Desiderata for a theory of meaning

Lecture 2

Hana Filip
Basic Intuition: Meaning of words and sentences

• Native speakers of a language have certain intuitions about properties of words and sentences and how words and sentences are related to one another that seem to reflect semantic knowledge.

Example:
(i) If Fido is a golden retriever, then Fido is a dog,
(ii) ... then Fido is an animal.
(iii) ... then Fido is a mammal.

• As a native speaker of English, you can infer (ii) and (iii) from (i): if (i) is true, then also (ii) and (iii) must be.
• Native speakers have such intuitions about English sentences and such intuitive judgments give us direct insights into the lexical properties of English words.
Basic Intuition:
Meaning of words and sentences

• These intuitive judgments can be systematically explored by
  – applying various empirical tests, and
  – they can be systematically captured in terms of truth conditions, or in terms of logical form of sentences.

• I.e., knowing what a true inference is (that a dog is a mammal) rests on our ability to make judgments about likeness and difference of meaning, two goals traditionally within the scope of logic.
Basic Intuition:
Meaning of words and sentences

Any adequate semantic theory must minimally satisfy the following requirements:

• provide a systematic account of the relation of sentence meaning and word meaning,
• allow for the automatic prediction of the entailments of every sentence of the language,
• allow us to characterize in a systematic way the variety of semantic relations that words and sentences can enter into: entailment, synonymy, contradiction, etc. Such relations help identify those aspects of meaning relevant to linguistic analysis. Since the semantic relations of entailment, synonymy and contradiction are all interdependent, the successful characterization of one of these terms will guarantee that the other relations can be accounted for.
• Entailment
• Presupposition
Entailment

(A) The park wardens killed the bear.
(B) The bear died / is dead.

Intuitions:
- Whenever (A) is true, (B) must be true (in any situation, at least in any normal, usual one).
- A and [not (B)] is a contradiction (cannot be true in any situation).
- The information that (B) conveys is contained in the information that (A) conveys.
- A situation describable by (A) must be also a situation describable by (B), but the reverse does not follow.

$A$ entails $B$ ($A \to B =_{def} \text{whenever } A \text{ is true, } B \text{ is true.}$
Entailment

(A) *The park wardens killed the bear.* $\rightarrow$ (B) *The bear died/is dead.* $\quad$ A $\rightarrow$ B

(B) *The bear died/is dead.* $\rightarrow\rightarrow$ (A) *The park wardens killed the bear.* $\quad$ B $\rightarrow\rightarrow$ A

(B) $\neg$(*The bear died/is dead.*) $\rightarrow$ (A) $\neg$(*The park wardens killed the bear.*) $\quad$ $\neg$B $\rightarrow$ $\neg$A

(A) $\neg$(*The park wardens killed the bear*),

then (B) *The bear died* may be either true or false.

$\neg\rightarrow$ does not entail
$\neg$ negation, NOT
$v$ or

Summary: Entailment

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Hana Filip
Entailment

- Entailments are sentences whose truth follows from the truth of some sentence

(B) *The bear died / is dead.*

is an entailment of

(A) *The park wardens killed the bear.*

- Entailments constitute at least a part of the truth conditions of sentences.
Presupposition

Background: Bertrand Russell’s (1905) analysis of **definite descriptions**

The present king of France is bald.

\[ \exists x [\text{PKF}(x) \land \forall y [\text{PKF}(y) \rightarrow x = y] \land \text{Bald}(x)] \]

In words:

(1) there is at least one individual \( x \) that is PKF

Bertrand Russell (1905): existence assertion
(Peter Strawson (1950): existence **PRESUPPOSITION**, see below)

(2) any \( y \) that also qualifies as being PKF must be identical with \( x \),
so that \( x \) is the only individual who is PKF (there is no more than one king of France): **uniqueness assertion**

(3) the individual \( x \) is bald, has the property of being bald: **property assertion**
Presupposition

Russell (1905):

*The present king of France is bald* is true when (1’) there is one (2’) and only one king of France and (3’) he is bald.

*The present king of France is bald* is false in each of the three cases in which that fails to be so:

(1’) when there is no individual who is the king of France  
(2’) when there is more than one king of France  
(3’) when there is one and only one king of France and that individual is not bald
Presupposition

Strawson (1950)

• *The present king of France is bald* does not ASSERT that there is a king of France, but rather PRESUPPOSES it.

• The sentence *The king of France is bald* is not devoid of meaning, but it does not follow from this that a given utterance of that sentence expresses a true or false proposition.

• If there is no king of France (PRESUPPOSITION FAILURE), then no one has been referred to, and hence no true or false proposition expressed.
Presupposition

On Strawson’s view (as on Frege’s):
a negative sentence, when uttered, will preserve its presuppositions.

(1) The present King of France is bald.

presupposition: there is a present King of France
assertion: he is bald

(2) The present King of France is not bald.

presupposition: there is a present King of France
assertion: he is not bald
Presupposition

Consequences of Strawson’s proposal for logic:

(1) **Principle of Bivalence**
(2) **Definition of logical/semantic presupposition**

(1) **Principle of Bivalence**: Strawson’s proposal implies that when a sentence involves a **presupposition failure** both that sentence and its negation fail to be true. It forces us to give up one of the central principles of symbolic logic, as it had been developed by Frege, Russell and others - the so-called **Principle of Bivalence**, according to which for any sentence either it or its negation is true. We also need to give up modus tollens: \( p \rightarrow q \), and \( \neg q \), then \( \neg p \).

