Reduced Relatives: Lexical Constraint-Based Analysis
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REDUCED RELATIVES: LEXICAL CONSTRAINT-BASED ANALYSIS

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1 Introduction

One of the central controversies in sentence processing concerns the role of structural factors. The touchstone for the two main competing schools of thought, structure-based and constraint-based, are garden-path sentences, such as *The horse raced past the barn fell*, discussed in sentence processing literature since at least Bever (1970). I will here present a recent structure-based approach to garden-path sentences of Stevenson and Merlo (1997), which is couched within Government and Binding Theory, and contrast it with an alternative account that presuppposes constraint-based approaches to natural language description in psycholinguistics and linguistics (HPSG and Construction Grammar). The goal is to show that thematic properties, which characterize the two fuzzy cluster concepts Proto-Agent and Proto-Patient (Dowty, 1988, 1991), can account for a great number of processing differences between sentences with reduced relative clauses based on unergative verbs, on the one hand, and on unaccusative verbs, on the other hand. One advantage of this novel way of looking at the garden-path phenomenon is that it allows us to understand the influence of the main predicate in a sentence on the magnitude of the garden-path effect. This type of data has so far gone unnoticed, to my knowledge, and it is problematic for *purely* structure-based accounts.

2 Data and the Main Question: Sentences with Reduced Relative Clauses

It is well-known that sentences with reduced relative clauses vary from being hard or nearly impossible to interpret to being very easy, at least on a first pass. For example, (1a) is unacceptable or difficult to process, while (1b) is far easier:

(1) a. #The horse RACED past the barn fell.
b. The butter MELTED in the pan was fresh.

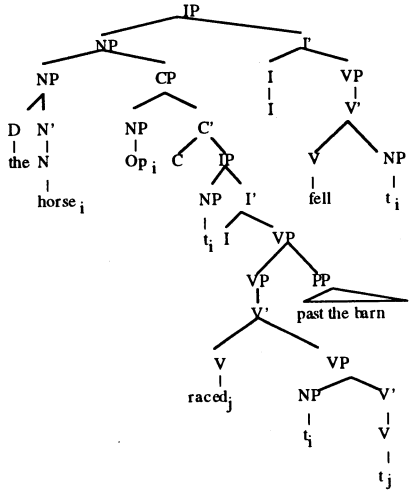
Many researchers agree that this difference is correlated with the type of verb used in the reduced relative clause. As far as their inherent or basic lexical class is concerned, *raced* is unergative and *melted* unaccusative, a distinction introduced by Perlmutter (1978), and also noticed by (Hall, 1965). In standard Government and Binding approaches (Hale and Keyser, 1993, for example), unergative verbs are syntactically characterized as having an external argument, but no direct internal argument, while unaccusative verbs have no external argument, and a direct (non-clausal, non-PP) internal argument. According to semantic characterizations given by Van Valin (1990) and Dowty (1991), for example, unergative verbs tend to entail agentivity in their single argument and to be aspectually atelic. Unaccusative verbs take a patient-like argument and are mostly telic. Assuming that the difference between (1a) and (1b) is correlated with the unaccusative-unergative distinction, the following questions arise: 'What is the nature of the lexical knowledge that differentiates between unergative and unaccusative verbs?'

3 Stevenson and Merlo (1997)

According to Stevenson and Merlo, it is the differences in structural configurations at the lexical level that set unaccusative verbs apart from unergative ones, and that ultimately result in the differences in the processing difficulty of sentences with

reduced relative clauses. They presuppose Hale and Keyser's (1993) lexical syntax and also apply some ideas of Dowty's (1979) much earlier lexical decomposition approach that is grounded in generative semantics. On Stevenson and Merlo's view, the difficult sentence (1a), for example, is assigned the syntactic structure (2):

(2) Stevenson and Merlo (1997:382)



