Psych 56L/ Ling 51: Acquisition of Language

Lecture 9
Lexical Development I

Announcements

Midterm returned, grades also available on EEE
Review questions for lexical development available
HW2 due 2/17/11

Lexical Knowledge in Adults

We know a lot of words

Average English-speaking college student knows ~150,000
Average first grader knows ~14,000 (and has only been alive ~2000 days) - that’s 7 new words a day, assuming that the child learns right from the first day s/he is 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...

/gəblən/  
goblin  
creature

the goblin is..., some goblins are...

So what exactly is a word, anyway?

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

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.

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

Hypothesis 1: Meaning as reference

- 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

Problems?
- Words can label non-existing real world referents
  - The Crown Prince of Massachusetts
  - unicorn
- Words can refer to abstract referents
  - infinity
  - Inevitability

Hypothesis 2: 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 1: Meaning as reference

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
- Learning: Many non-encountered instances
  - Fish?
Hypothesis 2: Meaning as definition

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

- Bachelor
  - # My husband is a bachelor.
  - Bachelor \(\rightarrow\) UNMARRIED
  - # I met a two-year-old bachelor.
  - Bachelor \(\rightarrow\) ADULT
  - # My sister is a bachelor.
  - Bachelor \(\rightarrow\) MALE
  - # My dog Rex is a bachelor.
  - Bachelor \(\rightarrow\) HUMAN

How do we create new meanings?

Compositional semantics.

red triangle

red

3-sided closed figure

[red] [3-sided] [closed] [figure]

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 2:
Meaning as definition

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

Bachelor (revisited)
[UNMARRIED]
[ADULT]
[MALE]
[HUMAN]
Alfred is an unmarried adult male, but he has been living with his girlfriend for the last 23 yrs. Their relationship is happy. Is Alfred a bachelor?

Hypothesis 2:
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 2:
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 2:
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 3: 

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

Ostrich vs. Robin vs. Bat

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good member</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bad member</td>
<td></td>
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</tr>
</tbody>
</table>

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

“1’ll give you 30 seconds – name as many fruits as you can”
Hypothesis 3: Prototype Theory

Meaning as graded membership to a category

- Production task: people generate prototypical exemplars of a category earlier than less prototypical members

Example response: apple, orange, banana, peach, grapefruit, apricot, grapes, blueberries, honeydew, ...

Finding: Prototypical items are categorized faster, even when frequency is controlled for.

<table>
<thead>
<tr>
<th>High Freq</th>
<th>Low Freq</th>
</tr>
</thead>
<tbody>
<tr>
<td>+Proto (orange-fruit) Fast v</td>
<td>(peach-fruit) Moderate v</td>
</tr>
<tr>
<td>-Proto (fig-fruit) Moderate</td>
<td>(coconut-fruit) Slow</td>
</tr>
</tbody>
</table>

- Verification task

Finding: Prototypical items are categorized faster, even when frequency is controlled for.
Hypothesis 3: Prototype Theory
Meaning as graded membership to a category

- Feature naming

Findings:
1. Necessary and sufficient features DO NOT emerge
2. However, prototypical exemplars share more features with other exemplars.

<table>
<thead>
<tr>
<th>apple</th>
<th>lemon</th>
<th>fig</th>
</tr>
</thead>
<tbody>
<tr>
<td>fruit</td>
<td>fruit</td>
<td>fruit</td>
</tr>
<tr>
<td>red</td>
<td>yellow</td>
<td>brown</td>
</tr>
<tr>
<td>juicy</td>
<td>sour</td>
<td>wrinkled</td>
</tr>
<tr>
<td>round</td>
<td>juicy</td>
<td>tropical</td>
</tr>
<tr>
<td>sweet</td>
<td></td>
<td>sweet</td>
</tr>
</tbody>
</table>

- Current Recap
  - Concepts are made of:
    - Features
      - often perceptually grounded
  - How are features combined:
    - family resemblance: no single feature necessary
    - more shared features = better category member

Hypothesis 3: 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"

Family Resemblance Structure

- Smith Family

- Smith Features
  - Beard
  - Brown hair
  - Big nose
  - Big ears
  - Mustache
  - 8/8 = 1
  - 6/8 = .75
  - 6/8 = .75
  - 6/8 = .75
  - 4/8 = .5
Hypothesis 3: Prototype Theory
Meaning as graded membership to a category

Family Resemble Structure
- Smith Family
- Middle Smith has all features
  - beard 1 *.1.0
  - brown hair 1 *.75
  - big nose 1 *.75
  - big ears 1 *.75
  - mustache 1 *.5

- Total 3.75

Hypothesis 3: Prototype Theory
Meaning as graded membership to a category

Family Resemble Structure
- Smith Family
- Middle Smith #3 has a few features
  - beard 1 *.0
  - brown hair 1 *.75
  - big nose 0 *.75
  - big ears 1 *.75
  - mustache 0 *.5

- Total 2.5
- poorer instance than middle Smith

Hypothesis 3: Prototype Theory
Meaning as graded membership to a category

Family Resemble Structure
- Item with too few features is not a member of the category
  - beard 0 *.1
  - brown hair 0 *.75
  - big nose 1 *.75
  - big ears 0 *.75
  - mustache 0 *.5

- Total .75
- Not a Smith

Family Resemble 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.
Recap: Children’s Lexical Development

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

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

Presumably, children would learn probabilistic associations between features and category membership when they are learning what things should be called what.

Questions?

You should be able to do up through question 3 on HW2 and up through question 7 on the lexicon review questions.