Some related proposals:
- logical systems with three values: *true, false, neither-true-or false* (Keenan 1972)
- two-valued system with *truth-value gaps* (Van Fraassen 1971)
Presupposition

Consequences of Strawson’s proposal for Logic:

(1) Principle of Bivalence
(2) Definition of logical/semantic presupposition

(2) Definition of logical/semantic presupposition: Following Strawson, many philosophers and linguists have developed the theory of presuppositions further, and tried to solve the problems that any theory of presuppositions introduces into logic. The theory of presuppositions is a subject of research in its own right.
Presupposition

Definition of logical/semantic presupposition:
constancy under negation

A statement A presupposes another statement B iff (based on Strawson):
(i) if A is true, then B is true: $A \rightarrow B$
(ii) if A is false, then B is true: $\neg A \rightarrow B$

Example: If Joan regrets breaking the vase, then she broke it.
If Joan does not regret breaking the vase, then she broke it.

Joan regrets breaking the vase.
Joan does not regret breaking the vase.
Presupposition: Joan broke the vase.
Presupposition

• We can take a sentence, negate it, and see what components survive - i.e., are shared by both the positive and negative sentence. This test divides the semantic components of a sentence into two sets:

• PRESUPPOSITIONS: Those components that ‘survive’ the negation, i.e., never fall within the scope of negation (i.e. which must be interpreted as true when the corresponding positive is asserted to be false):
  (1) Joan regrets breaking the vase.
  (2) Joan does not regret breaking the vase.

  Presupposition: Joan broke the vase.

• ENTAILMENTS: Those components that DO NOT ‘survive’ the negation, i.e., fall within the scope of negation (i.e. which must be interpreted as false when the corresponding positive is asserted to be false):
  (1) That person is a bachelor.
  (2) That person is not a bachelor.

  Entailment: That person is unmarried.
  I.e., the meaning component UNMARRIED of bachelor is negated in (2).

Presupposition

*John managed to stop in time.*
*John did not manage to stop in time.*

**Presupposition** of the verb *manage*: John *tried* to stop in time.
Presupposition

*All Mary’s lovers are French.*

*It is not the case that all Mary’s lovers are French.*

**Presupposition:** Mary has (three or more) lovers.

The quantifying determiner *all x’s* presupposes that there are *three or more* x’s
Presupposition

John stopped beating his wife.
John did not stop beating his wife.

**Presupposition:** John had been beating his wife.
Relations between words

1. ambiguity
2. synonymy
3. antonymy
4. hyponymy
5. symmetry
Lexical Ambiguity

Lexical ambiguity: a single word is associated with more than one unrelated meaning

- Bull
  - Lexeme 1: male cow
  - Lexeme 2: papal communication
  - Lexeme 3: nonsense
Lexical Ambiguity

- Lexical ambiguity: a single word is associated with more than one unrelated meaning

*You should have seen the BULL we got from the pope.*

*bull* (i) papal communication
(ii) a male cow
(iii) nonsense
Lexical Ambiguity

- **Different sources of lexical ambiguity:**
  - Homophones (same pronunciation, different spelling)
    - right - write
    - piece - peace
  - Homographs (same spelling, different pronunciation)
    - bass [ˈbæs] (fish) - bass [ˈbeɪs] (guitar)
    - row [ˈrɔː] (argument) - row [ˈroʊ] (propel with oars)
  - Homographs and homophones
    - bat (wooden stick-like thing) - bat (flying scary mammal thing)
    - bank (financial institution) - bank (riverside)
Lexical Ambiguity

An ambiguous item can be disambiguated by
- intentions of the speaker, and / or
- linguistic context.

the role of linguistic context in disambiguation

(1) I found a mouse in my office. The mouse in my office is broken.
computer related tool

(2) I found a mouse in my office. The mouse in my office nibbled at my sandwich.
small furry animal
Lexical Ambiguity vs. Polysemy

- **POLYSEMY**: a single lexeme has multiple related meanings

(1) While some **banks** furnish sperm only to married women, others are less restrictive.
(2) I withdrew the money from the **bank**.
(3) The **bank** is constructed from red brick.
Lexical Ambiguity vs. Vagueness

- **VAGUENESS**
- is a matter of the relative looseness or of the nonspecificity of interpretation. For example, *many* as in *many linguists* is noncommittal as to the precise number of linguists involved. It seems to be part of what we know about *many* that it is imprecise in this sense.
- The term ‘ambiguous’ is often used wrongly in the meaning ‘vague’.
Lexical Ambiguity vs. Generality

- **GENERALITY**
- *system operator* covers both female and male persons
- its meaning is general enough to include both
  - *He’s our system operator.*
  - *She’s our system operator.*
Lexical Ambiguity

How do we know when a word is ambiguous (as opposed to polysemous, vague or general)?

*Boris discovered a mole.*

Meaning:  
(i) Boris discovered a **small burrowing animal**.
(ii) Boris discovered a **spy**.

