

Towards A Semantic Analysis of Argument/Oblique Alternations in HPSG

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- I outline here a semantic analysis of argument/oblique alternations (Levin 1993).
- Following Beavers (to appear b), when such alternations exhibit semantic contrasts it is always in the relative number of entailments associated with the alternating argument.
- I sketch a framework for capturing these contrasts in HPSG.¹

1 Alternations and Lexical Semantics

- I use as my primary case study the locative alternation (Fillmore 1968, Anderson 1971, Levin and Rappaport 1988, Jackendoff 1990, Dowty 1991, *inter alia*):
 - (1) a. John loaded the hay onto the wagon. (locatum=DO, location=oblique)
 - b. John loaded the wagon with the hay. (location=DO, locatum=oblique)
- The classic observation (Anderson 1971) is that whichever participant is realized as direct object receives a “holistically affected” interpretation (all moved or 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 truck.
 - b.#John loaded the hay onto the wagon, with enough left over to fill the truck.
- Obliques are **underspecified** for holistic affectedness: it is not entailed or contradicted.
- Other properties of the participants are **invariant** across the alternation:
 - One participant is always a location that comes to contain something.
 - One participant is always a locatum that comes to be at least partially moved.
- Other realization patterns that are morphosyntactically similar to (1) involve related but distinct differences in interpretation (cf. Fillmore 1977, Dowty 1991):
 - (4) a. John cut his hand on the rock. (hand affected; rock not necessarily)
 - b. John cut the rock with his hand. (rock affected; hand not necessarily)

¹This is part of a larger study based on a theory of thematic roles as sets of entailments, following Dowty (1991). I use “entailment” in the sense of Dowty’s (1989) “lexical entailment”, i.e. properties a verb ascribes to an entity due to its role in the event, ignoring their ontological status as e.g. entailments vs. implicatures.

- This contrast is in simple affectedness: objects are affected, obliques are not necessarily.
- Similarly, in dative alternations first objects are abstract “goals” specified for possession, *to*-PPs are “goals” underspecified for possession (Green 1974, Oehrle 1976, Pesetsky 1995, Harley 2003, Levin and Rappaport Hovav 2005; contra Krifka 1999).

- (5) a. John sent a package to London.
 b.??John sent London a package. (OK on “London Office” reading).

- Likewise for the numerous other alternations (Beavers to appear b):

- (6) **Reciprocal alternation** (Underspecified motion)
 a. The car and the truck collided. (car and truck in motion)
 b. The car collided with the truck. (car in motion; truck not necessarily)

- (7) **Conative alternation I** (Underspecified holistic affectedness)
 a. John ate the sandwich. (sandwich all eaten)
 b. John ate at the sandwich. (sandwich not necessarily all eaten)

- (8) **Conative alternation II** (Underspecified affectedness)
 a. John slashed the canvas. (canvas affected)
 b. John slashed at the canvas. (canvas possibly not affected)

- (9) **Preposition drop alternation** (Underspecified holistic traversal)
 a. John climbed the mountain. (entire mountain traversed)
 b. John climbed up the mountain. (mountain possibly not all traversed)

- (10) **Search alternation I** (Underspecified existence)
 a. John hunted a unicorn in the woods. (unicorn presupposed to exist)
 b. John hunted (in) the woods for a unicorn. (unicorn might not exist)

- (11) **Search alternation II** (Underspecified holistic coverage)
 a. John searched the woods for deer. (woods totally searched)
 b. John searched in the woods for deer. (woods maybe not all searched)

- Thus an adequate analysis of alternations must capture the following generalization:

