A Frame-Based Semantics of the Dative Alternation in Lexicalized Tree Adjoining Grammars

Introduction There is a growing consensus that lexical meaning interacts with constructional meaning in intricate ways and that this interaction is crucial for theories of argument linking and the syntax-semantics interface. The key question is how the meaning components are distributed over the lexical and morphosyntactic units of a linguistic expression and how these components combine. A model that is able to capture phenomena of this type should be sufficiently flexible with respect to the factorization and combination of lexical and constructional units. To this end, we propose a framework that integrates *Lexicalized Tree Adjoining Grammars* (LTAG) with *Frame Semantics*.[1] Its underlying "metagrammatical" specification allows a strong factorization of the syntactic and semantic information. Moreover, the framework is suitable for computational processing. We illustrate our approach by a fine-grained analysis of the dative alternation in English.

LTAG and grammatical factorization An LTAG (Joshi and Schabes, 1997) consists of a set of *elementary trees* and provides two operations for building larger trees: *substitution* (replacing a non-terminal leaf with a new tree) and *adjunction* (replacing an internal node with a new tree). The elementary trees of an LTAG are lexicalized and contain non-terminal leaves for all the arguments of their lexical head. Because of this extended domain of locality, LTAG is particularly well-suited for a frame-based compositional semantics. The semantic frame of a predicate specifies, among others, the thematic roles of its arguments. In LTAG, these can be immediately linked to the corresponding syntactic argument slots (Fig. 1). LTAG also allows for a high degree of factorization inside the lexicon: Elementary trees are usually specified by means of a *metagrammar* (Crabbé and Duchier, 2005) which consists of dominance and precedence constraints and category assignments. The elementary trees of the grammar are defined as the *minimal models* of this constraint system. The metagrammar formalism allows for a compact grammar definition and for the formulation of linguistic generalizations. In particular, the metagrammatical specification of a subcategorization frame defines the set of all unanchored elementary trees that realize this frame. Moreover, the formalism allows one to define tree fragments that can be used in different elementary trees, thereby giving rise to an additional factorization and linguistic generalization. A similar factorization is possible within the semantics. The semantic contribution of unanchored elementary trees, i.e., constructions, can be separated from their lexicalization, and the meaning of a construction can be decomposed further into the meaning of fragments of the construction. Due to this factorization, relations between the different parts of a certain syntactic construction and the components of a semantic representation can be expressed.

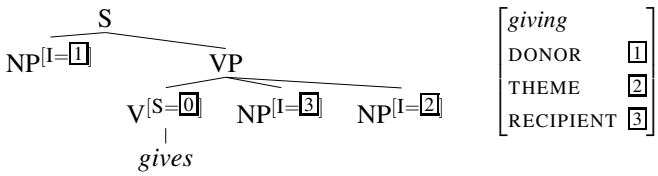

Figure 1: Elementary tree and semantic frame for *gives*

Semantic properties of the dative alternation The English dative alternation is concerned with verbs like *give*, *send*, and *throw* which can occur in both the double object (DO) and the prepositional object (PO) construction (1). The two constructions are traditionally associated with a 'caused possession' and 'caused motion'

(1) John sent Mary the book. (DO) / John sent the book to Mary. (PO)

interpretation, respectively. However, the contrast between the DO and the PO variant and their respective interpretations has been observed to span a wider range of options. Rappaport Hovav and Levin (2008) distinguish three types of alternating verbs based on differences in the meaning components they lexicalize: *give*-type, *send*-type, *throw*-type verbs.[2] They provide evidence that verbs like *give* have a caused possession meaning in both kinds of constructions. The *send* and *throw* verbs, by contrast, lexically entail change of location and allow both interpretations depending on the construction they occur in. The *send* and *throw* verbs differ in the meaning components they lexicalize: *send* lexicalizes caused motion towards a goal, whereas *throw* encodes

[1] Existing proposals of a syntax-semantics interface for Tree Adjoining Grammars focus on standard sentence semantics and are not concerned with the intricacies of lexical and constructional meaning; cf. Gardent and Kallmeyer (2003).

[2] For simplicity, we do not take into account differences in modality as between *give* and *offer*; cf. Koenig and Davis (2001).

the caused initiation of motion and the manner in which this is done. A spatial goal is not lexicalized by *throw* verbs, which accounts for the larger range of directional PPs allowed for these verbs. Krifka (2004) provides an explanation of why other causative motion verbs such as *pull* do not occur in the DO pattern: *pull* contrasts with *throw* in that it lexicalizes a "continuous imparting of force" between the causing event and the movement, which is incompatible with a caused possession interpretation. Finally, the DO construction with caused possession interpretation also occurs for creation verbs with benefactive extension as in *bake her a cake* (Goldberg, 2010). In sum, the DO and PO constructions strongly interact with the lexical semantic structure of the verb.

