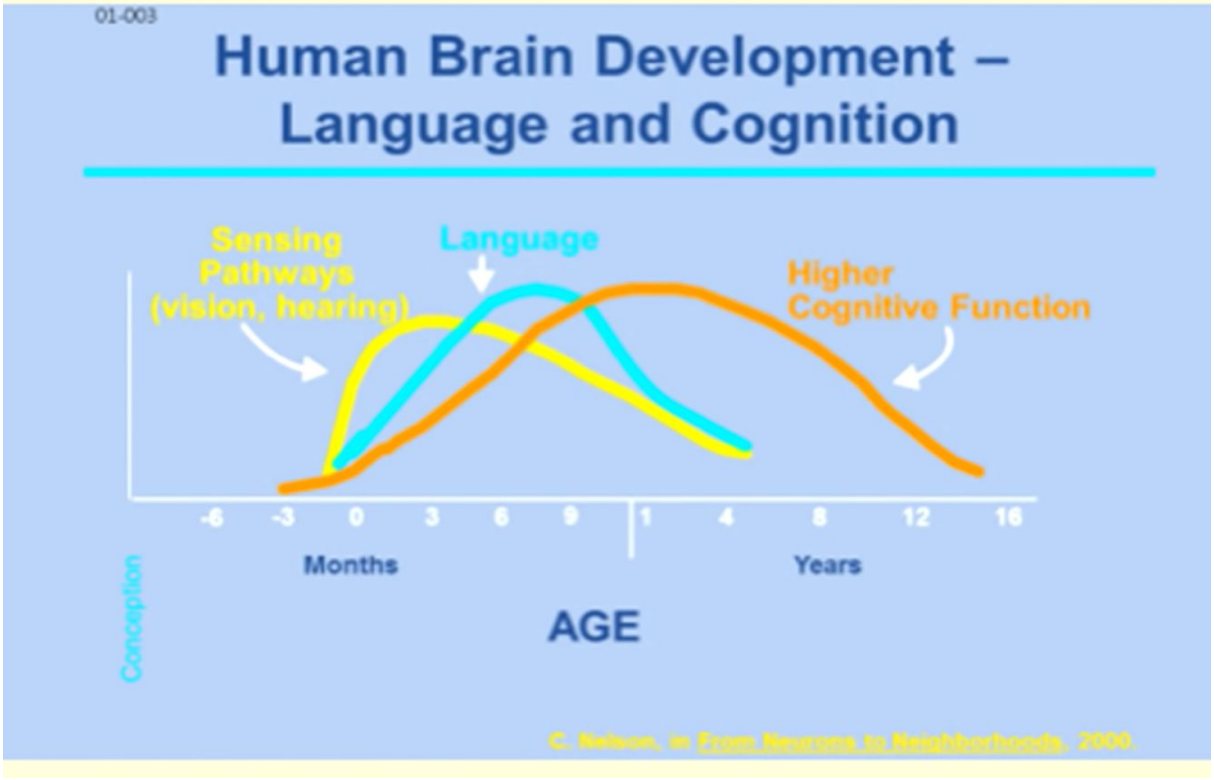
We will see how babies organise, interpret, and the meaning/references they form in their mind.

It's always an adorable moment for the parents to see his child's first proper word ^_^ It is definitely an incredible achievement for a 12-16-month-old :p
After the child learns his first word, there comes a sprout of many different words, it's like he has cracked some code to understand many words, or in reality, it is the result of a continuous process which he has been going through from the last trimester of the pregnancy!

By the age of 18 months, most of the babies can produce, on average, 50 words and understand the meaning of over 200 words!

The natural question is from where those words come from?

In my last answer too, I specifically stressed that children can acquire any language they are exposed to at or before their critical period!



(Sorry, A little blurry image)This image shows concisely when babies acquire language and other cognitive abilities.

In short, Children extracts the **phonological form** with auditory input which they receive, and then map them to an object(noun) or action(verb), and then they continuously refine this process until the words meaning and pronunciation matches with those of their mum or pappa or any other caregiver.

