

LSci 51/Psych 56L:  
Acquisition of Language

Lecture 12  
Lexical development I

# Announcements

Review questions for lexical development available

HW4 due 11/5/21

# Lexical knowledge in adults



# We know a lot of words

“...the average twenty-year-old native English speaking American knows 42 thousand dictionary words. As we get older, we learn one new word every two days, which means that by the age of 60, we know an additional 6000 words.”

-Professor Marc Brysbaert of  
Ghent University in Belgium

Brysbaert, Stevens, Mandera, & Keuleers 2016



<https://www.sciencedaily.com/releases/2016/08/160816111017.htm>



# We know a lot of words

Average first grader knows ~13,000 [Ames 1964] (and has only been alive ~2000 days) - that's 6 to 7 new words a day, assuming that children learn right from the first day they're born!



# What we know

Mental dictionary of words = **lexicon**

Each entry for a word contains a lot of information, including what the word sounds like, how to use the word in combination with other words, what the word means, what other words that word is related to...

/kɪri/

kitty



puppy

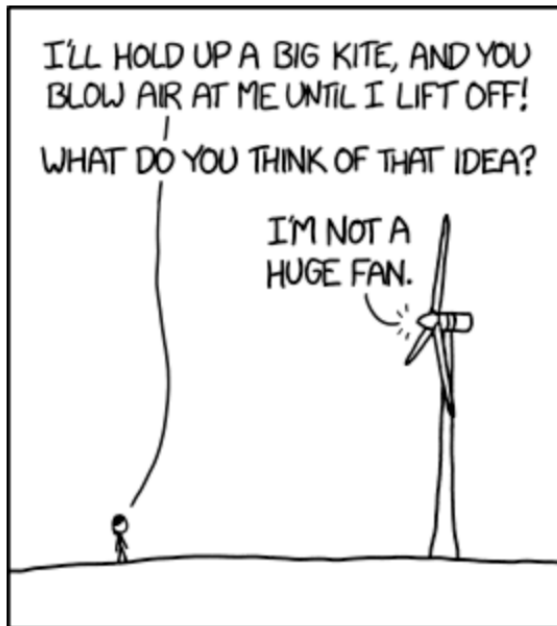
animal

cat

the kitty is..., some kitties are...

# A note about the complexity of lexicon items

Sometimes, a “word” can have multiple meanings. What’s likely going on is that there are multiple lexical items that both have the same word form.



fan<sub>1</sub> = a device with rotating blades that creates a current of air for cooling

fan<sub>2</sub> = a person who has a strong interest in or admiration for something

<http://xkcd.com/1378/>

# So what exactly is a word, anyway?

A word (or **morpheme**) is an arbitrary symbol that stands for something in the real world (even if it's only a concept in someone else's mind): kitty, goblin, silliness, labyrinth

Some concepts/meanings are more abstract:

“doing something in the past”, “continuing to do something”  
(ex: -ed in English, *kiss**ed***)      (ex: -ing in English, *was kiss**ing***)

# The arbitrary nature of words

[Extra]

<http://www.thelingspace.com/episode-67>

<https://www.youtube.com/watch?v=CcSCq8XDTaY>

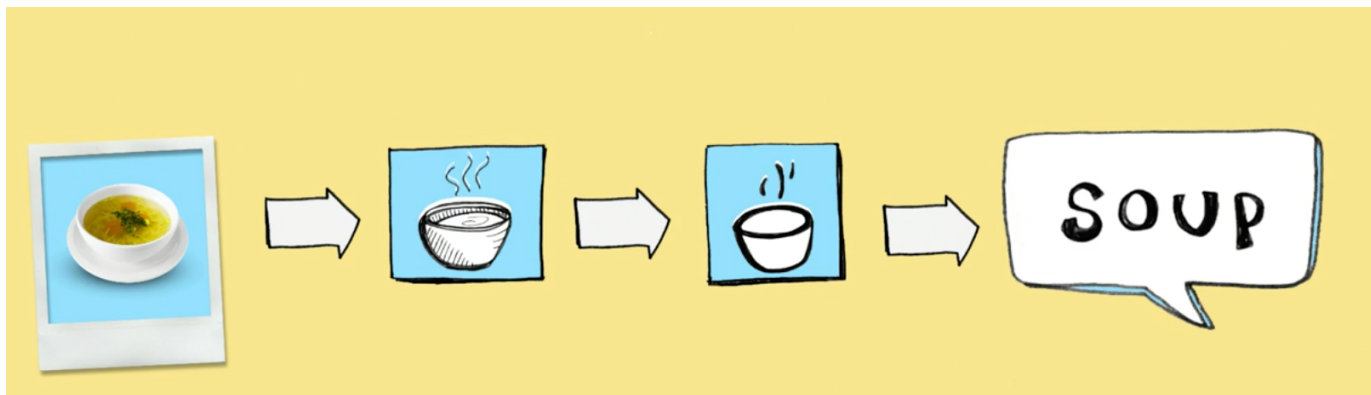
0:33-1:52: Arbitrariness of the Linguistic Sign



# The arbitrary nature of words

“And when you get to language, you see that it becomes a word whose look, the way it looks and the way it sounds, **has absolutely nothing to do with what it started with, or what it represents**, which is the bowl of soup. So it's essentially a **completely abstract, a completely arbitrary representation of something which is in the real world**, and this is something that children with autism have an incredible amount of difficulty with.” - Ajit Narayanan

[https://www.ted.com/talks/ajit\\_narayanan\\_a\\_word\\_game\\_to\\_communicate\\_in\\_any\\_language](https://www.ted.com/talks/ajit_narayanan_a_word_game_to_communicate_in_any_language)



# The arbitrary nature of words

[Extra]

<http://xkcd.com/1322/>



# New words

[Extra]

[https://www.ted.com/talks/erin\\_mckean\\_go\\_ahead\\_make\\_up\\_new\\_words](https://www.ted.com/talks/erin_mckean_go_ahead_make_up_new_words)

Erin McKean:

## Go ahead, make up new words!

TEDYouth 2014 · 6:52 · Filmed Nov 2014

34 subtitle languages ?

View interactive transcript

The video player shows a stage with a large screen displaying icons for a drum set, a microscope, a framed picture of a flower, and a speech bubble with a smiley face. A large play button is overlaid on the screen. The speaker, Erin McKean, is visible on the right side of the stage.



# New words

[Extra]

[https://www.ted.com/talks/john\\_koenig\\_beautiful\\_new\\_words\\_to\\_describe\\_obscure\\_emotions](https://www.ted.com/talks/john_koenig_beautiful_new_words_to_describe_obscure_emotions)



# So what exactly is a word, anyway?

Important: words **refer to things (referential)**. Not enough to simply have associations of sound with something (ex: saying “Eeek!” every time you see a spider)

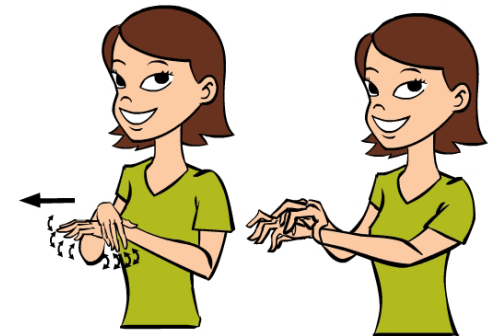


Some greetings and social routines (“Hi!” “See ya!”) might be considered non-referential language.