• **TEST 1: SO DO construction** (also **DO SO, DO SO TOO**)

*Boris discovered a mole and so did Clark.*

= Boris discovered a spy and Clark discovered a spy.
= Boris discovered a **small burrowing animal** and Clark discovered a **small burrowing animal**.
≠ Boris discovered a spy and Clark discovered a **small burrowing animal**.
≠ Boris discovered a **small burrowing animal** and Clark discovered a spy.
Lexical Ambiguity

• TEST 1: *SO DO* construction (also *DO SO, DO SO TOO*)

- The use of the *do so* expression or other verb phrase pro-form demands identity of meaning between it and its antecedent VP1

  Boris [discovered a mole] and [so did] Clark.
  
  VP1               VP2
  [i.e., discovered a spy] [i.e., discovered a spy]

- If the antecedent verb phrase (VP1) has more than one sense, then whichever sense is selected in this first full verb phrase must be kept the same in the following *do so* anaphor clause. It is not possible for the first clause to have the *mammal* interpretation for *a mole* and the second the *spy* interpretation for *a mole*, or vice versa. Therefore, *a mole* is ambiguous.

- Only identical interpretations are accepted in VP1 and VP2, non-identical interpretations are excluded (but may be accepted only as a pun).
Lexical Ambiguity

- TEST 2: Coordination construction with ellipsis
  Distinct UNRELATED meanings of an ambiguous lexeme (homophone, homograph) can give rise to an ‘oddity’ (marked with ‘?’) in a coordination construction with ellipsis

(1) a. Which flights serve\(_1\) (= provide) breakfast?
   b. Does Delta serve\(_2\) (= fly to) Philadelphia?
   c. ?Does United serve breakfast and San Jose?

(1) c. ’Does Delta serve\(_1\) breakfast and <does Delta serve\(_1\)> San Jose?’
- Syntactic constraint on the coordinands (units) in a coordination construction: they are typically of the same syntactic category: e.g., V, VP, clause, etc.
- Semantic constraint: If a part of the second coordinand is elided, it must be interpreted in a parallel (ideally identical) fashion with the first coordinand.
- Hence, due to the parallelism, the choice of a reading for serve in the first coordinand, namely something like provide, determines the reading of the understood serve in the second elided constituent, but provide San Jose is ODD here.
Lexical Ambiguity

• **TEST 2: Coordination construction with ellipsis**

  Distinct UNRELATED meanings of an ambiguous lexeme (homophone, homograph) can give rise to an ‘oddity’ in a coordination construction with ellipsis

Another example:

? *John* **took** (=withdrew) some money out of his savings and then a vacation.

Why is the above sentence odd? The reason is that the corresponding (understood) not elided coordination construction (reconstructed following the syntactic and semantic constraint on coordination construction with ellipsis, see the previous slide) must also have *took* meaning *withdrew*, which is not the meaning that *a vacation* requires:

? *John* **took**₁ (=withdrew) some money out of his savings and then he **took**₁ (=withdrew) a vacation.
Lexical Ambiguity

• TEST 2: Coordination construction with ellipsis
  
  Distinct RELATED meanings of a polysemous lexeme do NOT give rise to an ‘oddity’

(1) *Pick up the glass*, and pour *it* into the pitcher. (Green 1989, p. 48)

(2) *The newspaper Jan’s reading almost went bankrupt in 1983.*

• Here, different RELATED meanings of a single polysemous lexeme ‘glass’ (container, content) and ‘newspaper’ (a paper that is printed, the organization the publishes the paper) are used in different clauses without oddity
Lexical Ambiguity

• TEST 2: Coordination construction with ellipsis

**RUN:** 1. flow, 2. move fast on foot (ambiguity)

(1) a. *The Mississippi has run down to the Gulf and Bill to the bank.*
    b. *The water is running and so is Bill.*

**Conclusion:** run is ambiguous between the meaning of flow and move fast on foot, because the sense that the first sentence selects, namely flow, is unacceptable or odd in the second sentence.

**RUN:** 1. to continue in operation

(2) *This program will run, if your computer will.* Green (1989, p.55)
Syntactic (or structural) ambiguity

Competent women and men hold all the good jobs in the firm.

Different syntactic structures lead to different meanings:

i.  [ [Competent women] and men ] hold all the good jobs in the firm.

ii. [ Competent [women and men] ] hold all the good jobs in the firm.

i.  allows for an interpretation under which also incompetent men are among those who hold all the good jobs in the firm

ii. only allows that competent people hold all the good jobs in the firm
Lexical ambiguity & syntactic (or structural) ambiguity

Mary claims that John saw her duck.
• lexical ambiguity:
  duck (i) bird
  (ii) to lower oneself

• syntactic ambiguity:
  her duck (i) like my dog (possessive pronoun)
  (ii) like me jump (personal pronoun, accusative/DO case)
        subject-to-object raising construction
        ... John saw [she duck] subordinate clause

subject-to-object raising construction
Scope ambiguity

*Everyone in this room speaks one language.*

i. Everyone speaks one language or another.

   everyone \( > \) one

   ‘\( > \)’: takes scope over

ii. There is one specific language that everyone speaks.

   one \( > \) everyone
Pragmatic ambiguity ??

