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Abstract– We explore the particular variations of semantic felicity in co-predicative utterances the constraints on the combination of facets of polysemous words, and the possible adaptations that can be proposed to existing formal frameworks that support lexical semantics. As the linguistic data is incomplete and disputed, we also include a proposal for a linguistic survey aimed at clearing up many outstanding issues.[1]

1 The Generative Approach to Lexical Semantics and Polysemy

1.1 The Issue of Polysemy in Compositional Semantics

The inarguable facts that words in human languages can be employed with many different meanings, according to the context they are used in, is seemingly at odds with the principle of compositional semantics inherited from Montague, which presupposes that singular meaningful term can be provided for every lexical item. This can be resolved by Word Sense Disambiguation techniques (associating the most probable meaning to each word before composition, using data refined from corpora). Another approach is to hold polysemy to be an important feature of language, and to re-design the compositional semantics around it. In this approach, the lexicon becomes much more complex than a map of words to meanings, as each lexical entry can be combined with others in order to select the appropriate sense for a word used in a specific context: this is the so-called Generative approach to lexical semantics developped in [Pus95] and many subsequent works. We will discuss a few basic features of this approach in Section 1.2.

In the present paper, we will study the specific issue of the felicity of co-predicative utterances. Those constructs are detailed in Section 2.1, the issues of felicity in Section 2.3, and we will focus on the characterisation of constraints on felicity in Section 3, and the necessary adaptations of formal semantics in Section 4.

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[1] The present abstract is intended as a discussion material, detailing a specific issue in order to foster collaborations around the subject. Having been prepared by the author in his spare time, it is, by necessity, incomplete. The work presented here is closely related to ΛTY_n, a formal framework for lexical semantics developed since 2006 with Christian Bassac, Richard Moot, Christian Retoré and many other researchers at LaBRI and LIRMM. As a team, we would like to thank everyone that has joined in TYTLES and engaged in discussions and research around type-theoretical lexical semantics.

1.2 GL Qualia, Dots, Processes and Uses

[Pus95] and subsequent works such as [Ash11] have detailed the implications on Montagovian semantics of *relational* polysemy, distinguishing (among many other phenomena) four kinds of meanings that are distinct, but directly related (by opposition to *accidental* polysemy, which consists of different words that happen to be homonyms).

The *qualia* are derived from the "modes of explanation" of Aristotle; the idea is that a noun for something can refer to :

1. The thing itself (formal quale, as in *long sword*),
2. A salient part of the thing (constitutive quale, as in *dull sword → dull edge*), and, for artificial items,
3. Their creation process (agentive quale, as in *master's sword → sword made by a master blacksmith*),
4. Their use, for objects that have one (telic quale, as in *fine sword → sword fine for fighting*).

Pustejovsky argues that such uses are extremely common, and that a competent speaker of a language has access to a qualia, thus justifying that such information should be part of the lexicon itself.

Complex objects, called *dot-objects* (sometimes written •-objects) are words that denote a singular concept that can be envisioned on two or more different *facets*. Canonical examples include books (with physical and informational facets), meals (with an event and a food facet), newspapers (with an organisational and a physical aspect), etc. There are many examples which seem to stem from compounding essential and existential information. As the number and type of facets is not determined, contrary to qualia, and as those facets enjoy differentiated individuation conditions, they have proved to be one of the most serious difficulties for formal models of lexical semantics.

In addition, some implicit processes can shift the meaning of a word referring to something to different states: *grinding* can turn materials into artefacts, animals or plants into food (*delicious salmon*), *packaging* can provide implicit containers for masses (*there is water and wine on the table*) – see [MMR15] for details. Deverbal nouns are notoriously polysemous between process and result (*the construction is at the end of the street*) – see [Jac01], [RCR13].

Finally, additional facets can be bestowed upon a lexical item via explicit constructions, which are easier to account for. They include *as*-phrases (*I do not have issues with Mr. X as a lawyer; however, as a candidate...*) and *for*-phrases (*this knife is sharp enough for shaving*).

2 The Many Facets of Co-Predicative Sentences

2.1 Co-Predications

Co-predicative utterances, phrases or sentences, or *co-predications* for short, consist in the explicit reference to two (or more) different facets of the same lexical items at the same time. The most classical example is *heavy and interesting book*, but there are many others. The difficulty of co-predications is that the two predicates apply to different types (here, to physical and informational objects respectively). Lexical semantics frameworks that do not consider this and simply coerce the type of the argument to the one required by the predicate fail to provide a suitable typing for *book* in such sentences.

2.2 Mixing Polysemy Facets

In the original formulation by Pustejovsky, co-predications were mostly studied between facets of dot-objects. However, they can be equally valid between various sources:

- *two or more qualia*:
  - *good, expensive wine* (telic+formal);
  - *fast blue car* (constitutive+formal)...;
- *two or more facets* of a dot-object:
  - *red closed door* (physical+aperture);
  - *liberal, picture-less tabloid* (organisation+physical)...;
- *a facet of a dot-object and a qualia of another facet*:
  - *I have an inspired article in my briefcase* (agentive quale of the informational facet + physical facet);
- *process, result*, and other facets:
  - *the translation, printed right after its lengthy completion, is considered bold yet naive* (physical and agentive quale of the informative facet of the result + process);
- *an arbitrary number of references* to different facets in a coherent discourse:
  - *The book is 5lbs, and has 400 pages. It has been set in Times 12, with large margins. Its leather cover is aged but sound. Its writing took five years, and the completion of the hundred in-quarto printings four months. [...] It certainly is an interesting read.*

2.3 Felicitous and Infelicitous Co-Predications

There are thus many possible combinations of facets that can be predicated on simultaneously. However, some co-predications are infelicitous. We have elaborated previously on the case of grinding :
* *The salmon was lightning-fast and delicious*,
    many examples of process/result alternations:
* *The construction took three months and stands tall*,
    as well as capital-governments alternations:
* *Washington is an old American city and has denounced Teheran*.[2]

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[2] Those examples are subject to personal interpretation and linguistic idiosyncrasies that we will discuss in Section 3.3.

