

Language Development

PSYCH 320

Lecture 7

September 27, 2018

Announcements

- ▶ Midterm I in 1 week (October 4)
- ▶ Assignment I due in 2 weeks (October 11)

Focus on experiments for short answers and know ages of babies in experiment.

e.g. Describe an experiment that explains why babies do x?

Babies learn words in isolation, stress pattern of language, phonotoactics ('tl' is not a good sequence of consonants).

Words in isolation



In order for babies to be able to pull out these useful queues for segmenting words in their language, babies need to start with something else.

Hear some words in isolation like their own name. But this isn't enough on its own to realize that most words have sW stress patterns, etc.

Words in speech

- ▶ **i likethis homemade cookie**
- ▶ **a cookie is a nice treat**
- ▶ **i really need a piece of cookie now**

“*cookie*”

How are they finding the word “cookie” before knowing about stress patterns or phonotactics?

Saffran, Aslin, Newport (1996)

- Syllables inside a word are more likely to occur together than syllables from different words

- ▶ *kie#is* (from *cookie#is*) -- low probability
 - ▶ *coo.kie* -- high probability

coo.kie occur together more often it's a good bet they are part of the same word

Transitional probability = probability a syllable will come next given a syllable

In this example, the transitional probability of *coo.kie* = 1.

Saffran et al. (1996)

- ▶ Can 8 month old infants segment words on the basis of statistical information alone?
 - ▶ synthetic speech, no pauses, no stress, no phonotactic cues, etc.



	A	B
1.	xxxxxx	xxxxxx
2.	xxxxxx	xxxxxx
3.	xxxxxx	xxxxxx
4.	xxxxxx	xxxxxx

When the sounds stop playing, turn over your paper and write down A or B for the word in each pair that seems more familiar.

Saffran et al. (1996)

- ▶ 1. dapiku padoti
- ▶ 2. tupiro kugola
- ▶ 3. golabu tilado
- ▶ 4. titipi bidaku

