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At 6–9 months, human infants know the meanings of many common nouns

It was assumed that babies begin to acquire an understanding of language once they can derive intention through language (Carpenter et al, 1998). However infants can assign labels, as early on as 4.5 month olds and recognize their name in isolation - even in contrast to words with similar stress and length (Mandel et al., 1995). Similarly infant's preference (cross-linguistically) for pitch contour in infant directed speech like "Motherese", suggests that they can differentiate phonetic qualities of words (Fernald, 1985). In understanding phonemic differences, the problem arises that the learner must provide the proper structure from an infinite number of potential structures present in any set of data, without instruction and explanation of the linguistic operations (Chomsky, 1965). A study by Saffran, Aslin, and Newport (1996) revealed 8-month-old infants could discover the "words" in a continuous stream of speech 4 randomly ordered 3-syllable words, with no pauses between the words and no pitch or duration cues to indicate the location of word boundaries. Saffran coined the phrase "statistical learning" to describe the process by which learners acquire information about distributions of elements thus enabling us to create likely boundaries. Syllable distributions occur in relation to one another- thus the continuous stream of three syllable words could be easily distinguished by clear repeated segments. Beyond recognizing words, the question of our development of understanding words still remains unanswered. It cannot simply be meaning is derived from a statistical correlation since it would not lend to understanding abstract categories like "happy" or common mental state words like "think" later in development. Also nouns like "car" or "apple" are not very frequent yet they are readily recognized by infants. Perhaps understanding labels is contingent upon distinguishing sounds and words as unique units of meanings, but that doesn't explain our development of recognition nor understanding.

In research focused on infants (33 from 6-to-9-month-old and 50 from 10 to 20 months) psychologists Elika Bergelson and Daniel Swingley demonstrated that the infants were able to distinguish words for foods and body parts. Bergelson and Swingley composed two experimental set-ups. In the first paradigm (paired-picture trials), the child sat on the caregiver's lap facing a screen on which there were images of one food item and one body part. In order to reduce experimental noise of an unfamiliar voice, a parent wore headphones and heard a statement such as, "Look at the milk," or "Where's the apple?" and then relayed it to the child. The parent also wore a visor to avoid seeing the screen, reducing their abilities cue the infant on the task. An eye-tracking device, which can distinguish precisely where a child is looking and when, then followed the child's gaze.

The second kind paradigm, the scene trials, was similar to the previous set-up except that instead of the screen displaying a food item and a body part, it displayed objects in natural contexts, such as a few foods laid out on a table, or a human figure. Each trial measured whether hearing a word for something on the screen would lead children focus their gaze on the object for longer, indicating that they understood the word.

Difference in preference for colorful or pleasant pictures also effected the rate of fixation on objects. To partially eliminate this source of error, the experimenters subtracted the amount of time that the babies gazed at a given object when it was not being named from the time they looked when it was named. Another source of error was shown by the inferior performance of the 8- to 9-mo-olds on the scene trials may be traced to their tendency to fixate on the "eyes" and "face" even if they had no auditory cues to look at the image in the scenes containing faces.

Additional measures were taken into account, the MacArthur– Bates Communicative Development Inventory (CDI), an item exposure survey, showed that estimated word frequency was not correlated with either trial's results.

Bergelson and Swingley compared the patterns of learning during the months from 6 to 9 to infants at 8- and 9-month olds, and found no improvements in word recognition. It wasn't until 14 months that word recognition drastically improved. Success on the paired stimuli trial showed that simple stimuli could bee contrasted, so perhaps a word concept exists, but the scene trial indicated that infants cannot adaptable of their knowledge in different situations. Attentional ability also coincides with a peak in performance at 14-months, suggesting that this change in fixation maybe contingent upon focusing. Also target words were embedded in sentences, like "Look at the milk" or "Can you find.. ", which may lead to confusion around what the target is or exhaust infant's limited attentional capacities.

There are a some interesting questions that emerge from this study and the process by which infants able to connect a word with real world categories is still unknown. Mapping concepts like apple to mention of it without an apple in the perceived space is incredibly complex. Similarly abstract categories like "juice" or "mother" include parallel relations to other objects which cannot be easily operationalized. Easily bounded words like "cookie" were recognized just as often as less discrete stimuli like "hands".

These findings were consistent with nativist language theories, but supersede the age bounds of language acquisition- inferring infants are able to grasp more than just phonemic differences. Even before babbling begins babies understand some speech, this may explain why hearing-impaired infants with cochlear implants before 6 months develop on a more regular trajectory than those who aren't fitted with cochlear implants (Yoshinaga-Itano et. al, 1998).

"I think this study presents a great message to parents: You can talk to your babies, and they're going to understand a bit of what you're saying," Swingley said. "They're not going to give us back witty repartee, but they understand some of it. And the more they know, the more they can build on what they know."

Extended Discussion:

In reflection of this paper, I impugn my understanding of what word recognition actually means. I recently completed a word2vec project and felt a bit of pride as word relations like, “King” to “Queen” and “swim” to “swimming” trickled down by terminal’s output yet there was soon a disappointing sense that I accomplished nothing but a mere statistical trick to hack word understanding. In Cognition, we recently discussed basic chatbots like ELIZA and it’s more interesting predecessor SHRDLU which, provided limited capabilities, were met with amazement in the public’s eye. If anything these programs, including the more complex ones today, represent the superficiality of most of language. Language consists of operations that only touch on the surface of our available computational power. KNEXT attempts to derive world knowledge and taxonomies from text that we can so effortless compute. In this study we simply glance at word recognition- task that could be conditioned on a dog like “Chaser” and provide similar results. The only contradiction to this claim is that hearing impaired children (< 6 months) without cochlear implant will not have the same developmental trajectory as those with an implant- but that can be as explained as a lack of development out phoneme segmentation leading to a later onset of other language abilities that build on that. Naigles describes in her paper titled “Children use syntax to learn verb meanings”, that they are in preset patterns that can be replaced with arbitrary words like ‘gorping’. Naigles, Gleitman & Gleitman (1989) also present the idea of syntaxic bootstrapping, some phrase will be in “prohibited frames”. I think word recognition (and pattern recognition) is important to language, it perhaps allows us to bootstrap meaning (and maybe intersects with development of numerical concepts (Piantadosi et.al!)).

I found this experimental set up similar to Wittengenstein’s concept of language, with each player in a game trying to convey an image to other. Perhaps the game is influenced by the non arbitrary nature of some words or an underlying signaling in speech speech to look a certain way. Expanding on the idea of non-arbitrariness, phonesthemes may influence sound symbolic systems. These can be encoded in formant frequencies, pitch, and duration. Ultan (1978) observed that high front vowels are typically perceived as describing small things, whereas low back vowels are perceived as denote larger objects. Also, Ohala’s (1984) Frequency Code Hypothesis extends this regularity to consonants, so segments with higher frequencies, for example, high front vowels and voiceless obstruents, are used in words denoting smallness. Back low vowels with low F2 and voiced obstruents with lower frequencies tend to denote large objects. Front vowels were associated with bright colors, back vowels with darker hues, open vowels with red, and central vowels with achromatic grey (Grzybowski, 2010). In another test, Kohler used nonwords made up of either plosives, like buke, or continuants, like lole, and asked children which object the words referred to- pointing to a spiky shape or curvy shape. Even nose has a nasal consonants, and tongue begins with an alveolar stop, so the place of articulation may facilitate the mapping to the image. So perhaps children’s ability to distinguish phonemes in this experiment allows them to infer word meanings.