Computational Semantics and Pragmatics

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In the Previous Lecture

- Some proposals to flesh out the notion of word sense:
    * Decompositional approaches: break down word senses into smaller components
        ▶ meaning primitives
        ▶ generative lexicon (lexical tamplates and qualia structure)
    * Non-decompositional approaches
        ▶ logic-based compositional semantic theories
        ▶ definition-based / relational approaches

- Structure of the lexicon given ambiguity (homonymy/polysemy)
    * Enumerative approaches
        ▶ meaning primitives
        ▶ logic-base, definition-based, relational approaches
    * Generative approaches
        ▶ the generative lexicon framewok
        ▶ pragmatic approaches (only mentioned at the end)

Today

- An example of how ideas from theoretical lexical semantics (GL) can be addressed with a corpus-based approach.

Maria Lapata. 2001. A Corpus-based Account of Regular Polysemy: The Case of Context-sensitive Adjectives. In Proceedings of NAACL, 63–70. Pittsburgh, PA.

- WordNet
- Psychological theories of concepts / word meaning

WordNet

WordNet is a lexical database created to deal with tasks that require knowledge of lexical semantics. It can be searched online at
http://wordnetweb.princeton.edu/perl/webwn

- what kind of words (part of speech) are included in WordNet?
- how is WordNet organised?
- what are *synsets*?
- what semantic relations are covered?

WordNet: An Example

Noun

- **S:** (n) **port** (a place (seaport or airport) where people and merchandise can enter or leave a country)
- **S:** (n) **port**, port wine (sweet dark-red dessert wine originally from Portugal)
- **S:** (n) **port**, embrasure, porthole (an opening (in a wall or ship or armored vehicle) for firing through)
- **S:** (n) larboard, **port** (the left side of a ship or aircraft to someone who is aboard and facing the bow or nose)
- **S:** (n) interface, **port** ((computer science) computer circuit consisting of the hardware and associated circuitry that links one device with another (especially a computer and a hard disk drive or other peripherals))

Verb

- **S:** (v) **port** (put or turn on the left side, of a ship) *"port the helm"*
- **S:** (v) **port** (bring to port) *"the captain ported the ship at night"*
- **S:** (v) **port** (land at or reach a port) *"The ship finally ported"*
- **S:** (v) **port** (turn or go to the port or left side, of a ship) *"The big ship was slowly porting"*
- **S:** (v) **port** (carry, bear, convey, or bring) *"The small canoe could be ported easily"*
- **S:** (v) **port** (carry or hold with both hands diagonally across the body, especially of weapons) *"port a rifle"*
- **S:** (v) **port** (drink port) *"We were porting all in the club after dinner"*
- **S:** (v) **port** (modify (software) for use on a different machine or platform)

Adjective

- **S:** (adj) **port**, larboard (located on the left side of a ship or aircraft)

WordNet: An Example

Noun

- **S:** (n) **port** (a place (seaport or airport) where people and merchandise can enter or leave a country)
- **S:** (n) **port**, **port wine** (sweet dark-red dessert wine originally from Portugal)
  - *direct hypernym* / ***inherited hypernym*** / *sister term*
    - **S:** (n) fortified wine (wine to which alcohol (usually grape brandy) has been added)
      - **S:** (n) wine, vino (fermented juice (of grapes especially))
        - **S:** (n) alcohol, alcoholic drink, alcoholic beverage, intoxicant, inebriant (a liquor or brew containing alcohol as the active agent) *"alcohol (or drink) ruined him"*
          - **S:** (n) beverage, drink, drinkable, potable (any liquid suitable for drinking) *"may I take your beverage order?"*
            - **S:** (n) food, nutrient (any substance that can be metabolized by an animal to give energy and build tissue)
              - **S:** (n) substance (a particular kind or species of matter with uniform properties) *"shigella is one of the most toxic substances known to man"*
                - **S:** (n) matter (that which has mass and occupies space) *"physicists study both the nature of matter and the forces which govern it"*
                  - **S:** (n) physical entity (an entity that has physical existence)
                    - **S:** (n) entity (that which is perceived or known or

Concepts and Word meaning

- Psycholinguists typically consider that a word gets it significance by being connected to a mental representation – a concept.

  * this contrasts with traditional views in linguistics and philosophy of language, which are "externalists" or referential.

- Cognitive psychologists are interested in the process of categorisation: how humans classify an object as an instance of a concept.

  * how are concepts structured to allow us to use them for categorization?
  * how does categorisation actually work?

Gregory L. Murphy (2002) *The Big Book of Concepts*, MIT Press.