• Strictly speaking, ambiguity is a semantic phenomenon, involving linguistic meaning rather than speaker meaning.
• Therefore, ‘pragmatic ambiguity’ might be best avoided, it is an oxymoron.
• Reason:
  – Generally, when we use ambiguous words or sentences, we do not consciously entertain their unintended meanings, although there is psycholinguistic evidence that when one hears ambiguous words one momentarily accesses and then rules out their irrelevant senses.
  – When people use ambiguous language, generally its ambiguity is not intended.
  – Occasionally, however, ambiguity is deliberate, as in an utterance of *I'd like to see more of you*, when intended to be taken in more than one way in the very same context of utterance.
(See Kent Bach, Routledge Encyclopedia of Philosophy, entry AMBIGUITY)
Synonymy

• Synonyms can be substituted for each other in a given larger expression (e.g., sentence) without affecting its truth value:
  couch = sofa
  ‘=‘: semantic equivalence
  *I bought a couch.* = *I bought a sofa.*

• True synonyms are rare in natural language. Although the terms may be interchangeable in many contexts, usage may vary as a result of such factors as connotations due to regional origin, level of formality, professional vs. lay context, pejorative vs. neutral vs. complimentary connotation, linguistic origin.

  (1) TV commercial:
  *It’s hard to sell “pop” to people who drink “soda”.*
  (Upstate New York: *soda* in Syracuse and *pop* in Rochester.)

  (2) *salt / sodium chloride*

  (3) *purchase / buy, remember / recall, liberty / freedom*
Synonymy

- Some terms can only be substituted for each other in certain larger expressions without affecting their truth value, but not in others

This is a big house. = This is a large house.
This is my big sister. ≠ This is my large sister.
Synonymy

• Synonymy of sentences

(i) *It is tough to please John.*

(ii) *John is tough to please.*

• ‘tough’ movement construction
• different syntactic structure
• no (truth-conditional) difference in meaning
Antonymy

- Antonyms are words that are opposite in meaning

Types of antonyms
(1) ungradable antonyms (complementaries)
(2) gradable (contraries)
(3) converses (x R⁻¹ y ↔ y R x)
Antonymy

• ungradable antonyms (complementaries)
words that mutually exclude each other

alive       vs.    dead
pass        vs.    fail
hit         vs.    miss (the target)
marrided    vs.    single
innocent    vs.    guilty

Test
• Intuition:
  (i) If Pluto is alive, then he is not dead & If Pluto is dead, then he is not alive.
  (ii) If Pluto is NOT alive, then he is dead & If Pluto is NOT dead, then he is alive.
• Formal representation:
  (i) the truth of one requires the falsity of the other  \( X \rightarrow \neg Y \land Y \rightarrow \neg X \), and
  (ii) the falsity of one requires the truth of the other  \( \neg X \rightarrow Y \land \neg Y \rightarrow X \).
Antonymy

• gradable antonyms (contraries)
  • items that lexicalize a scale, they can be true of objects to a certain degree
    \textit{hot (warm lukewarm tepid cool) cold}

Test
• Intuition: If something is \underline{hot}, it is not \underline{cold}
  If something is \underline{not hot}, it is not necessarily \underline{cold}.

• Formal representation:
  (i) the \underline{truth} of one requires the falsity of the other: \(X \rightarrow \neg Y \land Y \rightarrow \neg X\)
  (ii) the \underline{falsity} of one \underline{DOES NOT} require the truth of the other

• different terminology: subsective adjectives, relative adjectives, attributive adjectives
  (Parsons 1990, p.43)
Antonymy

• **gradable antonyms (contraries)**

• Small elephants constitute a **subsection** of the set of elephants:
  \([\text{small elephant}] \subseteq [\text{elephant}]\)
  ‘[[elephant]]’: interpretation of the word *elephant*
  ‘\(\subseteq\)’: subset

**Subset Venn Diagram**

- B: the set of elephants
- A: the set of small elephants
Antonymy

- gradable antonyms (contraries)

  scalar adjectives like *small* describe properties that are vague:
  How small is small?  Small relative to what?
  *small elephant* vs. *big mouse*

  The vagueness of *small* and *big* involves a comparison class, and the context helps provide the comparison class (e.g., elephants, mice), or the standard relative to which what counts as small or big is determined
Antonymy

• gradable antonyms (contraries)

• the head noun N is often the most salient contextual cue that sets the standard for the subsective or relative adjective modifying it:

(1)  *Barnie is a small elephant* = Barnie is an elephant  \(\land\) Barnie is small for an elephant

\[ X \text{ is ADJ } N \quad = \quad X \text{ is N} \quad \land \quad X \text{ is ADJ for } F \]

where F is some standard (comparison class) that is figured out from context, and often F = N.

• The prototypical properties of the referent of the head noun N set the standard for the interpretation of the subsective or relative adjective modifying it: e.g., good

  *a good mother*
  *a good pilot*
  *a good pencil*
  *good coffee*
Antonymy

• gradable antonyms (contraries)
• Other linguistic and extra-linguistic context can set the salient standard for subsective or relative adjectives

(1) Lee built a really tall snowman.
(2) Lee’s 2-year-old son built a really tall snowman yesterday.
(3) The D.U. fraternity brothers built a really tall snowman last weekend.