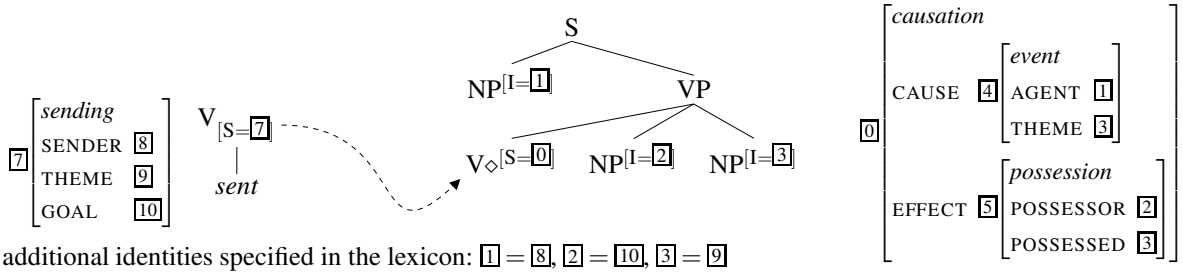

Figure 2: Lexical selection of the elementary tree for *sent* in the DO construction of (1)

Sketch of analysis Modelling the above data in our approach calls for a sufficiently detailed decomposition of the semantics of verbs and constructions using frames represented as typed feature structures. Moreover, the semantic frames and their subcomponents are to be associated with morphosyntactic trees and tree fragments. The following analysis of a DO construction serves as a first sketch of how this program can be put into practice. More details will be provided in the full paper, including a more thorough event structure representation in the decompositional frames. Fig. 2 shows the lexical selection for the DO example in (1). The lexical head *sent* is linked to the unanchored construction, which is associated with the semantic frame for the caused possession interpretation. In the lemma entry of *send*, one can specify equations between attributes of the lexical item and attributes of the argument nodes in the unanchored tree that the lexical item selects. This is how the identities 1 = 8, 2 = 10, 3 = 9 are added. The unification of 0 and 7 leads to a semantic frame for the DO elementary tree anchored with *sent* where the SENDER is the AGENT of the causing event, the GOAL is the POSSESSOR of the result state, etc. The unanchored tree in Fig. 2 and its associated semantic frame can be further decomposed in the metagrammar by means of the template specifications shown in Fig. 3 ($\prec$ is immediate linear precedence, $\prec^*$ is linear precedence). The minimal model of *DOConstr* is the unanchored tree from Fig. 2 plus its semantic frame.

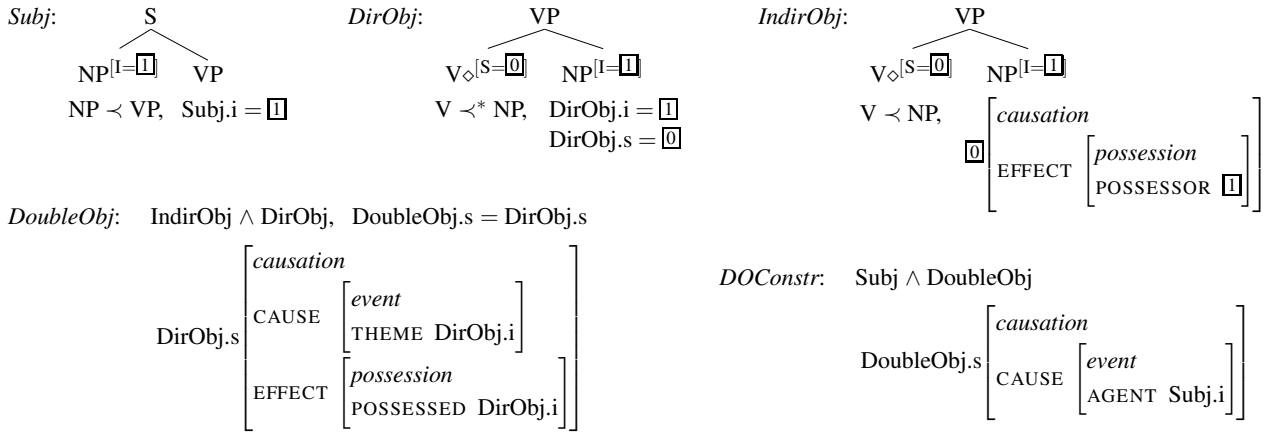

Figure 3: Metagrammatical factorization of the DO construction

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