L98: Introduction to Computational Semantics
Lecture 4: Compositionality and Multi-Word Expressions

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Lecture 4: Compositionality and Multi-Word Expressions

1. Principle of compositionality
2. Selectional preferences
3. Semantic side effects
4. Noun compounding
5. Idioms
6. Collocations

Semantic composition and ideosyncracity

- Lexical items have linguistic properties (linguistic selection)
- Subcategorisation is one of these.
- Today we look phenomenologically at what happens to semantics when two items combine.
- How much ideosyncracy is there in the combination?

Example: *walkman*

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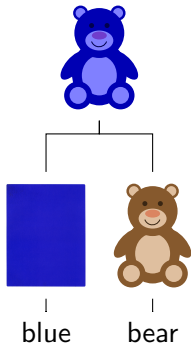
Example: *walkman*

Principle of Compositionality

Modeling syntactico-semantic composition

The Principle of Compositionality

The meaning of an expression is a function of **the meanings of its parts** *and of* **the way they are syntactically combined**.

B. Partee

Modeling syntactico-semantic composition

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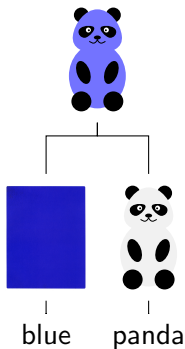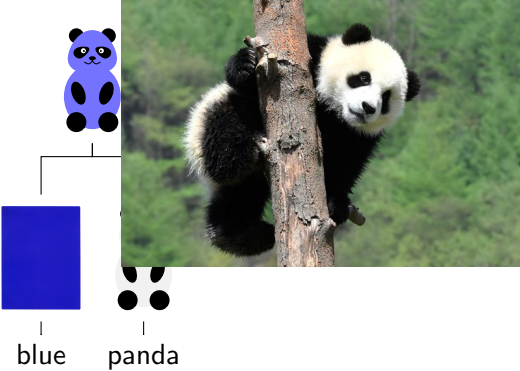
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Modeling syntactico-semantic composition

The Principle of Compositionality

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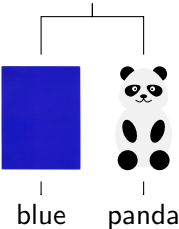

blue   panda

Modeling syntactico-semantic composition

The Principle of Compositionality

The meaning of an expression is **its parts** *and of* **the way they are s**

blue   panda

Infelicities

Pleonasm (tautologies)

(1) a. a female mother
   b. the other alternative
   c. the weight is lighter than

Dissonance (selectional preference violated):

(2) a. Kate is more married than most women I know
   b. a very unique antique

Implausibility (selectional preference stretched):

(3) The kitten drank a bottle of wine.

Selectional Preferences

Selectional preferences

- Def: the property of a governor selecting particular **semantic** features of its dependent items
- For instance, the most literal sense of *eat* selects for its direct object something edible, and for its subject it selects an animal, marginally a plant

Example of **inspecific** selectional preferences:

(4) a. I saw X $\rhd X$ can be nearly anything concrete

      b. I thought of Y $\rhd Y$ can be nearly any entity, abstract or concrete

Example of a **specific** selectional preference:

(5) I deveined Z $\rhd Z$ must be a shrimp-like animal

Resnik (1995) describes this in terms of conditional properties and presents a WN-based algorithm for estimating the specificity of a verb.

Quantifying selectional preferences: Resnik (1995)

- **Selectional preference strength** $S_R(v)$ **of verb** v**:** the degree of selectiveness of a predicate about the semantic class of its arguments; expressed in bits of information.
- Semantic classes c are WordNet synsets
- $S_R(v)$ is based on difference in distribution between
  - $P(c)$ – likelihood of direct object of falling into semantic class c
  - $P(c|v)$ – likelihood of direct object of falling into semantic class c if associated with verb v

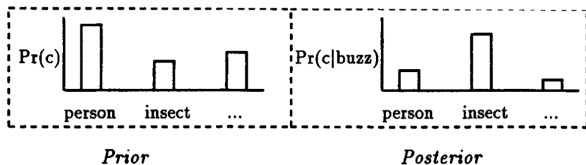# Difference in distributions: Resnik (1995)

Prior · Posterior

image from Resnik (1995)

Measuring differences in distributions

This is standardly done using the Kullback-Leibler (KL) divergence.
We determine $S_R(v) = D(P(c|v)||P(c))$ as follows:

$$S_R(v) = \sum_c P(c|v) \log \frac{P(c|v)}{P(c)}$$

This calculation will give us the Selectional preference $S_R(v)$ of a verb, calculated across *all* WN classes.