# How word forms become arbitrary over time

About Bohn, Kachel, & Tomasello 2019

“...the following steps appear plausible: first, people create reference to actions and objects via signs that resemble things. ...use the same signs for the same things. The signs thus gain interpersonal and eventually conventional meaning. Over time, the relationships between the signs and things become more abstract and the meaning of the individual signs more specific.”



More about word meaning  
(one major part of the lexicon)

# Word meaning: A meaning is worth a thousand pictures?

“Words call up **an idea that is more robust than an image** and to which we more rapidly respond. Words have a way of calling up what you know that **filters the environment for you.**” — Linda Smith

<http://www.sciencedaily.com/releases/2014/04/140417090838.htm>



# Why use words?

[https://www.ted.com/talks/john\\_koenig\\_beautiful\\_new\\_words\\_to\\_describe\\_obscure\\_emotions](https://www.ted.com/talks/john_koenig_beautiful_new_words_to_describe_obscure_emotions)

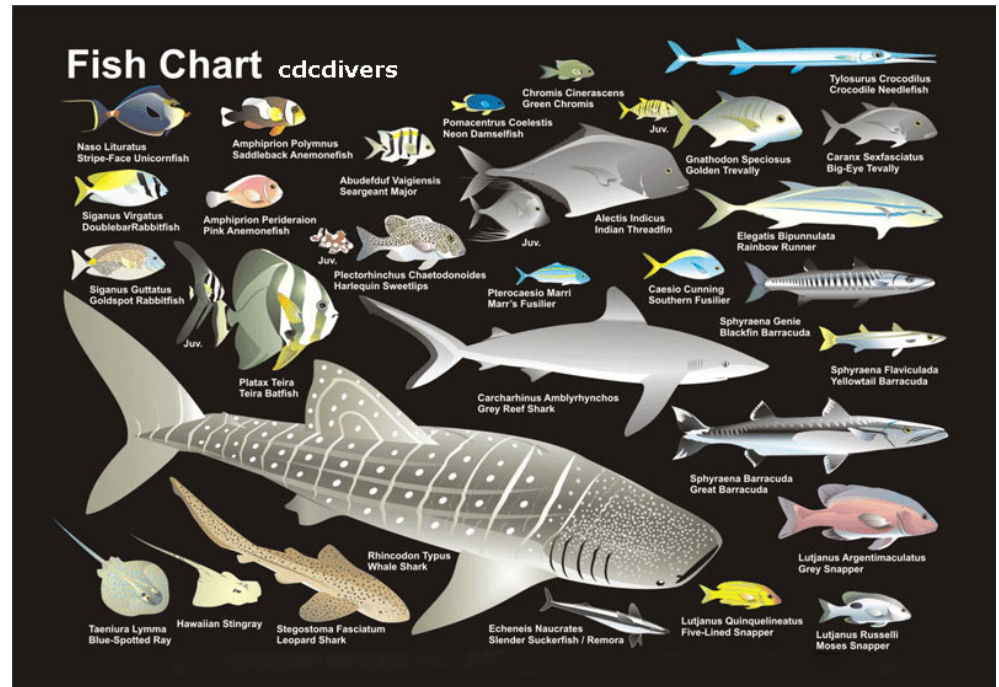
4:22-5:02

“...they're really asking, "Well, how many brains will this give me access to?" Because I think that's a lot of how we look at language. **A word is essentially a key that gets us into certain people's heads.** And if it gets us into one brain, it's not really worth it, not really worth knowing. Two brains, eh, it depends on who it is. A million brains, OK, now we're talking. And so a real word is one that gets you access to as many brains as you can. That's what makes it worth knowing.” - John Koenig



# Hypothesis 1: Meaning as reference [Extra]

- Meaning = Reference
- The meaning of a word (or phrase) is whatever it refers to in the world
  - George Washington = a particular person
  - Fish = a kind of animal
  - Red = property of objects

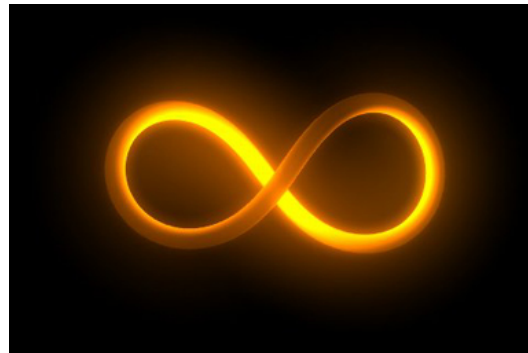


# Hypothesis 1: Meaning as reference

[Extra]

Problems?

- Words can label non-existing real world referents
  - *The Crown Prince of Massachusetts*
  - *unicorn*
- Words can refer to abstract referents
  - *Infinity*
  - *Inevitability*





# Hypothesis 1: Meaning as reference [Extra]

## Problems?

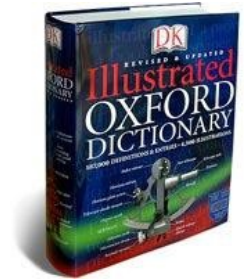
- Same referent, different meaning
  - Morning star* (the last visible star in the eastern sky as dawn breaks)
  - Evening star* (the first star visible in the western sky as sun sets)



- Creatures with a heart*
- Creatures with a kidney*

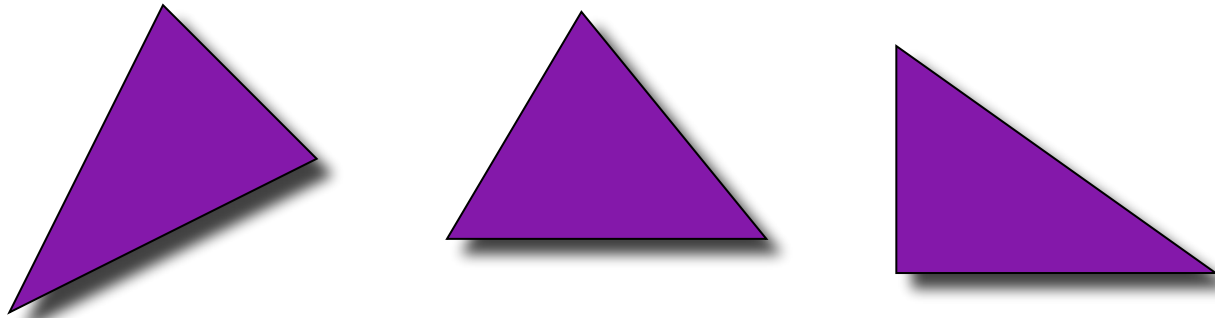


# Hypothesis: Meaning as definition



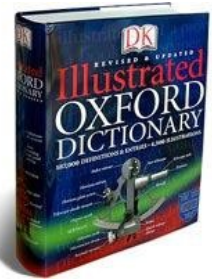
## The Classical Theory

- Word meanings are a set of properties that are **necessary** and **sufficient** for membership in the category.



