Lexical Semantics: Introduction

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In the Beginning There was a Question ...

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What is Lexical Semantics?

What is Lexical Semantics?

- What is a lexical item/unit?
  - ⋆ a word?
  - ⋆ what about phrases?
  - ⋆ what about sub-word structure and morphology?

(Fillmore, 2003)

What is Lexical Semantics?

- What is semantics?
  - ⋆ meaning?
  - ⋆ can we ignore syntax, then?
  - ⋆ can we ignore pragmatics (domain effects, ...)?

(Fillmore, 2003)

What is Lexical Semantics?

- Working definition:

  the study of what individual lexical items mean, why they mean what they do, how we can represent all of this, and where the combined interpretation for an utterance comes from

Example of Lexical Semantics in Action (1)

- Predict the morphosyntax (esp. countability [countable/non-countable]) of:
  - ⋆ **coagulopathy:**
  - ⋆ **muntjac:**

Example of Lexical Semantics in Action (1)

- Predict the morphosyntax (esp. countability [countable/non-countable]) of:
  - ⋆ **coagulopathy:** group of conditions of the blood clotting (coagulation) system in which bleeding is prolonged and excessive; a bleeding disorder
  - ⋆ **muntjac:** small Asian deer with small antlers and a cry like a bark
- More tomorrow from me ...

Example of Lexical Semantics in Action (2)

- Interpret the following compound nominalisations:
  - ⋆ *risk recognition*
  - ⋆ *doctor involvement*
- Cf.:
  - ⋆ *police failure* ≡ *(the) police* $_{\text{SUBJ}}$ *fail*
  - ⋆ *player selection* ≡ *[SB] selects (the) player* $_{\text{OBJ}}$
- More tomorrow from me ...

Example of Lexical Semantics in Action (3)

- Given the following interpreted Japanese relative clause constructions:
  - ⋆ *the [magnate-bought] shop* ≡ *(the) shop the magnate bought*
  - ⋆ *the [small-child-bought] shop* ≡ *(the) shop at which the small child shopped*

- Interpret the following:
  - ⋆ *the [bought-book] author*
  - ⋆ *the [bought-book] person*
  - ⋆ *the [bought-book] reason*
- Lexical semantics vs. syntax vs. pragmatics
- The role of construction semantics (more from Collin Baker ...)

Lexical Semantics and Brethren

- Lexical semantics overlaps crucially with fields such as:
  - ⋆ lexicography
  - ⋆ phraseology
  - ⋆ philosophy
  - ⋆ corpus linguistics
  - ⋆ syntax
  - ⋆ pragmatics
  - ⋆ child language acquisition
  - ⋮

- ... and computationally
  - ⋆ natural language understanding
  - ⋆ computational lexicography
  - ⋆ computational language learning (lexical acquisition)
  - ⋆ knowledge representation
  - ⋮

Computational Lexical Semantics: Recognised Sub-tasks

- Word sense discrimination/disambiguation
- Semantic role labelling
- Multiword expression compositionality/decomposability
- Ontology learning and population
- Semantic language modelling

Structure of Course

1. Introduction to Lexical Semantics (L1)
2. Frame Semantics, Constructions, and the FrameNet Lexical Database (L2,4)
3. Learning Lexical Semantic Representations (L3)
4. Lexical Semantics and Ontologies (L5,7)
5. Approximating Semantic Similarity with Distributional Similarity (L6)
6. Semantic Distance and Lexicographic Resources (L8)

Lecture Format

- 8 $\times$ 1.5 hour lectures
- (Hopefully) modular course structure
- Recommended readings for each lecture listed on the web page
- Slides posted on the web page

Caveats

- Language orientation (English-centricity)
- Coverage of topics (instructor-centricity)
- Selection of readings (accessibility-centricity)
- Widely-varying accents, spelling and examples (dialect-eccentricity)

INTRODUCTION TO LEXICAL SEMANTICS

Starting at the Beginning ...