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Speech stream

golabutupiropadotibidakugolabubidaku

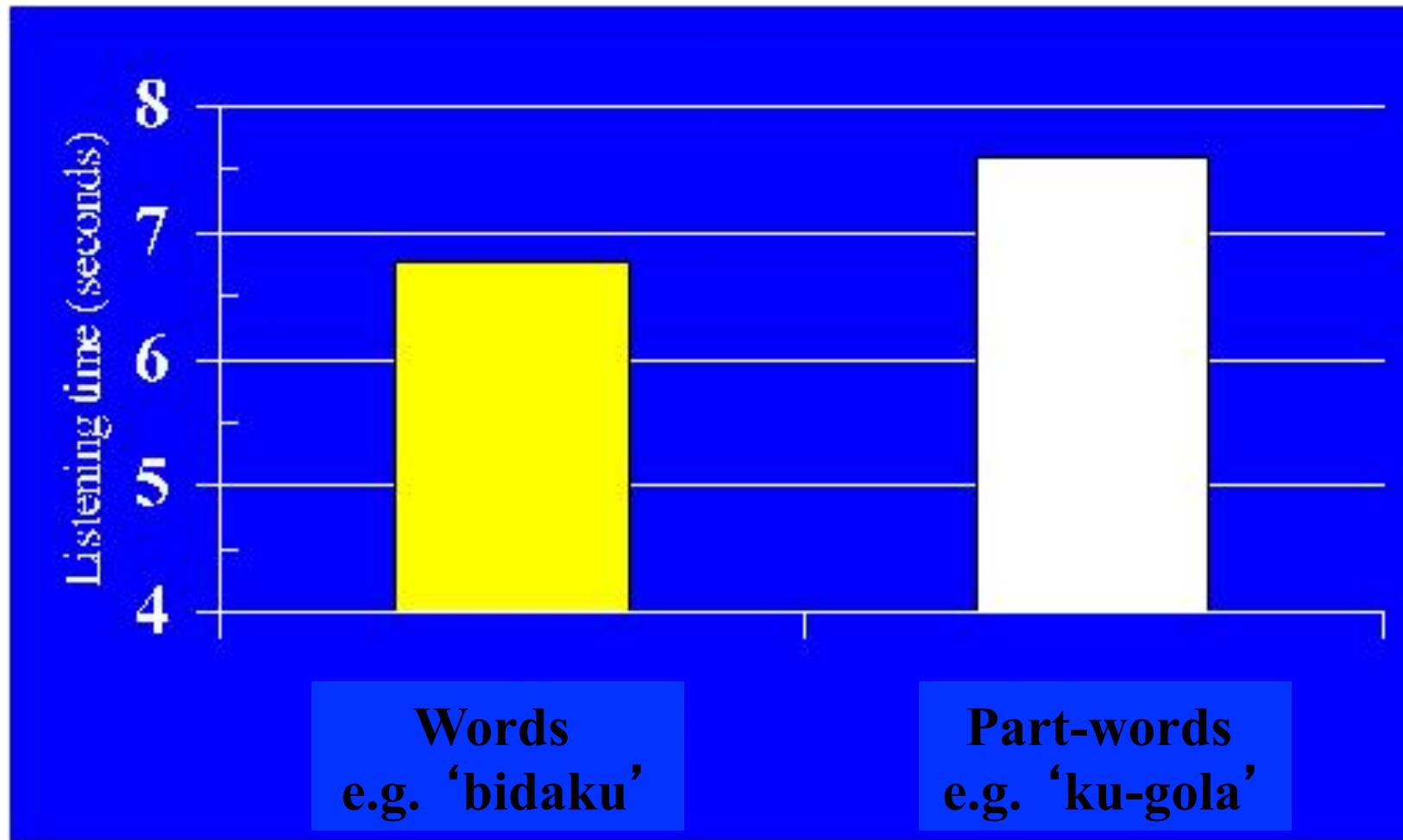
- ▶ “go” is always followed by “la” and “la is always followed by “bu”
- ▶ “bu” can be followed by “tu”, “pa”, or “bi”
 - transitional probability is lower
- ▶ words “golabu”
- ▶ partwords “kugola”

We only care that there is a difference in the trials after hearing the speech stream.

We only care that the babies were able to differentiate between words and non-words.

You don't need to know phonotactics or stress patterns to do this!

Saffran et al. (1996) Results



Does it scale up?

- ▶ Very controlled stimuli in Saffran et al
- ▶ Some say yes, some say no

Does this scale up to a real language and not just streams of only 4 words?

Debatable, English learning babies can do this with Italian words but they only succeed when the words the babies had to find were the same number of syllables.

Summary

Syllable co-occurrence = transitional probability

- ▶ Infants can use syllable co-occurrence to segment a continuous speech stream
- ▶ Doesn't require knowledge of 'words' before it works
- ▶ Turns out not to be specific to words at all (or to humans!)

This is also true with "tone" words or "shape" words.

Monkeys can do this

Speech segmentation summary

▶ Infants use many cues to segment

- ▶ Known words heard in isolation
 - ▶ Frequent words (like names)
 - ▶ IDS Infant directed speech
 - ▶ Stress pattern
 - ▶ Phonotactics
 - ▶ Statistical regularity of syllables (syllable co-occurrence)
transitional probability (she has said this word a lot and probably will use this term on exams)
- Might be able to figure out some properties from the few words they hear in isolation and use those to find more words.

▶ How they weight cues changes with age (Johnson & Jusczyk, 2001; Thiessen & Saffran, 2003)

Learning words is hard

- ▶ Finding and storing word forms (*dog*)
- ▶ Figuring out referents
- ▶ Mapping words onto referents



Words

- ▶ **Referential** Words refer to concepts



- ▶ **Arbitrary**

Nothing about the word “dog” tells you anything about dogs.



Some exceptions: onomatopoeia

e.g. the word “ribbit” is pronounced like the sound a frog makes

There could be special contexts where you get additional information like a mother reading a story to a baby might point to the picture of a dog as she says the word.

