Some Thoughts on the “Vehicle” of Concepts

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Two Underlying Themes of this Talk

- From *taxonomic* relations to *thematic* relations
  - This is compatible with the slogan “From thesaurus to Ontology”, which is an apparent theme of this conference.

- From *lexical* meanings to *super-lexical* meanings
  - This may not be compatible with the theme of this conference.
  - The meanings of sentences, or even of phrases, are not necessarily given as compositions of lexical meanings.
  - They need to be specified directly.
Our Points

- Developers of language resources/lexical ontologies need to:
  - pay due attention on the (semantics of) superlexical units as well as the (semantics of) lexical units
  - paying due attention to collocational units at phrasal or sentential levels
    - No reason not to treat regular phrases like idioms
  - without assuming that words (or morphemes) are the “vehicle” of concepts.
    - Do verb really denote concepts? — Who knows?
    - Where do concepts, both in terms of types and roles, come from?
Our View on Formal Ontology

- To us, formal ontology serves as a set of **heuristics**
  - It is useful if it provides us with *precise definitions* of lexical concepts, or guide us to do so.
- But if it requires *strict formalization*, it is hard to use and can be useless in the end,
  - unless it captures actual meanings of words in use and it becomes clear how it is applied to *superlexical* and concepts (to be defined later), even *ad hoc* ones.
- Actual meaning of words are not simply concepts: they are also “values” of words used as *tokens* in *language game* (Wittgenstein); and they are *negotiable* (Wenger) probably for this reason.
Beyond a Thesaurus
Most of us wanted to shift over from taxonomic relations to thematic relations.

- *is-a* relation (e.g. *penguin* is-a *bird* (against its unprototypicality), *bird* is-a *animal*) is an example of a taxonomic relation.

- *is-used-for* relation (*knife* is-used-for cutting with, *pen* is-used-for writing with) and *is-made-of* relations (*chair* is-made-of *wood* or *metal*)
Any Theory of Thematic Relations?

- But *is there a good theory of thematic relations?*
- which
  - has a good precision?
    - Thematic relations are not mere associations.
  - has a good coverage?
  - is effective to deal with granularity issues?
    - thematic roles themselves are on hierarchy.
Go beyond Qualia Structure

- **Generative Lexicon Theory** (Pustejovsky 1995) with a subtheory of *qualia* structure is a good candidate.
  - GLT resulted in the SIMPLE database employing *extended* qualia structure (Busa, et al. 2001; Ruimy, et al. 2001)
- But we want to go further, in that it is unlikely that thematic relations are confined to only four qualia roles of:
  - (1) **formal** (for *is-a*), (2) **constitutive** (for *is-made-of*), (3) **agentive** (for *is-product-of*), (4) **telic** (for *is-used-for*)
What is the Qualia Structure of

- *replacement* relation exemplified by in X and Y in
  - X replace Y; Z replaced X with Y (X を Y に取り換える)?

- *substitute* relation exemplified by X and Y in
  - use X {(as a substitute) for; instead of; in place of} Y
    (XをYの代わりにする; Y(のところ)をXで代用する)?
      - This is required to account for a sense of *artificial*: why
        *artificial leather* can mean *leather substitute* (but *artificial life*
        can’t mean *life substitute†)?

- *sacrifice* relation exemplified by in X and Y in
  - X is {sacrificed; a sacrifice} for Y; Z sacrifice X for Y (X
    を犠牲に Y を得る/する)?
### How Replacement, Substitute, & Sacrifice Are Different?

<table>
<thead>
<tr>
<th>Case</th>
<th>X is a replacement of Y</th>
<th>X is a substitute for Y</th>
<th>X is a sacrifice for Y</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Value</strong></td>
<td>( X &gt; Y ) or ( X = Y )</td>
<td>( X &lt; Y ) or ( X &lt;&lt; Y )</td>
<td>( X = Y ) (but on different measures)</td>
</tr>
<tr>
<td><strong>Availability</strong></td>
<td>( X &gt; Y )</td>
<td>( X &gt;&gt; Y ) or ( X &gt; Y )</td>
<td>( X = Y ) or ( X &gt; Y )</td>
</tr>
<tr>
<td><strong>Temporal co-existence potential</strong></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Sense of improvement</strong></td>
<td>Slightly positive</td>
<td>Strongly negative</td>
<td>Neutral or slightly negative</td>
</tr>
<tr>
<td><strong>Emotional commitment</strong></td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
We assume that *Frame Semantics* (FS) (Fillmore 1985) recently implemented by *Berkeley FrameNet* (BFN) (Fontenelle, ed. 2003) serves as a foundation for a theory of thematic relations, in that:

- Most of BFN frames characterize more or less concrete “situations” (encoding *who did what for what purpose*) that correspond to “units” of human understanding, at different degrees of granularities.
- BFN frames cover Schank’s *memory organization packets* (MOPs) (Schank 1983, 1999).
- Frames describe “cases” in the sense of *Case-based Reasoning* (Kolodner 199x)
Our Premises

- Understanding of an expression $E$ consists in identification of a situation $S$ “evoked” by $E$
  - $S$ is the specification of human’s conception of what happened, or what’s happening.
  - *Frame evocation by linguistic expression* is a kind of what Schank (1983, 1999) called *reminding*.

- Words are not efficient units to determine $S$’s.
  - They only “evoke” (a set of) situations.
  - Collocational units (if not multi-word units *per se*) do this more efficiently.
  - confirmed by a lot of evidence from research into word sense disambiguation.
• Fundamental questions:
  • What defines *roles* as differentiated from *types*?
  • Where do *qualia structures*, or *extended qualia structures* (that look even daunting) come from?
    • These are not easy questions.

• FrameNet/Frame Semantics suggests an answer
The relationship between the set $E$ of “entities” (as types) and the set $S$ of “situations” (as types) orthogonal, as indicated by the FE-grid (frame-element grid) in the next slide, where

- Entities are arranged horizontally
- Situations are arranged vertically

Situation-specific (semantic) roles (aka frame elements in BFN term) at the intersection of $E$ and $S$ are mediators of $E$ and $S$. 
Wearing
Publishing
Writing
book
soap
Washing
Buying
shirt
Reading
Teaching
But

- We can’t talk about this due to space consideration.
- See the appendix of this slides available at
On the Second Theme

- Many language resources have been developed to describe the semantics of *lexical* units, monolingually or multilingually.
  - Lexical resource is just *a kind of* language resource.
- How about the semantics of *superlexical* units, e.g.,
  - “constructions” (Fillmore et al. 1988).
  - “multi-word expressions” (MWEs) (Sag et al. 199x)
  - “nonlinear expressions” (Ikehara et al. 2005).
It’s getting clearer and clearer that the meanings of sentences as understood by human are not given as simple compositions of lexical meanings; rather, it is better to think of them as superlexical in nature.

- This is confirmed by idioms, which is not a minor portion of language.
- Many people claim that idioms are fixed in number and fixed in form, but it is very likely to be a myth.
- It is not obvious at all how to distinguish non-idioms from idioms unless an operative definition of superlexical meanings is given.
Definition of Superlexical Meaning

- Meaning, $m(u)$, of a multi-word unit, $u = w_1 + w_2 + w_n$, is superlexical iff
  - $m(u)$ cannot be constructed from the set of $M = \{m_1, m_1, ..., m_n\}$ where $m_i = m(w_i)$ using a trivial function $F(M)$.
- We need to avoid *compositionalist* bias on meaning because
  - It encourages (usually unrewarded) attempts to reduce the meaning of a collocational unit into a function of lexical meanings.
  - It blocks objective evaluation of $F$ for complexity.
Japanese Examples of Idioms

- Some nouns can be used only within idiomatic expressions.
- Some examples of Japanese nouns 気 (ki)
MWUs, constructions, nonlinear expressions are far from minor and negligible; rather, they are pervasive and important.