A word could have a ton of different meanings for them like we had seen the example of “gavagai” in our lecture notes, that how many different meanings could this simple word take!

There are basically three significant problems for the babies to get the meaning of words the first is “finding the words”, the second is “

identifying the concept", and the third is "learning over multiple situations".

We will see that there is a giant **feedback loop**, which refines babies' initial learning continuously with repeated exposure.

The following picture gives a brief overview of acquisition stages!

Stage	Typical age
Babbling	6-8 months
One-word stage or holophrastic stage	9-18 months
Two-word stage	18-24 months
Telegraphic stage or early multiword stage	24-30 months
Later multiword stage	30+ months

Finding the Words

The input that a child gets from the environment and caregivers doesn't have neatly separated lexical units, but the input information does contain statistical data, of which I have talked about in my last answer(Baysian babies).
These statistical data help them to strengthen those neurons which shoot up when they listen to repeated word boundaries.
It is easier for them to learn the word bit by bit. First babies identify the most clearly heard word boundaries and then try to speak it, that's how the cooing and babbling like " gaga" turn into "water" in a few months!

According to a study conducted by Graf Estes et al. on statistical segmentation study, which showed that 17-month-olds could map these mere word boundaries into meanings(objects), but they did it only for words which have more well-defined boundaries only, word frequency didn't matter here.

Shukla et al. noticed that this ability is in 6-month-olds too, but these could only mark those words which were prosodically familiar to them.

These studies imply that mere input is not sufficient to make out the word, but how the babies structure these word representations of sound sequence -- Feed the next learning task.

It has been seen that infant can use features of their language grammar to make out the word, for example:-

12-month-old English infants can use preceding auxiliary to make out verbs (e.g. can run, to run).

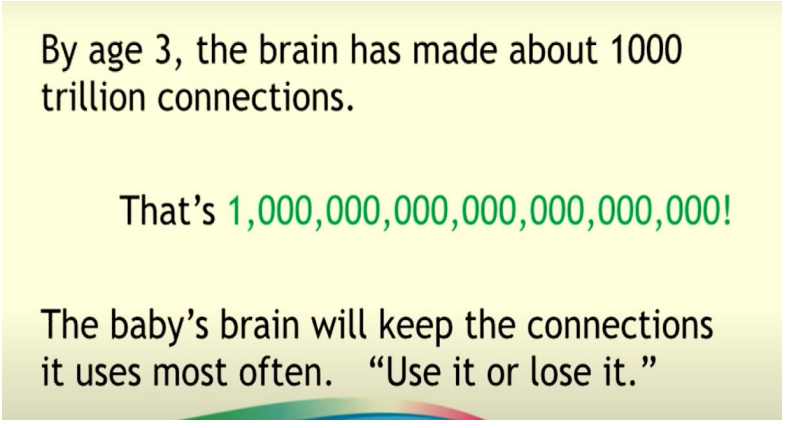
14-month-old french and 15-month-old german infants were seen to use determiners to make out *nouns.*

Once the child has identified the grammatical category of the word, he then proceeds to narrow down his own hypothesis regarding the meaning of the word by seeing the relationship between word and its types, example: nouns usually denote objects and verbs indicate the events.

Identifying The Concept

After making out the structure of that word by Input, now, he begins to identify the concept to which that word maps too! And this is no trivial task. As we know from the example of “givagai” :p
The input by the surrounding usually contains ‘the objects that are observable’, who is speaking and what seems to be his intent, syntactically similar words.

The babies are born with 100 billion neurons, when will those help him :p
This advantage of the brain is known as cognitive biases, that make them realise that few hypotheses(the



meaning which they think) are better than other hypotheses.
These methods allow the babies to map the word to its meaning.