- Lexical semantics is concerned with the identification and representation of the semantics of lexical items
- If we are to identify the semantics of lexical items, we have to be prepared for the eventuality of a given word having (shock, horror) multiple interpretations = **polysemy** (cf. **monosemy**)

Polysemy

- **Polysemy** = the condition of a single lexical item having multiple meanings
- Polysemy vs. homonymy (cf. *bank* vs. *bass*)
- Polysemy vs. indeterminacy (cf. *father* vs. *uncle*)
- Regular/logical vs. irregular polysemy (cf. *ash*)
- Regular vs. complementary polysemy (cf. *door* vs. *farm*)

Cruse, 1986; Hirst, 1987; Ravin and Leacock, 2000; Pustejovsky, 1995

Distinguishing Polysemes

- The polysemy of a word can be tested by a variety of means, including:
  - ⋆ **antagonism**: can the word be used in a sentence with multiple competing interpretations? (cf. *Kim can't bear children*)
  - ⋆ **zeugma**: can the word be used in a context where multiple competing interpretations are simultaneously evoked? (cf. *Kim and her visa expired*)

Cruse, 1986; Hirst, 1987; Ravin and Leacock, 2000; Pustejovsky, 1995

- ⋆ **independent truth conditions**: can the word be used in a given sentence with different truth conditions according for different interpretations? (cf. $Kim\ is\ wearing\ a\ light\ jacket$)
- ⋆ **definitional distinctness**: it is impossible to come up with a unified definition which encompasses the different sub-usages of the word

  ⋮

- Note the importance of attested usages in gauging polysemy

Approaches to Lexical Semantic Categorisation

- Attributional semantic categorisation
- Semantic clustering
- Relational semantic categorisation

Attributional Semantic Categorisation

Attributional Semantic Categorisation

- For each lexical item, come up with a semantic description of each of its distinct usages, in isolation of the categorisation of other lexical items, e.g.:

  enrichment (n) the act of making fuller or more meaningful or rewarding

- Methodologies:
  - ⋆ definitional semantics
  - ⋆ decompositional semantics

Definitional Semantics

- Standard lexicographic approach to lexical semantics:

  semantics = *the study of language meaning*
  tailor = *a person whose occupation is making and altering garments*

- Definitions are conventionally made up of a genus (what class the lexical item belongs to) and differentiae (what attributes distinguish it from other members of that class)

Jackson, 2002; Wilks et al., 1996

- "Decoding" vs. "encoding" dictionaries
- Pros:
  - ⋆ familiarity (look-up and annotation)
- Cons:
  - ⋆ subjectivity in sense granularity (splitters vs. lumpers) and definition specificity
  - ⋆ circularity in definitions
  - ⋆ consistency, reproducibility, ...
  - ⋆ often focus on diachronic rather than synchronic semantics

Jackson, 2002; Wilks et al., 1996

The Corpus Revolution in Definitional Semantics

- Moves towards corpus-based lexicography in an attempt to reduce subjectivity in sense granularity and definition specificity (e.g. COBUILD)

  = move from type- to token-based sense discrimination/annotation

Decompositional Semantics

- Define words by way of a constrained representation language, in an attempt to avoid circularity and enforce consistency of annotation, e.g. LCS:

```
(:DEF_WORD "give"
 :LCS (cause (* thing 1)
       (go poss (* thing 2)
           ((* to 5) poss (thing 2) (at poss (thing 2) (thing 6))))
       (give+ingly 26)))
```

e.g. definition of *love* in Natural Semantic Metalanguage (Goddard, 2000):

```
X loves Y =
X often thinks about Y
X thinks good things about Y
X wants to do good things for Y
X wants good things to happen to Y
when X thinks about Y, X often wants to be with Y
when X thinks about Y, X often feels something good
```

- Also: Generative Lexicon (to be covered by Paul Buitelaar ...)

- Pros:
  - ⋆ systematic representation/in-built definition of well-formedness
- Cons:
  - ⋆ obscurity of representation
  - ⋆ disagreement about primitives/semantic language
  - ⋆ subtle semantic distinctions can be impossible to make due to restrictions in the representation language

Jackendoff, 1990; Dorr, 1997; Wierzbicka, 1996; Pustejovsky, 1995

Decomposability and Multiword Expressions

- The decomposability of a MWE = *degree to which the semantics of an MWE can be ascribed to those of its parts*

  kick the bucket $\longrightarrow$ `die'`

  spill the beans $\longrightarrow$ `reveal'(secret')`

Decomposability and Syntactic Flexibility

- Consider:

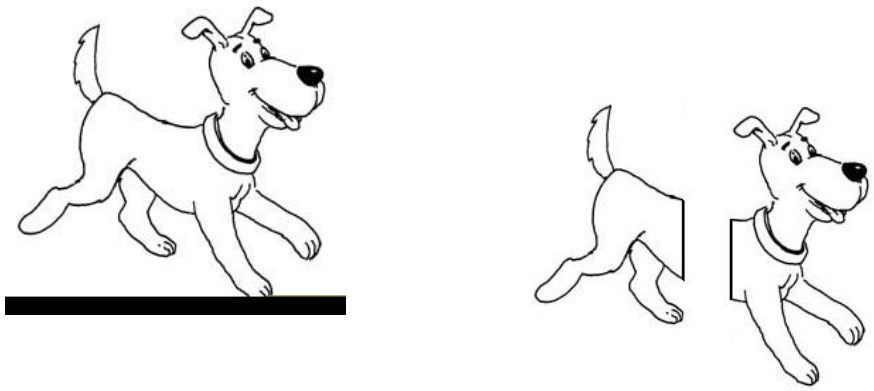
  **the bucket was kicked by Kim*
  Strings were pulled to get Sandy the job.
  The FBI kept closer tabs on Kim than they kept on Sandy.
  ... the considerable advantage that was taken of the situation

- The syntactic flexibility of an idiom can generally be explained in terms of its decomposability

Attributional Semantics and the Syntax-Semantics Interface

- Countability:
  - ⋆ A syntactico-semantic property of the noun phrase
  - ⋆ Bounded, indivisible individuals
    prototypically COUNTABLE: *a dog, two dogs*
  - ⋆ Unbounded, divisible substances
    prototypically UNCOUNTABLE: *gold*

Allan, 1980; Bond, 2005; Wierzbicka, 1988



vs.

Allan, 1980; Bond, 2005; Wierzbicka, 1988

Countability Classes

- **countable:** *book, button, person* (*one* *book*, *two* *books*)
- **uncountable:** *equipment, gold, wood* (**one* *equipment*, *much* *equipment*, **two* *equipments*)
- **plural only:** *clothes, manners, outskirts* (**one* *clothes*, *clothes horse*)
- **bipartite:** *glasses, scissors, trousers* (**one* *scissors*, *scissor kick, pair of* *scissors*)

Allan, 1980; Bond, 2005; Wierzbicka, 1988

Countability and the Syntax-Semantics Interface

- Semantic properties of a given noun are strong predictors of both its countability (lexical semantics) and surface manifestation (syntax):
  - ⋆ (simple) enumerable ↔ countable
  - ⋆ usable as bare singular NP ↔ uncountable
- I.e., syntax offers a powerful semantic validation tool

Allan, 1980; Bond, 2005; Wierzbicka, 1988

Differences in Conceptualisation

- Knowing the referent is not enough to determine countability, e.g. *scales*

Allan, 1980; Bond, 2005; Wierzbicka, 1988

Differences in Conceptualisation

- Knowing the referent is not enough to determine countability, e.g. *scales*

1. Thought of as being made of two arms: (British)
   a pair of scales
2. Thought of as a set of numbers: (Australian)
   a set of scales
3. Thought of as discrete whole objects: (American)
   one scale/two scales

- Also *Lego* – countable or uncountable?

Differences in Realisation

- Looking at corpus data to determine countability leads to its own challenges, e.g. *enrichment*

Allan, 1980; Bond, 2005; Wierzbicka, 1988

Differences in Realisation

- Looking at corpus data to determine countability leads to its own challenges, e.g. *enrichment*

  Education itself provides enrichment to ...
  ... would bestow great enrichment upon ...
  Job enrichment is part of ...

  It was a developmental enrichment.
  ... an enrichment of life.
  ... received many enrichments ...

Basic vs. Derived Uses

- Countability categorisation is confused by the existence of highly-productive conversion rules, e.g.:
  - ⋆ **the Universal Grinder**: countable noun with individuated semantics → uncountable noun with "piecemeal" semantics (e.g. *the floor was littered with computer*)
  - ⋆ **the Universal Packager**: uncountable noun with substance semantics → countable noun with portion of substance semantics (e.g. *two beers*)

- Rather than consider all nouns as both countable and uncountable, we generally identify the "basic" uses of a given noun and derive alternate uses through the use of lexical rules (but consider $chicken$ vs. dog vs. $worm$)

- Cf. regular/logical polysemy

Lexical Semantics, Sense and Context

- There is growing awareness in lexical semantics of:
  - ⋆ context-sensitivity
  - ⋆ sense specificity
  - ⋆ basic vs. derived word usages (and the fuzziness of the boundary)
  - ⋆ difficulties in making categorical judgements for a word
- Case in point: aspectual (aka. Vendler) verb classes
- Lots more from Paul Buitelaar ...