Difficulties

- We lack a theory of superlexical semantics that helps us to describe with collocations effectively
- N.B. Linguistics (still) lacks a precise definition of collocations.
## Examples from Japanese

<table>
<thead>
<tr>
<th>ID</th>
<th>Japanese example containing 気 (ki)</th>
<th>Near word-by-word transliteration into English</th>
<th>English translations</th>
<th>Word-by-word English translates for &gt; phrase idiomatic?</th>
<th>Is it lexicalized?</th>
<th>Is the sense of 気 transparent?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>HUMAN(x)は &lt;気まぐれ&gt; だ</td>
<td>for HUMAN(x), his/her interest is unstable.</td>
<td>HUMAN(x) is capricious, HUMAN(x) has unpredictable/wild interests.</td>
<td>interests?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>HUMAN(x)が STATUS(y)を &lt;気取る&gt;</td>
<td>HUMAN(x) puts STATUS(y) on his/her mood?</td>
<td>HUMAN(x) tries to appear as STATUS(y)</td>
<td>mood?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>HUMAN(x)は &lt;気違い&gt; だ</td>
<td>for HUMAN(x), his/her temper is different.</td>
<td>HUMAN(x) is crazy.</td>
<td>temper?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>HUMAN(x)が PHENOMENON(y) に &lt;気づく&gt;</td>
<td>HUMAN(x) place his/her notice/sense on PHENOMENON(y)</td>
<td>HUMAN(x) (sense, take notice of) PHENOMENON(y)</td>
<td>sense? notice?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>HUMAN(x)は (TIME(z)は) ACTIVITY(y)に &lt;気が 乗らない&gt;</td>
<td>for HUMAN(x), his/her mood will not be on ACTIVITY(y) (at,on) TIME(z).</td>
<td>HUMAN(x) is not inclined to ACTIVITY(y) (at,on) TIME(z).</td>
<td>mood?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>HUMAN(x)が PHENOMENON(y) に &lt;気が つく&gt;</td>
<td>HUMAN(x) place his/her notice/sense on PHENOMENON(y)</td>
<td>HUMAN(x) (sense, take notice of) PHENOMENON(y)</td>
<td>sense? notice?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>HUMAN(x)は HUMAN(y) に &lt;気が ある&gt; [x, y are opposite sexes]</td>
<td>for HUMAN(x), his/her notice/sense is at HUMAN(y)</td>
<td>HUMAN(x) is attracted to HUMAN(y) [x, y are opposite sexes]</td>
<td>sense? notice?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>HUMAN(x)は &lt;気が 長い&gt;</td>
<td>for HUMAN(x), his/her temper is long.</td>
<td>HUMAN(x) is patient.</td>
<td>temper?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>HUMAN(x)は &lt;気が 短い&gt;</td>
<td>for HUMAN(x), his/her temer is short</td>
<td>HUMAN(x) is impatient.</td>
<td>temper?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>10</td>
<td>HUMAN(x) は &lt;気が 多い&gt;</td>
<td>for HUMAN(x), his/her interests are multiple.</td>
<td>HUMAN(x) is inconstant, fickle, mobile, mercurial (especially in woman).</td>
<td>interest?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>11</td>
<td>HUMAN(x)が BEHAVIOR-OF(y)で &lt;気を 悪ぐする&gt;</td>
<td>for HUMAN(x), his/her feeling/mood goes bad by BEHAVIOR-OF(y).</td>
<td>HUMAN(x) gets offended by BEHAVIOR-OF(y). BEHAVIOR-OF(x) hurts HUMAN(x)'s feeling.</td>
<td>feeling? mood?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>12</td>
<td>(JUDGE(z)には) (ACT(y)をするした) HUMAN(x)の &lt;気が 知れない&gt;</td>
<td>for HUMAN(x) to have done/do ACT(y), his/her ideas are not understandable to JUDGE(z).</td>
<td>JUDGE(y) has no idea why HUMAN(x) is going to do/did ACT(y).</td>
<td>ideas?</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
Criteria to distinguish non-idioms from idioms are essentially unclear.

- **Transparency** parameter is just one of the many factors that contribute to idiomaticity.
- **Lexicalization** parameter is just another factor.

There are many collocational units with relatively transparent meanings that show idiom-like behavior.

- Conventional metaphors (Lakoff & Johnson 1980, 1999) are virtually weak idioms.
- Against common belief, it is hard to say that idioms are not finite in number.
What Idioms with 気 Suggest [2/2]

- How much do we gain even if we come to know exactly what concept each instance of 気 refer to if the exact meaning of each phrase as a whole remains unclear?
- Even for (7)-(12), where 気 has a relatively transparent meaning, ultra-lexicalist expectation for reducing it to a single, generic and basic meaning is either ungrounded or vacuous if successful.
- This suggests that precise knowledge of lexical meanings does not always bring us to our goal, specification of the content understood via language.
Most of phrases (VPs, NPs), which are believed to have regular, compositional semantics, can (and actually do) have irregular, not truly compositional semantics,

- let alone sentences.