Conceptual knowledge and cognitive biases

Infants have remarkable tools like mirror neurons, sensory-motor, etc. These tools help them to filter out the information from a myriad of information in a systematic way.
Infants can see objects based on intricate features like their style, number, colour, functions.
They also make out that certain events are associated with particular words after repeated cues from their input.
Infants can make out relationships between different words and events.
Gleitman has correctly pointed out "*an observer who notices everything can learn nothing*". As the children are so well equipped with the cognitive abilities, it also increases the hypothesis space for them, they have more options available to map to the meaning of the word.
But, babies have some biases towards particular objects and situations, so these biases help them to get out of so many competing hypotheses.
Some of them like the whole *object assumption,* I clearly remember the example of Verma sir lecture's, examples of stylus and pen - belief that a word labels an entire object.
Shape bias - generalising the same word to objects with the same shapes.
Noun-category bias- a generalisation of one word to all objects of its kind.
Mutual-exclusivity - babies assign different meanings to each word, if two things seem to point at the same object then they will be able to differentiate between them by giving labels to more basic level features, like stylus in pen.
When two words seem to be pointing to the same object, then the babies use their biases, mutual exclusivity and the social conditions under which the word has been said. Remarkable!

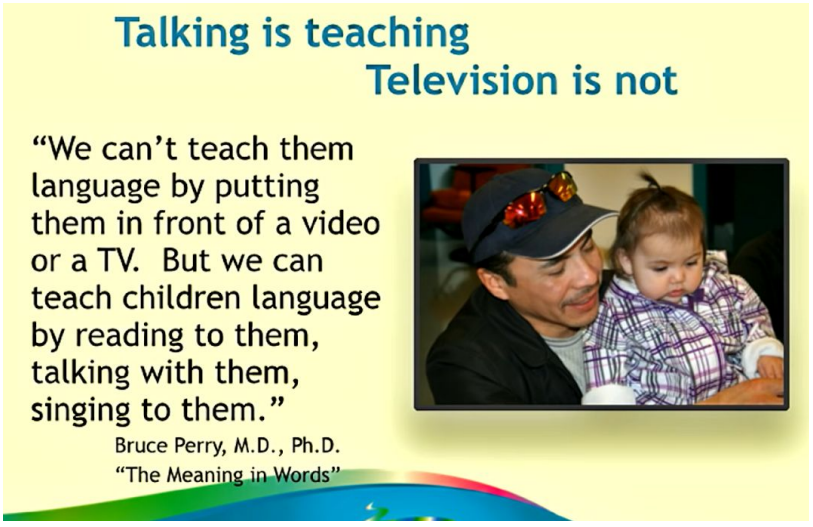
Social-pragmatic skills

Children pay attention to how we use language and understand the context in which it is said by the speaker.
They expect language to be used for the purpose of communication.
In a recent study, 6-month-old children noticed the beeps from the mouths of humans who were engaged in conversation, and that baby interpreted the beeps as if they were a part of any language.

Such early social sensitivity generates a set of instrumental methods to narrow down from many meanings to one or few meanings of the words. Babies notice the speaker's direction of gaze or pointing and get hints of the meaning of the words that they are listening to!

Babies only follow human directions, and ignore robots' gaze as they do not expect it to be indicative of any meaning!

Below picture summarises my point really nicely!



They are also sensitive to speakers' communication intent.

In a study, two-year-old mapped nouns word to objects that the human actor was searching for, and ignored the things which the human actor rejected.

They are also seen to use an adult's surprise or excitement to infer that a word is used to label an object that the adult has not seen before!

By the age of four, children develop more complex social-pragmatic skills, taking into the picture the speaker's intent, knowledge state and reliability.

The above picture shows beautifully how the children imitate and understand other intent through social interaction and pragmatics!

The progress of the child will determine what type of modifications in the feedback loop should be made by adults to enhance the learning.

Linguistic cues

Social-cues are particularly useful in transparent situations like when the child sees the speaker pointing towards the cup while saying ‘cup’. This way, there is a high likelihood that the child will map that word correctly!

But the maximum number of input the child gets is not so transparent, according to a study by Inverson el al. only 15% of parents' utterances are accompanied by gestures. In such a situation, new words and linguistic context.

Gillette et al.(1999) “human simulation paradigm”, when adult participants were made to watch the muted video of parent utterances to children by just observational and social cues, only 10 % of them were able to guess the correct word meaning pair, but when they had access to the linguistic context in which the word appeared, they performed much better.

