

# Towards A Semantic Analysis of Argument/Oblique Alternations in HPSG

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In this paper I outline a semantic analysis of argument/oblique alternations. I argue that when such alternations exhibit semantic contrasts it is always in terms of the relative number of entailments associated with the alternating participant. I sketch a framework for capturing these contrasts in HPSG, using the locative alternation as a case study:<sup>1</sup>

- (1) a. John loaded the hay onto the wagon.
- b. John loaded the wagon with the hay.

In (1a) the locatum is realized as a direct argument and in (1b) as an oblique, and vice versa for the location participant. The classic semantic observation (Anderson 1971) is that whichever participant is realized as direct object receives a “holistically affected” interpretation (all moved or all loaded up):

- (2) a. John loaded the hay onto the wagon,  
      leaving enough space for the grain.
- b. #John loaded the wagon with the hay,  
      leaving enough space for the grain.
- (3) a. John loaded the wagon with the hay,  
      with enough left over to fill the pick-up.
- b. #John loaded the hay onto the wagon,  
      with enough left over to fill the pick-up.

Only the oblique realizations are acceptable in a context where they are not holistically affected.

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<sup>1</sup>This is part of a larger study based on a theory of thematic roles as sets of entailments, following primarily Dowty (1991). I use the term “entailment” in the sense of Dowty’s (1989) “lexical entailments”, i.e. properties a verb ascribes to an argument due to its role in the event, ignoring their ontological status as e.g. entailments vs. implicatures. See Beavers (to appear) for more details on the English data motivating this analysis and previous literature on the semantic basis of alternations.

Thus they are **underspecified** for holistic affectedness (i.e. they neither entail nor contradict it). Other properties, however, are **invariant**, e.g. one participant is always a location, the other a locatum, and both are always at least partially affected (loaded/moved). Other realization patterns that are morphosyntactically similar to (1) involve related but distinct differences in interpretation, as in (4).

- (4) a. John cut his hand on the rock. (hand affected; rock not necessarily affected)
- b. John cut the rock with his hand. (rock affected; hand not necessarily affected)

While the variants in (1) differ in holistic affectedness, (4) exhibits a contrast in simple affectedness. Otherwise, the morphosyntactic and semantic similarities suggest that (1) and (4) are two manifestations of one alternation where the exact contrasts are verb-specific (cf. Fillmore 1977, Dowty 1991).

While the locative alternation has been well studied (see Levin and Rappaport 1988, *inter alia*), few authors have observed that there is a general contrast between alternating direct arguments and obliques in terms of underspecificity (though see Ackerman and Moore 2001, which I discuss further below). For example, in the dative alternation (e.g. *Rich threw Barry the ball/the ball to Barry*) the recipient is invariably a goal (which the theme is intended to reach), but when it is realized as first object it is also an intended possessor, giving rise to the fact that inanimate locations realized as first objects must be construed of as capable of possession (e.g. the London office in *John sent London a package*; Green 1974). Likewise for the reciprocal alternation *The*

*car and the truck collided/The car collided with the truck*, when both entities are realized as a conjoined subject both must be in motion but when one is realized as an oblique it is underspecified for motion. Thus an adequate analysis of alternations must capture the following generalization:

- (5) Direct argument variants entail more about the alternating participant than oblique variants.

Previous HPSG analyses have generally failed to capture this, typically by not providing a rich enough semantics to capture the contrasts and not characterizing the argument/oblique contrast in a general way. For example, Koenig and Davis (2004) analyze English locative alternations in terms of UND(ERGOER) assignment. The entity linked to UND is always direct object, and the alternation arises from different choices of UND (resulting from different choices of KEY relations; see Kordoni 2002 for related HPSG work on Greek and Van Valin 2002 for a similar approach in Role and Reference Grammar). However, this does not directly capture the semantics of locative alternations since no specific entailments are associated with either variant. One could stipulate that the entity linked to UND must be associated with more entailments. However, this does not explain what those entailments are on a verb-by-verb basis, and also fails to generalize since recipients in the dative alternation are not necessarily linked to UND (e.g. Kordoni 2004 posits an additional macrorole) and in the reciprocal alternation there is not necessarily an UND feature at all (see also Beavers to appear for discussion of why analyses based on structured semantic representations are generally ill-suited to capture (5)).