3 Characterising Constraints on Felicity

3.1 Relaxable and Fixed Constraints

The most evident constraints are the following: facets that can cognitively co-exist for the same object are not constrained in their co-predications, while facets that are only present after a transformative process (grinding, packaging, resultatives) are exclusive to all others.

In addition, a proper name of a polysemous entity (such as a city or place) can be used as a paraphrase for a specific group of people (such as the name of the capital being a proxy for the national government), to the exclusion of all other possible senses. We can thus distinguish between two rough classes of facets: *flexible* and *rigid*.

However, the rigidity constraint can be relaxed in some cases. A syntactic split of the components of the co-predications can render some infelicitous phrases acceptable : *the salmon, which was very fast, is delicious*, or *the construction, that took three months to complete, stands tall*. Beyond the syntactical separation, the use of different tenses or explicit contrast using *yet* or *but* can also relax the constraints on the use of facets that correspond to different, exclusive states of the same entity.

Capital/government (and related) alternation constraints are much more difficult to relax, considering: *Washington is an old American city. It is located on the banks of the Potomac. * It has denounced Teheran.*.

That distinction has given us the three classes of constraints that we have been using until now, *flexible* facets, *semi-rigid* facets (the constraints can be relaxed via syntactic means) and *rigid* facets (the constraints are fixed).

3.2 City Names: a Short Case Study

However, this does not cover the whole complexity of constraints on the felicity of co-predications. See [RCR13] for a case study on deverbal co-predications; we will discuss here the specific case of city names.

City names are highly polysemous, with many possible facets that can be separated in two groups. The first is composed of facets that pertain to the city as a whole: architecture, location, size, atmosphere, climate, population, lifestyle. . . that we will call *characteristics*, and the second, of facets we will call *essentials*, that use the name of the city to refer to a specific group of people, such as city/metropolis/regional/national government and sport clubs. In our first approximation, characteristics are flexible and essentials are rigid.

However, the following constructions can allow some of the essentials to co-predicate:

– *lexical proximity* – if two facets share the same lexical field, as in *Barcelona dominates Europe in football as well as in handball*;
– *object identity* – if the predication is made on a single direct object, as in *Barcelona dominates Europe in football as in architecture*;
– *zeugma* – if zeugma are considered acceptable, as in *Barcelona dominates Europe in football as they do Madrid in politics*;

- *discourse flow* – logical relations in the narration can provide felicitous readings, as in *Detroit, by lake Michigan, has filed for bankruptcy; the city has become desolate and lifeless*.
- The above can be daisy-chained in order to co-predicate over seemingly incompatible facets in a long discourse: *Bordeaux, struggling with traffic issues due to its growing population and its geographical position on both sides of the Garonne, wishes to build a new bridge in order to ease commuting between those*.

3.3 Evaluating the Idiosyncrasies of Felicity in Co-Predications

We want to stress that felicity is an highly subjective notion, that varies from speaker to speaker. Additionally, it appears that some of the constraints are idiosyncratic; anecdotical evidence, including separate personal communications from Asher, Lecomte and Luo indicate that some common co-predications are felicitous in English but not in Chinese. While this should not stop formal frameworks to develop mechanisms that integrate constraints on co-predications, establishing a robust catalogue of the actual usages is important.

We would like to propose a set of templates for sentences that can be adapted to valid local city data, with co-predications we consider felicitous, infelicitous, and forced by the various mechanisms evoked above, as well as straightforward predications on a single facet as controls. This survey should be conducted by native speakers of several languages in different linguistic groups (minimally Romance, Germanic and East-Asiatic), and we would like it to be part of collaborative international projects that are being constructed as a result of the recent interest in lexical semantics.

4   A Proposal for Linear Types and Terms

Constraints on co-predications can be added to current lexical frameworks as an external mechanism[3]. However, it is also possible to allow for every possible combination with a redesign of the formalism. Our proposal incorporates a λ-calculus whose terms are typed with formulae of the second-order linear intuitionistic logic.

Linear ΛTY_n is adapted from our framework in the following way:

- Simple predications are implemented by linear application (*heavy* is $H^{\varphi \multimap \mathbf{t}}$).
- Basic morphisms (type transformations) also (selecting the physical facet is done via $\Lambda \alpha . f^{\alpha \multimap \varphi}$).
- Lexical transformations (giving access to specific facets of each term) are implemented as pairs, the first component being an accessor to the facet (a type transformation, as above) and the second assessing the compatibility of the facet with other transformations.

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[3] It is sufficient to keep track of the flexible/rigid characteristic of terms, relaxing the constraints when appropriate using a set of rules that detect syntactic or discursive features, and to stop the composition when incompatible co-predications are detected; this is the approach we have proposed so far, see [Ret14] for a recent synthesis in our ΛTY_n framework.

– Additional terms, that modify this compatibility, can be provided by syntax, discourse and pragmatics in order to relax the constraints when appropriate.

A detailed account of this proposal is given in [Mer15].

Summary

While the work presented here is still in progress, we are convinced that the issue of constraints on co-predication is of importance in the establishment of precise natural language semantics. We hope to gather enough linguistic data in order to characterise the extent of the phenomena, and have the necessary formal tools to treat it accurately. Our goal remains to integrate issues of lexical semantics and polysemy directly in the flow of analysis of natural language, from syntax to semantics and logical representation.

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