This shows the importance of linguistics cues!

Syntactic bootstrapping - children use this ability to understand the linguistic context to infer verbs' meaning. For example, - 2.5-year-old children were able to use a set of syntactic structure in which the verbs occur to precisely determine its meaning.

They use this technique as usually maternal input contains the necessary information to fuel syntactic bootstrapping.

Basically, this is like we are given a task to find the meaning of some unknown words using the context in which it is used, we all have used this repeatedly in our English language papers :p

Every language has many patterns in them which help to acquire it.

Another example is of a baby of 2 years of age, who can count the number of nouns in the input and can name two-noun events with the first noun being addressed by the agent and the second being addressed by the patient.

The extent to which babies can use syntactic bootstrapping depended on their language skills as well as their understanding of the referenced event.

Various studies suggest that less and less linguistic context information is sufficient as the child gets older.

Learning Over Multiple Situation

In this long journey, we have seen so many mechanisms by which babies and infants learn from minute exposure. But, as known one scenario is not that informative, so the child must learn the information from multiple different situations, like every time he baths, he sees his mom washing dishes, playing in the rain, drinking water, from all these different situations, how is he able to understand the word water signifies water!

While using this mechanism, the children extract multiple hypotheses on every learning situation, keep them in their minds, and then compare across various situations, and then select the best probable ideas.

Some studies have found that young children and even adults are sensitive to various events and track some statistical occurrence of words and objects.

Trueswell and colleagues found through their studies that children use “purpose-but-verify”, which means that they store only a single hypothesis in their mind and verify it in every new situation.

Children filter their input across different situations based on their cognitive abilities and capacity or learning strategies.

Statistically, observed data is observed as input, but human biases, constraints, learning techniques and mechanisms are necessary for lexicons to be learned in such a short time!

As an example: - Frank et al. showed that social cues like a speaker's intention were able to make a child understand the word meaning!

Multiple encounters also help the children strengthen their newly-learnt word.

Both “fast mapping” and relatively slow “extended mapping” are mechanisms for word learning.

Fast learning implies that only after single exposure with the new word, children form some kind of rough idea or initial representation of the word and its meaning.

With more encounters, that same path of a word which was first made in mind gets strengthened, and as this process repeats, that path gets

stronger and stronger. Here the children refine and optimise their initial hypothesis about word meaning and making necessary changes as seen by the feedback loop.

Yes, after learning so much, it is definitely evident that the process of learning a word meaning is complicated. We, humans, are born with a magnificent mind, and they repeatedly use it by various discussed mechanisms to learn new words and their purpose.

Although so much research has already been done and is still going on, there is no end to knowledge, there will always be something to explore, this world is made of infinite possibilities and we humans are the most intelligent ones!

I accept that what we know is minuscule of what is the actual reality, but that's how we are making progress. Studying babies and learning mechanisms gave me immense opportunity to explore the new unknowns which will continue to expand.

It is not as simple as what I thought it would be, it's much more than just environment input which is required to acquire language, but how our powerful mind organises, interprets and stores meaning of the words!

I am sure that we will see mind-boggling progress in the coming years due to this edge-cutting technology. I would like you to watch this video by deb Roy, he has recorded his child's entire childhood and made some magnificent conclusions regarding the birth of a word! Link

Thank you for giving so much time and energy in going through my answer. I am really blessed and thankful to get this opportunity to explore this field! And I believe that someday I will too write a research paper on some aspect of the human brain!
Keep well and Safe
Thank you :)
Tejesh Vaish

Citations:-

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2) Fenson L, Dale PS, Reznick JS, Bates E, Thal DJ, Pethick SJ, Tomasello M, Mervis CB, Stiles J. Variability in early communicative development. Monographs of the Society for Research in Child Development. 1994;59(5):i, iii–v, 1–185. DOI: 10.2307/1166093.

3) Tomasello M. The item-based nature of children's early syntactic development. Trends in Cognitive Sciences. 2000;4(4):156–63. http://dx.doi.org/10.1016/S1364-6613(00)01462-5.