Instead, I encode (5) in terms of thematic roles defined as sets of entailments as in Dowty (1989, 1991). For a verb  $V$  describing situation  $s$ , the role a participant  $x$  plays in  $s$  is defined as a set of verb-specific entailments  $R$ , which I refer to as an **individual thematic role** (following Dowty 1989). Thus  $R$  is the set of all things, from the very general to the quite specific, that  $V$  says about  $x$ 's role in  $s$ . Individual thematic roles are related to one another in terms of **specificity**. For two individual thematic roles  $R$  and  $Q$ ,  $R$  is more specific than  $Q$  if  $Q \subset R$ . I characterize (5) in terms of thematic roles as in (6).

- (6) **Morphosyntactic Alignment Principle (MAP):** When participant  $x$  may be realized as either a direct or oblique argument of verb  $V$ , it bears role  $R$  as a direct argument and role  $Q$  as an oblique where  $Q \subset R$ .

However, (6) fails to explain *which* roles  $R$  and  $Q$   $x$  will bear for a given verb and alternation, i.e. it misses the generalization that the verb-specific contrasts cross-classify into more general types based on very general notions like degrees of affectedness. For instance, (1) exhibits a contrast in terms of holistic affectedness (however manifested for a given verb, e.g. completely loaded/moved for *load*, completely sprayed/covered for *spray*), whereas (4) exhibits a contrast in simple affectedness (manifested in different ways e.g. for *cut* vs. *break*).

A better solution would derive the contrasts for each verb in terms of a more limited and general notion of possible contrasts. Following Dowty (1989), I propose to do this in terms of smaller, more general sets of entailments called **thematic role types**. Thematic role types are universal sets of non-verb-specific entailments that cross-classify individual thematic roles in terms of properties such as affectedness, possession, motion, etc., relevant for argument linking.<sup>2</sup> For instance, for the alternations in (1) and (4) I propose the thematic role types in Table 1 on the following page (which are also relevant for other object alternations; see Beavers to appear).

Thematic role types form specificity contrasts just as individual thematic roles do, forming general hierarchies reflecting decreasing specificity:

- (7) HOL. AFFECTED  $\supset$  AFFECTED  $\supset$  PARTICIPANT

The alternations of individual thematic roles in (1) and (4) can be described as **minimal contrasts in their thematic role types** along (7):

(8)

Role Type	<i>load/spray</i>	<i>cut/break</i>
HOL. AFFECTED	DO	
	↓	
AFFECTED	OBL	DO
		↓
PARTICIPANT		OBL

<sup>2</sup>The thematic role types I propose here are L-thematic roles in the sense of Dowty (1989), defined as linguistically significant intersections of individual thematic roles, i.e. subsets that many individual thematic roles share in common. In light of Dowty (1991) these could be defined instead as sets of proto-role entailments as in Beavers (to appear), though I ignore proto-roles here. Note that the term "type" here is not related to the HPSG notion of "type".

Thematic Role Type	Example Individual Thematic Roles of this Type
HOLISTICALLY AFFECTED	Completely loaded or moved entity ( $DO_{load}$ )
AFFECTED	Loaded, moved entity (oblique $_{load}$ ), or cut entity ( $DO_{cut}$ )
PARTICIPANT	Entity not known to be affected (oblique $_{cut}$ )

Table 1: Example Thematic Role Types

This can be characterized via a function from individual thematic roles to individual thematic roles as in (9), by which we can reformulate (6) as in (10).

- (9) For thematic role types  $\tau_1$  and  $\tau_2$ ,  $\tau_1 \supset \tau_2$ , forming a minimal thematic role type contrast, and for individual thematic role  $R$  of type  $\tau_1$ , the role  $Q = \min(R)$  is the maximal subset of  $R$  of type  $\tau_2$ .
- (10) **MAP (Revised):** When participant  $x$  may be realized as either a direct or oblique argument of verb  $V$ , it bears role  $R$  as a direct argument and role  $\min(R)$  as an oblique.