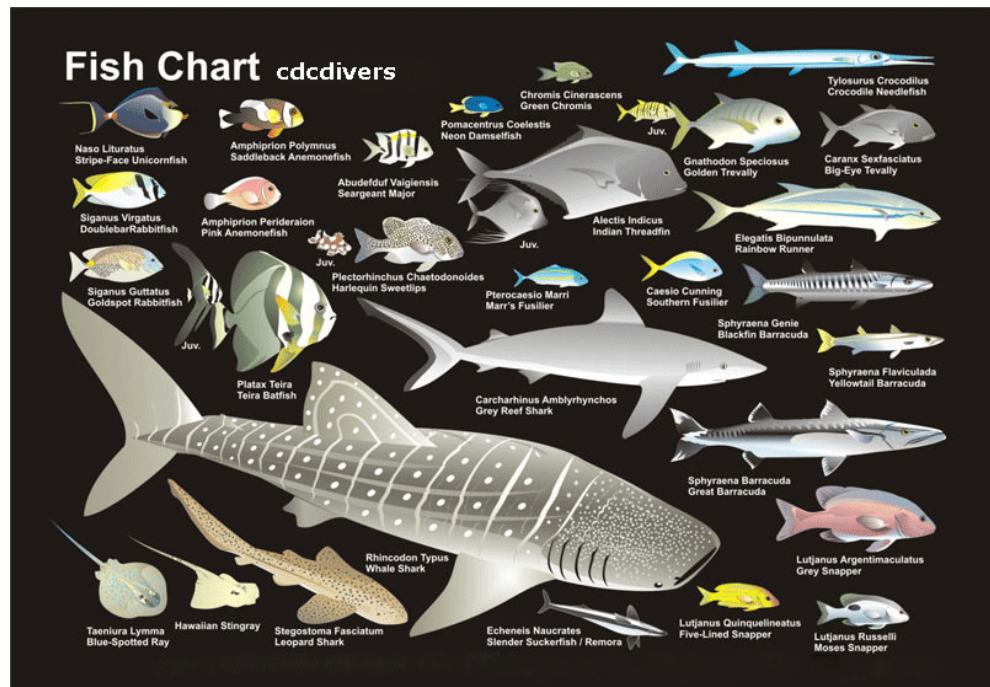
- Meanings are analyzable into bundles of semantic primitives (features).
- Triangle: a closed, three sided figure, whose angles add up to 180 degrees.

# Hypothesis: Meaning as definition [Extra]

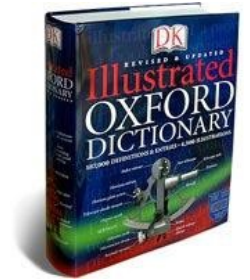


Word meanings are a set of properties that are necessary and sufficient for membership in the category.

- Fish
- [aquatic]
- [water-breathing]
- [cold-blooded]
- [animal]
- [chambered heart]



# Hypothesis: Meaning as definition

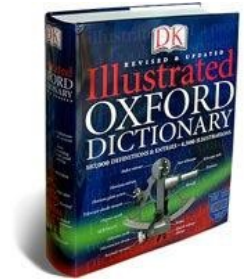


**How do we come up with the right set of properties?**

- Bachelor
  - # My husband is a bachelor.
    - Bachelor —> UNMARRIED
  - # I met a two-year-old bachelor.
    - Bachelor —> ADULT
  - # My sister is a bachelor.
    - Bachelor —> MALE
  - # My dog Rex is a bachelor.
    - Bachelor —> HUMAN

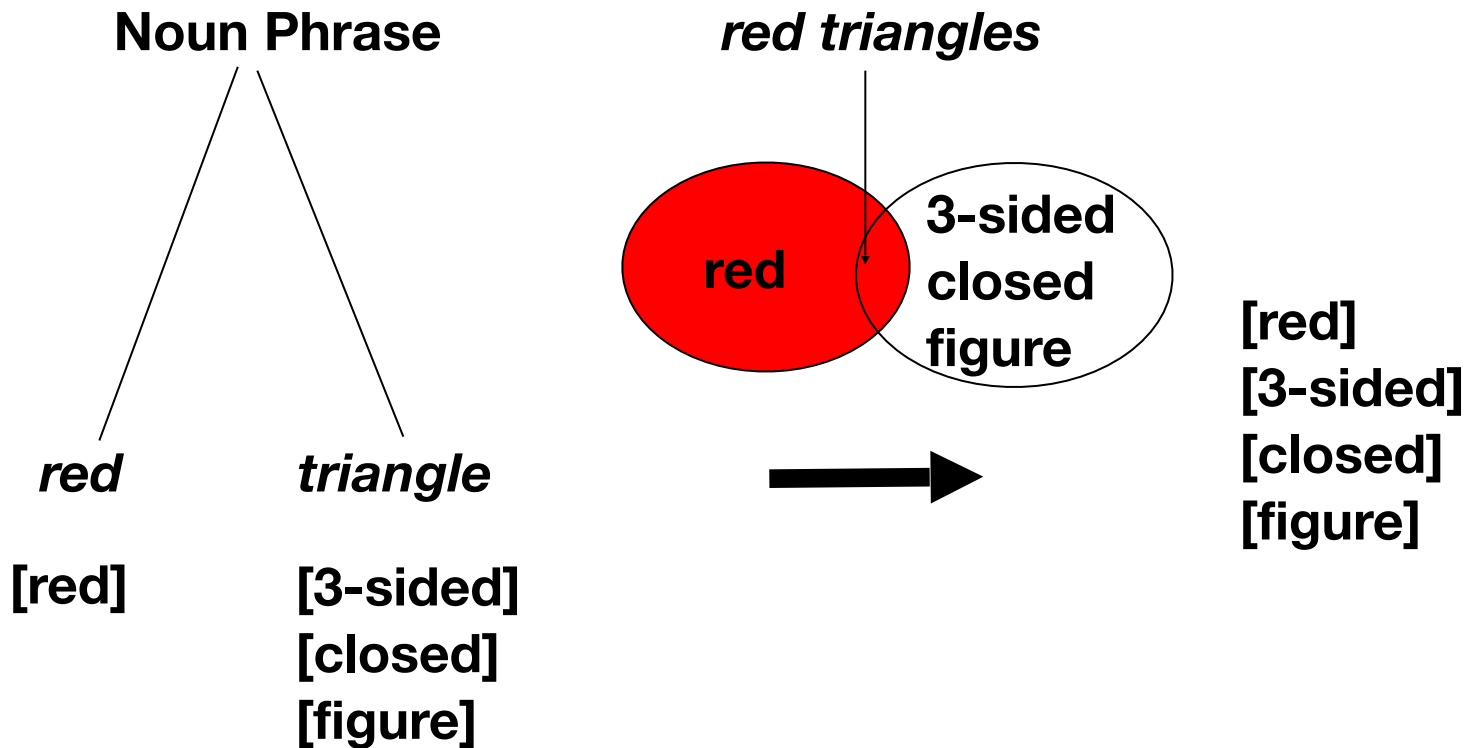
**[UNMARRIED]  
[ADULT]  
[MALE]  
[HUMAN]**

# Hypothesis: Meaning as definition

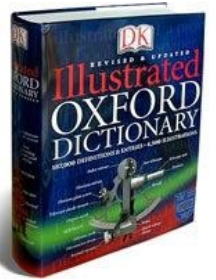


How do we create new meanings?