The parser, a symbolic/connectionist hybrid, developed by Stevenson (1994a,b), cannot activate the structure (2) needed for a grammatical analysis of sentences like (1a), "because of its limited ability to project empty nodes and to bind them in the structure" (Stevenson and Merlo, 1997:397). Hence, their model predicts that sentences with reduced relatives headed by passive participles derived from unergatives are judged "all mostly or completely unacceptable" (p.355). In particular, manner of motion verbs "lead to a severe garden path in the RR construction" (p.353). There are "sharp distinctions between unergative RR clauses and RR clauses with other verbs" (p.396). Some of their examples (p.353) are given in (3):

(3) a. The students advanced to the next grade had to study very hard.
b. The clipper sailed to Portugal carried a crew of eight.
c. The troops marched across the fields all day resented the general.
d. The model planet rotated on the metal axis fell off the stand.
e. The dog walked in the park was having a good time.
f. The ship glided past the harbor guards was laden with treasure.

In contrast, "unaccusative RRs are all completely acceptable or only slightly degraded" (p.355). Stevenson and Merlo's (1997:353) examples are given in (4):

(4) a. The witch melted in the Wizard of Oz was played by a famous actress.
b. The genes mutated in the experiment were used in a vaccine.
c. The oil poured across the road made driving treacherous.
d. The picture rotated 90 degrees was easy to print.

Although Stevenson and Merlo (1997) acknowledge that other factors are important in processing, such as lexical frequencies, thematic fit, context, world knowledge, etc., syntactic constraints are claimed to override all the other factors in cases of conflict and syntactic constraints alone can cause failure to interpret a sentence (see p.392).

However, a close look at the relevant data reveals a different picture from that proposed by Stevenson and Merlo. Sentences with reduced relatives based on unergative verbs, including manner of motion verbs, manifest a considerable degree of variability in acceptability, and, in fact, perfectly acceptable sentences of this type are easy to find. Consider examples in (5):

(5) a. The victims rushed to the emergency room died upon their arrival.
b. The cart rolled down the ramp overturned when it hit a bump.
c. The dog walked in the park was wearing a choke collar.
d. The diplomats jetted to Iraq were unable to diffuse the crisis.
e. The convict moved into an isolation cell became depressed.
f. The soldiers marched across the fields were ambushed by the enemy.

There are also sentences with reduced relatives headed by participles derived from unaccusative verbs that are more difficult to interpret than some sentences with reduced relatives based on unergatives. Examples are given in (6):

(6) a. The theatre darkened for the movie frightened some preschoolers.
b. The plaster hardened in the oven cracked with loud popping sounds.
c. The bubble burst in the hallway made the principle jump.
d. The paper yellowed in the sun was wrinkled.

What has so far gone unnoticed is that both types of sentences exhibit similar gradient effects in acceptability that are crucially influenced by the lexical semantics of the main verb in a matrix clause. To put it in the simplest terms, the fewer agent-like properties and the more patient-like properties the main verb assigns to its subject, the easier the whole sentence with a reduced relative clause is judged. This idea will be discussed in detail in section 4, but let me illustrate it here with a few examples. In (7a) the subject of *complained, the patients*, is a volitional agent in the denoted event, and we see that the whole sentence is less acceptable than (7b) with *died* as the main verb, whose subject undergoes a change of state. A similar contrast can be found in (8):

(7) a. The patients rushed to the emergency room *#complained to the nurse.*
b. The patients rushed to the emergency room *died.*

(8) a. The Great Dane walked in the park *#tugged at the leash.*
b. The Great Dane walked in the park *wore a choke collar.*

Similar to reduced relatives with passive participles derived from unaccusative verbs, such as *darkened* in (9), we see that the use of *frightened* as opposed to *smelled* in the matrix clause is correlated with a difference in the acceptability of the whole sentence. The reason is that *frightened*, but not *smelled*, presents the subject *the theatre* as the cause of the change of the psychological state in the referent of the direct object *some preschoolers*. Other similar examples are given in (10):

(9) a. The theatre darkened for the movie *#frightened* some preschoolers.
b. The theatre darkened for the movie *smelled* like popcorn.

