The Generative Lexicon
James Pustejovsky

Iris Perkmann

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What is the *Generative Lexicon*?

Theoretical background
Goals and problems

Previous approaches …

- view the lexicon as static set of word senses.
- assume that words behave as either active functors or passive arguments.

Main goals of the proposal are …

- accounting for the creative use of words in new contexts.
- re-evaluating the role of compositionality.
Criticism of Existing Representations

- no general coherent view on what the entire lexicon will look like
- very verb-based, all ambiguity comes from polysemous verbs
Basic assumptions

- semantics can’t be completely divorced from syntax
- semantics of natural language should be the image of nonlinguistic conceptual organizing principles
Basic principles

- clear notion of semantic well-formedness, "semanticality"
- representations that are richer than thematic role descriptions
- principled method of lexical decomposition
- the lexicon is not just verbs
Methods in lexical semantics I

- establish differences between the grammatical classes
  verbs=predicators, nouns=arguments

- find distinctions between elements of the same word class
  count/mass nouns, animate/non-animate

- test for distinctions on the basis of diathesis
  John broke the glass./The glass broke.
  John cut the bread./*The bread cut.

- test for entailments
  - context-free
    killing entails dying
  - context-sensitive entailments
    John forgot that he locked the door.
    John forgot to lock the door.
Methods in lexical semantics II

- test for ambiguity
  - homonymy and
  - polysemy

- establish the compositional nature of a lexical item
  the female suspect
  the alleged suspect
Approaches in lexical semantics

- **primitive-based theories**
  word meaning can be defined in terms of a fixed set of primitive elements

- **relation-based theories**
  words can be defined through a network with other words ("meaning postulates")

- **new way of viewing primitives**
  looking at compositional aspects, no specified number of primitives
  method for the decomposition of lexical categories
  fixed number of generative devices
Model
Levels of semantic representation

Lexical meaning can be captured by assuming the following levels of representation:

- Argument Structure
- Event Structure
- Qualia Structure
- Inheritance Structure
Argument Structure

The behavior of a word as a function. Predicate argument structure for a word, which indicates how it maps to syntactic expressions.

- **True arguments:** necessary
  *John arrived late.*

- **Default arguments:** logical, not necessarily expressed
  *John built the house *out of bricks.*

- **Shadow arguments:** already incorporated, just for specification
  *Mary buttered her toast *with an expensive butter.*

- **True adjuncts:** situational modification
  *Mary drove down to New York *on Tuesday.*
Argument Structure

\[
\begin{array}{c}
\text{build} \\
\text{ARGSTR} \\
\vdots
\end{array}
\begin{bmatrix}
\text{ARG}_1 & \text{animate-individual} \\
\text{ARG}_2 & \text{artifact} \\
\text{D-ARG}_1 & \text{material}
\end{bmatrix}
\]

John(\text{ARG}_1) build the house(\text{ARG}_2) (out of bricks (\text{D-ARG}_1))
Argument Structure

\[
\begin{bmatrix}
\text{book} \\
\text{ARGSTR} \\
\ldots
\end{bmatrix}
\begin{bmatrix}
\text{ARG}_1 & x: \text{information} \\
\text{ARG}_2 & y: \text{phys}_\text{obj}
\end{bmatrix}
\]
Event Structure

Identification of the particular event type

- state ($e^S$)
- process ($e^P$)
- transition ($e^T$)

recursively defined on the syntax, therefore property of words, phrases and sentences
an event sort such as $e^T$ may be decomposed into two sequentially structured subevents, ($e^P$, $e^S$).
Event Structure

\[
\begin{array}{c}
\text{build} \\
\text{EVENTSTR} \\
\text{...}
\end{array}
\begin{array}{c}
\begin{bmatrix}
E_1 & \text{process} \\
E_2 & \text{state} \\
\text{RESTR} & <_\alpha
\end{bmatrix}
\end{array}
\]
Event Structure

\[
\begin{bmatrix}
\text{tall} \\
\text{EVENTSTR} & E_1 & \text{state} \\
... & \\
\end{bmatrix}
\]
Qualia Structure

The essential attributes of an object as defined by the lexical item.

- **Constitutive Role**: the relation between it and its constituent parts (material, weight, parts and component elements)
- **Formal Role**: that which distinguishes it within a larger domain (orientation, magnitude, shape, dimensionality, color, position)
- **Telic Role**: its purpose and function (purpose that an agent has in performing an act, built-in function or aim that specifies certain activities)
- **Agentive Role**: whatever brings it about (creator, artifact, natural kind, causal chain)
Qualia Structure

```
\[
\begin{array}{c}
\text{QUALIA} \\
\text{novel(x)} \\
\vdots \\
\text{CONST} \\
\text{FORMAL} \\
\text{TELIC} \\
\text{AGENT}
\end{array}
\begin{array}{c}
narrative(x) \\
book(x) \\
read(y,x) \\
write(y,x)
\end{array}
\]
```
Qualia Structure

\[
\begin{align*}
\text{build} & \quad \ldots \\
\text{ARGSTR} & \quad \begin{cases} 
\text{ARG2} & 2 \\
\text{D-ARG1} & 3 
\end{cases} \\
\text{QUALIA} & \quad \begin{cases} 
\text{create-lcp} & \\
\text{AGENTIVE} & \text{exist(e}_2, 2) \\
\text{AGENTIVE} & \text{build}\_\text{act(e}_1, 1, 2) \\
\text{ART} & \text{artifact} \\
\text{AGRT} & \text{CONST - physobj} \\
\text{MATERIAL} & \text{material} \\
\text{AGRT} & \text{mass} \\
\end{cases}
\end{align*}
\]
Inheritance Structure