For example, if *the wagon* in (1) has individual thematic role  $LOCATION_{load}$  of type HOLISTICALLY AFFECTED as direct object, its role as an oblique is  $\min(LOCATION_{load})$  of type AFFECTED, which includes all the entailments in  $LOCATION_{load}$  save those that make it type HOLISTICALLY AFFECTED rather than AFFECTED. To capture (10) in HPSG I first assume a feature ROLES in each verb's CONT value (assuming the MRS semantics of Copestake et al. 2003 but ignoring scoping-related features):

$$(11) \text{ verb-mrs} \Rightarrow \text{mrs} \ \& \ \left[ \text{ROLES } \text{set}(\text{set}(\text{entailments})) \right]$$

ROLES defines the set of maximal individual thematic roles a verb licenses, i.e. the roles a verb will assign to its direct arguments. Each verb specifies on its RELS lists elementary predications of type *role-rel*, which attribute an individual thematic role in ROLES to a participant:

$$(12) \text{ role-rel} \Rightarrow \text{elementary-predication} \ \& \ \left[ \begin{array}{l} \text{ARG1 } i \\ \text{ROLE } \text{set}(\text{entailments}(i)) \end{array} \right]$$

We can capture (10) as constraints on  $v\text{-lxm}$ , which for expository purposes I present in two parts. First is the linking of direct arguments to maximal roles, done simply by associating each NP argument directly with a role on the verb's ROLES list:<sup>3</sup>

<sup>3</sup>For the remainder of the document I ignore irrelevant features such as SS and LOC in the paths to the features of interest.

$$(13) \text{ v-lxm} \Rightarrow \left[ \begin{array}{l} \text{ARG-ST} \left\langle \text{NP}_{i_1}, \dots, \text{NP}_{i_n} \right\rangle \circ \text{list}(\text{non-NP}) \\ \text{CONT} \left[ \begin{array}{l} \text{ROLES} \left\{ \overline{R_1}, \dots, \overline{R_n} \right\} \cup \text{set} \\ \text{RELS} \left\langle \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } i_1 \\ \text{ROLE } \overline{R_1} \end{array} \right], \dots, \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } i_n \\ \text{ROLE } \overline{R_n} \end{array} \right] \right\rangle \circ \text{list} \end{array} \right] \end{array} \right]$$

The roles assigned to obliques are more complicated. Ideally, they are the output of  $\min$  for some role on ROLES. However, we also want to restrict which oblique markers occur in which alternations. Following Gawron (1986), Markantonatou and Sadler (1995), and Wechsler (1995) I assume that oblique markers are semantically contentful, contributing individual thematic roles that must be compatible with the role assigned by the verb. For example, the PPs relevant for (1) are given in (14).

$$(14) \text{ a. } \left[ \begin{array}{l} \text{ORTH} \left\langle \text{onto, the, wagon} \right\rangle \\ \text{CONT} \left[ \begin{array}{l} \text{ROLES} \left\{ \text{LOCATION}_{goal} \right\} \\ \text{RELS} \left\langle \left[ \begin{array}{l} \text{wagon-rel} \\ \text{ARG1 } i \end{array} \right] \right\rangle \end{array} \right] \end{array} \right]$$

$$\text{ b. } \left[ \begin{array}{l} \text{ORTH} \left\langle \text{with, the, hay} \right\rangle \\ \text{CONT} \left[ \begin{array}{l} \text{ROLES} \left\{ \text{CAUSALLY-INTERMEDIATE} \right\} \\ \text{RELS} \left\langle \left[ \begin{array}{l} \text{hay-rel} \\ \text{ARG1 } i \end{array} \right] \right\rangle \end{array} \right] \end{array} \right]$$

The PPs in (14) correspond to two potential arguments of *load*, where the individual thematic roles supplied by each preposition represent their inherent semantics. For locative prepositions the  $LOCATION_{goal}$  role is the general set of entailments that define a participant as a locational goal (where I assume specific choices of locational prepositions, e.g. *on(to)*, *in(to)*, are pragmatically determined and not part of the thematic role per se). Following Croft (1991), I assume *with* assigns a role CAUSALLY-INTERMEDIATE, representing an entity that is causally intermediate in the event's force-dynamic structure, i.e. acted upon by the agent but force-dynamically antecedent to other participants.

