

Verb Meaning and Co-compositionality: Manner, Means, and Result

James Pustejovsky
Brandeis University

University of Lisbon
Lisbon, Portugal
February 23, 2018



- Meaning Components for Predicates
- The Manner/Result Complementarity Hypothesis
- Event Factorization in Generative Lexicon
- Architecture of the Lexicon
- Event Structure: Dynamic Event Models

- (1) a. MANNER VERBS: specify a manner of carrying out an action.
cry, hit, pound, run, shout, shovel, smear, sweep, ...
- b. RESULT VERBS: specify the result of an event.
arrive, clean, come, cover, die, empty, fill, put, remove, ...
- (5) a. A manner verb can combine with a result XP:
Pat wiped the table clean.
- b. A result verb can be accompanied by an adverbial XP expressing manner:
Pat cleaned the table by wiping it.

Manner/Motion-Path Encoding in Russian

Process-Result in Russian Manner/Creation Predicates

- a. Ivan stroil dom
lit. 'Ivan build-PAST.IMPERF the house'
'Ivan was building the house'
- b. Ivan po-stroil dom
'Ivan po-build-PAST.PERF the house'
'Ivan built the house'
- c. Ivan žaril rybu/ omlet
lit. 'Ivan fry-PAST.IMPERF'
'Ivan was frying the fish/ the omelet'
- d. Ivan po-žaril rybu.
lit. 'Ivan po-fry-PAST.PERF the fish'
'Ivan fried the fish'
- e. Ivan s-žaril omlet
'Ivan s-fry-PAST.PERF the omelet'
'Ivan fried the omelet'

- a . 'Kim cruzó el río nadando'
lit. 'Kim crossed the river swimming-GERUND'
'Kim swam across the river'
- b. Kin pere-plyla reku
lit. 'Kim across-swam-PERF. the river'
'Kim swam across the river'

Creation-Manner Ambiguity (Spanish)

a. CREATION:

coser un vestido 'sew a dress'

b. MANNER:

coser un botón 'sew a button'

Object Semantics Determines Polysemy of Verbs

- (1) a. CHANGE-OF-STATE: [DP ___ DP_{PHYS_OBJ}]
b. CREATION: [DP ___ DP_{ARTIFACT}]

- (2) a. Mary baked the potato.
b. John sewed a button.
c. The child carved the stick.

- (3) a. Mary baked a cake.
b. John sewed a dress.
c. The child carved a boat.

Some Factors Contributing to Meaning

- Change of being or state of an individual (e.g., location, size, constitution, or other relation);
- Causation and encoding of agency;
- Specific attributes of the arguments of the verb;
- Specification of manner and means of an activity;
- Temporal or spatial constraints on the event;
- Intentionality of the actor;
- Specification of an instrument involved;
- Mention of the psychological state of the participants;
- Determination of the medium of the situation or event.

Canonical realization rules

Rappaport Hovav and Levin (1998)

- (7) manner → [x ACT_{<MANNER>}]
(e.g., *jog, run, creak, whistle, ...*)
- (8) instrument → [x ACT_{<INSTRUMENT>}]
(e.g., *brush, hammer, saw, shovel, ...*)
- (9) container → [x CAUSE [y BECOME AT <CONTAINER>]]
(e.g., *bag, box, cage, crate, garage, pocket, ...*)
- (10) internally caused state → [x <STATE>]
(e.g., *bloom, blossom, decay, flower, rot, rust, sprout, ...*)
- (11) externally caused, i.e. result, state →
[[x ACT] CAUSE [y BECOME <RESULT-STATE>]]
(e.g., *break, dry, harden, melt, open, ...*)⁴

Manner/Result Complementarity

Rappaport Hovav and Levin (1998)

- LEXICALIZATION CONSTRAINT: A root can only be associated with one primitive predicate in an event schema, as either an argument or a modifier.
- COMPLEMENTARITY: Manner and result meaning components are in complementary distribution; a verb typically lexicalizes only one.

Problems with M/R Complementarity

- It's too strong: there are many examples not explained: *cut* has both manner and result readings; *climb* incorporates both components at the same time.
- It's too weak: it doesn't link manner and result behavior to the other event types, most importantly, accomplishment verbs.
- Creation verbs incorporate elements of both manner and result.