How the word is globally related to other concepts in the lexicon.
Structure for phrases

\[
\begin{array}{c}
\text{into the cave} \\
\text{ARGSTR} \\
\quad \text{ARG1} \quad 1 \quad \boxed{\text{physobj}} \\
\quad \text{ARG2} \quad 2 \quad \boxed{\text{the_cave}} \\
\text{EVENTSTR} \\
\quad E_1 \quad e_1: \text{process} \\
\quad E_2 \quad e_2: \text{state} \\
\quad \text{RESTR} \quad \leq \alpha \\
\quad \text{HEAD} \quad e_2 \\
\text{QUALIA} \\
\quad \text{FORMAL} \quad \text{at}(e_2, [1, 2]) \\
\quad \text{AGENTIVE} \quad \text{move}(e_1, [1]) \\
\end{array}
\]
# Levels of semantic representation

Levels are connected by generative devices, e.g. co-composition, type coercion, selective binding (…)
Examples
Polysemy

1. John **baked** the potato.
   (bake1 = change(x, State(y)))

2. John **baked** the cake.
   (bake2 = create(x,y))
Polysemy

\[ \lambda y \lambda x \lambda e^P [bake(e^P) \land agent(e^P, x) \land object(e^P, y)] \]

potato = natural kind

cake = artifact, brought into being by baking (AGENTIVE role)

→ “projects” an event structure of its own (“cospecification”)
Co-compositionality

Arguments to a function are as active in the semantics as the verb itself. The product of function application would be sensitive to both the function and its active argument.
Polysemy

bake as process

\[ \exists e^P [bake(e^P) \land \text{agent}(e^P, j) \land \text{object}(e^P, a\text{-potato})] \]

P

\[ \text{John baked a potato} \]

V

NP

VP
**Polysemy**

bake as derived transition

\[
\exists e^P, e^S [create(e^P, e^S) \land bake(e^P) \land \text{agent} (e^P, j) \land \text{object} (e^P, x) \land \\
cake(e^S) \land \text{object}(e^S, x)]
\]

[T](#)

P

<P, T>

John baked a cake

P

V NP

VP
**Metonymy**

→ **Semantic Type Coercion**: A semantic operation that converts an argument to the type that is expected by a function, where it would otherwise result in a type error.

1. Mary enjoyed the book.
2. John began a novel.
Metonymy

\[ \lambda P_T \lambda PP \lambda x[\text{begin}'(P_T(x^*))](x^*) \] 

\[ \lambda x[\text{novel}(x) \land \]

\[ \text{Const}(x) = \text{narrative}'(x) \land \]

\[ \text{Form}(x) = \text{book}'(x) \land \]

\[ \text{Telic}(x) = \lambda y, e^T \left[ \text{read}'(x)(y)(e^T) \right] \land \]

\[ \text{Agent}(x) = \lambda y, e^T \left[ \text{write}'(x)(y)(e^T) \right] \]

\[ \rightarrow \text{transition event} \]

\[ \rightarrow \text{transition event} \]

\[ \rightarrow \text{type coercion} \]

1. John began to **read** a novel.
2. John began to **write** a novel.
3. ??John began the flower.
Modifiers

Adjectives such as *fast* can modify some qualia for a noun.

1. a fast car: driving
   \[ Q_T(car) = \lambda x\lambda y\lambda e^P \ [drive(x)(y)(e^P)] \]

2. a fast typist: typing
   \[ Q_T(typist) = \lambda x\lambda e^P \ [type(x)(e^P)] \]

3. a fast motorway: traveling
   \[ Q_T(motorway) = \lambda x\lambda e^P \ [travel(cars)(e^P)\&on(x)(cars)(e^P)] \]
**“Double Figure-Ground”**

1. Mary painted **the door**.
2. Mary walked through **the door**.

**Figure**: physical object

**Invert-Figure**: aperture

door (**x***, **y***)
- Const: aperture(**y***)
- Form: phys-obj(**x***)
- Telic: pass-through(T,z,**y***)
- Agentive: artifact(**x***)
“Double Figure-Ground”

- Count/Mass Alternations
- Container/Containee Alternations
- Product/Producer Diathesis
- Plant/Fruit Alternations
- Object/Place Reversals
- …
Lexical Inheritance

relations between lexical entries

- **Fixed inheritance**: static network of relations, e.g. hyponyms and hypernyms.

- **Projective inheritance**: operates generatively from the qualia structure to create a relational structure for ad hoc categories.
Projective transformation

Projective transformations on a predicate generate a new predicate through:

- \( \neg \) negation
- \( \leq \) temporal precedence
- \( \geq \) temporal succession
- \( = \) temporal equivalence
- act adding agency
Projective inheritance

1. The prisoner **escaped** last night.
2. The prisoner **ate** dinner last night.

1 is more prototypical.
Transformations on Telic Role

prisoner (*x*)
  Form: human(*x*)
  Telic: [confine(y,*x*) & location(*x*, prison)]

- ≤: confine(y, x) ≤ ¬confine(y, x) = T₁
- act: act(x, T₁) = “escape”
- act: act(y, T₁) = “release”

- ≤: ¬confine(y, x) ≤ confine(y, x) = T₂
- act: act(x, T₂) = “turn in”
- act: act(y, T₂) = “capture”

→ way of generating related concepts
lexical entries which can be generated by these transformations, are related.

*escape* is within the space of related concepts generated from *prisoner*, therefore it is more prototypical.
Conclusion

- In the Generative Lexicon, meaning can be generated, word meanings are not fixed and inflexible.
- This is done using 4 levels of semantic representation and a number of generative devices (like co-composition, type coercion)
References