Vendler, 1957; Dowty, 1979

Semantic Clustering

Semantic Clustering

- Capture semantically-related word groupings implicitly in the form of clusters
- Obviates the need for the determination of definitions (attributional semantics in reverse)

Wilks et al., 1996

- Example semantic clustering-based resource: Moby Thesaurus (based on 1913 Roget's):

  Great Leap Forward, advance, advancement, amelioration, amendment, ascent, augmentation, bettering, betterment, boost, complement, enhancement, **enrichment**, eugenics, euthenics, fecundation, fertilization, fortification, furtherance, headway, impregnation, improvement, insemination, lift, melioration, mend, mending, pickup, preferment, progress, progression, promotion, recovery, restoration, revival, rise, upbeat, uplift, upping, upswing, uptrend, upward mobility, vitaminization

- Polysemy = occurrence in more than one class

Wilks et al., 1996

- Pros:
  - ⋆ implicit definition
  - ⋆ possibilities for combining word classes into a single class
- Cons:
  - ⋆ no explicit indication of what a word means in a given class
  - ⋆ (generally) flat structure not amenable to the representation of cross-cluster correspondences
  - ⋆ multi-dimension classification

Semantic Clustering and the Syntax-Semantics Interface

- As typified most famously by the work of Levin, 1993, many semantic distinctions correlate closely with (observable) syntactic phenomena

  ➔ it is possible to carry out semantic clustering based on (readily reproducible) syntactic tests

Diathesis Alternations

- A **diathesis alternation** is a regular variation in the argument structure of a verb, and can be either:
  - ⋆ **morphosyntactic** – truth-functionally equivalent; main difference in information structure

    $Kim\ saw\ Sandy \leftrightarrow Sandy\ was\ seen\ by\ Kim$
  - ⋆ **morphosemantic** – variation in grammatical form correlates with variation in lexical semantics

    $Kim\ opened\ the\ door \leftrightarrow The\ door\ opened$

Example Diathesis Alternations

- Causative/inchoative alternation:

  $Kim\ broke\ the\ window \leftrightarrow The\ window\ broke$

- Middle construction alternation:

  $Kim\ cut\ the\ bread \leftrightarrow The\ bread\ cut\ easily$

- Conative alternation:

  $Kim\ hit\ the\ door \leftrightarrow Kim\ hit\ at\ the\ door$

- Body-part possessor ascension alternation:

  $Kim\ cut\ Sandy's\ arm \leftrightarrow Kim\ cut\ Sandy\ on\ the\ arm$

Diathesis Alternations and Verb Classes

- A verb's (in)compatibility with different alternations is a strong predictor of its lexical semantics:

	BREAK	CUT	HIT	TOUCH
Causative	YES	NO	NO	NO
Middle	YES	YES	NO	NO
Conative	NO	YES	YES	NO
Body-part	NO	YES	YES	YES

$$\text{BREAK} = \{break,\ chip,\ crack,\ crash,\ crush,\ \ldots\ \}$$
$$\text{CUT} = \{chip,\ clip,\ cut,\ hack,\ hew,\ saw,\ \ldots\ \}$$
$$\text{HIT} = \{bang,\ bash,\ batter,\ beat,\ bump,\ \ldots\ \}$$
$$\text{TOUCH} = \{caress,\ graze,\ kiss,\ lick,\ nudge,\ \ldots\ \}$$

Levin, 1993

- **Corollary**: we can predict the syntax of novel words we are given the semantic class for (cf. countability examples earlier)

- The principal weakness of syntax-based verb classification is that there are often subtle divergences in semantics between synonyms (cf. *eat* vs. *devour* vs. *gobble*)

Lexical Semantics and the Lexicon-Semantics Interface

- Firth, 1957 famously made the observation:

  you shall know a word by the company it keeps

  which is commonly known as the **distributional hypothesis**

- Blunter instrument but with greater flexibility than a strict interpretation of the syntax-semantics interface

- More from James Curran ...

A Case in Point

Acyclovir is a specifically anti-viral drug ...
Acyclovir has been developed and marketed by ...
Acyclovir given intravenously, ...

Coagulopathy is a well recognised complication ...
... could stimulate a coagulopathy ...
... is also probably responsible for a coagulopathy ...
... a patient with a coagulopathy.