**Compositional semantics.**



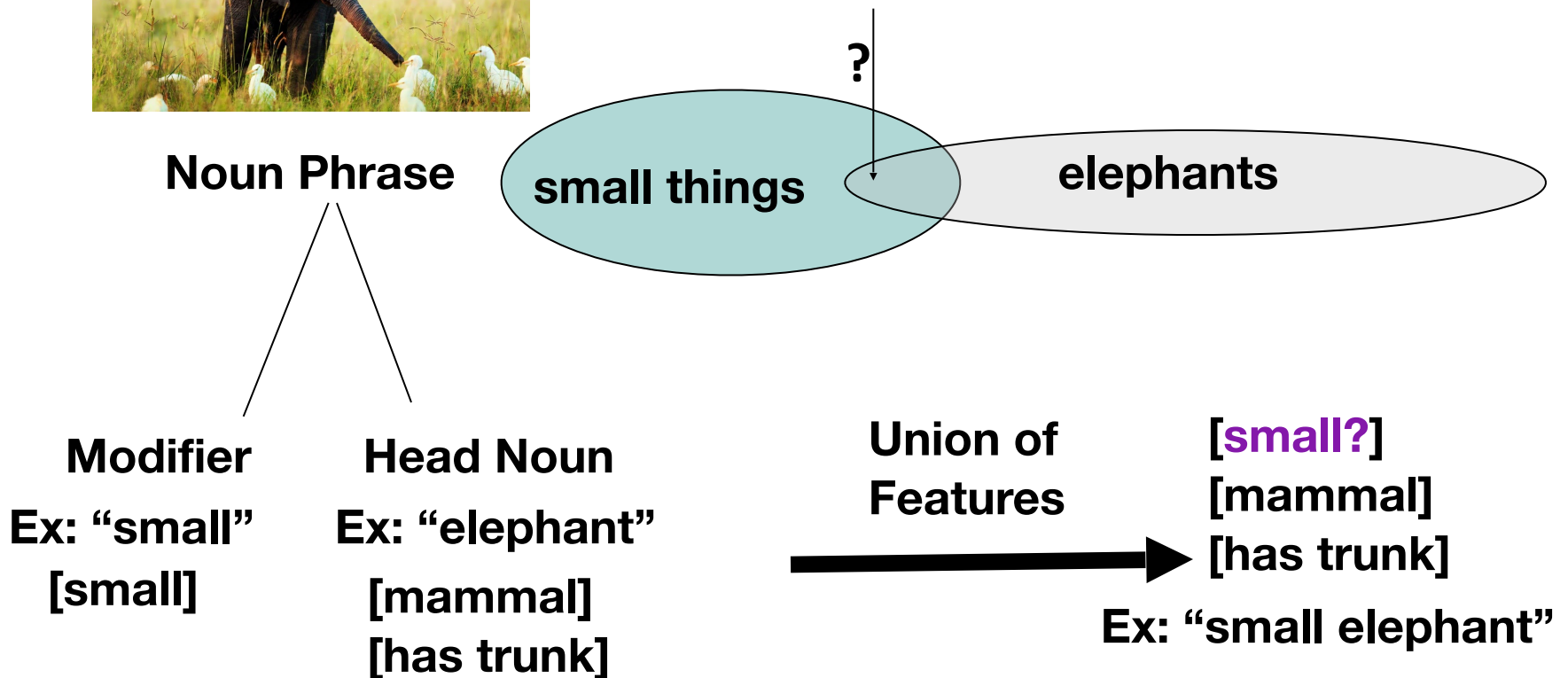
# Hypothesis: Meaning as definition



- Composition doesn't always seem to work, though...

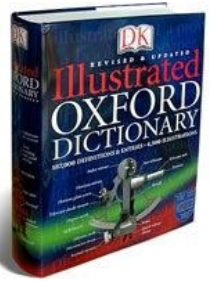


*Are small elephants really in the set of small things to begin with?*





# Hypothesis: Meaning as definition



- Issues with adjectives

<http://www.thelingspace.com/episode-55>

<https://www.youtube.com/watch?v=M96aiDk2ePw>

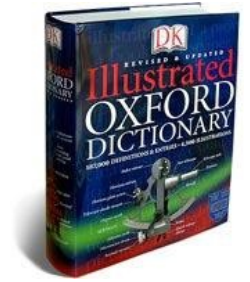
4:57-5:11: adjective types

5:11-5:34: intersective adjectives (like *red* and *extraterrestrial*)

5:34-6:26: subjective adjectives (like *small*)



# Hypothesis: Meaning as definition



Also, necessary and sufficient features aren't always so easy to come up with.

What is a game?  
(Wittgenstein 1953)



Is it always amusing?

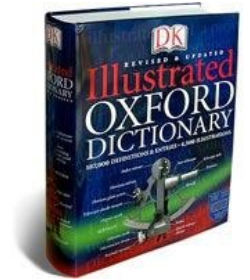
Is skill required?

Is it always competition?

Must luck play a role?



# Hypothesis: Meaning as definition



Also, necessary and sufficient features aren't always so easy to come up with.

## Bachelor (revisited)

**[UNMARRIED]**

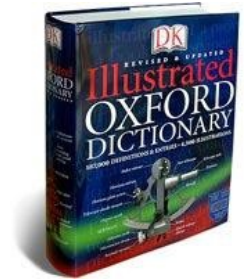
**[ADULT]**

**[MALE]**

**[HUMAN]**

Amos is an unmarried adult male, but he has been living with his girlfriend for the last 23 years. Their relationship is happy. Is Amos a bachelor?

# Hypothesis: Meaning as definition



Also, necessary and sufficient features aren't always so easy to come up with.

## Bachelor (revisited)

**[UNMARRIED]**

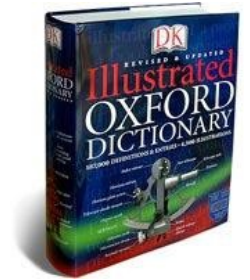
**[ADULT]**

**[MALE]**

**[HUMAN]**

Bernard is an unmarried adult male, and he does not have a partner. Bernard is a monk living in a monastery. Is Bernard a bachelor?

# Hypothesis: Meaning as definition



Also, necessary and sufficient features aren't always so easy to come up with.