Learning Words

18 months: 50 words



6 years: 9,000-14,000 words

=

9 new words per day

Scenario: Walking with someone who speaks a different language and a rabbit runs out in front you and the person shouts “Gavagai!”

“*Gavagai!*”



Quine: What does *gavagai* mean?

▶ 17

It could mean rabbit, look, warning, rodent, etc.

How do you figure out what the actual meaning is?

-
- ▶ “...for any set of data there will be an infinite number of logically possible hypotheses consistent with it. The data are never sufficient logically to eliminate all competing hypotheses (Markman, 1990).”

You need more information, you can't just "know".

Fast mapping (Carey, 1978)

Made sure kids didn't know what the color "chromium" was

- ▶ Word “chromium” introduced to 3-4 year olds in neutral context



Can you bring me the chromium tray?

- ▶ Even 13 month olds can fast map with a few exposures (Woodward et al, 1994)

Kids decided pretty quickly “chromium” meant a color (but didn’t remember the word when tested later)

- ▶ Fast mapping ≠ complete understanding

A little help

- ▶ Knowledge about the world

- ▶ Biases

- ▶ Lexical
- ▶ Pragmatic
- ▶ Attentional

- ▶ Statistics of environment

You hear the word “Gavagai” again in the context of rabbits.

- ▶ Other language cues

Figured out chromium was a color because it was contrasted with a red tray.

Knowledge about the world

- ▶ Much knowledge in place by the time infants begin to learn words
- ▶ Over first year, infants' understanding of physical world, objects develops (Xu & Carey, 1996)
- ▶ Words (nouns) apply to categories of objects

These biases are invoked when an unfamiliar word is heard.

Lexical biases

Narrow the hypothesis space

- ▶ **Whole-object assumption** for learning nouns
- ▶ **Mutual exclusivity**
- ▶ **Taxonomic assumption**



“Look, a Dax”

nouns refer to whole objects so you won’t pick the coat which only has the same property as the animal

If you hear the word “Daxy” then maybe you would pick the coat.

“Can you find me another one?”



Lexical bias: Words refer to whole objects

- ▶ A novel label is likely to refer to the whole object and not its parts, substance, etc.



Lexical bias: Words are mutually exclusive

► Find the dax!

You know the words shoe and cookie, you pick the one you don't know.

You do this because you assume the same object can't have more than one label.



