Extended Meanings of Verbs: a Proposal of Formalization

Roser Morante
morante@lingua.fil.ub.es
University of Barcelona

Abstract

This paper puts forward a proposal of analysis and representation of the extended meanings of a predicate. In a first step, the basic meaning is defined in terms of a set of meaning components linked to the arguments of the predicate [Talmy 85]. By means of qualia structures [Pustejovsky 91] assigned to each of the meaning components of the verb, extended meanings are derived. It will be exemplified with the analysis of verbs of transfer in Spanish, specifically the verb llevar ('to bring'). A main advantage of this methodology is that it can be implemented in a LKB based on typed feature structures [Copestake 92].

1 Introduction

This paper presents an analysis of the extended meanings of verbs, as well as a proposal of formalization exemplified through the verb llevar ('to bring') in Spanish. The proposal aims both, at offering an explanation about the principles underlying the semantics of verbal predicates, and at putting forward a means for codifying them, so that the analysis can be implemented in NLP applications.

Following [Pustejovsky 95], accounting for the generativity of senses in a language is the primary goal of lexical and compositional semantics. Thus, a framework that deals with the semantic analysis of natural language is motivated by, among others, the following theoretical and computational concerns:

- *Explaining the interpretation of words in context.*
- *Deriving a potentially infinite number of senses for words from finite resources.*
- *Accounting for the systematic relatedness between word senses in a formal and predictable way.*

That some kind of systematic relatedness can be found for the senses of a word is something that researchers from different backgrounds postulate ([Briscoe et al. 93], [Lakoff and Brugman 86], [Pustejovsky 95], [Ramos 96], etc.). The basic assumption they make is that word meaning is highly structured and not simply a set of unrelated semantic features. What is more, due to the fact that the lexicon has come to play a central role in the development of computational tools, it is considered that compact representations of sense extensions is desirable from an engineering perspective, as it reduces the size of the lexicon [Sanfilippo 92].

In that respect, a phenomenon that NLP needs to handle is polisemy. Regarding predicates, three kinds of polisemy have been pointed out. [Copestake and Briscoe 95] distinguish between constructional polisemy and sense extension. Constructional polisemy is sense modulation induced by the context, or co-composition in [Pustejovsky 95]. Sense extension is a lexical, rule-based

process which creates derived meanings from basic ones. [Pustejovsky and Busa 95] define a third type, verbal polisemy, which refers to the different syntactic realizations of the same verb, that is to say, the verbal alternations in [Levin 93]. This paper focuses on sense extension and its representation in a LKB based on inheritance of typed feature structures.

I start from the analysis of predicates put forward by the Pirápides Project (PP) of the University of Barcelona [Castellón et al. 98], which aims at building a multilingual LKB for predicates. In that framework predicates are semantically analysed in terms of meaning components, on the basis of which predicates are grouped in semantic classes.

Meaning components have been established for predicates in their basic meanings. Nevertheless, evidence from corpora shows that in a high proportion of occurrences verbal predicates appear in their extended meanings. Thus, there is a need for finding a methodology of analysis and representation that allows the incorporation of extended meanings to the LKB. The proposal put forward in this paper is a preliminar one, that needs to be improved. It basically consists in assigning qualia structures to the meaning components that conform the predicate, so that operations on the qualia structure allow the generation of extended meanings.

Section 2 describes the framework of the PP, which I take as a starting point. Section 3 introduces the qualia as a means for deriving meaning oppositions. Section 4 presents the analysis of the verb llevar ('to bring') in Spanish, and, finally, section 5 evaluates the proposal.

2 An eclectic framework for the analysis of predicates

Studies of verb semantics have been carried out from several approaches (scripts [Schank and Abelson 77], frames [Fillmore 82], lexical conceptual structures [Jackendoff 90], meaning components [Talmy 85], semantic nets [Miller and Fellbaum 91], qualia structures [Pustejovsky 95], etc.). In the PP an eclectic framework has been developed for the representation of predicates. The main aim of the project is the construction of a multilingual LKB [Vázquez et al. 99], based on inheritance of typed feature structures [Copestake 92], [Carpenter 92]. With that purpose, a model of lexical entry has been defined, so that the information that is specified for each predicate is strictly codified and kept in a format retrievable for NLP systems.