Models of lexical semantics

Traditional view

- The denotation of a word may be single or multiple.
 - English *lamp*, denoting the device for giving light.
 - English *paper*, which denotes, inter alia, “the material used for writing” (recycled paper) and an “essay published in an academic journal” (a technical paper).
- A word with a single denotation is called *monosemous*, while a word with multiple denotations is referred to as *polysemous*.
- Polysemy is seen as **a checklist of senses**.
- Sense enumerative lexicons.

Models of lexical semantics

Dynamic view (Pustejovsky, 1995, 2011)

- Context Dependence of meaning
 - Functional notion of polysemy.
 - The ability of lexical items to exhibit different (conceptually) related senses in different contexts, rather than a checklist of separate senses.
- Two major approaches.
 - **Meaning potential**: meaning is attached to units larger than words (.i.e. patterns: corpus linguistics and computational lexicography).
 - **Core meaning** and contextual operations of meaning adjustment.

Language Meaning is Structurally Distributed

Generative Lexicon

- By **Spreading the Semantic Load** of Composition in Language, we allow a predicate's arguments to contribute to the dynamics of meaning construction.
- This requires an deeper ontology for arguments than typically assumed, including a **rich type system** and **qualia structure**.
- This also requires more flexible rules of compositionality.

Factoring the Meaning of Events

- DYNAMIC EVENT MODEL:
 - (a) states;
 - (b) state transitions
- EVENT MODEL consists of:
 - (a) object model (what changes);
 - (b) action model (what makes it change or self-change).
- EVENT TEMPLATES assumed by Rappaport Hovav and Levin (1998) are derivable from simple these dynamic event models.

Typology of Manner

- EVENT-ORIENTED: spatial, temporal, or social constraints on a predicate:
swim/fly, stare/glance
- AGENT-ORIENTED: posture, self-defined movement of the agent:
stagger/walk/teeter, stutter/slure/mumble

Opposition Structures introduce Results

Opening a coconut

Given an **opposition structure**, employ the manner below:

- open by cracking
- open by cutting
- open by smashing
- open by shaving

Hence, *cut* is a **manner for achieving a resulting state**, *open*.

Manner Subtypes

Cutting

Given an **manner for achieving a resulting state**, employ the means below:

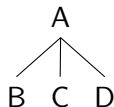
- cut by means of a saw
- cut by means of a knife
- cut by means of an axe
- cut by means of a laser

Hence, *saw* is a **means subtype of a manner for achieving a resulting state**, *open*.

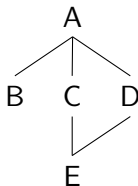
General Architecture for Lexical Information

- (4) a. **SYNTACTIC TYPE**: this identifies the structural mode of presentation of a word in the syntax, e.g., as a Noun, Verb, Adjective, as so on, as well as the word's argument structure.
- b. **SEMANTIC TYPE**: this identifies the conceptual type for a lexical item, while positioning it within a type hierarchy. This typing includes basic semantic class distinctions as well as those associated with event classes and qualia structure.
- c. **LEXICAL SEMANTIC RELATIONS**: this includes relations such as meronymy, antonymy, synonymy, and varieties of CAUSE.
- d. **WORD SYNTAX**: this includes the structure of a lexical item as a word or morpheme (morphology), or as a *multiword expression* or *phrasal construction*.

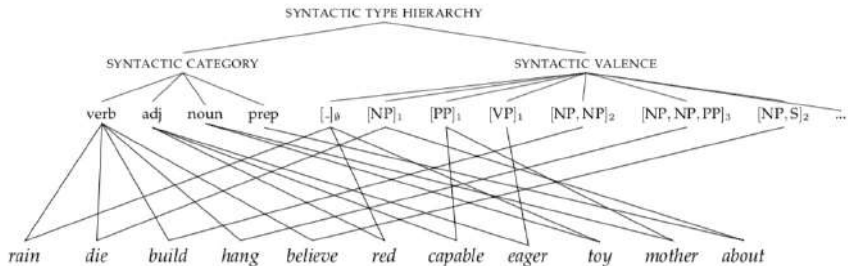
- $B \sqsubseteq A$ means that B is a subtype of A in our domain.
- A is said to be completely defined by its daughters: that is, a least upper bound operation \sqcup , called *join*, has the following property: $A = B \sqcup C \sqcup D$.