(10) a. The genes mutated in the experiment *#attacked* their host.
b. The genes mutated in the experiment *were used* in a new vaccine.

To summarize, there is no sharp contrast between sentences that contain unergative-based reduced relatives and those that contain unaccusative-based ones. Second, and more importantly, both types of sentences are similar in exhibiting clear gradient effects with respect to acceptability judgments and parsing difficulty, which are influenced by the lexical semantics of the main verb in a matrix clause. It must be emphasized that sentences with reduced relatives based on unergative verbs manifest far greater variability and are on average significantly harder to interpret than unaccusative-based ones.

Most importantly, different degrees of acceptability observed in (5) - (10) resist an explanation in purely structure-based terms, including those couched in lexical syntax of Stevenson and Merlo (1997). Recall that they predict that *all* sentences with reduced relatives headed by inherently unergative verbs are predicted to pose 'sharp difficulty' (p.392) for an interpreter, and they cannot be assigned a grammatical analysis by the parser. In order to account for unaccusative-based reduced relatives that are *not* easy to interpret, such as those in (11), Stevenson and Merlo resort to semantic factors, in addition to structural ones, to argue that they are unergative. The reason is, according to them, that verbs like *caramelise, solidify*, and *yellow* entail 'internal causation' (see Levin and Rappaport Hovav, 1995:210-11) in their semantic description, a feature that distinguishes unergative verbs from unaccusative ones, the latter being 'externally caused' (see ibid.). Only unaccusative verbs, but not unergative ones, sanction the expression of a causal 'external' agent or force as their subject-NP, when they are used transitively. Stevenson and Merlo illustrate this point with examples in (12).

(11) a. #The candy caramelised in an hour burned.
b. #The wax solidified into abstract shapes melted.
c. #The paper yellowed in the sun shrank.

(12) a. The sun yellowed the paper. Stevenson and Merlo, 1997:365
b. #The chain-smoker yellowed the papers.
c. #The sculptor solidified the wax.
d. The sculptor hardened the wax.

By this test, *yellow* in (12b) and *solidify* in (12c) are unergative and *harden* in (12d) is unaccusative. Moreover, (12b) is less acceptable than (12a), because its subject referent may be intentionally involved in the denoted event, while in (12a) it cannot, the denoted change of state is "indirectly brought about by some natural force" (p. 365). Yet at the same time, Stevenson and Merlo observe (p. 357) that agentive manner of motion verbs, which are unergative, used transitively *require* their subject argument to be an Agent: cp. **The downpour marched the soldiers to the tents* vs. *The commander marched the soldiers to the tents.* (This observation is based on Cruse, 1972; Jackendoff, 1972; Levin and Rappapport Hovav, 1995.) This inconsistency clearly indicates that a test based on the possibility of the overt expression of an agent/causal force cannot be the right diagnostic for deciding the membership of verbs in the unaccusative and unergative class. The main source of confusion are here the correlations 'non-agentivity - external causation - possibility

of an overt expression of an external agent/force', on the one hand, and 'agentivity - internal causation - prohibition against an overt expression of an external agent/force', on the other hand. Moreover, what is lacking is a precise characterization of the notions 'internal and external causation', introduced by Levin and Rappaport Hovav (1995).

The fact that Stevenson and Merlo do resort to rather subtle semantic criteria in order to account for difficult cases is instructive, because it shows that purely structure-based accounts are insufficient and that semantic explanations are necessary in addition to structure-based ones. Indeed, one may ask to what extent, if at all, syntactic factors are necessary in addition to semantic ones in order to account for the garden-path phenomenon. If we focus on the differential semantics of the verbs in the material discussed here, we can begin to understand the overlapping distribution of sentences with reduced relatives as well as the great deal of variability with respect to how good or bad they are judged to be. A particularly fruitful way of capturing the relevant semantic entailments of verbs is in terms of Dowty's theory of thematic Proto-Roles and argument selection. In the next section I will introduce Dowty's theory and its application to the interpretation of sentences with reduced relative clauses.