Resnik, ctd

- But often we are interested in the selectional association between a verb and a synset c.

- This is the **relative** contribution of this class to the overall selectionality of the verb:

$$A_R(v, c) = \frac{1}{S_R(v)} P(c|v) \log \frac{P(c|v)}{P(c)}$$

Resnik, example result

| Verb	Dir. Obj. (pref.)	$A_R(v,c)$	Dir Obj. (dispref.)	$A_R(v,c)$
read	WRITING	6.80	ACTIVITY	-0.20
write	WRITING	7.26	COMMERCE	0
see	ENTITY	5.79	METHOD	-0.01

- The Resnik algorithm can also be used to perform WSD.
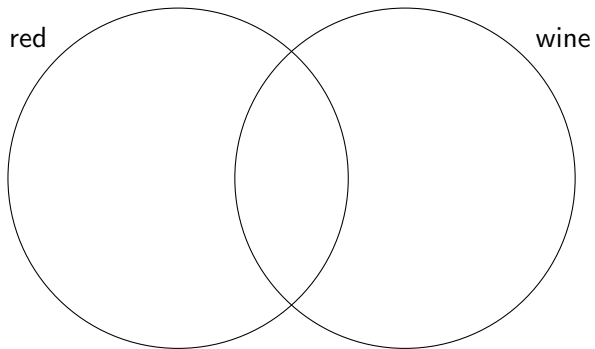
Semantic Side Effects

Modulation of meaning and semantic relativity

- "blue bear" type of combinations are rare
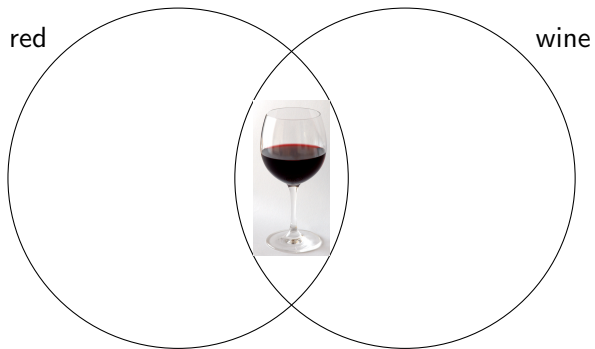- There are usually side effects when two semantic units are concerned.
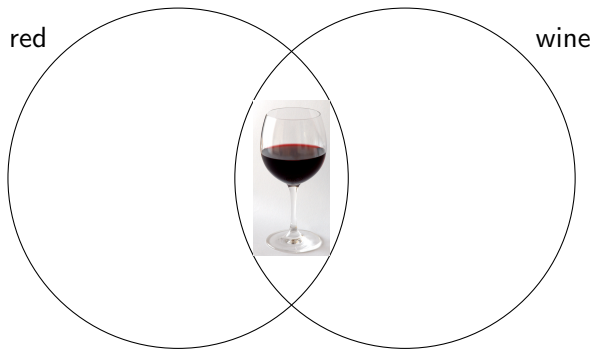
Semantic side effects (sense modulation)
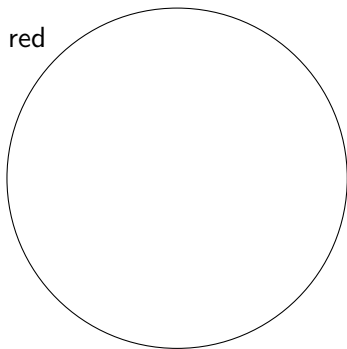
red

Semantic side effects (sense modulation)

Semantic side effects (sense modulation)

Semantic side effects (sense modulation)

Semantic relativity

(6) a. red hair

red   "red"
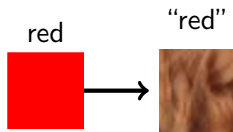
   b. white wine

white   "white"
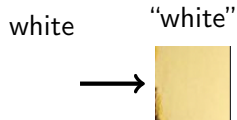
(7) a. long eyelashes

   b. short rivers

Noun Compounding

Rules for compounding in English

- Syntactic and semantic head is right
- Before head, nominal modifiers can be added
- Some linguists say they turn into adjectives

(8) colour TV

- These are normally in **singular:**

(9) a. *neural network**s** approach
   b. neural network approach
   c. *problem**s** resolution
   d. problem resolution

Semantic headedness

What is right-most is the semantic head, right?