Thus, we can claim that

- semantic descriptions of larger units are useless, unless they are indexed against concrete situations (or parameterized) state of affairs).
- (formal) ontology is useful as far as it helps us specify the set of situations.
Metaphor is a Big Challenge, Still

- Natural texts have a lot of *deviant* expressions including metaphor.
- Dynamic identification of creative metaphors is still a big challenge.
  - Compared to creative metaphor, conventional metaphors (Lakoff & Johnson 1980) are easier to handle.
How to Cook a Husband

- A good many husbands are utterly spoiled by mismanagement in cooking and so are not tender and good.
- Some women keep them constantly in hot water; others let them freeze by their carelessness and indifference. Some keep them in a stew with irritating ways and manners. Some wives keep them pickled, while others waste them shamefully.
- It cannot be supposed that any husband will be tender and good when so managed, but they are really delicious when prepared properly.
A good many husbands are utterly spoiled by mismanagement in cooking and so are not tender and good.

Some women keep them constantly in hot water; others let them freeze by their carelessness and indifference. Some keep them in a stew with irritating ways and manners. Some wives keep them pickled, while others waste them shamefully.

It cannot be supposed that any husband will be tender and good when so managed, but they are really delicious when prepared properly.
How to Cook a Chicken

- A good many *chickens* are utterly spoiled by mismanagement in cooking and so are not tender and good.

- Some women keep them constantly in hot water; others let them freeze by their carelessness and inattentiveness. Some keep them in a stew with cursory ways and manners. Some wives keep them pickled, while others waste them shamefully.

- It cannot be supposed that any *chicken* will be tender and good when so managed, but they are really delicious when prepared properly.
The problem boils down to context identification, which boils down to terminology/usage type detection.

So, the general problem is if we can predict/detect what people talk about based on

- the way they use a language, or
- how particular words are used in a particular way.
Japanese Weather Report Language

- Which sentences, with right prosody, are likely to be said by a weather reporter on TV or radio, and which are not?

  1. 明日は{晴れ; 曇り; 雨; ...}でしょう。
  2. 明日は {晴れ; 曇り; 雨; ...} だろう。
  3. 明日は全国的に {晴れ; 曇り; 雨; ...} でしょう。
  4. 明日は全国的に {晴れ; 曇り; 雨; ...} だろう。

- Native Japanese would not expect (3) and (4) to be uttered by weather reporter.
Another Moral

- We clearly need a theory of superlexical semantics
  - or lexical pragmatics (Blutner 2002).
- It will depend on a good (formal) ontology.
Need for a Theory of Superlexical Semantics
Are Idioms Special and Exceptional?

- Probably not.
  - To what degree are “regular” cases compositional?
    - Aren’t we just too insensitive to noncompositionality?
  - Labeling difficult cases “idioms” isn’t no solution.
    - The idiom/non-idiom distinction isn’t really obvious
      - Our view is likely to be influenced by our compositionalist bias.
  - Any way, no proper identification procedure is defined yet for idioms.
More Notes on Idioms

- Idioms are not a coherent class.
  - Different subclasses of idioms show different degrees of variabilities

1. John *kicked the bucket*.
2. *The bucked was kicked* (?*by John*).
   - The wide-spread belief that the form of idioms is fixed is obviously false for certain cases.

- “Conventional” metaphors (Lakoff & Johnson 1980) are virtually a weak form of idioms.
  1. We’re at the cross-road. [Relationship Is A Journey]
Are Word Meanings (Really) Concepts?

- Idioms are easier cases. Normal texts are full of **nonlinear expressions** (Ikehara, et al. 2005) that are cannot be treated as idioms, posing other kinds of problems:
  - It is not rare that an *array* of concepts is assigned to a single word.
  - It is not rare that a single concept is distributed over multiple, often discontinuous, elements of a sentence.
    - can be revealed with *Multilayered Semantic Frame Analysis (MSFA)* (Kuroda & Isahara 2005; Kuroda, et al. 2006)
- These cases run counter to the simplistic view of *word meanings as concepts*. 
MSFA is a form of dynamic lexicon, N. Calzolari mentioned, in which sense description is

- strongly instance based, and
- made against not only words but also multiword units, or collocational patterns, of any length

A sample MSFA of the following example will be given in the next few slides.

