Introduction to Semantic Role Labelling

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Levin's Verb Classes and Alternations: Background

Levin, a prominent linguist, takes an advantage of a (Chomsky+Generative and Fillmore+Case-Grammar)-ism to propose a system of verb classes and relating them to their semantics.

Levin's Verb Classes and Alternations: Background (contd.)

Verbs can be classified in several ways, e.g., transitive vs. intransitive, finite (carry information regarding person and number of their subject) vs. infinite (participles, infinitives, and gerunds), and so on:

Classes are formed wrt. criteria chosen for their definition!

Levin classifies verbs primarily based on syntactic behaviour (or clues, i.e. verbs' subcats, more precisely their alternation patterns), as well as certain semantic criteria (semantics of argument fillers).

Levin's Verb Classes and Alternations: Background (contd.)

Levin believes that syntactic behaviour (variations/subcats) is a reflection of semantics (like Fillmore did).

Levin is aware of predicate-argument structure as opposed to Chomsky who introduced the notion of subcats as a pure syntactic instrument.

Background to Verb Classes

RECAP (2nd Session):
Verb alternation (aka. diathesis alternation): When the verb *v* can be used in different subcategorizations *x*, *y*, *z*, ... (i.e., with various syntactic argument or with different valency), we say *v* has diathesis alternation (or simply alternation patterns) *x*, *y*, *z*, ...

(1)   John gave Mary a kiss.

(2)   John gave a kiss to Mary.

Two objects in (1) vs. one object plus a *to* construct in (2), often called as the English Dative Alternation.

It is widely believed that a verbs' alternation patterns correlate to their semantics, and that they can be used to classify them into classes.

Background to Verb Classes (contd.)

VERB CLASSES: To re-emphasize: various verb classification systems are possible!

In the context of our discussion, Fillmore (1967) is often cited as a pioneering work that showed the importance of verb classes as a tool for:

* structuring verb lexicon;
* identifying elements of meaning which are related grammatically;
* discovering and structuring shared patterns of verb behavior;
* . . . .

Background to Verb Classes (contd.)

Fillmore (1967) focused on two verbs (*hit* and *break*) as the representative for two classes of verbs:

> **Class Break:** break, shatter, crack, split, bend, . . .
>
> **Class Hit:** hit, bump, kick, strike, slap, . . .

And, he argued that members of the same class share similar behavioral patterns which are different than the other class.

Background to Verb Classes (contd.)

Fillmore (1967) (according to Levin (2009)) showed that HIT and BREAK class are different in:

* Availability of transitive use and instrumental with PP-construct:

(3)   John broke the window (with a ball). ✗

(4)   John hit the window (with a ball). ✓

* Availability of the causative alternation (transitive-pattern = 'cause to *intransitive*-pattern'):

(5)   John broke the window. (The window broke.) ✓

(6)   John hit the window. (The window hit) ✗

And do on . . . .

Background to Verb Classes (contd.)

On the other hand, the members of the same class show similar patterns such as:

BREAK class: verbs of change of state: involve a change of state in an entity.

Hit Verbs: verbs of surface contact: involve (often forceful) contact with an entity, without entailing a change in its state.

(7)   The rock broke the window, but it wasn't damaged.✗
           broke asserted CHANGE OF STATE.

(8)   The rock hit the window, but it wasn't damaged.✓
           hit asserted CONTACT and not change of STATE.

Background to Verb Classes (contd.)

Levin hypothesized that (Levin and Hovav, 2005):

Because classes of verbs with similar meanings show "characteristic argument realization patterns", the patterns have something to do with meaning common to class members.

Therefore, she investigates the correlation between a) syntactic behaviours of verbs and b) possible semantic interpretations of their arguments.

Levin Verb Classes

What did Levin do? In a nutshell:

- identified/defined more than 70 different alternation patterns;
- analyzed ≈3100 verbs with respect to these alternation patterns and the semantic arguments shared between them;
- categorized these 3100 verbs into 49 coarse verb classes (192 fine grained categories), where, in each class, *verbs share a certain number of alternations*.