Lexical Semantics and Context (1)

- Lexicosyntactic context is commonly used by corpus linguists to analyse lexical semantics, through a combination of:
  - ⋆ concordancing
  - ⋆ analysis of common verb–argument collocations
  - ⋆ analysis of passives and other constructions
  - ⋆ analysis of co-occurrence with certain adverbs/auxiliaries
  - ⋮

Relational Semantic Categorisation

Relational Semantic Categorisation

- Capture correspondences between lexical items by way of a finite set of pre-defined semantic relations
- Methodologies:
  - ⋆ lexical relations
  - ⋆ constructional relations

Lexical Relations

- (Possibly directed) semantic relations which pertain to pairs of lexical items, e.g.

	bush	*orange*	*tea*	*tree*
bush				
orange				
tea				
tree				

Cruse, 1986; Miller et al., 1990; Fellbaum, 1998; Widdows, 2005

Synonymy

- **Propositional synonymy**: X is a propositional synonym of Y if (i) X and Y are syntactically identical, and (ii) substitution of Y for X in a declarative sentence doesn't change its truth conditions (e.g. *violin* and *fiddle*)

- Why propositional synonymy is over-restrictive:
  - ⋆ syntactic identity (cf. *eat* and *devour*)
  - ⋆ collocations (cf. *cemetery* and *graveyard*)
  - ⋆ gradability (cf. *sofa/settee* vs. *boundary/frontier*)

Cruse, 1986; Miller et al., 1990; Fellbaum, 1998; Widdows, 2005

- More pragmatic view of synonymy via syntax: synonyms are inter-substitutability in **some/most** rather than **all** contexts

- Synonymy via semantics: synonyms share "common traits" or attributional overlap, walking the fine line between "necessary resemblances" and "permissible differences" (Cruse, 1986), cf:

  grain vs. *granule*
  green vs. *purple*
  alsation vs. *spaniel*

- Permissible differentiation via **clarification**:

  Here is a grain, or granule, of the substance.
  #The cover is green, {or,that is to say} purple.

  and **contrast**:

  Here is a grain or, more exactly, granule
  #He likes alsations, or more exactly, spaniels

- Properties of synonymy:
  - ⋆ symmetric
  - ⋆ applies only to lexical items of the same word class
  - ⋆ applied at the sense or lexical item-level?
  - ⋆ ≈ converse of polysemy

Hypernymy and Hyponymy

- **Hyponymy**: X is a hyponym of Y iff $f(X)$ entails $f(Y)$ but $f(Y)$ does not entail $f(X)$:

  $$Kim\ has\ a\ pet\ \underline{dog} \rightarrow Kim\ has\ a\ pet\ \underline{animal}$$
  $$Kim\ has\ a\ pet\ \underline{animal} \not\rightarrow Kim\ has\ a\ pet\ \underline{dog}$$

  N.B. complications with universal quantifiers and negation:

  $$Kim\ likes\ all\ \underline{animals} \rightarrow Kim\ likes\ all\ \underline{dogs}$$
  $$Kim\ likes\ all\ \underline{dogs} \not\rightarrow Kim\ likes\ all\ \underline{animals}$$

Cruse, 1986; Miller et al., 1990; Fellbaum, 1998; Widdows, 2005

- **Hypernymy**: Y is a hypernym of X iff X is a hyponym of Y

- Properties of hypernymy/hyponymy:
  - ⋆ asymmetric
  - ⋆ applies only to lexical items of the same word class
  - ⋆ applies at the sense level

Cruse, 1986; Miller et al., 1990; Fellbaum, 1998; Widdows, 2005

Basic-level Categories

- Basic-level categories have maximal "cue validity", i.e. are easy to draw/visualise (cf. *furniture* vs. *chair* vs. *throne*)

- In attribute terms, basic-level categories:
  - ⋆ maximise the number of attributes shared by members of the category
  - ⋆ minimise the number of attributes shared with other categories

Rosch, 1975

Antonymy

- **Complementarity**: X and Y are complementaries if X and Y define mutually-exclusive sets which encompass all of a conceptual domain, cf.:

  ?The door is neither open nor shut
  I am feeling neither good nor bad

- **Antonymys**:
  - ⋆ are fully gradable
  - ⋆ when intensified move in opposite directions along

their scale of domain (cf. *heavy* vs. *light*)

- ⋆ do not bisect their domain of operation

- Similarity with synonymy, in terms of attributional overlap

- Antonymy is generally considered to operate at the lexical item-level (cf. *rise/fall* vs. *ascend/descend*)