This role encompasses both locatums and instruments (see Levin and Rappaport 1988 on *with* as a “displaced theme” marker).

To ensure compatibility between the preposition’s and verb’s individual thematic roles, the latter must be a superset of the former. I encode this via a function *sup*, where  $sup(P, Q) = Q$  if  $P \subseteq Q$  and  $\perp$  if  $P \not\subseteq Q$ .<sup>4</sup> The linking constraints are:<sup>5</sup>

$$(15) \quad v\text{-}lxm \Rightarrow \left[ \begin{array}{l} \text{ARG-ST} \left\langle \begin{array}{l} PP_{j_1} \left[ \text{ROLES} \left\{ \boxed{P_1} \right\} \right], \\ \dots, \\ PP_{j_m} \left[ \text{ROLES} \left\{ \boxed{P_m} \right\} \right] \end{array} \right\rangle \circ \text{list}(\text{non-PP}) \\ \text{CONT} \left\langle \begin{array}{l} \text{ROLES} \left\{ \boxed{Q_1}, \dots, \boxed{Q_m} \right\} \cup \text{set} \\ \text{RELS} \left\langle \begin{array}{l} \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } j_1 \\ \text{ROLE } \min(\text{sup}(\boxed{P_1}, \boxed{Q_1})) \end{array} \right], \\ \dots, \\ \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } j_m \\ \text{ROLE } \min(\text{sup}(\boxed{P_m}, \boxed{Q_m})) \end{array} \right] \end{array} \right\rangle \circ \text{list} \end{array} \right\rangle \end{array} \right]$$

Thus for each PP in (15), its role is a subset of some role Q in the ROLES set of that verb (corresponding to a decrease in thematic role type) and a superset of the role P determined by the preposition:

$$(16) \quad \text{Role}_{Prep} \subseteq \text{Actual Role} \subseteq \text{Role}_V$$

$$P \subseteq \min(\text{sup}(P, Q)) \subseteq Q$$

All *load* need specify is its ARG-ST and a list of maximal roles (including a locatum and locational goal, both holistically affected). No explicit linking needs to be stated (though I stipulate subject linking since I am primarily concerned here with objects):

$$(17) \quad \left[ \begin{array}{l} \text{ORTH} \langle \text{load} \rangle \\ \text{ARG-ST} \langle NP_i, NP, PP \rangle \\ \text{CONT} \left\langle \begin{array}{l} \text{ROLES} \left\{ \boxed{1} \text{LOADER}, \text{LOCATUM}_{load}, \text{LOCATION}_{load} \right\} \\ \text{RELS} \left\langle \begin{array}{l} \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } i \\ \text{ROLE } \boxed{1} \end{array} \right], \dots \end{array} \right\rangle \end{array} \right\rangle \end{array} \right]$$

<sup>4</sup>The function *sup* is only for presentational convenience. It simply serves to coidentify every entailment of the preposition’s role with an entailment in the verb’s role. Spelling this out explicitly reduces the readability of the AVMs.

<sup>5</sup>This constraint is English specific. For a language like Finnish with more elaborate case morphology (13) and (15) could be trivially elaborated by including a distinction between NPs which have a CASE feature with a structural case value vs. those with an oblique case value (which pattern like PPs). Note that the constraints in (15) are defaults; a particular verb can override the general linking of obliques to certain classes of roles if it idiosyncratically selects a particular oblique marker.