The analysis of predicates in that framework starts from the hypothesis in [Levin 93], following which the syntactic behaviour of a predicate is semantically determined, in such a way that predicates with the same general meaning should accept the same syntactic alternations. However, the application of Levin's methodology to Spanish has evidenced that the acceptance of a syntactic alternation depends on several aspects of the structure of the predicate, be it the event structure, the conceptual categories it encodes or its meaning components.

That the behaviour of predicates cannot be explained applying such a univocal relation between semantics and syntax has also been proved by the application of Levin's classes to other languages [Saint-Dizier 96], [Jones et al. 94], and its implementation in computational applications [Dorr and Jones 96]. In other cases, researchers point out the need for establishing classes on the basis of more fine-grained selection restrictions for the classification to be effective [Wu and Palmer 94]. Consequently, the lexical entry defined in the PP consists of three basic modules, namely syntax, semantics and event structure, which converge in a logical form. Details about the

structure of the PP LKB can be found in [Vázquez et al. 99]. For each module, an inheritance device assigns feature structures to the predicates, depending on the semantic class to which they belong.

A subcategorization frame and a set of alternations are assigned to the predicate in the syntax module. Alternations are understood as the different possibilities of syntagmatic expression of a predicate according to the possibilities of focalization on its semantic aspects, either in the event structure or in the meaning components. Each possibility of focalization expresses different meaning oppositions, even though the same sense of the verb is always kept. In the event structure module predicates are assigned a type of event structure [Pustejovsky 91]. Two basic types are considered, states and events. The latter are further subdivided into simple and complex. In addition, for complex events information is declared about the relation holding between events.

Meaning components are assigned to predicates in the semantic module. Two kinds of components are defined, basic and secondary. For each of them three features are assigned: the type, the mechanism of realization (sintagmatic, lexicalised, underspecified) and an index that relates it to information in other modules. The combination of basic components (initiator, entity, path, change, etc.) defines the conceptual content of a class. Secondary components may complete the meaning of a subclass of predicates (manner, location, time, etc.). The assumption underlying that semantic analysis of predicates holds that the verb and its complements form a conceptual unit, decomposable and susceptible of being expressed through several linguistic resources: sintagmatic expression, incorporation, lexicalization [Talmy 85] or underspecification [Fillmore 86].

Next section introduces a means for deriving extended meanings, which basically consists in adding a new complex feature to each of the meaning components, namely the qualia structure.

3 Qualia structure and extended meanings

As it has been explained, information relative to meaning components is declared in the semantic module. Although they are not conceived as primitives, their explicative potential is similar. On the one hand, meaning components allow to express commonalties between members of the same semantic class. On the other hand, they account for the contrast between predicates of different classes. For example, verbs of transfer ('to give') are differentiated from verbs of change ('to break') by assigning a trajectory component to the former and a meaning component change to the last.

A limitation of meaning components is that, by definition, they do not allow to account for contrasts between predicates of the same class and between senses of the same verb. Those contrasts could be dealt with by establishing subclasses based on selection restrictions. For example, two verbs of transfer like bring and say could be differentiated by assigning to their meaning component entity the ontological types object and message, respectively. That assignment would explain the oppositions of those verbs in their basic meanings, 'someone (initiator) brings something (entity) to someone' and 'someone(initiator) says something (entity) to someone'.

Nevertheless, ontological semantic restrictions become inappropriate when fronted with the extended meanings of verbs. Firstly, for selection restrictions to be explicative, they need to be very specific. Secondly, specific selection restrictions do not capture the aspects that the senses of a verb have in common. For example, the verb llevar ('to bring') in Spanish in one of its senses

a verb have in common. For example, the verb llevar ('to bring') in Spanish in one of its senses accepts that the following complements fulfil the meaning component entity: glasses, trousers, wig, wheel, radar, motor, etc. Through simple selection restrictions those elements could be grouped under a category object.