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

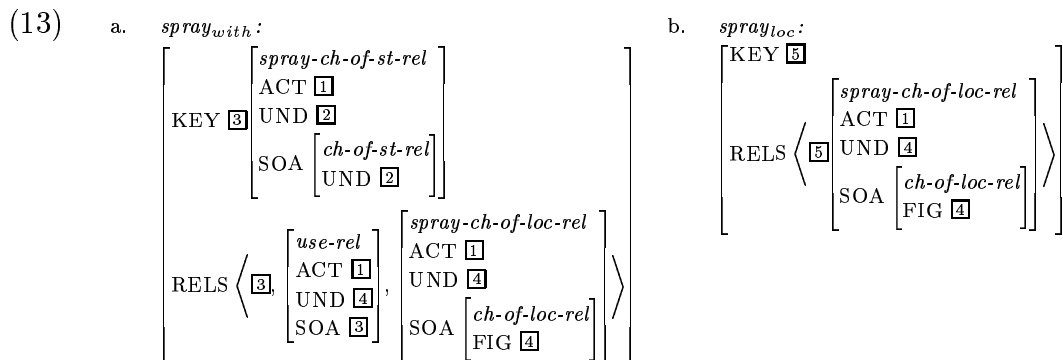
- The exact contrasts are simultaneously verb, verb-class, and alternation specific:

- **Alternation Specific:** All “locative” alternations underspecify affectedness.
- **Verb Class Specific:** *Spray/load* locative alternations underspecify holistic affectedness while *cut/break* alternations underspecify simple affectedness.
- **Verb Specific:** *Spray* alternations underspecify total movement/coverage, *load* underspecifies total movement/being loaded up.

- Ideally we want a general theory of alternations allowing degrees of lexical idiosyncrasy.

2 Previous HPSG Approaches to Alternations - Davis and Koenig

- Previous HPSG analyses generally do not posit rich enough semantics to capture (12). Koenig and Davis (2004) analyze locative alternations in terms of UND assignment.



- KEY.UND is always direct object, and alternations arise from different KEY choices.²
- Following Davis and Koenig (2000) and Davis (2001), UND is associated with verb-specific characteristic entailments (e.g. “incremental theme” a la Dowty 1991).
- But since these are not encoded directly, it isn’t clear how to state the contrast in (12).
- One could stipulate that the KEY.UND must be associated with more entailments than other patientive attributes (cf. Davis 2001). This presents several problems:
 - It fails to explain in a general way which entailments vary for each variant, verb, verb class, or alternation.
 - It fails to generalize to non-undergoer alternations such as dative and reciprocal.
 - It is unclear how one-argument alternations (e.g. preposition drop, *search*) work, especially those with different contrasts for different verbs (conative).
 - It also assumes polysemy. Can this be eliminated?
- One could replace UND with attributes representing the characteristic entailments (as in Koenig and Davis 2003), but this falls prey to most of the same problems.
- In general, a key motivation for this line of analysis is to eliminate unnecessary constructs like thematic hierarchies (cf. Davis and Koenig 2000, p.56, Davis 2001, p.25ff).
- However, this approach still relies on a mediating level of structure (predicate decomposition/attributes and/or KEY choice) between entailments and argument structure.
- To get the fine-grained contrasts in (12) we want the full spectrum of entailments to be first class entities upon which we can state grammatical constraints.³

²See Kordoni (2002, 2004) for related HPSG work on Greek and Van Valin (2002) for a similar approach in Role and Reference Grammar. Note that *use-rel* and *spray-ch-of-state-rel* have vanished in the *spray_{loc}* variant, although these presumably are invariant across both variants and should be present in both AVMS.

³See Beavers (to appear b) for further discussion of why predicate decompositions as in Levin and Rappaport (Hovav) (1988, 1998), Pinker (1989), Jackendoff (1990), Davis (1996, 2001), *inter alia* are ill-suited to capture (12). See Koenig and Davis (2004) for a more general critique of such approaches.

3 A Purely Entailment Based Approach

- I encode (12) in terms of thematic roles as sets of entailments as in Dowty (1989, 1991).

(14) For verb V describing situation s , the role participant x plays in s is a set of V -specific entailments R , which I refer to as its **individual thematic role** (Dowty 1989, p.76).

- 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 . Such thematic roles are rich in information.

(15)

	V-Specific	More General	Most General
LOCATUM _{load}	{ x loaded onto sth, ... }	x is moved, ...	x is affected, ... }
LOCATUM _{spray}	{ x sprayed out of sth, ... }	x is moved, ...	x is affected, ... }

- Some individual thematic roles are related to one another in terms of **specificity**.