- He spilled the *political* beans
  - due to C. Fellbaum’s talk I heard at DGFs at Bielefeld
Nearly Full MSFA

<table>
<thead>
<tr>
<th>Frame ID</th>
<th>G1</th>
<th>G2</th>
<th>F4</th>
<th>F1</th>
<th>F3</th>
<th>F2</th>
<th>F6</th>
<th>F7</th>
<th>F8</th>
<th>F10</th>
<th>F11</th>
<th>F5</th>
<th>F9</th>
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<tr>
<td>2</td>
<td>elaborates G2</td>
<td>constitutes F2</td>
<td>constitutes F2</td>
<td>elaborates F6; targets F7</td>
<td>presupposes F10; fails F10</td>
<td>presupposes F5; elaborates F8</td>
<td>presupposes F5,F9</td>
<td>targets F5</td>
<td>?elaborates F11</td>
<td>realizes F5,F10</td>
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<tr>
<td>4</td>
<td>*</td>
<td>Stater</td>
<td>Speaker</td>
<td>Describer</td>
<td>*</td>
<td>*</td>
<td>Target[+person ]</td>
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<tr>
<td>8</td>
<td>He</td>
<td>Statement</td>
<td>Speech</td>
<td>EVOKER = GOVERNOR: Reference Source</td>
<td>Spiller</td>
<td>Scatterer</td>
<td>Leaker</td>
<td>Failer</td>
<td>Holder</td>
<td>Hider</td>
<td>Keeper[+potential]</td>
<td>Trier</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>spilled</td>
<td></td>
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</table>
### Simplified MSFA (just relevant ones)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>G</th>
<th>H</th>
<th>I</th>
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<tr>
<td>1</td>
<td>Frame ID</td>
<td>F2</td>
<td>F6</td>
<td>F7</td>
<td>F5</td>
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<tr>
<td>2</td>
<td>Frame-to-Frame relations</td>
<td>elaborates F6; targets F7</td>
<td>presupposes F10; fails F10</td>
<td>presupposes F5; elaborates F8</td>
<td>?elaborates F11</td>
</tr>
<tr>
<td>3</td>
<td>Frame Name</td>
<td>Spilling</td>
<td>Scattering</td>
<td>Leaking= Failing to Keep Secret</td>
<td>Keeping Secret</td>
</tr>
<tr>
<td>8</td>
<td>He</td>
<td>Spiller</td>
<td>Scatterer</td>
<td>Leaker</td>
<td>Keeper[+potential]</td>
</tr>
<tr>
<td>9</td>
<td>spilled</td>
<td>GOVERNOR</td>
<td>EVOKER</td>
<td>EVOKER[1,3]</td>
<td>EVOKER?</td>
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<tr>
<th>A</th>
<th>Frame ID</th>
<th>B</th>
<th>Frame-to-Frame relations</th>
<th>C</th>
<th>Frame Name</th>
<th>D</th>
<th>Sense</th>
<th>E</th>
<th>targeted sense</th>
<th>F</th>
<th></th>
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<tbody>
<tr>
<td>F2</td>
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<td>F6</td>
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<td>F6</td>
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<td>F7</td>
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<tr>
<td>Frame-to-Frame relations</td>
<td>elaborates F6; targets F7</td>
<td>presupposes F10; fails F10</td>
<td>presupposes F5; elaborates F8</td>
<td>?elaborates F11</td>
<td></td>
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</tr>
<tr>
<td>Frame Name</td>
<td>Spilling</td>
<td>Scattering</td>
<td>Leaking= Failing to Keep Secret</td>
<td>Keeping Secret</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>He</td>
<td>Spiller</td>
<td>Scatterer</td>
<td>Leaker</td>
<td>Keeper[+potential]</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>spilled</td>
<td>GOVERNOR</td>
<td>EVOKER</td>
<td>EVOKER[1,3]</td>
<td>EVOKER?</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
(1) conveys the sense of *idolizing* and *worship* (憧れ), but where does it come from? Or which words or collocations convey it?