The problem lies in the fact that no distinction is expressed between that sense (equivalent to English 'wear' or 'have incorporated') and the basic meaning. For defining that sense it is necessary to express that the object linked to the meaning component entity has to be an alienable part or component of the element linked to the meaning component initiator. Furthermore, Spanish examples that literally translated would be 'a person wears a motor', 'a person wears a hand' or 'a car wears glasses' have to be ruled out

This is why a mechanism has to be found explicative enough to capture generalizations and enough specific for explaining the above mentioned contrasts. Assigning a qualia structure to meaning components is what I propose for giving an account of the semantic oppositions between predicates of the same class and between senses of a predicate. A qualia structure [Pustejovsky 91] provides the essential attributes of an object distributed among four aspects of the meaning of the word, captured through the following roles:

- *Formal role: contains that what distinguishes an object within a larger domain.*
- *Constitutive role: expresses the relation between the lexical items and its constitutive parts.*
- *Telic role: defines its purpose and goal.*
- *Agentive role: gives the information about whatever brings it about.*

Two are the main advantages of a qualia structure. In the first place, different aspects of the same objects can be focalised, independently or additionally. Taking into account that the same object can appear with a broad sample of verbs, it seems coherent to assume that each verb will activate a different aspect of the same entity. In the second place, a qualia structure is easily implementable in a LKB. It can be assigned as a complex feature consisting of four types to the meaning components of the predicate. What generates the extended meaning then, are operations on the types of the qualia structure of the meaning components of the predicate in its basic meaning. In section 4 those operations will be exemplified with the verb llevar in Spanish.

To sum up, the meaning oppositions that have been introduced so far can be expressed as follows:

- *Between predicates of different semantic classes, by means of basic meaning components.*
- *Between predicates of the same class in their basic meanings, through a default qualia structure.*
- *Between extended senses of the same verb, through operations on the default qualia structure.*

In next section this methodology will be applied for analysing a verb belonging to the class of transfer.

4 Meaning oppositions: the verb llevar in Spanish

In the framework of the PP the verb llevar has been classified as belonging to the class of transfer verbs [Morante et al. 98]. As a verb of transfer it has been assigned a set of meaning components, which distinguish verbs of transfer from the rest of verbs belonging to other semantic classes:

Transfer (predicate) -> (predicate, ([1]initiator, [2]entity, [3]trajectory))

The pattern of the verb in its basic meaning is as follows:

(llevar, alguien [1], algo/a alguien [2], a alguien/a algún sitio [3])

(bring, someone [1], something/someone [2], to someone/somewhere [3])

The default values of the features in the qualia structure of each meaning component are:

[1] Formal: animate [2] Formal: transportable [3] Formal: location

Telic: empty Telic: empty Telic: empty

Constitutive: empty Constitutive: empty Constitutive: empty

Agentive: empty Agentive: empty Agentive: empty

Two more features are added for differentiating the verb from the rest of verbs of its class:

[1] Formal: volitional [3] Agentive: [1] [2]

By that two properties of the verb are reflected, that it is a causative and agentive verb, and that both the initiator of the movement and the entity go through the trajectory. Once those features have been specified, there is a need for representing the meaning oppositions between extended meanings by means of changing the values of the features in the qualia of each meaning component.

Previously, a task needs to be carried out, which is the definition of the senses in which the verb is to be found. [Kilgarriff 90, 95] argues that dictionaries are potential good sources of information about the behaviour of lexical items. Following the author, working from dictionaries provides not only a supply of facts to be formalized, but also some indications about the way they are represented, what types of facts they are and what place they have in the overall lexical description.

In the light of other studies [Boguraev and Briscoe 89], [Castellón 97] it cannot be denied that dictionaries present those advantages. However, it has to be precised that most of works defending the value of dictionaries for the delimitation of senses are applied to the English language. They use for example the LDOCE, which is that it is corpora-based. The current state of the art for Spanish dictionaries is far from being the same, since they do not incorporate information

extracted from corpora. Consequently, they do not reflect the use of the language as well as corpora do. This is why, the delimitation of senses for the present work has been done by analysing the occurrences of the verb in a corpus of 5 million words, LEXESP.

Next, some of the meaning oppositions of the verb llevar are listed. For reasons of space I do not include the complete qualia structure for each one. The information is presented according to the following format. A number in brackets indicates main oppositions. Each of them might contain several subopposition. The values of the qualia features are expressed in terms of conditions. For each set of values, the general pattern is adduced with a literal English translation and one example from the corpus. In the translation the verb is replaced by an 'X'.