(16) For two individual thematic roles R and Q , R is more **specific** than Q if $Q \subset R$.

- Thematic roles have inherent subset relationships, allowing us to reformulate (12):

(17) **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 $Q \subset R$.

- But this does not predict *which* roles x will bear for a given alternation and verb V . We need a more limited and general notion of possible contrasts.

- Following Dowty (1989), I do this via more general roles called **thematic role types**.⁴

(18) A **thematic role type** is a universal set of general, non-verb-specific entailments that cross-classify individual thematic roles in terms of properties such as affectedness, possession, motion, etc., relevant for argument linking.

- For object alternations I propose the following role types (Beavers to appear b).

(19)

Thematic Role Type	Informal Definition	Example Individual Thematic Roles
HOLISTICALLY AFFECTED	Affected to a specific degree	Completely loaded or moved entity (DO _{load})
AFFECTED	Affected to a non-specific degree	Loaded, moved entity (oblique _{load}), or cut entity (DO _{cut})
PARTICIPANT	Unspecified for affectedness	Entity not known to be affected (oblique _{cut})

⁴These are L-thematic roles in the sense of Dowty (1989): linguistically significant intersections of individual thematic roles. Note that the term “type” here is not related to the HPSG notion of “type”.

- “Affected” means changed, moved, created, etc. This can be defined precisely in the scalar approach to dynamic predicates in Beavers (to appear a). (cf. Hay et al. 1999).
- Thematic role types form specificity contrasts just as individual thematic roles do, forming general hierarchies reflecting decreasing specificity:

$$(20) \quad \text{HOLISTICALLY AFFECTED} \supset \text{AFFECTED} \supset \text{PARTICIPANT}$$

- These could be sets of proto-role entailments (following Dowty 1991) where HOLISTICALLY AFFECTED corresponds to the proto-patient role and other roles are subsets of it. I do not discuss this further here, though see Beavers (to appear b) and below.
- The alternations of individual thematic roles in (1) and (4) can be described as **minimal contrasts in their thematic role types** along (20):

$$(21) \quad \begin{array}{l} \text{General Contrast} \\ \textit{load/spray} \\ \textit{cut/break} \end{array} : \begin{array}{l} \text{HOLISTICALLY AFFECTED} \\ \text{DO} \\ \text{DO} \end{array} \rightarrow \begin{array}{l} \text{AFFECTED} \\ \text{OBL} \\ \text{DO} \end{array} \rightarrow \begin{array}{l} \text{PARTICIPANT} \\ \text{OBL} \\ \text{OBL} \end{array}$$

- In essence a relativized harmonic alignment of roles to markedness (cf. Aissen 2003).
- This can be characterized via a function *min* from individual thematic roles to individual thematic roles as in (22), by which we can reformulate (17) as in (23).

(22) For thematic role types τ_1 and τ_2 , $\tau_1 \supset \tau_2$, forming a minimal thematic role type contrast, and for individual thematic role R of type τ_1 , the role $Q = \textit{min}(R)$ is the maximal subset of R of type τ_2 .

(23) **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 $\textit{min}(R)$ as an oblique.

- For example, *the wagon* as a direct object in (1) has individual thematic role $\text{LOCATION}_{\textit{load}}$ of type HOLISTICALLY AFFECTED.
- Its role as an oblique is $\textit{min}(\text{LOCATION}_{\textit{load}})$ of type AFFECTED, including all the entailments in $\text{LOCATION}_{\textit{load}}$ save those that would make it type HOLISTICALLY AFFECTED.

$$(24) \quad \begin{array}{l} \text{John loaded the wagon with the hay.} \\ \left\{ \begin{array}{l} \text{all of } x \text{ is all filled up} \\ \textit{d.x is affected to d degree} \\ \dots \\ x \text{ is loaded} \\ x \text{ is affected} \\ \dots \\ x \text{ is a locational goal} \end{array} \right\} \supset \begin{array}{l} \text{John loaded the hay onto the wagon.} \\ \left\{ \begin{array}{l} x \text{ is loaded} \\ x \text{ is affected} \\ \dots \\ x \text{ is a locational goal} \end{array} \right\} \end{array}$$

- These are alternations of *individual thematic roles*; they are merely keyed to thematic role types (which are subsets of the individual roles).
- Verb, verb class, and alternation specific contrasts are intrinsically captured in this.
- Invariant entailments survive: these do not play in thematic role types.