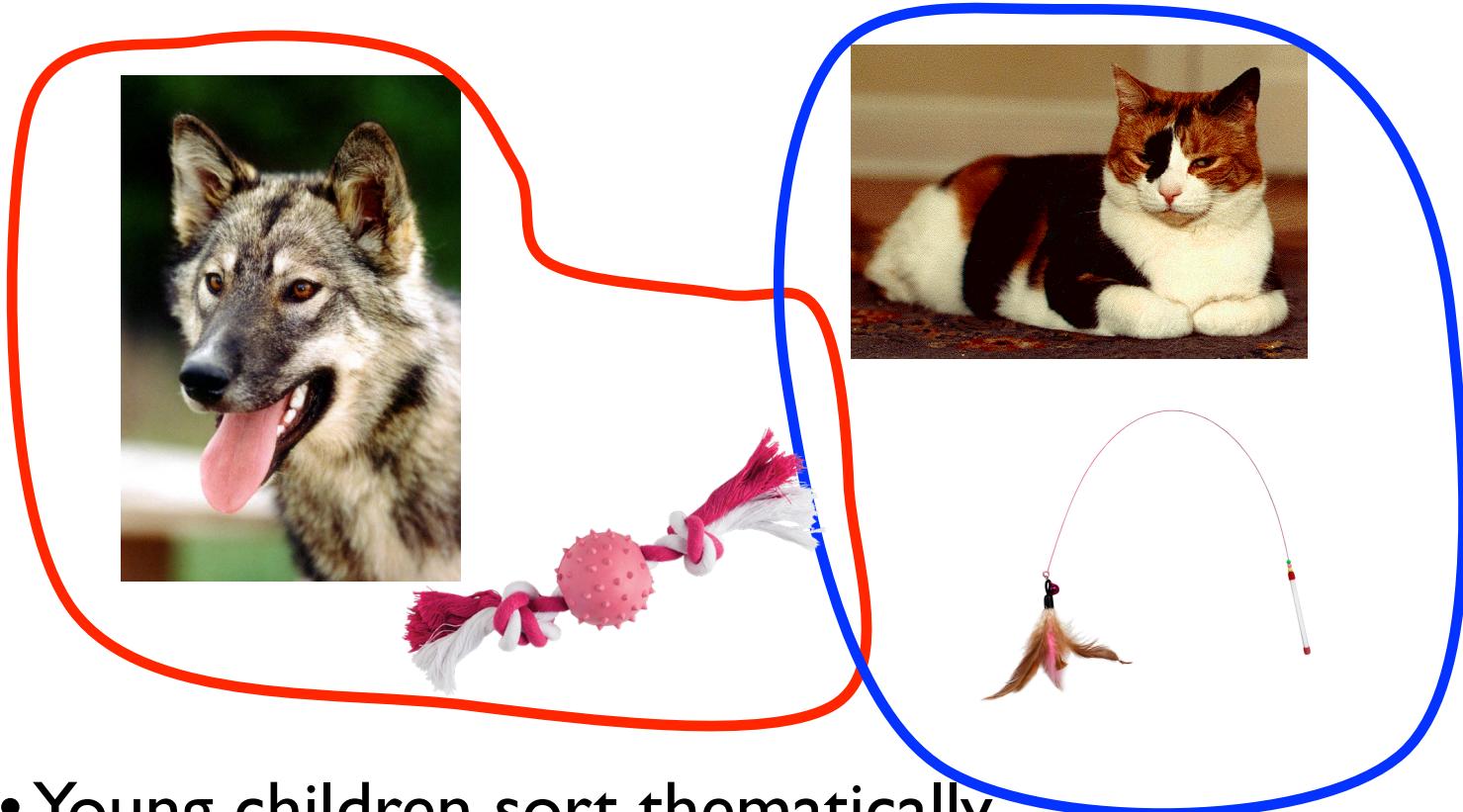
Kids don't make any assumption that "dax" is a property of a shoe or cookie or that "dax" is a kind of cookie.