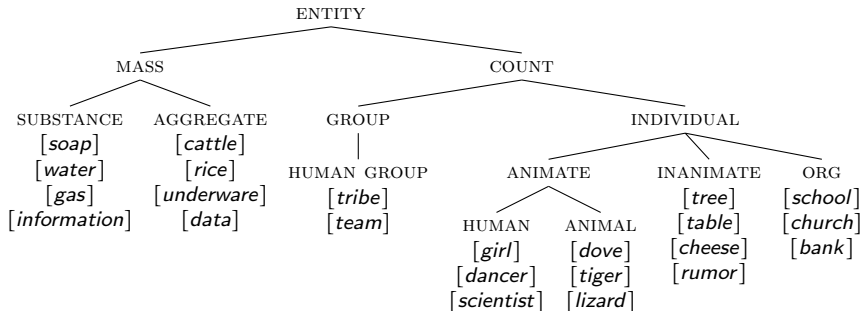
- If we intersect the properties of different types, then we have an operation called *meet*, \sqcap , which is formally the greatest lower bound of two types.
- In the tree below, E is the meet of C and D .
- That is, the category E inherits all the properties from both C and D above it.



Syntactic Types



Entity Subtypes



Qualia Structure

Pustejovsky (1995)

- A *Quale* (singular of *Qualia*) indicates a **single aspect of a word's meaning**, defined on the basis of the **relation** between the **concept** expressed by the word and **another concept** that the word evokes.

Qualia Structure

Pustejovsky (1995)

- A *Quale* (singular of *Qualia*) indicates **a single aspect of a word's meaning**, defined on the basis of the **relation** between the **concept** expressed by the word and **another concept** that the word evokes.
- Among the conceptual relations that a word may activate Qualia relations as defined in GL are those that are **exploited in our understanding of linguistic expressions**.

Qualia Structure

Pustejovsky (1995)

- A *Quale* (singular of *Qualia*) indicates a **single aspect of a word's meaning**, defined on the basis of the **relation** between the **concept** expressed by the word and **another concept** that the word evokes.
- Among the conceptual relations that a word may activate Qualia relations as defined in GL are those that are **exploited in our understanding of linguistic expressions**.
- *fresh bread* = “bread which has been **baked** recently.”

Qualia Structure

- **Formal role (F)**: basic semantic type, including features that distinguish the object within a larger domain (orientation, shape, dimension, color): *violin* is a MUSICAL INSTRUMENT.
- **Agentive role (A)**: factors involved in the origin or 'bringing about' of an object, such as creator, artifact, causal chain, etc. E.g., the violin is created through the event of BUILDING or, more generally, CREATING.
- **Telic role (T)**: purpose or function of the object, or the built-in function or aim of certain activities. The violin is created for PRODUCING MUSICAL SOUND.
- **Constitutive (C)**: relation between an object and its proper parts (i.e., its material and component elements), or between an object and the whole it is a part of. E.g., WATER is major constituent of coffee; and a finger is part of a HAND.

$$(5) \left[\begin{array}{l} \textit{violin}(x) \\ \text{QS} \end{array} \right] = \left[\begin{array}{l} \text{F} = \text{musical_instrument}(x) \\ \text{A} = \text{build}(y,x) \\ \text{T} = \text{produce_music_on}(z,x) \\ \text{C} = \text{strings_of}(w,x) \end{array} \right]$$

Qualia as Semantic Type Constraints

- Natural Types
- Artifactual Types

tree	
QS =	$\left[\begin{array}{l} \text{FORMAL} = \text{phys_obj}(x) \\ \text{CONSTITUTIVE} = \text{trunk_of}(y,x), \text{foliage_of}(z,x) \\ \text{TELIC} = \text{unspecified} \\ \text{AGENTIVE} = \text{unspecified} \end{array} \right]$
cake	
QS =	$\left[\begin{array}{l} \text{FORMAL} = \text{phys_obj}(x) \\ \text{CONSTITUTIVE} = \text{ingredient_of}(v,x), \text{part_of}(w,x), \\ \text{TELIC} = \text{eat}(y,x) \\ \text{AGENTIVE} = \text{bake}(z,x) \end{array} \right]$

Multiple Inheritance with Qualia