(1) An Ass having heard some Grasshoppers chirping, was highly enchanted; and, desiring to possess the same charms of melody, demanded what sort of food they lived on to give them such beautiful voices.
(3) conveys the sense of *fasting* (断食), but where does it come from?

(2) AN ASS having heard some Grasshoppers chirping, was highly enchanted; and, desiring to possess the same charms of melody, demanded what sort of food they lived on to give them such beautiful voices. They replied, “The dew.”

(3) The Ass resolved that he would live only upon dew,
Why does sentence (4) mean what it means?

(3) A FISHERMAN skilled in music took his flute and his nets to the seashore. Standing on a projecting rock, he played several tunes.

(4) in the hope that the fish, attracted by his melody, would of their own accord dance into his net, which he had placed below.
See MSFAs at

- http://www.kotonoba.net/~mutiyama/cgi-bin/hiki/hiki.cgi?c=view&p=msfa-aesop03-s01
- http://www.kotonoba.net/~mutiyama/cgi-bin/hiki/hiki.cgi?c=view&p=msfa-aesop03-s05
- http://www.kotonoba.net/~mutiyama/cgi-bin/hiki/hiki.cgi?c=view&p=msfa-aesop11-s03

for more details.

But they are made in Japanese. Sorry for non-Japanese speakers.
• It is no solution to explain that their meanings are *matters of pragmatics*. This makes sense only under the assumption that
  • Semantics can dispense with pragmatics (Is this really more than our *hope*)?
  • Pragmatic meanings can be inferred with a proper mechanism (How much is known about inferences?).
• This cannot be guaranteed as far as we want to build a wide-coverage knowledge base of superlexical meaning.
Summary

• In this talk, I presented
  • arguments for the need for a (better) theory of thematic relations as well as taxonomic relations
  • arguments for the need for a theory of superlexical meaning
• and suggested
  • for both cases, approaches based on, or derived from, FrameNet/Frame Semantics can provide some insights
Acknowledgements

Keiko Nakamoto (Bunkyo University)
Hajime Nozawa (NICT)
Daisuke Yokomori (Kyoto University Graduate School)

We are indebted from the discussion with people above.
Thank You


• 中本 敬子・黒田 航 (2005). 意味フレームに基づく選択制限の表現: 動詞「襲う」を例にした心理実験による検討. 言語科学会第7回大会ハンドブック: 75--78

From Taxonomy to Organization of Thematic Roles
FrameNet/Frame Semantics allows us to expect semantic roles/frame elements form hierarchies.
Given “Murder IS-A Intended Activity (IS-A Event),” we have:

- Victim IS-A Patient
- Weapon IS-A Instrument
- Death IS-A Product
- Victim’s being Dead IS-A Result
- etc

Diagram contains the subnet for HAS-A relations only.
Given “Murder IS-A Intended Activity (IS-A Event),” we have:

- Victim IS-A Patient
- Weapon IS-A Instrument
- Death IS-A Product
- Victim’s being Dead IS-A Result
- etc

Diagram contains the subnet for HAS-A relations only.
Ontology of Thematic Roles

IS-A links are in orange
HAS-A links are in orchid
Other relations are in black
Firstness, Secondness, & Thirdness

- Can we derive the following Peicean distinction from the FE-grid?
  - *Firstness* of “entities”
  - *Secondness* of “situations” (especially “actions”)
  - *Thirdness* of “roles”

- But the ordering of secondness and thirdness looks arbitrary, because they cannot be given independently.
The upper ontology of events provides a template for situations.

More precisely, it can be thought of (at least) three layers of:

- relations among states
- relations among participants
- relations among attributes
Definitions

- Relation of a “state” $s$ to an “event” $e$ is one of $\text{part-of}$ (equated with $\text{has-a}$ relation)
  - Seamless stream of “states” is a “stage” or “phase.”
- Relation of a “participant” $p$ to a “state” $s$ is one of $\text{part-of}$.
  - cf. Relation of a “semantic role” $r$ to a “situation” $s$ is one of $\text{part-of}$.
- Relation of an “attribute” (aka “property”) $a$ to a “participant” $p$ is one of $\text{part-of}$.
Layered Structure of Event

HAS-A relation is indicated by purple link; others by black links.
Layered Structure of Event

Layered Structure of Event

HAS-A relation is indicated by purple link; others by black links.
HAS-A relation is indicated by purple link; others by black links.
Layered Structure of Event

HAS-A relation is indicated by purple link; others by black links.
Layered Structure of Event

HAS-A relation is indicated by purple link; others by black links.
From Interpretation to Understanding
FrameNet/Frame Semantics defines a “situation” as an organization of situation-specific variables, called “frame elements” (aka semantic roles).