- YES, by default this is so in English.
- A glass house is a house. A house cat is a cat. A cat house is a house. BUT,
- Milchschaum (milk foam; German) vs foamed milk (languages make different decisions here)

Archaic forms have different headedness:

(10) a. **bare**foot (archaic adjective)

  b. **cut**-throat, ne'er-**do**-good, **spend**-thrift . . .

  c. **gum** arabica

Observation I: structural ambiguity

(11) copper bird house

Observation II: relationship between head and modifier

- Wide variety of possibilities
- Directed by semantic properties of the two items
- Research topic, e.g. thesis by Diarmuid O Séaghdha

Wood screw vs brass screw

- screws are artefacts
- wood screw concentrates on function of artefact
- brass screw concentrates on material of artefact
- Pusteyovsky (1993) calls these qualia
- Different qualia for different semantic types (e.g idea-carriers, natural kinds)
- Productive patterns exist
- His theory is called the Generative Lexicon

Student nurse, student theatre

- by or for students?
- Object/subject view

(12) a. trainee doctor

  b. president assassin

  c. blind administrator

  d. employee nurse

(13) Nurse Practitioner vs General Practicioner vs Nurse

Self-exercise (voluntary)

- Write down the next 10 simple compound nouns you come across (head plus one nominal modifier)
- Try to analyse the relation that holds between them.

Idioms and other MWEs

Pain in the neck

What is a multi-word expression?

- a lexical unit that consists of more than one word

- a concept that happens to contain a blank in its lexicalisation

- a morpheme that was created in a non-compositional way from other morphemes

- "Multi-word expression" is a multi-word expression: may not necessarily be a combination of "words"

Words and graphemes

- Standard definition of word (in English) — string between blanks/punctuation BUT:
- The use of a blank to delineate words is a speciality of some writing systems
  - Spaces were not used to separate words in Latin until roughly 600–800 CE
  - Chinese
  - Japanese — but script boundaries act as word boundaries
  - Hebrew: uses word separator
- Baby books in Japanese have blanks between the words
  - This is comparable to Arabic writing for beginners with vowel markings
  - Competent readers don't need these training wheels

Compounding and semi-compounding in English

Word compounding in English is subject to language change:

(14) a. test set

    b. test-set

    c. testset

- These are points on a cline (def cline: a continuum with an infinite number of gradations from one extreme to the other)
- Also consider the following transformation:

(15) a. high-density solution

    b. a solution with high density

Words as linguistic units?

Cross-lingual evidence: words are an arbitrary unit

Compounding in German

(16) Stadtkernerneuerungspläne ▷(plans to regenerate the core of the city)

Compounding in Chinese

avoidance of single-syllable "words"

Examples from Mandarin

Teaching kids

(17) a. 熊猫/panda 不/not 是/is 猫/cat
      b. 棉花/cotton 不/not 是/is 花/flower
      c. 海马/seahorse 不/not 是/is 马/horse
      d. 袋鼠/kangaroo 不/not 是/is 鼠/mouse

Menu

(18) a. 夫/husband 妻/wife 肺/lung 片/slice
      b. popular Sichuan cold dish made of thinly sliced beef and beef offal

MWEs are listemes

A listeme is something that needs to be listed (in the lexicon) because it's arbitrary to a certain degree:

(19) pain in the neck

Degrees of compositionality:

Tech terms are often partially compositional:

(20) hypertension

Tech terms can also change subcategorisation frame in the new technical domain

(21) The patient presented **with** hypertension.

Idioms, even less compositional:

(22) a. spill the beans

   b. leave no stone unturned

Some compositionality (example due to A. Copestake):

(23) let the cat out of the **transparent** bag

Japanese & Chinese Tech terms

WMD

(24) a. Japanese: 大量破壊兵器 (tai-ryou-ha-kai-hei-ki)
    b. Chinese: 大规模杀伤性武器

hypertension

(25) a. Japanese: 高血圧症 (kou-ketsu-atsu-shou)
    b. Chinese: 高血压

primary pulmonary hypertension

(26) a. Japanese: 原発性肺高血圧症
      (gen-patsu-sei-hai-kou-ketsu-atsu-shou)
    b. Chinese: 原发性肺高压

Some super-dead metaphors are idioms

Metaphors are images shared in a language community. They go through a "life cycle" from invention to calcification. (Much more on this in Lecture 13)

Metaphors at the end of their life cycle

(27) a. bee's knees

     b. bee in bonnet

     c. hobby horse

     d. chip on shoulder

Proverbs are idioms

(28) a. call a spade a spade
      b. appeler un chat un chat

(29) a. Don't count your chickens before they hatch   ▷杀鸡取卵
      b. Don't distribute the bear before you caught it   ▷Russian
      c. Don't praise the day before the evening

"Ok I gotta get started on my work. This paper isn't going to write itself."

"I need to get a new job. These bills aren't going to pay themselves."