Evidently, the result is a set of verb classes and a set alternation patterns.

A complete overview of Levin's alternation patterns and verb classes can be found in Levin (1993) (and her subsequent publications).

Levin Verb Classes (contd.)

Causative/Inchoative Alternation (>1200): blast, close, feed, file, give ... We have already seen:

(9)   The boy broke the vase.

(10)   The vase broke.

Dative Alternation (>750) ask, drive, drop, slam, slap, ...

(11)   John asked him a question.

(12)   John asked a question from him

Conative Alternation (to attempt, modifies meaning towards implying an "attempted action" − > 450) pick, consume, bang ...

(13)   The boy hit the door.

(14)   The boy hit at the door.

Levin Verb Classes (contd.)

Causative/Inchoative
Induced Action
Substance/Source
Unspecified Object
Understood Body-Part Object
Understood Reflexive Object
Understood Reciprocal Object
PRO-arb Object
Characteristic Property of Agent
Characteristic Property of Instrument
"way" Object
Instructional Imperative
Conative
Locative Preposition Drop
"with" Preposition Drop
Dative
"Blame"
"Search"
Body-Part Possessor Ascension
Possessor Object
Attribute Object
Possessor and Attribute

Possessor Subject (transitive)
Possessor Subject (intransitive)
"As"
Benefactive
Spray/Load
Clear
Wipe alternation
Swarm
Clear
Material/Product
Total Transformation
Simple Reciprocal
"Together" Reciprocal
"Apart" Reciprocal
Simple Reciprocal
"Together" Reciprocal
"Apart" Reciprocal
Fulfilling

Levin Verb Classes (contd.)

Image Impression
"With/Against"
"Through/With"
Time Subject
Source Subject
Natural Force Subject
Instrument Subject
Abstract Cause Subject
Locatum Subject
Location Subject
Container Subject
Raw Material Subject
Sum of Money Subject
Virtual Reflexive
Reflexive of Appearance
Verbal Passive
Prepositional Passive
Adjectival Passive (transitive verbs)
Adjectival Perfect Participles

(intransitive verbs)

"There"-Insertion
Locative Inversion
Cognate Object Construction
Cognate Prepositional Phrase

Construction
Reaction Object Construction
X's Way' Construction
Resultative Construction
Unintentional Interpretation with

Reflexive Object
Unintentional Interpretation with

Body-Part Object
Bound Nonreflexive Anaphor as

Prepositional Object
Directional Phrases with Nondirected

Motion Verbs
Obligatory Passive
Obligatorily Reflexive Object
Inalienably Possessed Body-Part Object
Expletive "It" Subject
Obligatory Adverb
Obligatory Negative Polarity Element

Levin Verb Classes (contd.)

HOMEWORK: Bring an explanation of the alternation pattern assigned to you next week (max two sentences + an example that shows the alternation)

Levin Verb Classes (contd.)

Based on the ability of each verb to license/not-license the aforementioned verb alternations, Levin built her hierarchy of verb classes:

"alternating change of state" verbs	~257	ionize freeze ripen detonate degrade hasten sweeten awaken topple worsen . . .
"amuse" verbs	~220	intimidate ruffle relax aggravate stagger dazzle horrify appall reassure cheer . . .
"run" verbs	~124	run scud lope crawl stray scram gallop swagger walk roll . . .
"bang" verbs	~119	tootle gurgle thunder wheeze hiss clunk whump vroom jangle thunk . . .
"butter" verbs	~109	sequin salve diaper putty drug ink poison bronze shoe heel . . .
"fill" verbs	~96	festoon pad litter mask lard adorn blot endow pollute spot . . .
"snap/cackle" verbs	~77	snuffle gibber carol burble rasp yap hiss crow lisp gabble . . .
"bark" verbs	~67	pipe scream chirrup snuffle howl yelp neigh snort chatter bleat . . .
"characterize" verbs	~62	regard repudiate classify enter establish reveal appreciate confirm certify enlist . . .
"marvel" verbs	~58	react glory cringe wallow feel gloat rhapsodize madden weep bask . . .
"tape" verbs	~59	strap link screw clip rivet rope epoxy padlock tether thumbtack . . .
"correspond" verbs	~57	mingle rendezvous conflict joke concur wrangle feud war dispute neck . . .
"cook" verbs	~45	deep-fry charcoal-broil charbroil heat microwave oven-fry percolate parch broil oven-poach . . .
"pocket" verbs	~53	spindle cage pen case bin ground skewer beach coop land . . .
"debone" verbs	~50	deluster demast defeather descale dehorn debone derind degrit degrease dewax . . .
. . .	. . .	. . .