(1) Basic meaning

(and (if (mcom, trajectory) then (sintagmatic, true))

(if (mcom, trajectory) then (formal-role, locative)))

1.1 Alguien lleva algo a algún sitio (someone X something somewhere)

1.2 Alguien lleva a alguien a algún sitio (someone X someone somewhere)

1.1 Me_yo llevaron_llevar a_a una_un casa_casa

1.2 El_el montaje_montaje que_que la_la compañía_compañía lleva_llevar últimamente_último por_por los_el pueblos_pueblo

(2) Variants of basic meaning

(if (if (mcom, initiator) then (formal-role, abstract)

then (if (mcom, entity) then (formal-role, volitional)))

2.3 Algo lleva a alguien a algún sitio (something X someone somewhere)

2.3 Sus_su inquietudes_inquietud lo_el llevaron_llevar a_a Africa_Africa

(if (mcom, initiator) then (telic-role, transport)

2.4 Un vehículo lleva a alguien a algún sitio (a means of transport X someone somewhere)

2.4 El_el avión_avión que_que los_él llevará_llevar a_a Lisboa_lisboa

(if (mcom, trajectory) then (formal-role, temporal))

2.5 Algo/alguien lleva a alguien a algún punto en el tiempo

(something/someone X someone to a point in time)

(and (if (mcom, initiator) then (constitutive-role, human))

(if (mcom, entity) then (telic-role, perform))

(if (mcom, trajectory) then (and (formal-role, art) (telic-role,see))))

2.6 Alguien lleva algo a ser representado (someone X something to be performed)

2.6 Llevar_llevar al_al ballet_ballet una_un historia_historia de_de amor_amor

(3) Extended meanings with meaning component trajectory/goal expressed

(and (if (mcom, trajectory) then (formal-role, state))

(if (mcom, entity) then (or (formal-role, animate) (formal-role, abstract))))

3.1 Algo/alguien lleva a alguien/algo a un estado

(something/someone X someone/something into a state)

3.1 El_el contacto_contacto con_con el_el inglés_inglés llevará_llevar a_a una_un necesaria_necesario interferencia_interferencia

(and (if (mcom, initiator) then (telic-role, interpret))

(if (mcom, trajectory) then (and (formal-role, state) (formal-role, extreme))

(if (mcom, entity) then (telic-role, be interpreted)))

3.2 Alguien/algo lleva algo a un estado extremo

(someone/something X something into an extreme state)

3.2 Esta_este película_película de_de Charles_Sturridge_charles_sturridge lleva_llevar a_a su_su extremo_extremo un_un aspecto_aspecto de_de la_la vida_vida inglesa_inglés

(and (if (mcom, trajectory) then (formal-role, activity))

(if (mcom, entity) then (formal-role, animate))

(if (mcom, initiator) then (formal-role, abstract)))

3.3 Algo lleva a alguien a hacer algo (something X someone to do something)

3.3 Razones_razón que_que llevan_llevar a_a poner_poner a_a Forster_forster en_en cine_cine

(4) Extended meanings with trajectory/goal grammatically expressed

(and (if (mcom, trajectory) then (grammatical, true))

(if (mcom, initiator) then (formal-role, animate))

(if (mcom, entity) then (telic, win)))

4.1 Alguien se lleva algo ganable (someone X something by winning it)

4.1 Rominger_rominger se_él llevó_llevar la_la etapa_etapa más_más bonita_bonito

(and (if (mcom, trajectory) then (grammatical, true))

(if (mcom, initiator) then (formal-role, animate))

(if (mcom, entity) then (and (formal, emotion) (formal, punctual)))

4.2 Alguien se lleva una emoción (someone X an emotion)

4.2 qué_qué sorpresa_sorpresa te_tú vas_ir a_a llevar_llevar ...

(5) Extended meanings with trajectory/goal underspecified

(and (if (mcom, trajectory) then (underspecified, true))

(if (mcom, entity) then (and (constitutive-role, part-of [1:initiator])

(formal-role, removable))))

5.1 Algo/alguien lleva algo (something/someone X something)

5.1 que_que lleva_llevar el_el bonito_bonito título_título de_de El_el Castañazo_castañazo,

5.1 Me_yo horrorizaba_horrorizar tener_tener que_que llevar_llevar una_un dentadura_dentadura .

(and (if (mcom, trajectory) then (underspecified, true))

(if (mcom, initiator) then (formal, animate))

(if (mcom, entity) then (telic, live)))

5.2 Alguien lleva una existencia (someone X an existence)

5.2 Llevan_llevar unas_un vidas_vida desflecadas_desflecar , vacilantes_vacilante,

(6) Extended meanings with trajectory/path

(and (if (mcom, trajectory) then (subcomponent, path))

(if (mcom, trajectory) then (telic-role, measure))

(if (mcom, initiator) then (formal-role, animate))

(if (mcom, entity) then (formal-role, state))))

6.1 Alguien lleva un tiempo en un estado (someone X a measure of time in a state)

6.1 Llevan_llevar muchos_mucho años_año casados_casado

Those are some of the senses that have been defined for the verb llevar. As it might have been noticed, the criterion underlying the definition consists basically in the detection of regularities in the selection restrictions, expressed through the roles in the qualia structure. Next section evaluates this proposal and puts forward future lines of research.