Classical View of Concepts

According to the classic view of concepts, widespread until the 1970's:

- concepts are mentally represented as definitions: a definition gives characteristics that are necessary and jointly sufficient for membership in the category.
  - ∗ all approaches to word meaning we saw yesterday are *definitional* in this way – even GL, I think
- categorisation under this view = application of definition to item.
- law of excluded middle: every object either belongs or does not belong to the category
- no distinction between category members: anything that meets the definition is an equally good member of the category.

Problems for the Classical View

It turns out this is not how concepts behave . . .

- No necessary conditions: Wittgenstein and others argue that most concepts can't be properly defined
  - ∗ if the classic view is correct, it should be possible to come up with the defining features of, say, games. But, is it?
- Conceptual fuzziness: category membership is not discretely determined (clear empirical evidence)
  - ∗ borderline cases
  - ∗ members and non-members form a continuum
- Typicality effects: Not all category members are perceived equally (clear empirical evidence):
  - ∗ typical category members are the good examples - what you normally think of when you think of the category.
  - ∗ properties that strongly affect typicality judgements (e.g. *flying* for bird) are not necessary conditions.

Typicality Effects

Differences in typicality are one of the most robust and reliable effects in categorisation research (over 95% agreement on typicality judgements).

- Faster identification and production of typical members
  * identifying a pictured robin / identifying a pictured chicken as a bird
  * robin is a bird / chicken is a bird
- Retrieval of instances of a given concept: more typical before less typical
- Typicality influences the likelihood of drawing inferences
  * a disease affects robins $\rightarrow$ it affects other birds
- Order of acquisition with children: more typical before less typical
- Correlation between inconsistent category membership judgements (borderline cases) and typicality ratings
- . . .

Typical vs. Atypical Items

Typicality is a graded phenomenon: typical items, moderately typical, atypical, borderline category members.

What makes items typical?

- Frequency? there isn't a simple correlation
- Family resemblance. Typical items. . .
  * tend to have features common in their category
  * tend to not have features common to other categories.
- Example:
  * common features of birds: has two wings, has feathers, lays eggs, flies, small, sings, perch trees
  * *oriole* has many of these features even though it is not very frequent
  * *chicken* is more frequent but has few of these features

Rosch & Mervis Experiments

- Subjects were asked to rate a list of item within a category (furniture, fruit. birds) for how typical they were.
- Different subjects were asked to give features for each item (has four legs, is soft, . . .).
- They quantified the frequency of each feature in the category
- Results:
  * strong correlation between high typicality ratings and items with most common features in the category (high familiy resemblance score).

Rosch & Mervis (1975). Family Resemblances: Studies in the Internal. Structure of Categories, *Cognitive Psychology*, 7(4):573–605.

Alternatives to the Classical View

Two main theories that arose after the downfall of the classical view of concepts and which aim to explain typicality effects:

- Prototype theory
- Exemplar theory

Prototype Theory

Eleanor Rosch was one of the main critics of the classical view of concepts and the proponent of an early alternative.

According to this alternative (family of theories) the representation of a category is based on the notion of prototype.

- a prototype can be thought of as a *summary representation*
  * features that are usually found in the category members, weighted
  * "contradictory" features may be included with different weights
  * categorization criterion based on feature weights
  * no feature is required to be present
- this view can explain the lack of definitional features, borderline cases, faster categorization of typical items, etc.

Exemplar View

The exemplar view rejects the idea that there is a representation that encompasses an entire concept.

According to this view, a concept is just the set of instances of that concept that one person remembers.

To categorise new items, we weight them by how similar they are to the items in our memory.

- the most typical items are those that are more similar to many category members
- borderline cases are those that are almost equally similar to remembered category members and non-members
- typical items would be categorised faster because it is easier to find evidence

Summing Up

None of these theories suffers from the problems of the classical view:

- category membership is a matter of degree - the theories rely on the idea of similarity, which is inherently continuous
- this gradation of similarity leads to typicality differences

Prototype theory: proposes that in general people rely on summary representations of the entire category.

Exemplar theory: rejects summary representations and proposes that generally people rely on items kept in memory.

$\Rightarrow$ Ideally our lexical semantic theories should account for typicality effects.

To Do

Readings on Distributional Semantic Models

- A. Lenci (2008) Distributional Semantics in Linguistic and Cognitive Research, *Italian Journal of Linguistics*, 20(1):1-30.
- P. Turney and P. Pantel (2010) From Frequency to Meaning: Vector Space Models of Semantics, *Journal of Artificial Intelligence Research*, 37:141-188.