(4) **good pencil** vs. **good stick**
*Good for what?* For propping a window open, for skewering marshmallows, etc. - evaluation/interpretation depends on the context of use:
*This is a good pencil for propping a window open.*
*This is a good stick for writing marks in the sand.*

Antonymy

• gradable antonyms (contraries)

• Evaluation of subsective / relative adjectives in dependence on FRAME in the sense of Fillmore (1975, 1982)
  (1) STINGY vs. GENEROUS scale
    Frame: evaluation with respect to the behavior’s treatment of fellow humans
  (2) THRIFTY vs. WASTEFUL/PROFLIGATE scale
    Frame: skill or wisdom displayed in the use of money or other resources
• Contrast ‘within frames’
  *He’s not stingy - he’s really generous.*
• Contrast ‘across frames’
  *He’s not stingy - he’s thrifty.*
Antonymy

• **Converses**

  The lamp is *above* the table.
  The table is *below* the lamp.

• The converse relation $R^{-1}$ or converse of a given relation $R$ is the relation that holds between any $x$ and any $y$ if and only if relation $R$ holds between $y$ and $x$

  **Converses:**  \( x \, R^{-1} \, y \iff y \, R \, x \)

  \( \iff \) if and only
  
  material equivalence: \( \iff \iff \equiv \)

• The converse, $R^{-1}$, of a non-symmetric, two-place relation $R$ is a relation that is just like it except in having the opposite sense.
## Antonymy

- **Converses:** $x \, R^{-1} \, y \iff y \, R \, x$

### PREPOSITIONS

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<td>vs.</td>
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### VERBS

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<th>vs.</th>
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<td>give</td>
<td>vs.</td>
<td>receive</td>
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### NOUNS

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<th>employer</th>
<th>vs.</th>
<th>employee</th>
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<td>vs.</td>
<td>wife</td>
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<td>ancestor</td>
<td>vs.</td>
<td>descendant</td>
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<td>guest</td>
<td>vs.</td>
<td>host</td>
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Symmetry

Max is married to Minnie.  \iff Minnie is married to Max.
Minnie resembles Kim.  \iff Kim resembles Minnie.

- be\_married\langle Max, Minnie\rangle  \iff be\_married\langle Minnie, Max\rangle
  be\_married is a two-place predicate

- Given a two-place predicate \( P \), \( P \) is \textbf{symmetric}
  if and only if for every ordered pair \( \langle x, y \rangle \) in the denotation of \( P \), the
  pair \( \langle y, x \rangle \) is also in \( P \).
Symmetry

• What about
  
  *embrace*
  *collide*
  *meet*
  *argue*
  *agree*?
Symmetry

John and Mary embraced.
→ John embraced Mary. ‘→’ entails
→ Mary embraced John.

Based on the above examples you might be led to conclude that embrace is a symmetrical relation.

However,
John embraced Mary does not entail Mary embraced John.
Mary embraced John does not entail John embraced Mary.

• Therefore, embrace is not a symmetrical relation.
Symmetry

What is the difference between (i) and (ii)?

(i)  *John embraced Mary.*

(ii)  *John and Mary embraced.*

Mary must be AGENTIVELY involved in the hugging in (ii), but not necessarily in (i), (ii) has the reciprocal reading:

(iii)  *John and Mary embraced each other.*  (ii) = (iii)

Supporting argument provided by the observation that (ii) sentence is odd, because of the NONAGENTIVENESS of the lamppost:

(i)  *The drunk embraced the lamppost.*  ex. attributed to Chomsky in Quang Phuc Dong

(ii)  # *The drunk and the lamppost embraced.*  (aka James D. McCawley) 1970

Other examples:
*hug, kiss*  -  Why are they not symmetrical?  Can you give some relevant examples?

*The green peace activist hugged the tree.*

*The prince kissed the Sleeping Beauty.*

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The car and the bus collided.  
Is collide a symmetrical relation?

Gleitman (1969)
The car and the bus collided.  
\[ \rightarrow \text{The car collided with the bus.} \]
\[ \rightarrow \text{The bus collided with the car.} \]

However,

(i) Last night, a bus collided with a bridge abutment, killing 11.
(ii) ?? Last night, a bridge abutment collided with a bus, killing 11.

\begin{itemize}
  \item Therefore, the verb \textit{collide} is not a symmetrical relation.
\end{itemize}

What is the reason for the oddity of (ii)?
Both the participants -- the bus and the bridge abutment - must be in motion.

Other examples:
\textit{see, argue, agree}.  

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Symmetry

Test (summary)
• A form with conjoined subjects entails two nonconjoined forms

  *John and Mary married.*
  → John married Mary.
  → Mary married John.

• Each nonconjoined form also entails the other nonconjoined form
  → John married Mary. (→ Mary married John.)
  → Mary married John. (→ John married Mary.)

Examples: marry, resemble, match
Hyponymy

• A relation of inclusion
• A relation that hold between two lexemes where one denotes a subclass of the other

animal
  
  | 
  
  dog is a hyponym of animal

All dogs are included in the set of animals.
Hyponymy

• A relation of inclusion
• A relation that hold between two lexemes where one denotes a subclass of the other

\[
\text{\underline{animal}} \text{ is a \textit{hypernym} of \underline{dog}} \\
| \\
\text{\underline{dog}} \text{ is a \textit{hyponym} of \underline{animal}}
\]

All dogs are included in the set of animals.
Hyponymy

Another example:

Diagram:

```
vehicle ← hypernym → vehicle

car ← hyponym → car
```
Hyponymy

- **Taxonomic hierarchy**

```
animal
  dog
    spaniel
    shephard
  bird
    robin
    eagle
  fish
    cod
    trout
  insect
    ant
    butterfly
```
Semantic Relations and Semantic Networks