5 Discussion and future work

The main advantages of using the qualia structure for purposes of senses representation have already been pointed out: it allows to focus on different aspects of an entity and it can be implemented in a LKB based on typed feature structures. Notwithstanding, the problems it poses for its real incorporation into a NLP tool cannot be ignored.

The basic hindrance lies in the need of a powerful and fine-grained ontology. Such an ontology should reflect the fact that objects can be approached from multiple perspectives. Furthermore, it should have to be exactly defined how the LKB incorporates the qualia structure and how the qualia relates to the information in other modules.

Apart from that, the effectiveness of the methodology for the analysis of predicates presented here should be tested by carrying out several tasks. In the first place, general tendencies of behaviour should be found for predicates of the same semantic class. That would allow to define productive rules of meaning extensions.

Until now, the methodology has been applied for high frequency verbs of transfer. The semantic class of transfer has been studied in depth from several theoretical frameworks, so that an agreement can be reached as for the meaning components defining that class. Thus, relating several senses of the verb by assigning different qualia structures to the same set of meaning components is a reachable goal. However, extending the same analysis to other semantic classes may present difficulties.

An additional task to carry out consists in trying to find regularities, if there are, between the content of the qualia structures assigned to the meaning components and the syntactic behaviour of the predicate. For example, in the case of the verb llevar, only the senses of subgroup (1) accept naturally the passive alternation, senses of subgroup (2) sound odd when transformed into passive, and the rest of senses do clearly not accept it.

Finally, a topic of discussion would be the assignment of all the senses of the verb llevar to the same semantic class, the class of transfer, on the basis of its basic meaning, or if each sense would belong to different classes. The second option would go counter the cognitivist tradition, that establishes a set of cognitive schemes to which metaphorical processes are applied in order to derive metaphoric meanings [Lakoff 87]. As Langacker puts it [Langacker 91], a situation can be constructed in several ways. Thus, if a language chooses to express a concrete meaning through a concrete construction, that construction may convey a different meaning or, at least a different connotation than the same concept expressed through a different construction.

Acknowledgements

This work has been supported by the postgraduate scholarship from the Comissionat per a Universitats i Recerca de la Generalitat de Catalunya (ref. FI 97/00306 PG).

References

[Boguraev and Briscoe 89] Boguraev, B.K. and E.J. Briscoe (1989) Computational Lexicography for Natural Language Processing. Longman. Harlow.

[Briscoe et al. 93] Briscoe, T., de Paiva, V. and A. Copestake (1993) Inheritance, Defaults, and the Lexicon. CUP, Cambridge.

[Castellón 97] Castellón, I. (1997) Extracción de relaciones, Research Report 1/97, Linguistics Section, University of Barcelona.

[Castellón et al. 98] Castellón, I, Fernández, A., Martí, M.A., Morante, R., G. Vázquez (1998) Los verbos de cambio y transferencia. Actas del XVI Congreso Nacional de AESLA. Universidad de la Rioja.

[Copestake 92] Copestake, A. (1992) The representation of lexical semantic information. D.Phil Thesis, University of Sussex, Cognitive Science Research Paper, CSRP 280.

[Copestake and Briscoe 95] Copestake, A. and T. Briscoe (1995) Semi-productive polisemy and sense extension. Journal of Semantics, 12:15-67.

[Dorr and Jones 96] Dorr, B. And D. Jones (1996) Use of Syntactic and Semantic Filters for Lexical Acquisition: Using WordNet to Increase Precision. Proceedings of the Workshop on Predicative Forms and in Lexical Knowledge Bases. Toulouse.

[Fillmore 82] Fillmore, Ch. J. (1982) Frame Semantics. In The Linguistic Society of Korea (ed.) Linguistics in the Morning Calm. Hanshin Publishing Co., Seoul. 111-137.