4 Thematic Properties of Verbs and Language Comprehension

4.1 Dowty (1988, 1991)

Dowty proposes that the only thematic roles are two cluster concepts, Proto-Agent and Proto-Patient, each characterized by a set of verbal entailments, given in (13) (see Dowty, 1991:572):

(13) Contributing properties for the Agent Proto-Role:
- a. volitional involvement in the event or state
- b. sentience (and/or perception)
- c. causing an event or change of state in another participant
- d. movement (relative to the position of another participant)
- (e. referent exists independent of action of verb).

Contributing properties for the Patient Proto-Role:
- a. undergoes change of state
- b. incremental theme
- c. causally affected by another participant
- d. stationary relative to movement of another participant
- (e. does not exist independently of the event, or not at all).

Proto-Agent and Proto-Patient properties are 'higher-order generalizations about meanings'. "[A]n argument of a verb may bear either of the two proto-roles (or both) to varying degrees, according to the number of entailments of each kind the verb gives it" (Dowty, 1991:547). The Argument Selection Principle (p.576) determines the direct association of clusters of Proto-Agent and Proto-Patient properties with grammatical relations in a many-to-one fashion:

(14) Argument Selection Principle
In predicates with grammatical subject and object, the argument for which the predicate entails the greatest number of Proto-Agent properties will be lexicalized as the subject of the predicate; the argument having the greatest number of Proto-Patient properties will be lexicalized as the direct object.

4.2 Compatibility between Subjects in Sentences with Reduced Relative Clauses

I suggest that a decisive factor (though not the only one) for the acceptability of a sentence with a reduced relative clause is the constellation of Proto-Patient and Proto-Agent properties assigned by the main verb in a matrix clause and the passive participle in a relative clause to their respective subjects. This idea is formulated in (15):

(15) Hypothesis
The acceptability of sentences with reduced relative clauses, headed by passive participles derived from unergative and unaccusative verbs, increases when the passive participle and the main verb of a matrix clause assign their subject-NPs more Proto-Patient, and fewer Proto-Agent, properties.

The intuition behind (15) is that sentences are easier to interpret when there is an internal coherence among the interpretations of their constituents. One way this coherence can be achieved is in terms of compatible or even identical assignments of thematic properties to different NP arguments that are associated with one and the same participant in the domain of discourse. In sentences with a reduced relative clause the internal coherence depends in part on the thematic compatibility between the subject NP in the matrix clause and the PRO subject of the reduced relative. Let us take (1a) *#The horse raced past the barn fell.* At the point when *raced* is processed, the preferred syntactic-semantic pattern is that of the main clause with a highly agentive subject-NP. However, when *fell* is processed, *raced* must be understood instead as a passive participle. Passive participles in general presuppose the existence of corresponding active transitive verbs whose subjects correspond to active direct objects (see Sag and Wasow, 1997:164, for example; but passive subjects do not always correspond to active direct objects, see Postal, 1986; Zwicky, 1987; and others). Let us now look at the assignment of thematic properties by the verb *raced* in its intransitive and transitive (causative) use:

(16) Distribution of Proto-Agent (PA) and Proto-Patient (PP) properties for ***RACED***

a. Vi: unergative

The horse RACED *past the barn*
|
PA
(+ volition)
+ sentience
+ movement

b. Vt: lexical causative

The rider RACED *the horse past the barn*
| |
PA PA & PP
+ volition (+volition) **+causally affected**
+ sentience + sentience
+ causing + movement
event/change

The subject *the horse* of the intransitive *raced* corresponds to the object of the transitive *raced.* They share three Proto-Agent properties, two of which are also the Proto-Agent properties assigned to the subject *the rider* of the transitive *raced.* Although *the rider* and *the horse* as arguments of the transitive *raced* are close in Proto-Agent properties, they differ in so far as the former is the 'causer of the denoted event', a Proto-Agent property, while the latter is entailed to have the

Proto-Patient property of being 'causally affected by another participant'. This motivates the lexicalization of *the rider* and *the horse* as the subject and the direct object, respectively, as predicted by Dowty's Argument Selection Principle (see (14)).