- Morphological influences (cf. *long/short* vs. *lengthen/shorten*)

Cruse, 1986; Miller et al., 1990

- Other properties of antonymy:
  - ⋆ symmetric
  - ⋆ applies only to lexical items of the same word class (esp. adjectives and verbs)

Cruse, 1986; Miller et al., 1990

Other Lexical Relations

- There are many, many more lexical relations advocated by various theories (esp. MTT), including:
  - ⋆ meronymy/holonymy (part-whole)
  - ⋆ troponymy/hypernymy (cf. *walk* vs. *lollop*)
  - ⋆ entailment (cf. *snore* vs. *sleep*)
  - ⋆ Sing(ular)/Plu(ral) (cf. *bee* vs. *swarm*)
  - ⋆ Oper(ator) (cf. *question* vs. *ask*)
  - ⋆ Magn(ifier) (cf. *wound* vs. *badly*)
  - ⋮

WordNet

- WordNet is an open-source electronic lexical database of English, developed at Princeton University

  `http://wordnet.princeton.edu/perl/webwn2.1`

- Made up of four separate semantic nets, for each of nouns, verbs, adjectives and adverbs

- Lexical items are categorised into ∼115K (and counting) glossed **synsets** (= synonym sets)

Miller et al., 1990; Fellbaum, 1998

```
1. enrichment -- (act of making fuller or more
   meaningful or rewarding)
2. enrichment -- (a gift that significantly increases
   the recipient's wealth)
```

- Lexical relations at either the synset level or sense (= combination of lexical item and synset) level
- Strongly lexicalist:
  - ⋆ synsets only where words exist
  - ⋆ (near) absence of frame semantics

- Other quirks/properties:
  - ⋆ 25 **unique beginners** in noun semantic net
  - ⋆ taxonomic vs. functional hyponymy (cf. $chicken$ vs. $bird/food$)
  - ⋆ few proper nouns and no separate classification for proper nouns

Miller et al., 1990; Fellbaum, 1998

Psycholinguistic Foundations of WordNet

- Strong foundation on hypo/hypernymy (lexical inheritance) based on
  - ⋆ response times to sentences such as:

    a canary {can sing/fly,has skin}

    a bird {can sing/fly,has skin}

    an animal {can sing/fly,has skin}
  - ⋆ analysis of anaphora:

    I gave Kim a novel but the {book,?product,...} bored her

    Kim got a new car. It has shiny {wheels,?wheel nuts,...}
  - ⋆ selectional restrictions

Lexical Similarity

- A **lexical similarity function** maps two senses/lexical items onto a real number value (conventionally $\in [0, 1]$), representing their relative semantic overlap

- Models of lexical similarity:
  - ⋆ attributional
  - ⋆ cluster-based
  - ⋆ relational (all relations equal?)

Gärdenfors, 2000; Widdows, 2005

- Properties of lexical similarity:
  - ⋆ symmetric
  - ⋆ can potentially apply to lexical items of differing word classes
  - ⋆ applies at the lexical item or sense level
- More from Graeme Hirst ...

Constructional Relations

- Semantic relations which pertain to particular construction types, whereby we seek to interpret instances of a given construction by way of a finite set of relation types.
- Largely focused on (productive) multiword expressions for my purposes:
  - ⋆ compound nouns
  - ⋆ compound verbs in Japanese
  - ⋆ relative verb constructions in Japanese

Compound Noun Semantic Relations

- Compound nominals are largely unrestricted semantically

  diesel truck/oil/tanker, phone book, cloud bus, apple juice seat

- Compound nominalisations tend to occur with subject or object interpretation:

  machine performance, museum construction, student education BUT ALSO *soccer competition*

Isabelle, 1984; Downing, 1977; Levi, 1978; Lauer, 1995b; Lapata, 2002; Nicholson and Baldwin, 2005

Semantic Theories

- Every linguist has her own theory, but with commonalities
- Import of syntax, semantics, discourse and knowledge representation in different theories
- Claims that finite enumeration of semantic relations are psychologically untenable (Downing, 1977)

Example Theory 1: Levi, 1978

- 4 roles for nominalisations:
  - ⋆ ACT, PRODUCT, AGENT, PATIENT
    truck driver = AGENT
    student discontinuation = ACT
- 9 **recoverably deletable predicates** for compound nominals:
  - ⋆ IN, FOR, FROM, ABOUT (prepositional)
  - ⋆ CAUSE, MAKE, HAVE, USE, BE (relative clauses)
    power station = MAKE
    steel box = USE
    baby crocodile = BE