Although (17) stipulates few constraints, its output is restricted by the preposition inventory of English, yielding only two classes of head-complement structures, exemplified by (18) and (19):

$$(18) \quad \left[ \begin{array}{l} \text{ORTH} \langle \text{loaded, the wagon, with the hay} \rangle \\ \text{DTRS} \langle V, NP_j, PP_k \left[ \text{ROLES} \left\{ \boxed{1} \text{CAUSALLY-INTERMED.} \right\} \right] \rangle \\ \text{CONT} \left\langle \begin{array}{l} \text{ROLES} \left\{ \dots, \boxed{2} \text{LOCATUM}_{load}, \boxed{3} \text{LOCATION}_{load} \right\} \\ \text{RELS} \left\langle \dots, \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } j \\ \text{ROLE } \boxed{3} \end{array} \right], \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } k \\ \text{ROLE } \min(\text{sup}(\boxed{1}, \boxed{2})) \end{array} \right] \right\rangle \end{array} \right\rangle \end{array} \right]$$

$$(19) \quad \left[ \begin{array}{l} \text{ORTH} \langle \text{loaded, the hay, onto the wagon} \rangle \\ \text{DTRS} \langle V, NP_j, PP_k \left[ \text{ROLES} \left\{ \boxed{1} \text{LOCATION}_{goal} \right\} \right] \rangle \\ \text{CONT} \left\langle \begin{array}{l} \text{ROLES} \left\{ \dots, \boxed{2} \text{LOCATUM}_{load}, \boxed{3} \text{LOCATION}_{load} \right\} \\ \text{RELS} \left\langle \dots, \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } j \\ \text{ROLE } \boxed{2} \end{array} \right], \left[ \begin{array}{l} \text{role-rel} \\ \text{ARG1 } k \\ \text{ROLE } \min(\text{sup}(\boxed{1}, \boxed{3})) \end{array} \right] \right\rangle \end{array} \right\rangle \end{array} \right]$$

Acceptable structures similar to (19) could also be built with other acceptable locational goal markers (e.g. *in(to)*), while presumably *with* is the only general CAUSALLY-INTERMEDIATE marker in English (*by*, *via*, etc. mark more specific means/manner roles that are not subsets of *load*’s  $\text{LOCATUM}_{load}$  role). Any other prepositions, or different linking with the same prepositions, would result in a unification failure. Note that (following Markantonatou and Sadler 1995) no polysemy of the verb is required. Different variants arise from the thematic roles licensed by the verb and the inherent roles of the oblique markers, maintaining the (implicit or explicit) assumption of much recent work cited above that alternations are determined by the lexical semantics of the verbs and the relevant oblique markers.

This approach has two advantages over previous work discussed above. First, the semantics-to-morphosyntax mapping is encoded without intermediate levels of semantic structure such as predicate decompositions or structured elementary predications as in Koenig and Davis (2004) (see Beavers to appear for more discussion). Second, by basing the relevant generalizations on verb-specific individual thematic roles organized by types, it directly links the idiosyncratic semantics of each verb to the more general contrasts alternations exhibits across verbs.

Note that the generalization in (5) differs from the LFG approach in Ackerman and Moore (2001).

Ackerman and Moore propose that obliques deviate more than direct arguments from Dowty's (1991) proto-agent/patient roles ("less prototypical" in their PARADIGMATIC ARGUMENT SELECTION PRINCIPLE). On the approach outlined here, "less prototypical" is given a more specific interpretation as underspecificity of thematic role entailments, making a stronger claim. Furthermore, my approach, though defining thematic roles as sets of entailments, is not wedded to proto-roles and thus may capture a broader set of generalizations. For example, it is not a priori obvious that recipient realization in general needs to be modeled using proto-roles, even if the general principle in (5) nonetheless governs the semantic contrasts the dative alternation exhibits.

However, the analysis presented here is by no means complete; it is instead intended as a proof-of-concept for an entailment-based approach to alternations in HPSG. I have ignored several issues here, for instance verbs that do not undergo alternations (e.g. *put* and *fill* are non-alternating locative verbs) and alternations that exhibit no semantic contrast (e.g. *John blamed Mary for his problems/blamed his problems on Mary*). Likewise I largely ignore Dowty's proto-role theory, which could provide a more principled view of subject/object selection within which this framework could be situated (though see Davis 2001 for a critique of Dowty's approach). For more on these issues, see Beavers to appear. Finally, I make no predictions about which argument structures a given verb may have (having assumed that all locative verbs take one PP and two NP arguments). Presumably this is derivable from some of the same semantic factors discussed above, an issue I leave to future investigation.

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