## Bachelor (revisited)

**[UNMARRIED]**

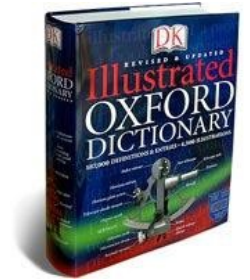
**[ADULT]**

**[MALE]**

**[HUMAN]**

Charles is a married adult male, but he has not seen his wife for many years. Charles is earnestly dating, hoping to find a new partner. Is Charles a bachelor?

# Hypothesis: Meaning as definition



Also, necessary and sufficient features aren't always so easy to come up with.

## Bachelor (revisited)

**[UNMARRIED]**

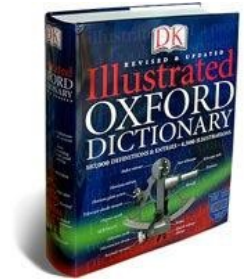
**[ADULT]**

**[MALE]**

**[HUMAN]**

Donald is a married adult male, but he lives in a culture that encourages men to take two wives. Donald is earnestly dating, hoping to find a new partner. Is Donald a bachelor?

# Hypothesis: Meaning as definition



Again, necessary and sufficient features aren't always so easy to come up with.

[https://en.wikipedia.org/wiki/Diogenes\\_of\\_Sinope](https://en.wikipedia.org/wiki/Diogenes_of_Sinope)

When Plato gave his definition of man as "featherless bipeds" and was much praised for the definition, Diogenes plucked a chicken and brought it into Plato's Academy, saying, "Behold! I've brought you a man."

After this incident, "with broad flat nails" was added to Plato's definition.

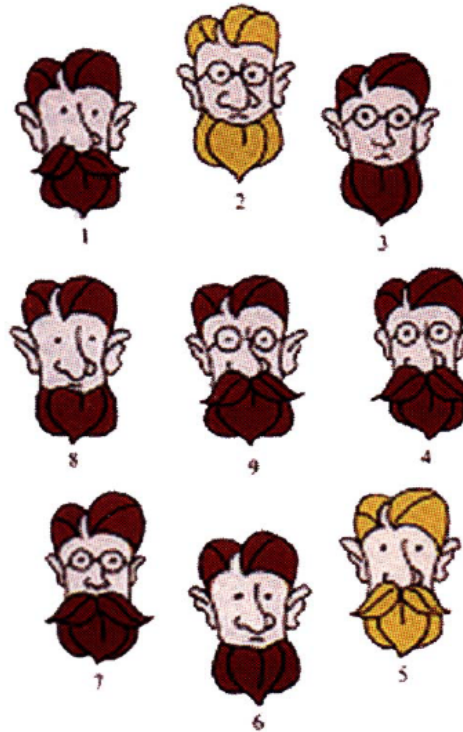
**[-feathers]  
[+biped]**



**[+broad,  
flat nails]**

# Hypothesis: Prototype Theory

Meaning as graded membership to a category



# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

- Categories have *graded membership*: Some members of a category are reliably rated as “better” members than others

Please rate the following in the category BIRD

1

2

3

4

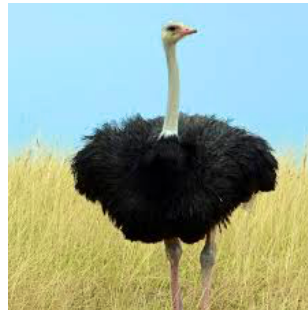
5

6

7

**Good  
member**

**Bad  
member**



**Robin vs. Ostrich vs. Bat**

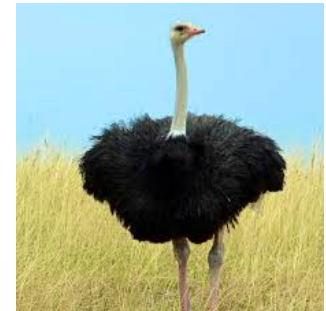
# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

- Categories have *graded membership*: Some members of a category are reliably rated as “better” members than others



- Robin: 1.1
- Eagle: 1.2
- Wren: 1.4
- Ostrich: 3.3
- Chicken: 3.8
- Bat: 5.8

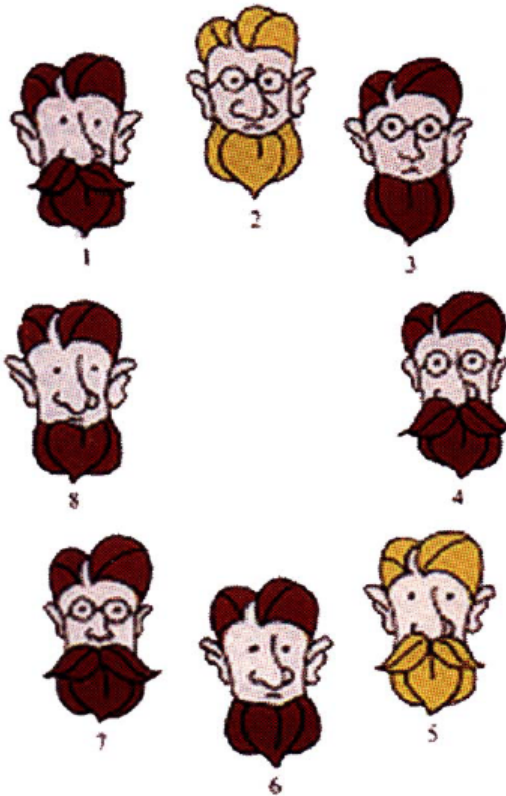




# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

### Family Resemblance Structure

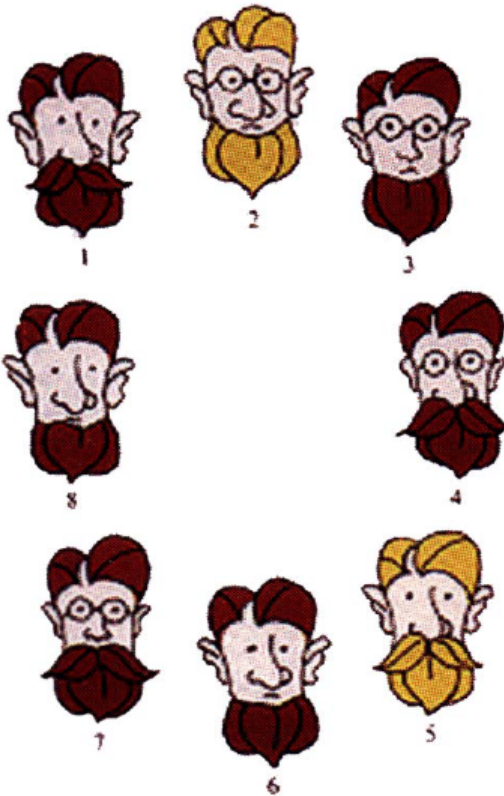


- Smith Family
- Degree of Category Membership (“Smithness”) depends on
  - the number of features and
  - how central they are to “Smithness”

# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

### Family Resemblance Structure



- Smith Family

- Smith Features

- Beard  $8/8 = 1$
- Brown hair  $6/8 = .75$
- Big nose  $6/8 = .75$
- Big ears  $6/8 = .75$
- Mustache  $4/8 = .5$