• semantic relations we have just covered are among those used to structure **SEMANTIC NETWORKS**
• a semantic network is a form of knowledge representation that concerns word meanings and other semantic objects
• a semantic network is a directed graph consisting of nodes (or vertices), which represent concepts, and edges (links, arcs, arrows), which represent semantic relations between concepts; network defines a set of binary relations on a set of nodes
Semantic Relations and Semantic Networks

Example of a semantic network

![Semantic Network Diagram]

- Animal
  - is an Mammal
  - is a Vertebrate
  - lives in Water
- Fish
  - lives in Water
- Bear
  - is a Mammal
- Whale
  - is a Mammal
  - has Fur
- Cat
  - has Fur
  - has Vertebrate
Semantic Relations and Semantic Networks

• Collins & Quillian - Semantic Network Model (1969)

• a model of organization of human semantic memory, or memory for word concepts

• Representational assumptions
  – Concepts are connected by labeled relations that indicate:
    • category membership: “isa” link (i.e., concepts are organized in a hierarchy)
    • properties: “is”, “has”, “can”
  – The meaning of a concept is its category membership and properties (configurational representation of meaning)
  – Hierarchical Organization and Cognitive Economy (i.e., if memory is limited, *cognitive economy* is critical - properties are linked *only* to the most general category to which they apply).
Semantic Relations and Semantic Networks

• Collins & Quillian - Semantic Network Model (1969)

Concepts are organized in a hierarchy.
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)

[Diagram showing relationships between Animal, Bird, Canary, Has skin, Eats, Breathes, Has wings, Can Fly, Can sing, Is yellow.]

Properties are associated with the most general concepts for which they are true.
Semantic Relations and Semantic Networks

• Collins & Quillian - Semantic Network Model (1969)

Retrieving information from the network takes time.
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)

Do canaries have skin?

Yes. (1433 ms)

Retrieving information from the network takes time.
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)

Two computational predictions

- Time to move up in the hierarchy and time to retrieve property information is additive.
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)
  a model of organization of human semantic memory, or memory for word concepts

Two computational predictions

Time to retrieve a property from a node is independent of the level of the node.
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)

- 2 Computational/Experimental Predictions
  Goal: Collins and Quillian tried to explain the relative reaction times taken by subjects to verify sentences that varied in the number of levels of the hierarchy that had to be traversed to find a meeting place between a concept and a property (P0, P1, and P2 sentences), or between two concepts (C0, C1, and C2 sentences):

* Property 0: A canary can sing
* Property 1: A canary can fly
* Property 2: A canary has skin

* Concept 0: A canary is a canary
* Concept 1: A canary is a bird
* Concept 2: A canary is an animal

* Property relation
  Superset, Hypernymy relation
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)

The participants were asked to evaluate the truth value of sentences thought to reflect the organization of semantic memory.

- Is a canary a bird? Yes (+ Reaction Time)
- Do canaries swim? No (+ Reaction Time)
Semantic Relations and Semantic Networks

- Collins & Quillian - Semantic Network Model (1969)
Semantic Relations and Semantic Networks

• Collins & Quillian - Semantic Network Model (1969)

Conclusions
• The assumptions of the hierarchical model are supported.
• Moving up one level in the hierarchy takes 75 ms and retrieving a property takes 225 ms.

Problems
• The model assumes that categories in semantic memory are Aristotelian (aka classical or based on necessary and sufficient conditions). This leads to a variety of problems resulting from the facts that
  – not all category members are equally good (i.e., prototypical) category exemplars.
  – boundaries of many categories are fuzzy.
Representing relations among words

- Lexical Decomposition
- Meaning Postulates
- Generative Semantics
Lexical Decomposition

- We can try to understand what *bachelor* means by making explicit its relation to other words or concepts like *married, not, male, adult*. One way of doing this is by *lexical decomposition* of words into such basic concepts:

(1) *bachelor*: [—married, + male, + adult]

—married: #My husband is a bachelor.
+ male:    #My husband is a pretty woman.
+ adult:    #My husband is five year old.
Meaning Postulates

• We can also try to understand what bachelor means by formulating constraints on how lexical items are related to one another.

• The formulation of constraints on the relation among lexical items can be thought of as “meaning postulates” - the term was coined by the philosopher Rudolph Carnap in his 1952 paper “Meaning Postulates.”

• Example: from (1) we can infer (2),
  (1)  John is a bachelor.
  (2)  John is an unmarried man.

• In order to provide an account of such inferences, the logic must be supplemented with an appropriate set of meaning postulates like

  (3)  Meaning postulate: If a person is a bachelor, then that person is unmarried.

• A meaning postulate is a special case of logical implication: “A implies/entails B, or “B is a (logical) consequence of A”,  → (if … then)
Meaning Postulates

• Carnap uses meaning postulates when defining \textit{analyticity} (within the framework of logical positivism in the empiricist tradition of David Hume).

• An analytic sentence “is true by virtue of meanings and independently of fact” (Quine 1953, p. 21). It is true in every possible world.

• Synthetic sentences are sentences whose truth or falsity is determined by factual information about the physical world.

• A sentence like (4) counts as an analytically true sentence

(4) Bachelors are unmarried.

• The meaning postulate in (3) captures this analyticity.