Syntactic patterns that become idiomatic

"This problem isn't going to solve itself"

- The **X** isn't going to **Y** itself
- Pragmatics – this is about taking responsibility for a task
- Currently in state of uptake/high acceptance by language community
- Does not involve specific lexical items
- Once you understood the pattern, you can apply it productively: **X** is a direct object of verb **Y**; "X-ing Y" is a task

THE CAKE ISN'T GONNA PICK ITSELF. HA HA.
Kung Fu (2021) - S01E01 Pilot
Source video - Top clips - Next line quiz

centerline

These Chairs Aren't Going to Sell Themselves
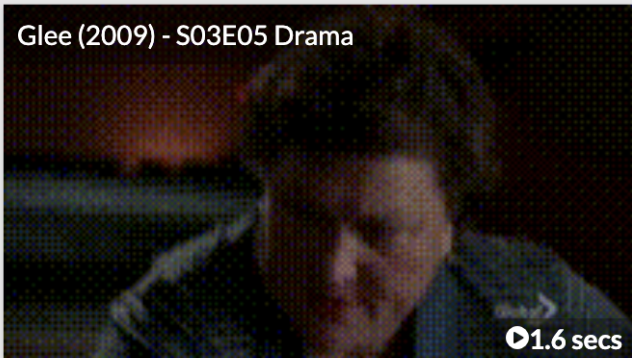
The Work of My Life: December 2021 Report

Doomberg
Jan 3

♡ 740   💬 44   ↪

centerline

Glee (2009) - S03E05 Drama

▶1.6 secs

Those footballs aren't going to inflate themselves.

centerline

The house isn't gonna decorate itself.
Encanto
Source video - Top clips - Next line quiz

centerline

The Office (2005) - S05E16 Blood Drive

▶2.9 secs

Those mines aren't going to sweep themselves.

centerline

These Spider Fangs Aren't Going To Photograph Themselves

Here is a photograph of a Sydney funnel-web spider, Atrax robustus: I won't explain the biology of this delightful animal here – you may read about it at Wikipedia in greater arachnological detail. Instead, I want to show the process by which I arrived at this composition.

Two recent "aren't gonna" news items: number 1

John Cardillo @johncardillo

Wrap this up girls. My shirts aren't going to iron themselves. #WomensMarch

RETWEETS 11   LIKES 30

1:44 PM - 21 Jan 2017

16   11   30

Two recent "aren't gonna" news items: number 2

Chris Shell at Selling Sunset says her "eggs aren't going to fertilize themselves" after Jason splits

Creativity

Phrasal Verbs

Phenomenology

(30) a. turn **off** the radio

b. turn the radio **off**

(31) a. set **up** shop

b. *set shop **up**

Compare:

(32) a. turn off the highway

b. *turn the highway off

Morphological effects with phrasal verbs

(33) a. wash**er** upp**er**

     b. lay**er** out

Morphological effects with phrasal verbs

(34) a. wash**er** upp**er**

b. lay**er** out

layer-out

noun

1. a person who prepares a dead body for burial.

    dated

The Knocker-Upper — the Extinct Profession of Waking People up by Knocking

Since alarm clocks were unreliable, people paid knocker-uppers to wake them up on time

from https://medium.com/lessons-from-history/knocker-upper-47bc8c5bfdbf

Collocations

Collocations

- Collocations are a phenomenon similar to MWE, but are more compositional
- They are strong preferences by speakers to select, out of a range of many possible lexical items of similar meaning, one particular lexical item.
- Historical reasons
- Listeme
- Second language acquisition at high level of competence

Pre-lecture exercise solutions

	unblemished	spotless	flawless	immaculate	impeccable
performance	-	-	X	X	X
argument	-	-	X	-	?
complexion	?	?	X	-	-
behaviour	-	-	-	-	X
kitchen	-	X	-	X	-
record	X	X	X	?	X
reputation	?	X	-	?	-
taste	-	-	X	?	X
order	-	-	-	X	X
credentials	-	-	-	-	X

Collocational restrictions are highly **unpredictable.**

(In)dependence of semantic units in combinations

Summary:

- This lecture was about how semantically independent two items are when they are combined.

- Fully independent means intersective interpretation if compatible (compositionality principle)

- Suiting to the event described, heads exert their selectional preferences (semantic limitations on what their participants should look like)

- In many such combinations, argument or adjuct, there are non-predictable modulation effects, side-effects (red wine)

- MWEs are lexical items consisting of more than one word

- In idioms and most other MWEs, the parts show non-compositional behaviour

- This dependence is weakest for mere collocations, but still there (that is why Language learners have such a hard time sounding fully fluent)