Typical unergative verbs used transitively do not fit the semantics of prototypical transitives. Intuitively, the latter can be understood in terms of a 'billiard ball model', as Langacker (1986) calls it, which involves two participants that interact in an asymmetric and unidirectional way, whereby one of them is directly affected by some action (possibly involving movement, contact, effect, and the like) instigated or caused by the other participant. Now, the direct object of an inherently unergative verb used transitively corresponds to the intransitive subject and has a thematic make up of a "good" Agent (having a few Proto-Patient and several Proto-Agent properties), rather than of a "good" Patient. That is, we may understand a sentence like (16b) as being semantically decomposable into two causally related clauses: (i) *The rider did something to the horse* and (ii) *The horse raced.* (See also Fillmore, 1971:46-7, for a similar example.) The horse is a Patient-like participant from the point of view of the first clause and an Agent-like participant from the point of view of the second. Having to reconcile these two different perspectives is directly related to the awkwardness often associated with the transitive use of unergative verbs. This also carries over to passive participles derived from inherently unergative verbs, because prototypical passive participles require a high number of Proto-Patient properties in their subject arguments. These observations correctly predict that reduced relatives with passive participles derived from inherently unergative verbs are hard to interpret if the transitive and/or passive use of unergatives is judged hard. This is illustrated by examples in (17) - (19):

(17) a. #John waltzed the debutante across the dance floor.
b. The debutante was waltzed across the dance floor.
c. #The debutante waltzed across the floor wore a beautiful dress.

(18) a. John glided the puck across the ice.
b. #The puck was glided across the ice.
c. #The puck glided across the ice slipped through the goalie's mitt.

(19) a. #The trainer danced the bears.
b. #The bears were danced around the ring by their trainer.
c. #The bears danced around the ring were amusing.

Of course, not all transitive and passive uses of inherently unergative verbs are odd. For example, *John walked his dog* and *Fido was walked by John tonight* are perfectly natural. Apart from the thematic compatibility discussed here, other factors, such as certain expectations related to the occurrence of highly conventionalized combinations of words and general world knowledge, may come into play and override the semantic mismatch described above.

To return to our lead example, the PRO subject of the passive participle in (20) has the same thematic properties as the corresponding active object in (16b), it is not a "good" Patient, and hence it does not fit the prototypical semantics of passives. The analysis of *raced* as a passive participle is then further made difficult by the main verb *fell,* because it assigns the Proto-Agent property 'movement' to its subject *the horse.* If, on the other hand, the main verb of a matrix clause assigns

Proto-Patient, rather than Proto-Agent, property (or properties) to its subject, the magnitude of the garden path effect is diminished. This is illustrated in (21) with the main verb *died,* which is somewhat easier to interpret than (20).

(20) ***The horse***$_i$ **[< PRO$_i$ > *RACED past the barn*]** ***fell***

PA	PA & PP	
+ movement	(+ volition) **+ causally affected**	+ movement
	+ sentience	(+ change of state)
	+ movement	

(21) ***The horse***$_i$ **[<PRO$_i$ > *RACED past the barn*]** ***died***

PP	PA & PP	PP
+ undergoes change of state	(+ volition) **+ causally affected**	**+ undergoes change of state**
	+ sentience	
	+ movement	

Although the difference between (20) and (21) may appear subtle, the subject of *died* is clearly a "bettter" Patient then the subject of *fell,* as it undergoes a permanent change of state.

Let us now look at sentences with reduced relatives headed by passive participles derived from unaccusative verbs. As (22) and (23) show the subject of the unaccusative *melted,* the object of the corresponding active transitive *melted* and the PRO subject of the passive participle *melted* are all entailed to have the same three Proto-Patient properties: 'change of state', 'Incremental Theme' and 'causally affected'.