4 Encoding in HPSG

- I encode (23) as constraints on $v-lxm$, which I present in two parts.
- 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):

$$(25) \quad v-lxm \Rightarrow mrs \ \& \ [\text{ROLES } \text{set}(\text{set}(\text{entailments}))]$$

- This defines the roles a verb assigns to its *direct* arguments via EPs of type *role-rel*:

$$(26) \quad \text{role-rel} \Rightarrow \text{elementary-predication} \ \& \ [\text{ARG1 } i \text{ } \text{ROLE } \text{set}(\text{entailments}(i))]$$

- Assigning roles to direct arguments is done by associating each NP argument directly with a role on the verb's ROLES list:

$$(27) \quad v-lxm \Rightarrow \left[\begin{array}{l} \text{ARG-ST} \langle \text{NP}_{i_1}, \dots, \text{NP}_{i_n} \rangle \circ \text{list}(\text{non-NP}) \\ \text{CONT} \left[\begin{array}{l} \text{ROLES } \{ \boxed{R_1}, \dots, \boxed{R_n} \} \cup \text{set} \\ \text{RELS } \left\langle \left[\begin{array}{l} \text{role-rel} \\ \text{ARG1 } i_1 \\ \text{ROLE } \boxed{R_1} \end{array} \right], \dots, \left[\begin{array}{l} \text{role-rel} \\ \text{ARG1 } i_n \\ \text{ROLE } \boxed{R_n} \end{array} \right] \right\rangle \circ \text{list} \end{array} \right] \end{array} \right]$$

- Ideally, the roles assigned to obliques 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), Wechsler (1995), and Davis (2001) 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 (28), where the individual thematic roles supplied by each preposition represent their inherent semantics.

$$(28) \quad \text{a.} \left[\begin{array}{l} \text{ORTH} \langle \text{onto, the, wagon} \rangle \\ \text{CONT} \left[\begin{array}{l} \text{ROLES } \{ \text{LOCATION}_{\text{goal}} \} \\ \text{RELS } \left\langle \left[\begin{array}{l} \text{wagon-rel} \\ \text{ARG1 } i \end{array} \right], \dots \right\rangle \end{array} \right] \end{array} \right] \quad \text{b.} \left[\begin{array}{l} \text{ORTH} \langle \text{with, the, hay} \rangle \\ \text{CONT} \left[\begin{array}{l} \text{ROLES } \{ \text{CAUSALLY-INTERMEDIATE} \} \\ \text{RELS } \left\langle \left[\begin{array}{l} \text{hay-rel} \\ \text{ARG1 } i \end{array} \right], \dots \right\rangle \end{array} \right] \end{array} \right]$$

- $\text{LOCATION}_{\text{goal}}$ defines a participant as a locational goal (specific choices of prepositions, e.g. *on(to)*, *in(to)*, are pragmatically determined and not part of the thematic role).
- Following Croft (1991), *with* assigns a role CAUSALLY-INTERMEDIATE, i.e. an entity that is intermediate in the event's force-dynamic structure, covering both instruments and locatums (cf. Levin and Rappaport 1988 on *with* as a “displaced theme” marker):

$$(29) \quad \begin{array}{cccc} \text{John} & & \text{hay} & & \text{wagon} & & \text{(Participants)} \\ \bullet & \longrightarrow & \bullet & \longrightarrow & \bullet & & \text{(Force dynamic chain)} \end{array}$$

- To ensure compatibility between the preposition's and verb's individual thematic roles, the latter must be a superset of the former:

$$(30) \quad \begin{array}{ccc} \mathbf{Role}_{Prep} & & \mathbf{Actual\ Role} & & \mathbf{Role}_V \\ P & \subseteq & min(Q) & \subset & Q \end{array}$$