Lexical bias: Words refer to taxonomic categories



Thematic vs. Taxonomic

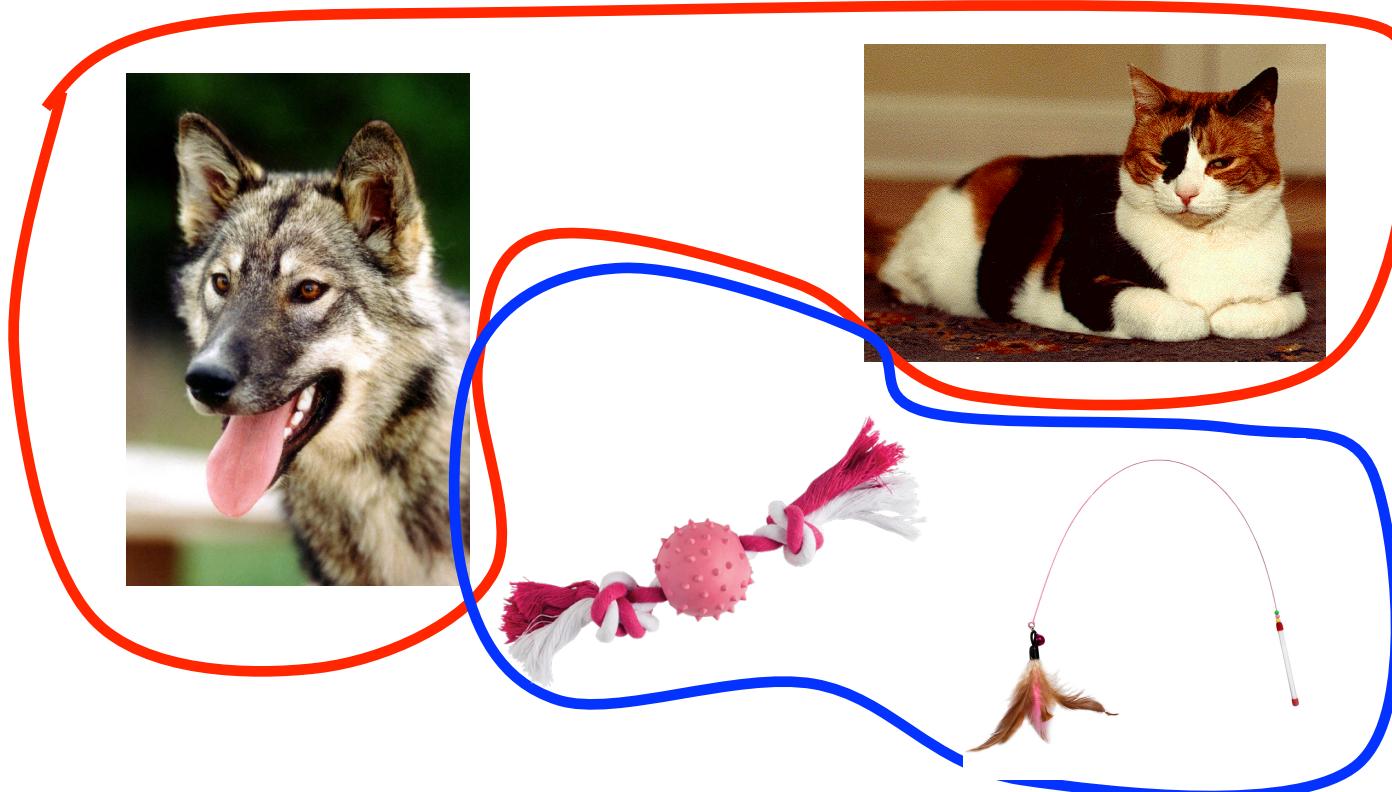
Words don't work like this. We don't have a word for "cat and cat toy".



- Young children sort thematically
- Focus on relationships

Thematic vs. Taxonomic

We have words for taxonomic categories like pet, animal, toy.



- Words group things differently (by kinds)

Word labels overcome thematic preference

- ▶ Markman & Hutchinson (1984)



No Word:

“I’m going to show you something.”

NovelWord:

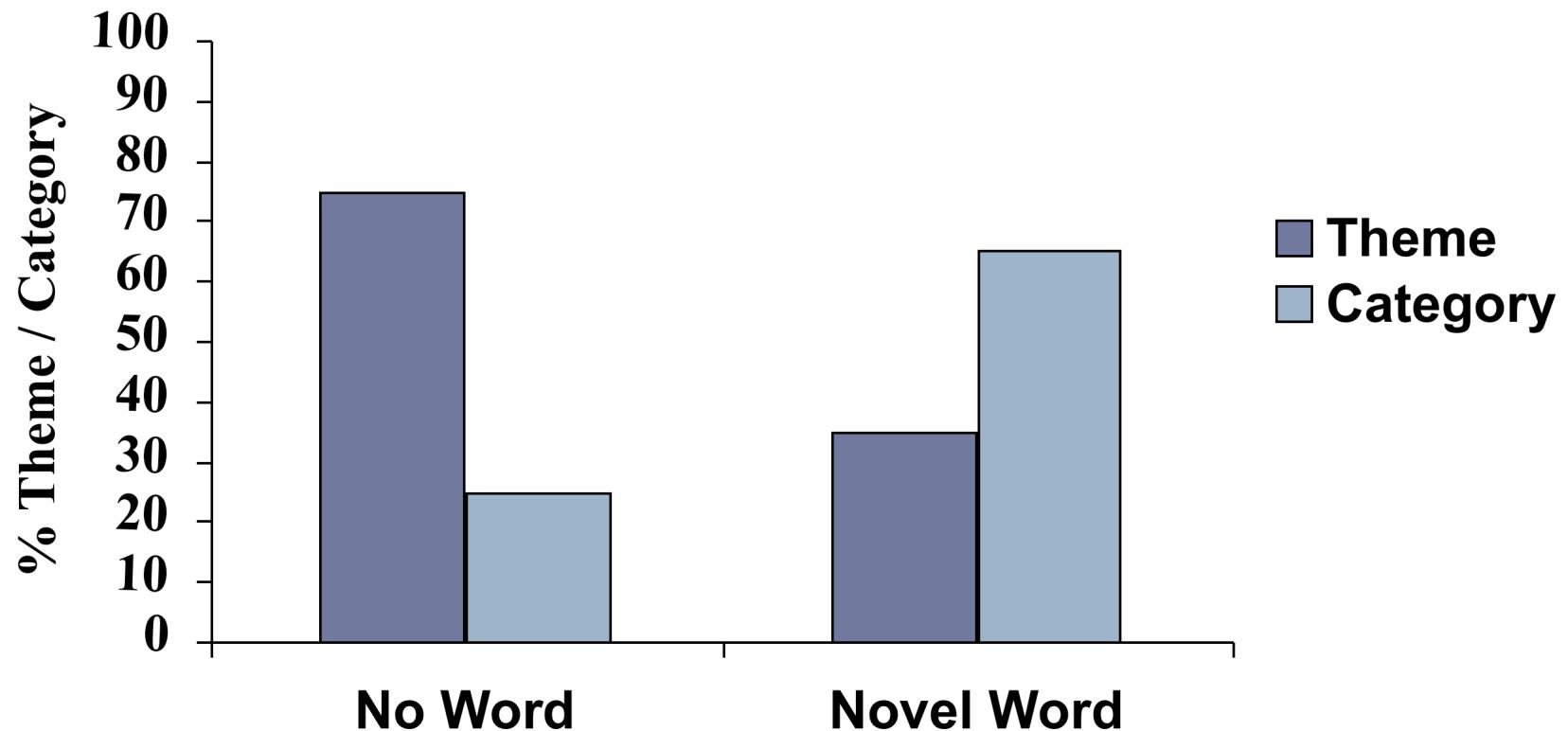
“I’m going to show you a dax.”

“...Can you show me another one.”

“...Can you show me another dax.”

Kids seem to know that a word can only be applied to a category and not a theme.

Choice of Theme vs. Category



Generalizing words

- ▶ **Extending words**
 - ▶ Taxonomically (words refer to things that are the same kind/category)
- ▶ **How do you know something is the same kind?**
 - ▶ Function, shape
- ▶ **How do you know what level to generalize at?**

Generalizing words

- ▶ Xu & Tenenbaum (2007):
- ▶ Type of evidence affects how children generalize words

Hypotheses and type of evidence

fep!



fep!



fep!



Lexical biases – words are special

- ▶ Whole object assumption
- ▶ Mutual exclusivity
- ▶ Taxonomic assumption

Words are special

Studies by Sandy Waxman and colleagues



Auto!/primate call!/tone!



Words become special

- ▶ 3 month olds react same way to human speech and monkey calls
 - ▶ But not bird calls
- ▶ By 6 months, only words facilitate categorization
 - ▶ Unless



(Ferguson & Waxman, 2016)

Pragmatic assumptions

- ▶ Attending to intentions of communication partners
(what does the speaker *intend*?)
 - ▶ Principle of conventionality
 - ▶ Principle of contrast
- ▶ Speaker would not use a new word if a familiar word was appropriate
- ▶ New word --> search for new meaning



Pragmatic assumptions

- ▶ Baldwin (1991): infants use eye gaze
- ▶ 18 mos olds map word onto object that speaker is looking at, not what they themselves are looking at



Attention and learning

- ▶ Map new words to new objects because new objects are more salient



Cross-situational statistics

- ▶ No one-one mapping between the world and a label: real-world context ambiguous
 - ▶ When I say the word rabbit, there is always something else in the visual scene in addition to a rabbit
- ▶ But across instances? (Yu & Smith, 2007)

Cross-situational statistics



DAX!

MOG!



BLICKET!

FEP!



DAX!

TOMA!

- ▶ Can children do this?