(22) Distribution of Proto-Agent (PA) and Proto-Patient (PP) properties for ***MELTED***:

a. Vi: unaccusative

The butter MELTED in the pan

PP
+ undergoes change of state
+ Incremental Theme
+ causally affected

b. Vt: lexical causative

The cook MELTED the butter in the pan

PA	PP
+ volition	+ undergoes change of state
+ sentience	+ Incremental Theme
+ causing event/change	+ causally affected

(23) ***The butter***$_i$ **[< PRO$_i$ > *MELTED in the pan*]** ***was fresh***

PP
+ undergoes change of state
+ Incremental Theme
+ causally affected

Consequently, the reanalysis of the unaccusative *melted* as a passive participle in (23) involves no change in the thematic properties of the argument *the butter.* This

facilitates an easy recovery from a garden-path, provided the lexical semantics of the main verb in the matrix clause also entails a high number of Proto-Patient properties in its subject. For example, (23) with the main predicate *was fresh* is judged easier to process than (24) with the main verb *dripped*, as is predicted by the hypothesis in (15).

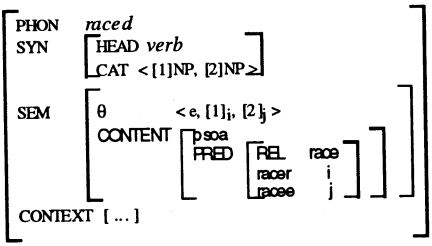
(24) #The butter melted on the stove dripped onto the kitchen floor.

To summarize, I showed that the unaccusative-unergative distinction that Stevenson and Merlo characterize as a syntactic distinction correlated with difficulty or ease of processing in reduced relative clauses can be re-cast as a distinction that concerns the assignment of thematic roles. One advantage of this novel way of looking at the garden-path phenomenon is that it allows us to understand a set of data that have never been systematically commented on before: namely, the influence of the main predicate in a sentence on the magnitude of the garden-path effect (see (7) - (10)). The analysis in terms of Dowty's thematic roles, encapsulated in (15), also makes the correct predictions here. The semantic account proposed here is understood as part of a constraint-based sentence processing system. As far as its linguistic assumptions are concerned, it presuppposes constraint-based approaches to natural language description: HPSG and Construction Grammar. In what follows I will outline the main characteristics of a constraint-based grammar assumed here and some plans for the future research.

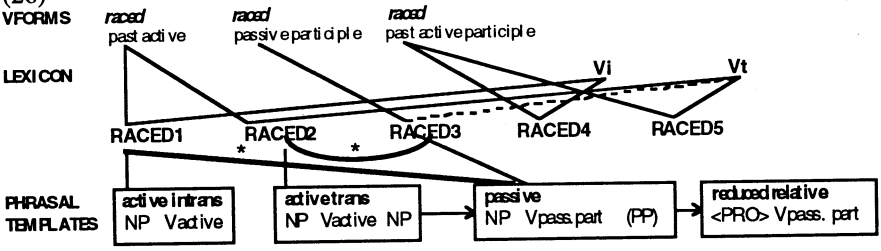
5 Lexical Entries and Constraint-Based Approach

The lexical constraint-based grammar presupposed here has all the main hallmarks of recent versions of HPSG (see Sag, 1997; Sag and Wasow, 1997, for example). Assumptions about lexical semantics of verbs and linguistic information directly associated with extra-linguistic context and general world knowledge are influenced by Fillmore's work and Construction Grammar (see Fillmore and Kay, in press). The overall architecture is monostratal, non-derivational and non-modular. It is characterized declaratively by specifying types of well-formed linguistic expressions (e.g., words, phrases, part of speech classes, argument structure classes, and traditional morphological classes, for example) and constraints on those types. All properties of linguistic expressions are represented as feature structures. The main explanatory mechanism is unification in the narrow sense of structure sharing of token-identical feature structures (cf. Pollard and Sag, 1994).