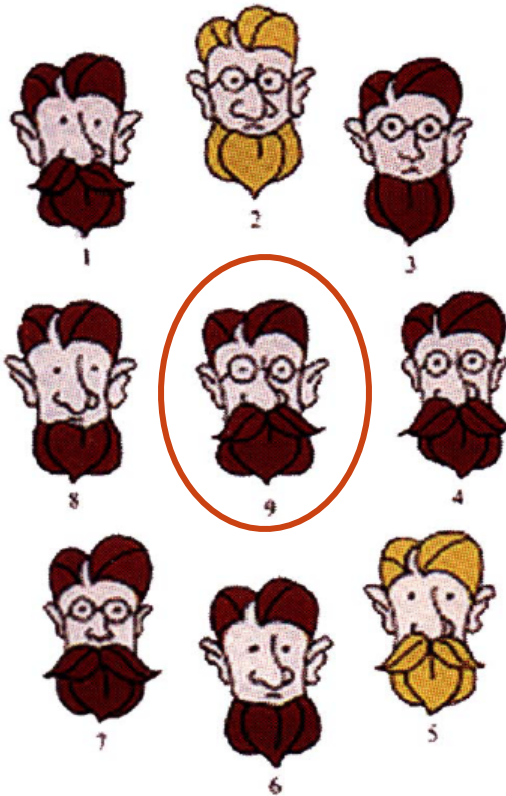
(non-Smith features:

No beard =  $0/8$ , blonde hair =  $2/8$ , small nose =  $2/8$ , small ears =  $2/8$ , no mustache =  $4/8$ )

# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

### Family Resemblance Structure



- Smith Family

- Middle Smith has all Smith features – calculate his score, based on other 8

beard  $1 * 1.0 +$

brown hair  $1 * .75 +$

big nose  $1 * .75 +$

big ears  $1 * .75 +$

mustache  $1 * .5$

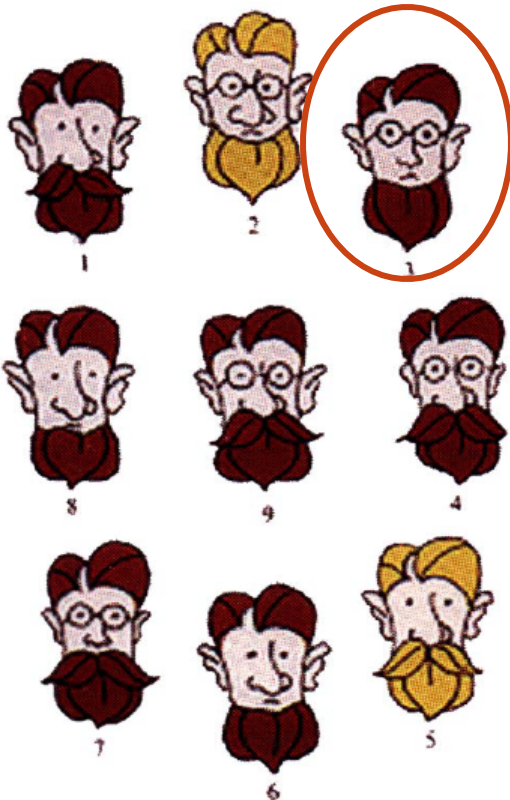


**Total 3.75**

# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

### Family Resemblance Structure



- Smith Family

- **Smith #3 has a few Smith features**

|             |           |
|-------------|-----------|
| beard       | 1 * 1.0 + |
| brown hair  | 1 * .75 + |
| small nose  | 1 * .25 + |
| big ears    | 1 * .75 + |
| no mustache | 1 * .5    |

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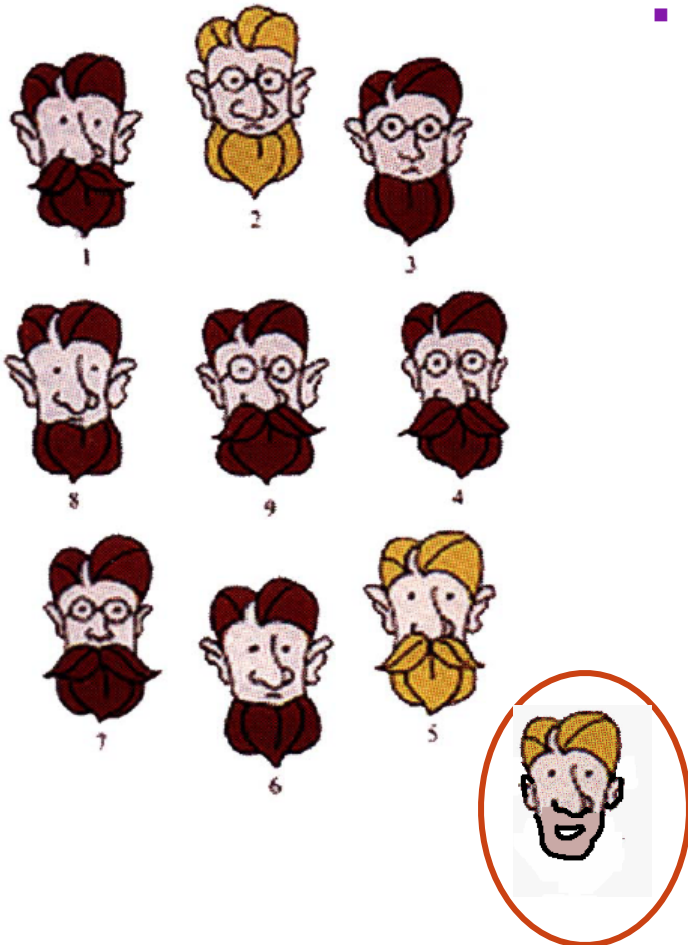
**Total 3.25**

**poorer instance than middle Smith**

# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

### Family Resemblance Structure



- Item with too few features is not a member of the category

|             |             |
|-------------|-------------|
| no beard    | $1 * 0 +$   |
| blonde hair | $1 * .25 +$ |
| big nose    | $1 * .75 +$ |
| small ears  | $1 * .25 +$ |
| no mustache | $1 * .5$    |



Total 1.75

– not a Smith

# Hypothesis: Prototype Theory

## Meaning as graded membership to a category

Family Resemblance Structure: One Formalization

- Features have associated probability
- These probabilities may be thought of as weights on the features for membership/identification purposes
- Category membership is based on a **weighted sum** of the features.

An important issue:  
Words  $\neq$  Concepts

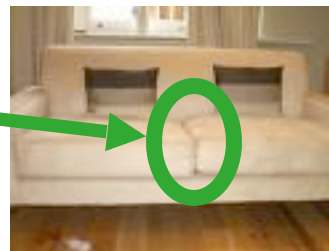


# Words ≠ Concepts

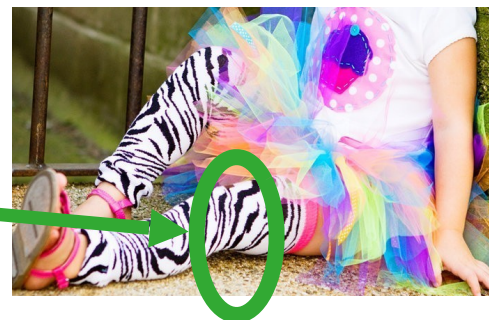
Words and concepts do not map one-to-one.