[Fillmore 86] Fillmore, Ch.J. (1986) Pragmatically Controlled Zero Anaphora. BLS 12. 95-107.

[Jackendoff 90] Jackendoff, R. (1990) Semantic Structures. MIT Press. Cambridge. Mass.

[Jones et al. 94] Jones, D.A., Berwick, R.C., Cho, F., Khan, Z., Kohl, K.T., Nomura, N., Radhakrishnan, A., Sauerland, U., and B. Ulicny (1994) Verb Classes and Alternations in Bangla, German, English, and Korean. A.I. Memo No. 1517, CBCL Memo No. 137, MIT.

[Kilgarriff 90] Kilgarriff, A. (1990) An analysis of distinctions between dictionary word senses. Tech. rep. CSRP 184, School of Cognitive and Computing Sciences, University of Sussex.

[Kilgarriff 95] Kilgarriff, A. (1995) Inheriting polisemy. In Computational Lexical Semantics. Saint-Dizier, P. and E. Viegas (ed.) CUP, Cambridge.

[Lakoff 87] Lakoff, G. (1987) Women, Fire, and Dangerous Things. University of Chicago Press. Chicago, IL

Chicago. IL.

[Lakoff and Brugman 86] Lakoff, G. and C. Brugman (1986) Argument Forms in Lexical Semantics. BLS 12. 442-454.

[Langacker 91] Langacker, R. W. (1991) Foundations of Cognitive Grammar, vol.2, Descriptive Application. Standford, Standford University Press.

[LDOCE 87] Longman Dictionnary of Contemporary English, New Edition. Edited by Della Summers et al. Harlow.

[Levin 93] Levin, B. (1993) English Verb Classes and Alternations. A Preliminary Investigation. University of Chicago Press. Chicago.

[Miller and Fellbaum 91] Miller, G. and C. Fellbaum (1991) Semantic Networks of English. In Levin, B. and S. Pinker (ed.) Lexical and Conceptual Semantics. Blackwell Publishers.Oxford. 1992.

[Morante et al. 98] Morante, R., Castellón, I. and G. Vázquez (1998) Los verbos de transferencia. Revista para el Procesamiento del Lenguaje Natural n. XX.

[Pustejovsky 91] Pustejovsky, J. (1991) The Generative Lexicon. Computational Linguistics 17.4, 409-441.

[Pustejovsky 95] Pustejovsky, J. (1995) The Generative Lexicon. A Theory of Computational Lexical Semantics. MIT Press. Cambridge, Mass.

[Pustejovsky and Busa 95] Pustejovsky, J. And F. Busa (1995) Unaccusativity and event composition. In Marco Bernidetto et al., editors, Temporal Reference, Aspect and Actionality, volume 1: Semantic and Syntactic Perspectives. Rosenberg & Seiler. Torino. 159-177.

[Ramos 96] Ramos, M. (1996) Hacia una generalización de la información colocacional en un léxico formal. Procesamiento del Lenguaje Natural, Revista n. 19. 51-62.

[Saint-Dizier 96] Saint-Dizier, P. (1996) Semantic Verb Classes on alternations and on WordNet-like Semantic Criteria: a powerful convergence. Proceedings of the Workshop on Predicative Forms and in Lexical Knowledge Bases. Toulouse.

[Sanfilippo 92] Sanfilippo, A. (1992) Verbal Diatheses: Knowledge Acquisition, Lexicon Construction and Dictionary Compilation. Draft.

[Schank and Abelson 77] Schank, R.C. and R. Abelson (1977) Scripts, Goals, Plans and Understanding. Erlbaum. Hillsdale, NJ.

[Talmy 85] Talmy, L. (1985) Lexicalization Patterns: Semantic Structures in Lexical Forms.Language Typology and Syntactic Description III: Grammatical Categories and the Lexicon. Ed. by T. Shoepen. 57-149. MIT Press. Cambridge, Mass.

[Vázquez et al. 99] Vázquez, G., Fernández, A., Martí, M.A., Morante, R., and I. Castellón (1999) A hierarchically structured LKB for verbs. Proceedings of the III Workshop on Computational

hierarchicaly structurea LKB for verbs. Proceeaings of the III Workshop on Computational Semantics. Tilburg.

[Wu and Palmer 94] Wu, Z. and M. Palmer (1994) Verb Semantics and Lexical Selection. Proceedings of the 4th Conference of the ACL.