Constraint-based approaches in linguistics and psycholinguistics share two main assumptions: First, a sentence's interpretation requires satisfaction of multiple (possibly differentially weighted) constraints from various domains of linguistic and non-linguistic knowledge. Second, the integration of such diverse constraints is facilitated by the information contained in lexical entries. Verb-based syntactic and semantic patterns provide a guide for interpreting core aspects of the sentence's structure and meaning, whereby semantic constraints often have a privileged status. Let me, therefore, introduce the main features of lexical entries using a simplified lexical entry for the transitive active *raced* in (25):

(25)


(25) contains phonological, syntactic, semantic and pragmatic information, encoded as values of the feature attributes PHON, SYN, SEM and CONTEXT, respectively. The value of SYN encodes syntactic information required for constructing syntactic projections headed by *raced*. The linking between the syntactic (SYN) and semantic (SEM) structure in the lexicon is mediated via co-indexation of syntactic arguments and thematic argument slots, and motivated by Dowty's Argument Selection Principle (here given in (14)). Each argument slot in the thematic structure of a verb corresponds to a cluster of Proto-Agent and/or Proto-Patient properties. Thematic argument slots in turn are co-indexed with individuals in the predication feature structure PRED, which together with 'psoa' constitutes the value of CONTENT. The feature structure PRED captures the assumption that verbs semantically express relations between individuals. The attributes 'racer' and 'racee' include properties that we associate with the individuals 'i' and 'j' on the basis of knowing that the statement 'i raced j' is true. The attributes 'racer' and 'racee' correspond to 'frame-specific participants' in Fillmore (1986) or 'individual thematic roles' in Dowty (1989). In a given single-clause predication, further semantic restrictions on participants are imposed by the interpretation of noun phrases. For example, '[racer i]' will be constrained by the content of the NP filling the '[1]NP' place. The proper association of '[1]NP' with '[racer i]' is ensured through the co-indexation in the thematic structure '$[1]_i$'. PRED does not provide an exhaustive account of all that we know about the meaning of a given verb. For example, what role an individual plays in a given situation depends on a number of other factors, including world knowledge, which is encoded under 'psoa', a parametrized state of affairs. (For a related, though not identical, use of 'psoa' see Pollard and Sag, 1994; Sag and Wasow, 1997.) Apart from the lexicon, a constraint-based grammar also includes the syntactic level with phrasal templates. This is illustrated in a highly simplified diagram (26):

(26)


In general, types at each level of representation are cross-classified in multiple

inheritance hierarchies according to their shared information. The information shared by a given class of objects is associated with a general type and is automatically passed down from the general type to specific members of the class. For example, RACED2 (past active transitive) and RACED5 (past active participle transitive) inherit information from the generic lexical entry for transitive verbs, here located in the node **Vt**. Types directly subsumed under the same supertype represent mutually exclusive alternatives. For example, RACED2 (past active transitive) and RACED3 (passive participle) are mutually exclusive (here indicated by the thick starred lines). Mutually exclusive types often represent multiple interpretation alternatives and differ in frequency of occurrence in the language. For example, the active intransitive use of *raced* is more frequent than the active transitive one. Such frequency information is also encoded in the lexical entries of verbs.

Unification allows us to represent dependencies and connections within one particular level of representation and also among different levels. Feature structures representing compatible types are unified in a new coherent structure by linking them to a single feature structure: e.g., [VFORM PAST.ACTIVE] ‰ [SYN Vi]. One advantage of this system is that it allows us to capture the observation that different types of information that characterize the use of a given word are dependent on each other so that accessing one type of information during sentence processing results in accessing others compatible with it. For example, if the sequence *The horse raced ...* is understood as the main clause, the information associated with the verb *raced* will be a complex feature structure comprising the information that this verb shares with all active past tense verbs. If the same sequence is understood as the head noun modified by a reduced relative clause, *raced* will be associated with the information shared with all passive participles, and due to its passive argument structure it will also activate the information associated with the active transitive use of *raced.*

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