(3) Meaning postulate: \textit{If a person is a bachelor, then that person is unmarried.}
Meaning Postulates

• \( \forall x[\text{Bachelor}(x) \rightarrow \neg \text{Married}(x)] \)
  For all x, if x is a bachelor, then x is unmarried.

• Synonyms: \( \forall x[\text{SOFA}(x) \rightarrow \text{COUCH}(x)] \land \forall x[\text{COUCH}(x) \rightarrow \text{SOFA}(x)] \)
  Therefore, \( \forall x[\text{SOFA}(x) \equiv \text{COUCH}(x)] \)

• Antonyms: \( \forall x[\text{DEAD}(x) \rightarrow \neg \text{ALIVE}(x)] \)

• Converses: \( \forall x \forall y[\text{PARENT}(x,y) \rightarrow \text{CHILD}(y,x)] \)
  \( \forall x \forall y[\text{PARENT}(x,y) \rightarrow \neg \text{CHILD}(x,y)] \)

• Hyponymy: \( \forall x[\text{DOG}(x) \rightarrow \text{ANIMAL}(x)] \)

For all: \( \forall \)
Logical Equivalence: \( \leftrightarrow, \Leftrightarrow, \equiv \) (also ‘if and only if’, iff)
And: \( \land \)
Logical implication (if … then): \( \rightarrow \)
Generative Semantics

• late 1960’s and early 1970’s

  John Robert ‘Haj’ Ross
  Paul Postal
  James McCawley
  George Lakoff
Generative Semantics

• developed out of transformational generative grammar (Noam Chomsky and his students at MIT in the mid 1960s) and in opposition to it, and in particular against its Interpretive Semantics

• Interpretive Semantics was designed to be compatible with Chomsky’s transformational syntax. Syntactic rules enumerated a set of well-formed sentences paired with syntactic structures, each of which was assigned an interpretation by the rules of a separate semantic theory. This left syntax relatively (though by no means entirely) "autonomous" with respect to semantics.

• Generative Semantics assumes a linguistic level of representation that reflects conceptual or semantic structure, which can be directly transformed into surface syntax by a set of transformations (e.g., predicate raising, lexicalization), with no significant intermediary level, that is, no “deep structure” of the kind proposed in Chomsky’s theory. Hence, interpretations are generated directly by the grammar, and there is no separation between syntax and semantics.
Tom almost killed Dick has three possible interpretations, depending on which part of the decomposition of *kill* the adverb *almost* modifies

1. *almost* modifies the whole sentence S
   - Tom *almost* did something, the result of which would have been Dick’s death.

2. *almost* modifies the highest VP
   - Tom did something which *almost* caused Dick’s death.

3. *almost* modifies the second highest VP
   - Tom did something to Dick, so injuring him that he *almost* died [i.e., almost became dead.]
Generative Semantics


\[
\begin{align*}
kill &= S \\
NP &\rightarrow \text{Tom} \\
VP &\rightarrow \text{CAUSE} V \\
&\quad \rightarrow \text{BECOME} V \\
&\quad \quad \rightarrow \text{NEG} \text{ NP} \\
&\quad \quad \quad \rightarrow \text{Dick} \text{ VP} \\
&\rightarrow \text{die} \\
&\rightarrow \text{dead} \\
&\rightarrow \text{NOT} (\text{ALIVE}) \\
&\rightarrow \text{ALIVE}
\end{align*}
\]

\[
\begin{align*}
x \text{ die: } &\quad x \text{ BECOME ( NOT (ALIVE ))} \\
y \text{ kill } x: &\quad y \text{ CAUSE (x BECOME ( NOT (ALIVE ))})
\end{align*}
\]
Decompositional analysis in Generative Semantics and Meaning Postulates

• The decompositional analysis implemented by syntactic structures in Generative Semantics can be restated by means of meaning postulates

• David Dowty. 1979. *Word Meaning and Montague Grammar. The Semantics of Verbs and Times in Generative Semantics and in Montague’s PTQ*. Dordrecht: Reidel. (See also Dowty 1972.)

**x die**

lexical decomposition: x BECOME ( NOT (ALIVE ))

meaning postulate: $\Box \forall x[\text{die'}(x) \leftrightarrow x \text{ (BECOME ( NOT (ALIVE )))}]$

**x kill y**

lexical decomposition: x CAUSE (y BECOME ( NOT (ALIVE )))

meaning postulate: $\Box \forall x \forall y[\text{kill'}(x,y) \leftrightarrow x \text{ CAUSE (y BECOME (NOT (ALIVE )))}]$
Decompositional analysis in Generative Semantics and Meaning Postulates

\( x \text{ die} \)

lexical decomposition: \( x \text{ BECOME ( NOT (ALIVE ))} \)

meaning postulate: \( \square \forall x[\text{die’}(x) \iff x \text{ (BECOME ( NOT (ALIVE ))}]) \]

\( x \text{ kill y} \)

lexical decomposition: \( x \text{ CAUSE (y BECOME ( NOT (ALIVE )))} \)

meaning postulate: \( \square \forall x \forall y[\text{kill’}(x,y) \iff x \text{ CAUSE (y BECOME (NOT (ALIVE ))}]) \]