- For presentational convenience, I encode this via a function sup , where $sup(P, Q) = Q$ if $P \subseteq Q$ and \perp if $P \not\subseteq Q$:⁵

$$(31) \quad v-lxm \Rightarrow / \left[\begin{array}{l} \text{ARG-ST} \left\langle \text{PP}_{j_1} [\text{ROLES } \{P_1\}], \dots, \text{PP}_{j_m} [\text{ROLES } \{P_m\}] \right\rangle \circ list(non-PP) \\ \text{CONT} \left[\begin{array}{l} \text{ROLES } \{Q_1, \dots, Q_m\} \cup set \\ \text{RELS } \left\langle \begin{array}{l} [role-rel \\ ARG1\ j_1 \\ ROLE\ min(sup(P_1, Q_1))] \end{array}, \dots, \begin{array}{l} [role-rel \\ ARG1\ j_m \\ ROLE\ min(sup(P_m, Q_m))] \end{array} \right\rangle \circ list \end{array} \right] \end{array} \right]$$

- The constraints in (27) and (31) determine the MAP principle.

5 Generating Alternations

- Given these constraints on $v-lxm$, alternations are licensed when:

- A verb V assigns some role R to a participant.
- There exists oblique marker P which inherently bears a role Q such that $Q \subseteq R$.

- The constraints on $v-lxm$ and the available verbs/oblique markers determine (a) when there is an alternation and (b) what the semantics is.
- For (1), all $load$ need specify is its ARG-ST and a list of roles its direct arguments would receive (including a locatum and locational goal, both holistically affected).
- No explicit linking need be stated (though I stipulate subject linking here):

$$(32) \quad \left[\begin{array}{l} \text{ORTH } \langle load \rangle \\ \text{ARG-ST } \langle NP_i, NP, PP \rangle \\ \text{CONT} \left[\begin{array}{l} \text{ROLES } \{ \square_{LOADER}, \text{LOCATUM}_{load}, \text{LOCATION}_{load} \} \\ \text{RELS } \left\langle \begin{array}{l} [role-rel \\ ARG1\ i \\ ROLE\ \square] \end{array}, \dots \right\rangle \end{array} \right] \end{array} \right]$$

- The preposition inventory of English restricts realization to only two kinds of head-complement structures:

⁵This constraint is English specific. For a language like Finnish with more elaborate case morphology (27) and (31) 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 (31) 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.

$$(33) \left[\begin{array}{l} \text{ORTH} \langle \textit{loaded, the wagon, with the hay} \rangle \\ \text{DTRS} \langle V, NP_j, PP_k [\text{ROLES} \{ \mathbb{1} \text{CAUSALLY-INTERMEDIATE} \}] \rangle \\ \text{CONT} \left[\begin{array}{l} \text{ROLES} \{ \dots, \mathbb{2} \text{LOCATUM}_{load}, \mathbb{3} \text{LOCATION}_{load} \} \\ \text{RELS} \langle \dots, \left[\begin{array}{l} \textit{role-rel} \\ \text{ARG1 } j \\ \text{ROLE } \mathbb{2} \end{array} \right], \left[\begin{array}{l} \textit{role-rel} \\ \text{ARG1 } k \\ \text{ROLE } \min(\textit{sup}(\mathbb{1}, \mathbb{2})) \end{array} \right], \dots \rangle \end{array} \right. \end{array} \right]$$

$$(34) \left[\begin{array}{l} \text{ORTH} \langle \textit{loaded, the hay, onto the wagon} \rangle \\ \text{DTRS} \langle V, NP_j, PP_k [\text{ROLES} \{ \mathbb{1} \text{LOCATION}_{goal} \}] \rangle \\ \text{CONT} \left[\begin{array}{l} \text{ROLES} \{ \dots, \mathbb{2} \text{LOCATUM}_{load}, \mathbb{3} \text{LOCATION}_{load} \} \\ \text{RELS} \langle \dots, \left[\begin{array}{l} \textit{role-rel} \\ \text{ARG1 } j \\ \text{ROLE } \mathbb{2} \end{array} \right], \left[\begin{array}{l} \textit{role-rel} \\ \text{ARG1 } k \\ \text{ROLE } \min(\textit{sup}(\mathbb{1}, \mathbb{3})) \end{array} \right], \dots \rangle \end{array} \right. \end{array} \right]$$