- By and large, ontology of nominals are derived from the hierarchy of situations, if not by-product.
- If semantic roles are participants of events, it is desirable to:
  - define concepts with reference to a specific situation
  - provide a systematic classification of semantic types and roles
- How to implement it?
No serious attempt is made to construct a formal ontology (Guarino 1998; Gruber 1994)

- The distinction between *subtype-of* and *instance-of* relations, argued for by Guarino (1998, among others) under the name of *is-a* overloading, is hard to make on the *usage* basis rather than on the *lemma* basis.

- We know such relations *need* to be distinguished but we need an *operative* definition, not a *theoretical* definition, without which we can’t deal with word senses in a real text.

- It boils down to word sense disambiguation procedure, to which no quick answer is known.
Assumptions

- Situations (as typed structures) are not only first class objects of ontological/conceptual system, but basic objects.
  - By and large, classification of nominals, except purely natural kinds, is by-product of situation classification.
    - This is true of functional classes such as roles
- Detailed descriptions of lexical meanings are sometimes superfluous.
  - Part of polysemy is a side effect.
- Usefulness of upper ontology is limited, as far as lower ontologies are specified.
Competitive Theory of Frame Selection

- All words in a sentence $s = w_1 \ w_2 \ \cdots \ w_n$ evoke a set of frames independently.
  - No upper limit to the number, causing a competition, yielding a “selectional” process
    - Generative Lexicon Theory’s “co-composition” is another name for this selectional process.
  - Of course, nouns and adjectives do this, too (cf. qualia structure (Pustejovsky 1995))
- Thus, a set of frames $F(s) = \{f_1, f_2, \ldots, f_n\}$ is assigned to $s$ (via independent evocations), $w_i$ usually receives an array of “frame elements” (aka “semantic roles”).
## Sample MSFA with PMA

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INDEX</td>
<td>WORD</td>
<td>I**</td>
<td>saw**</td>
<td>a man**</td>
<td>with**</td>
</tr>
<tr>
<td>2</td>
<td>p1</td>
<td>I</td>
<td>I*</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>p2</td>
<td>saw</td>
<td>S</td>
<td>saw*</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>p3</td>
<td>a man</td>
<td>S</td>
<td>V</td>
<td>a man*</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>p4</td>
<td>with</td>
<td>(S)</td>
<td>V</td>
<td></td>
<td>with*</td>
</tr>
<tr>
<td>6</td>
<td>p5</td>
<td>a telescope</td>
<td>(S)</td>
<td>V</td>
<td></td>
<td>P</td>
</tr>
</tbody>
</table>

### Frame ID (local)

<table>
<thead>
<tr>
<th>Frame ID (local)</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>G1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>elaborates F3</td>
<td>elaborates G1</td>
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### Frame-to-Frame relations (global)

<table>
<thead>
<tr>
<th>Frame Name</th>
<th>Perception_active[+visual]</th>
<th>*Perception_active</th>
<th>*Using</th>
<th>*Intentionally_act</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Perceiver[+visual]</td>
<td>*Perceiver_agentive</td>
<td>*Agent</td>
<td>*Agent</td>
</tr>
<tr>
<td>saw</td>
<td>GOVERNOR?</td>
<td>GOVERNOR?</td>
<td>*Purpose</td>
<td>*Act</td>
</tr>
<tr>
<td>a man</td>
<td>Object</td>
<td>*Phenomenon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>with</td>
<td>Instrument.MARKER</td>
<td>*Means</td>
<td>GOVERNOR?</td>
<td></td>
</tr>
<tr>
<td>a telescope</td>
<td>Instrument</td>
<td></td>
<td>Instrument</td>
<td></td>
</tr>
</tbody>
</table>