Verb Classes: Limitations

Palmer et al. (2010) enumerate a number of problems with Levin's verb classes (in particular for semantic role labelling): coverage, ambiguity, and so on: Please read their opinion!

However, apart from the specific critics in (Palmer et al., 2010), Levin (2009) herself lists certain limits of verb classification and suggests possible solution for them in a number of her publications.

(her responses to the critics are not necessarily directly helpful for our purposes, but they are certainly helpful to look at the matter from a broader perspective).

Verb Classes: Limitations (contd.)

For example, inadequacies are:

Limited coverage of hand-built resources

Levin suggests computational methods but we are well aware of these methods (mostly noise, inability to identify rare events and so on).

How to define verb classes:

What characteristic of verbs must be used?
What is the best most suitable class size?
What about verbs that seem to belong to more than one class?

What about verbs that stand somewhere between two classes?

Verb Classes: Limitations

We will get back to Verb Classes when we look into VerbNet.

Last word, for SRL, verb classes can be helpful:

a) as a source for pulling out *features* regarding verbs, e.g., in machine learning solution. And,

b) as a map/guidance for designing lexical knowledge bases (e.g., see Kilgarriff (1993)).

So far . . .

We briefly went through:

* Case Grammar
* LCS
* Proto-roles
* Verb Classes

One last remaining item in our list is Frame Semantics.

Frame Semantics

We end up more or less where we started: Frame Semantics emanated from Case Grammar.

Frame Semantics (contd.)

In the "case grammar" approach, the role names were primary, and the situations they served to represent were constructed from assemblies of these. What distinguishes frame semantics from case grammar is the switch from taking the role concepts as primary and the situation types as defined in their terms, to taking the frames as primary and defining role distinctions relatively to the frame. This has made it unnecessary to assume a fixed inventory of semantic cases, since the role concepts could be defined relatively to each frame Fillmore et al. (2008).

Frame Semantics (contd.)

Fillmore eventually turned his idea of Case Grammar to what is known as Frame Semantics by building on the idea of Frames (aka schema or script).

With this, Fillmore attempts for an elaborated representation of events that are being evoked by verbs.

Frame Semantics (contd.)

Frames are mostly known for their application in Knowledge Representation in Artificial Intelligence by Marvin Minsky (originally for image understanding).

Simply put, a frame is a data structure that provides tools and mechanisms for storing data about things (including events and situations and their participants).

A frame consists of

+ a number of slots or frame elements that store information about different aspects of the thing they represent;
+ and a number of mechanisms (within a frame and between frames).

Frame Semantics (contd.)

In Frame Semantics, Fillmore goes exactly the opposite way of Jackendoff's LCS: Remember that LCS is based on a minimal set of predicates invented for a generalized decompositional analysis,

While Fillmore too aim for a comprehensive analysis of relations between the semantic roles and the verb, he does not restrict himself to a small vocabulary.

Exact opposite, Fillmore use a very large vocabulary (which are organized as/through semantic frames) with the aim of elaborating the *rich and diverse* semantic relations in every other word.

Frame Semantics (contd.)

And, if it is necessary, Frame Semantics does not dare to specify a unique semantic frame for one single word/verb.

The fruit of Frame Semantics is FrameNet, which will be our topic of study next session.

We try to understand more of Frame Semantics through browsing FrameNet,

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