**Lexical gaps:** concepts that have no words associated with them

“**couch hole**” = gap between couch cushions child has to be careful to avoid when walking across the couch



A three-year-old (pointing to the back of her knee): "My **legpit** hurts."





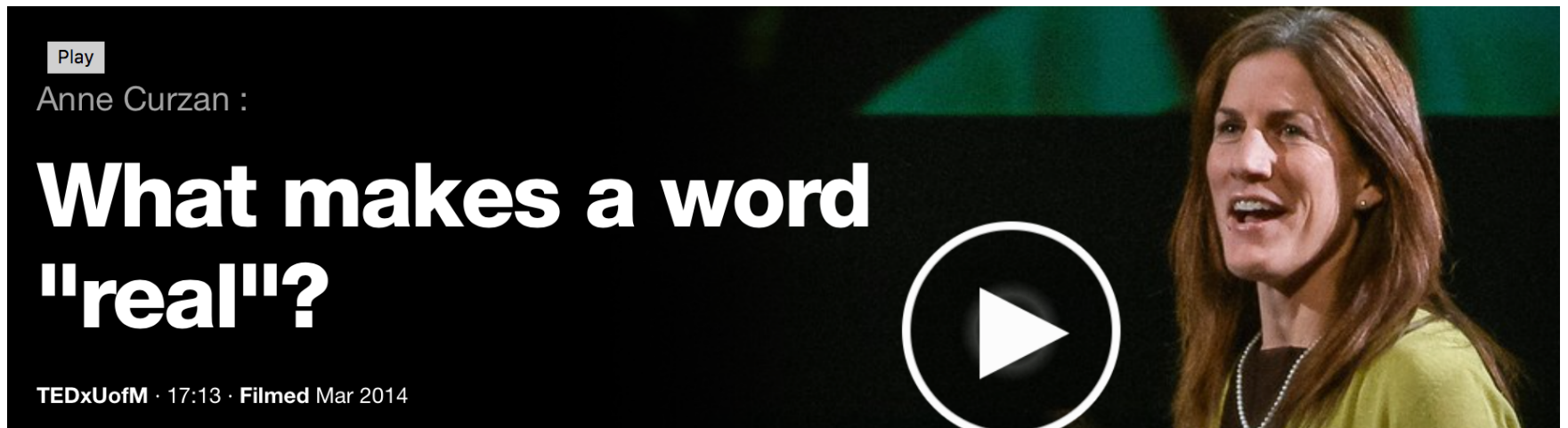
# Filling in lexical gaps: Concepts inspire new words

## [Extra]

Words and concepts do not map one-to-one.

**Lexical gaps no longer:** concepts that used to have no words associated with them

‘hangry,’ ‘defriend’ and ‘adorkable’



[https://www.ted.com/talks/anne\\_curzan\\_what\\_makes\\_a\\_word\\_real](https://www.ted.com/talks/anne_curzan_what_makes_a_word_real)

# Words $\neq$ Concepts

Words and concepts do not map one-to-one.

Words pick out some, but not all, conceptually available distinctions

Ex:



**vs.**



English

fingers

toes

*digits*

Spanish

dedos

# Words ≠ Concepts

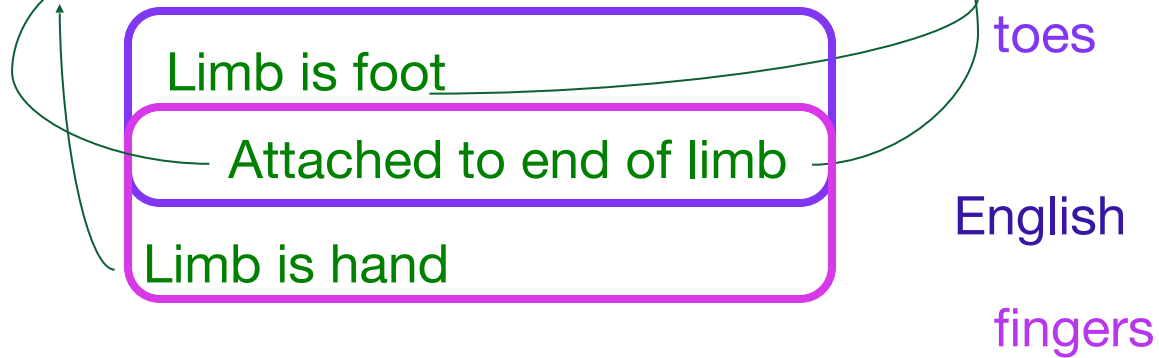
Words and concepts do not map one-to-one.

Words pick out some, but not all, conceptually available distinctions

Ex:



vs.



# Words ≠ Concepts

Words and concepts do not map one-to-one.

Words pick out some, but not all, conceptually available distinctions

Ex:



vs.



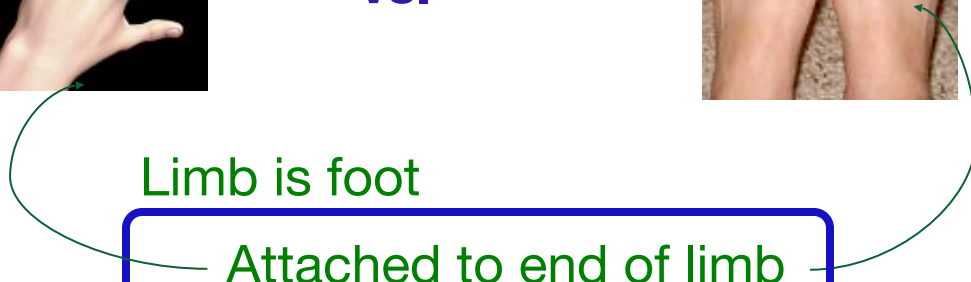
Limb is foot

Attached to end of limb

Limb is hand

English

digits



# Words ≠ Concepts

Words and concepts do not map one-to-one.

Words pick out some, but not all, conceptually available distinctions

Ex:



vs.