Example Theory 2: Lauer, 1995a

- Interpret compound nominals according to 7 prepositions:
  - ⋆ **of**: *state law* = *law* OF *state*
  - ⋆ **for**: *baby chair* = *chair* FOR *baby*
  - ⋆ **in**: *morning prayer* = *prayer* IN *morning*
  - ⋆ **at**: *airport food* = *food* AT *airport*
  - ⋆ **on**: *Sunday television* = *television* ON *Sunday*
  - ⋆ **from**: *reactor waste* = *waste* FROM *reactor*
  - ⋆ **with**: *gun man* = *man* WITH *gun*
  - ⋆ **about**: *war story* = *story* ABOUT *war*

Example Theory 3: Copestake, 2003

- Cateogrise compounds as first category that "fits":

1. **listed compounds**: *home secretary*
2. **hypernmic compounds**: *tuna fish, oak tree*
3. **deverbal compounds**: *satellite observation*
4. **relational compounds**: *jazz fan*
5. **made-of compounds**: *steel sword, polystyrene box*
6. **prepositional compounds**: *airshow accident*
7. **non-deverbal verb compounds**: *oil town*
8. **non-paraphrasable compounds**: *listeria society*

Constructional Semantics

- How do lexical items interact with each other and context?
- What is the linkage between lexical items and language as a communicative tool/discourse semantics?
- Can we extend the research on lexical item-level semantics to larger units (i.e. constructions)?
- All this and much, much more from Collin Baker ...

Summing Up

- What is lexical semantics?
- Different approaches to lexical semantic categorisation:
  - ⋆ attributional semantics
  - ⋆ semantic clustering
  - ⋆ relational semantics
- Recurring theme: the syntax-semantics interface

To Come

- Frame Semantics, Constructions, and the FrameNet Lexical Database (L2,4)
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- Lexical Semantics and Ontologies (L5,7)
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- Semantic Distance and Lexicographic Resources (L8)

(A Random Selection of) Online Resources

- On-line bibliography:

  `dingo.sbs.arizona.edu/~hharley/522/522Spring1999/LexSemBiblio.html`

- Levin verb classes: `www-personal.umich.edu/~jlawler/levin.verbs`
- WordNet: `wordnet.princeton.edu`
- VerbNet: `verbs.colorado.edu/~kipper/verbnet.html`
- FrameNet: `framenet.icsi.berkeley.edu`
- LCS Database: `www.umiacs.umd.edu/~bonnie/LCS_Database_Documentation.html`

References

Allan, K. (1980). Nouns and countability. *Language*, 56(3):541–67.

Baldwin, T. (1998). *The Analysis of Japanese Relative Clauses*. Master's thesis, Tokyo Institute of Technology.

Baldwin, T. and Bond, F. (2003). Learning the countability of English nouns from corpus data. In *Proc. of the 41st Annual Meeting of the ACL*, pages 463–70, Sapporo, Japan.

Bond, F. (2005). *Translating the Untranslatable: A Solution to the Problem of Generating English Determiners*. CSLI Publications, Stanford, USA.

Copestake, A. (2003). Compounds revisited. In *Proc. of the 2nd International Workshop on Generative Approaches to the Lexicon*, Geneva, Switzerland.

Copestake, A. and Briscoe, T. (1995). Semi-productive polysemy and sense extension. *Journal of Semantics*, pages 15–67.

Cruse, D. A. (1986). *Lexical Semantics*. Cambridge University Press, Cambridge, UK.

Dorr, B. J. (1997). Large-scale dictionary construction for foreign language tutoring and interlingual machine translation. *Machine Translation*, 12(4):271–322.

Downing, P. (1977). On the creation and use of English compound nouns. *Language*, 53(4):810–42.

Dowty, D. (1979). *The Semantics of Verbs and Times in Generative Semantics and in Montague's PTQ*. Springer, Dordrecht, Netherlands.

Fellbaum, C., editor (1998). *WordNet: An Electronic Lexical Database*. MIT Press, Cambridge, USA.

Fillmore, C. J. (2003). Topics in lexical semantics. In *Form and Meaning in Language*, chapter 6. CSLI Publications, Stanford, USA.

Firth, J. R. (1957). A synopsis of linguistic theory, 1930-1955. *Studies in Linguistic Analysis, Philological Society, Oxford*.