- Capitalized words: translation of lexical items into constants of predicate logic
- \text{die’, kill’}: primitive non-logical predicate constants
- Logical Equivalence: \( \iff \), \( \equiv \) (also \( \text{iff} \))
- Logically equivalent propositions may be characterized by saying that they have the same truth value for any assignment of truth values to the atomic propositions. (\( \iff \) may be restricted to logic formulas, while \( \equiv \) to reasoning about these formulas, as in metalogic.)
- \text{Necessarily} (modal logic operator): \( \square \)
Meaning Postulates and Decompositional Analysis

- Decompositional and meaning postulate approach have different psychological implications and make different claims about our semantic competence.
- **Decompositional approach:** ALIVE corresponds to the English word *alive*. Hence, the English word *alive* is conceptually simple but *kill* and *die* are not. *Kill* is more complex than *die*, because the lexical decomposition of *kill* contains that of *die*. Certain words are conceptually more complex than other words, and complexity is determined by the decompositional analysis.
- **Meaning postulate approach:** concepts corresponding to the English words *kill*, *die*, *alive* are directly labeled by constants in the semantic calculus. The semantic representation of *kill* does not contain that of *die*: both are basic expressions in the semantic calculus. However, this does not mean that there is no semantic complexity to *kill*, but the translation of *kill* does not reflect that complexity. *kill* is not necessarily psychologically more complex than *die*. 
Meaning Postulates and Decompositional Analysis


FFG argue that data on comprehension, ease of access, and similar processing considerations do not support the decompositional view. Therefore, something like the meaning postulate approach can be taken to be more compatible with psychological evidence on semantic processing. This is taken to be one of the most decisive attack on decompositional analysis, and against generative semantics.
Syntax-semantics interface

- Co-indexing
- Co-referentiality
- Binding
Antecedent - Anaphor

PRONOUNS

deictic
I am glad he is gone.

non-deictic / anaphoric
John entered the room. He took off his coat.

antecedent NP

anaphoric pronoun
Definite Descriptions and Proper Names

I am glad **the bastard** is gone. I am glad **Rufus** is gone.

- Definite descriptions and proper names behave like deictic pronouns in so far as they may refer directly to some individual in the discourse. They are referential, and pick out single individuals in the domain of discourse.
Anaphora

• A given expression (e.g., pronoun) is used anaphorically when it “picks up its reference” from another phrase in the surrounding text (sentence context or discourse context).

\[
\begin{array}{ll}
\text{John entered the room.} & \text{He took off his coat.} \\
\downarrow & \downarrow \\
\text{antecedent NP} & \text{anaphoric pronoun}
\end{array}
\]

• Anaphorically interpreted NPs (\textit{she, her, himself, his}) are said to be coreferential with or referentially dependent on their antecedent NPs.

• \textbf{COINDEXING}

\[
\begin{array}{ll}
\text{[John] }_i \text{ entered the room.} & \text{[He] }_i \text{ took off his coat.} \\
\uparrow & \uparrow \\
\text{antecedent NP} & \text{anaphoric pronoun}
\end{array}
\]
Anaphora - Coreferentiality

(1) Every time I see your brother, I feel like choking the bastard.

CO-REFERENTIALITY

(2) Every time I see your brother, I feel like choking the bastard.
Anaphora

For those of you who have children and don’t know it, we have a nursery downstairs.

(i) intended interpretation:
For those of you who have children and don’t know it, we have a nursery downstairs.

(ii) unintended interpretation:
For those of you who have children and don’t know it, we have a nursery downstairs.
Binding of variables

**Question:** Can *all* examples of anaphoric pronouns be subsumed under one characterization?

**Answer:** No. Some pronouns do not refer to an individual at all.

**Background:**

- *Every dog barked.*
- *Some truck were damaged.*
- *Pluto barked.*
- *The tallest man in the world won.*
- *He sneezed.*

↓

quantified NP’s

non-referential

A quantified noun phrase like *every dog* and *some truck* in the above sentences, cannot be represented by an individual in our domain of discourse, unlike *Pluto* (proper name), *the tallest man* (definite description) or *he* in the above sentences. They are non-referential.
Binding of variables

Every man$_i$ put a screen in front of him$_i$.
quantified DP       pronoun
antecedent          anaphor
non-referential     non-referential

• This means that the coindexing between the pronoun and the quantificational NP cannot be interpreted in terms of corefentiality in this case. Instead, co-indexing is interpreted as binding of variables.

• The interpretation/value of the pronoun *him* covaries with the interpretation/value of the variable introduced by the quantified subject NP *every man*. If your ‘world’ (the universe of discourse) consists of Steven, Leopold and Rufus, then you may first pick Steven as the value for *him* AND for the variable introduced by the quantified subject NP and check whether Steven put a screen in front of him. Then you do the same with Leopold and Rufus. The sentence is true just in case Steven, Leopold and Rufus each put a screen in front of him.

• The anaphoric pronoun *him* is treated as a bound variable. Therefore, we refer to this phenomenon as bound variable anaphora.
Binding of variables

Every man$_i$ put a screen in front of him$_i$.
quantified DP pronoun
antecedent anaphor
non-referential non-referential

• Since every man is non-referential, the pronoun him must be non-referential, as well, because the pronoun cannot derive its reference from its antecedent. The pronoun him here does not refer to an individual any more than its antecedent every man does.
• Therefore, not all anaphoric pronouns can be treated as referential.
HOMEWORK 2

DUE SEPTEMBER 22, 2008
IN CLASS - HARDCOPY

DeSwart, pp.42-44
(3) - (7)