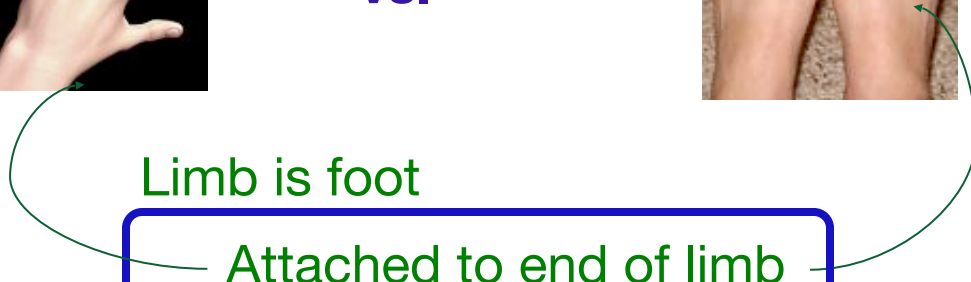
Limb is foot

Attached to end of limb

Limb is hand

Spanish

dedos



What about more abstract concepts/meanings?  
(which often may be associated  
with units smaller than whole words)  
[from Wagner 2010]



# Concepts associated with events



Tense: Locates an event in time

past:

*Jack hugged Lily.*

*Jack was hugging Lily.*

*Jack has hugged Lily.*

*Jack did hug Lily.*

*Jack had hugged Lily.*

present:

*Jack hugs Lily.*

*Jack is hugging Lily.*

future:

*Jack will hug Lily.*

*Jack will be hugging Lily.*

*Jack will have hugged Lily by tomorrow.*

# Concepts associated with events



## Clues for tense

### past:

If you can add “**yesterday**” at the end, and it sounds alright, this is probably in the past tense.

✓ *Jack **was hugging** Lily yesterday.*

✗ *Jack **hugs** Lily yesterday.*



# Concepts associated with events



## Clues for tense

### present:

If you can add “right now” at the end, and it sounds alright, this is probably in the present tense.

✓ *Jack hugs Lily right now.*

✗ *Jack will be hugging Lily right now.*

# Concepts associated with events



## Clues for tense

### future:

If you can add “**tomorrow**” at the end, and it sounds alright, this is probably in the future tense.

✓ Jack *will be hugging* Lily tomorrow.

✗ Jack *did hug* Lily tomorrow.

# Concepts associated with events

Aspect: signals the viewer's perspective  
of the event (complete vs. ongoing)



completed (“perfective”):

*Jack hugged Lily.*

*Jack has hugged Lily.*

*Jack will have hugged Lily by tomorrow.*

*Jack did hug Lily.*

*Jack had hugged Lily.*

incomplete (“imperfective”):

*Jack was hugging Lily. Jack is hugging Lily.*

*Jack will be hugging Lily.*

# Concepts associated with events



## Clues for aspect

Substitute the verb phrase “make a necklace (for)”:

If it’s completed, the necklace should exist in its final state.

If you add “and then [subject] stopped/stops/will stop” and it still sounds perfectly fine, this is imperfective.

*Jack hugged Lily.*

Translation: *Jack made a necklace for Lily*

*...and then he stopped making a necklace.*

Does the necklace now exist? **Yes.**

Does “*and then he stopped...*” **sound odd**? Yes. (Didn’t he already finish?)

This (the **-ed** ending on this verb) is **perfective**.

# Concepts associated with events



## Clues for aspect

Substitute the verb phrase “make a necklace (for)”:

If it’s completed, the necklace should exist in its final state.

If you add “and then [subject] stopped/stops/will stop” and it still sounds perfectly fine, this is imperfective.

*Jack **did** hug Lily.*

Translation: *Jack **did** make a necklace for Lily*

*...and **then he stopped** making a necklace.*

Does the necklace now exist? **Yes.**

Does “*and then he stopped...*” **sound odd**? Yes. (Didn’t he already finish?)

This (the **did**) is **perfective**.

# Concepts associated with events



## Clues for aspect

Substitute the verb phrase “make a necklace (for)”:

If it’s completed, the necklace should exist in its final state.

If you add “and then [subject] stopped/stops/will stop” and it still sounds perfectly fine, this is imperfective.

*Jack will have hugged Lily by tomorrow.*

Translation: *Jack will have made a necklace for Lily by tomorrow  
...and then he will stop making a necklace.*

Will the necklace exist by tomorrow? **Yes.**

Does it **sound odd** to add “and then he will stop...”? Yes. (Won’t he already have finished?) This (*will have -ed*) is perfective.

# Concepts associated with events



## Clues for aspect

Substitute the verb phrase “make a necklace (for)”:

If it’s completed, the necklace should exist in its final state.

If you add “and then [subject] stopped/stops/will stop” and it still sounds perfectly fine, this is imperfective.

*Jack **was** hugging Lily.*

Translation: *Jack **was** making a necklace for Lily*

*...and **then he stopped** making a necklace.*

Does the necklace exist now? **Not yet** – could still be in progress.

Is it **okay** to add “and then he stopped...”? **Yes.**

This (**was -ing**) is imperfective.

# Concepts associated with events



## Clues for aspect

Substitute the verb phrase “make a necklace (for)”:

If it’s completed, the necklace should exist in its final state.

If you add “and then [subject] stopped/stops/will stop” and it still sounds perfectly fine, this is imperfective.

*Jack **is** hugging Lily.*

Translation: *Jack **is** making a necklace for Lily*

*...and **then he stops** making a necklace.*

Does the necklace exist now? **Not yet** – still in progress.

Is it **okay** to add “and then he stops...”? **Yes.**

This (**is -ing**) is imperfective.



# Concepts associated with events



## Clues for aspect

Substitute the verb phrase “make a necklace (for)”:

If it’s completed, the necklace should exist in its final state.

If you add “and then [subject] stopped/stops/will stop” and it still sounds perfectly fine, this is imperfective.

*Jack **will be** hugging Lily.*

Translation: *Jack **will be** making a necklace for Lily*

*...and then he will stop making a necklace.*

Will the necklace exist later? **Not yet** – could still be in progress.

Is it **okay** to add “and then he will stop...”? **Yes.**

This (**will be -ing**) is imperfective.

# Concepts associated with events

All languages mark either **tense** or **aspect** or **both**, but there is wide variation in their precise expression.

Tense-only: **modern Hebrew**

Aspect-only: **Mandarin**

English: **both**



# Concepts associated with events

Another difficulty: These kinds of meanings can be naturally related to each other, which means it can be difficult to realize they're actually separate concepts

## Class one: "the present moment"

present tense + imperfective aspect

(naturally incomplete because you're watching it happen)

ex: *Jack hugs Lily.*

## Class two: "the completed past"

past tense + perfective aspect

(naturally in the past because you know it finished)

ex: *Jack hugged Lily.*

# Concepts associated with events

Some final thoughts:

Our subjective experience of time passing may help identify that tense is a relevant concept. There may be a more perceptually grounded way to identify something as definitively “present” vs. “past” vs. “future” than there is to identify something as definitively a “game” or a “fruit” or a “Smith”.

Our subjective experience of events happening may help identify that incomplete vs. complete is a relevant distinction. As with time, there may be a more perceptually grounded way to identify something as definitively “complete” vs. “incomplete”.

# Recap: Children's lexical development

Children must figure out the lexicon of their language, including the correspondence between sounds and meaning.

Lexical meaning isn't necessarily so easy to define. A current theory that shows promise is a probabilistic implementation of prototype theory.

Different components of meaning may overlap, such as with tense and aspect. This shows us that the meaning we have for a word can involve many different logically separate concepts, even if we aren't explicitly aware of them.

# Questions?



You should be able to do up through question 5 on HW4 and up through question 6 on the lexical development review questions.