- Acceptable structures similar to (34) are licensed by other goal markers (e.g. *in(to)*).
- Presumably *with* is the only CAUSALLY-INTERMEDIATE marker in English (*by, via*, etc. mark more specific means/manner roles not subsets of LOCATUM_{load}).
- Any other obliques, or different linking with the same ones, lead to unification failure.
- No verbal polysemy is required; alternations arise from the shape of the lexicon (following Markantonatou and Sadler 1995, who also assume underspecified verbs but with a complex semantics involving reified proto-roles *causer/patient*; cf. ACT/UND).

6 Comparison to Ackerman and Moore

- This approach differs from Ackerman and Moore (2001), who propose that direct arguments are “more prototypical” than obliques relative to Dowty’s proto-roles:

(35) PARADIGMATIC ARGUMENT SELECTION PRINCIPLE:

Let $P(\dots, arg_i, \dots)$ and $P'(\dots, arg'_i, \dots)$ be related predicates, where arg_i and arg'_i are corresponding arguments. If arg_i and arg'_i exhibit different grammatical encodings and arg_i is more prototypical with respect to a particular proto-role than arg'_i , then arg_i ’s encoding will be less oblique than arg'_i ’s encoding. (*ibid*, Ch.7, (2), p.169)

- However, what “more” or “less” prototypical means is not specified.
- On my approach, “less prototypical” is given a more specific interpretation as underspecificity of individual 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 objects it makes sense to assume a proto-patient role to explain the variability in what can be the object (see Levin 1999 on the wide spectrum of possible object roles):

- (36) a. John ate the bread. (Holistically affected)
 b. John tore the bread. (Affected)
 c. John touched the bread. (Participant)

- The direct object is always the entity closest to being HOLISTICALLY AFFECTED.
- But there is no evidence for a “proto-recipient” since first objects are categorically possessors (subject of HAVE; Green 1974). No ditransitive selects for goal/target FOs.
- The MAP nonetheless predicts the semantics of dative shift, since it makes claims about the relative roles of direct arguments to alternant obliques, proto-role or not.
- It is not clear how Ackerman and Moore’s approach explains this.

7 Conclusion

- This approach has three advantages over previous work discussed above.
 - It captures the verb, verb class, and alternation specific underspecificity contrasts, linking them in a transparent way.
 - The form-to-meaning mapping is encoded without intermediate structure.
 - It reduces polysemy.
- Assumes thematic role types, which follow directly from assuming entailment sets.
- It moves towards bringing obliques into the theory of Dowty (1991), but without the levels of intermediate representation argued to be necessary by Davis (2001).
- However, this analysis is by no means complete; I have ignored several issues here:
 - Subject and object linking more generally
 - * We still need a proto-role theory (see Beavers to appear b).
 - Verbs that do not undergo alternations (e.g. *put*, *fill*, *donate*)
 - * (Some) can be modeled by asymmetric proto-role assignments.
 - Non-semantic alternations (*John blamed Jo for his problems/his problems on Jo*)
 - * Other factors are known to govern alternations, such as animacy, referentiality, heaviness, definiteness, etc. (Erteschik-Shir 1979, Givón 1984, Arnold et al. 2000, Wasow 2002, Aissen 2003, Bresnan and Nikitina 2003).
 - * The MAP is just one of many harmonic alignment principles.
- Finally, I make no predictions about which argument structures a given verb may have (having assumed e.g. that all locative verbs take one PP and two NP arguments).
- However, degree of affectedness is known to partly govern transitivity cross-linguistically (cf. Hopper and Thompson 1980, Tsunoda 1981, 1985, Testelec 1998), and ditransitivity is cross-linguistically correlated with transfer of possession (Croft et al. 2001).
- Thus some aspects of argument structure, which I assume is partly independent of linking (cf. Davis 2001), may be predictable by the same criteria governing alternations.

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