Gärdenfors, P. (2000). *Conceptual Spaces: The Geometry of Thought*. MIT Press, Cambridge, USA.

Goddard, C. (2000). Polysemy: A problem of definition. In (Ravin and Leacock, 2000), chapter 7, pages 129–151.

Hirst, G. (1987). *Semantic Interpretation and the Resolution of Ambiguity*. Cambridge University Press, Cambridge, UK.

Isabelle, P. (1984). Another look at nominal compounds. In *Proc. of the 10th International Conference on Computational Linguistics (COLING '84)*, Stanford, USA.

Jackendoff, R. (1990). *Semantic Structures*. MIT Press, Cambridge, USA.

Jackendoff, R. (1991). Parts and boundaries. In Levin, B. and Pinker, S., editors, *Lexical and Conceptual Semantics*, pages 1–45. Blackwell Publishers, Cambridge MA and Oxford UK.

Jackson, H. (2002). *Lexicography: An Introduction*. Routledge, London, UK.

Lapata, M. (2002). The disambiguation of nominalizations. *Computational Linguistics*, 28(3):357–88.

Lauer, M. (1995a). Corpus statistics meet the noun compound: Some empirical results. In *Proc. of the 33rd Annual Meeting of the ACL*.

Lauer, M. (1995b). *Designing Statistical Language Learners: Experiments on Noun Compounds*. PhD thesis, Macquarie University.

Levi, J. N. (1978). *The Syntax and Semantics of Complex Nominals*. Academic Press, New York, USA.

Levin, B. (1993). *English Verb Classes and Alterations*. University of Chicago Press, Chicago, USA.

Mel'čuk, I. (1995). Phrasemes in language and phraseology in linguistics. In Everaert, M., van der Linden, E.-J., Schenk, A., and Schreuder, R., editors, *Idioms: Structural and Psychological Perspectives*, chapter 8. Lawrence Erlbaum Associates.

Mel'čuk, I. (1998). Collocations and lexical functions. In *Phraseology: Theory, Analysis, and Applications*, pages 23–54. Oxford: Clarendon Press.

Mel'čuk, I. and Polguère, A. (1987). A formal lexicon in meaning-text theory (or how to do lexica with words). *Computational Linguistics*, 13(3–4):261–275.

Miller, G. A., Beckwith, R., Fellbaum, C., Gross, D., and Miller, K. J. (1990). Introduction to WordNet: an on-line lexical database. *International Journal of Lexicography*, 3(4):235–44.

Nicholson, J. and Baldwin, T. (2005). Statistical interpretation of compound nominalisations. In *Proc. of the Australasian Language Technology Workshop 2005*, pages 152–9, Sydney, Australia.

Nunberg, G., Sag, I. A., and Wasow, T. (1994). Idioms. *Language*, 70:491–538.

Pustejovsky, J. (1995). *The Generative Lexicon*. MIT Press, Cambridge, USA.

Ravin, Y. and Leacock, C., editors (2000). *Polysemy: Theoretical and Computational Approaches*. Oxford University Press, Oxford, UK.

Riehemann, S. (2001). *A Constructional Approach to Idioms and Word Formation*. PhD thesis, Stanford, USA.

Rosch, E. (1975). Cognitive representations of semantic categories. *Journal of Experimental Psychology*, 104:192–233.

Sag, I. A., Baldwin, T., Bond, F., Copestake, A., and Flickinger, D. (2002). Multiword expressions: A pain in the neck for NLP. In *Proc. of the 3rd International Conference on Intelligent Text Processing and Computational Linguistics (CICLing-2002)*, pages 1–15, Mexico City, Mexico.

Sinclair, J., editor (1987). *Looking Up: An Account of the COBUILD Project in Lexical Computing*. Collins ELT, London, UK.

Stubbs, M. (2001). *Words and Phrases: Corpus Studies of Lexical Semantics*. Blackwell, Oxford, UK and Malden, USA.

Vendler, Z. (1957). Verbs and times. *The Philosophical Review*, 66:143–60.

Widdows, D. (2005). *Geometry and Meaning*. CSLI Publications, Stanford, USA.

Wierzbicka, A. (1988). *The Semantics of Grammar*. John Benjamin.

Wierzbicka, A. (1996). *Semantics: Primes and Universals*. Oxford University Press, Oxford, UK.

Wilks, Y., Slator, B. M., and Guthrie, L. M. (1996). *Electric Words: Dictionaries, Computers and Meanings*. MIT Press, Cambridge, USA.