Describing valence-increasing constructions with XMG

Valeria Generalova
Heinrich Heine University of Dusseldorf
Dusseldorf, Germany
generalo@hhu.de

Abstract

This paper presents an analysis of syntactic and semantic derivations caused by the addition of a derivational affix to the verb.[1] It examines two valence-increasing constructions – causative and applicative – leading to the formation of three-argument cores. The paper contributes to the project based on Role and Reference Grammar (RRG) and uses eXtensible MetaGrammar (XMG) as the main technical framework.

1 Introduction

Morphological derivation sometimes leads to further structural changes.[2] Namely, in some languages, there are morphological devices to encode valence-modifying operations. As the argument structure changes, syntactic and semantic derivations take place. This paper examines constructions with a morphological derivation of a verb leading to valence increase. It aims to present a formalized description suitable for grammar-engineering purposes of both syntactic and semantic derivations conditioned by the addition of an affix to a verb.

This paper is a position work and does not offer any quantitative experimental data. Nevertheless, it aims to contribute to an existing grammar engineering project, which has been first presented as Generalova and Petitjean (2020). The present paper grounds on Role and Reference Grammar (RRG, Van Valin and LaPolla (1997); Van Valin (2005)). It is a powerful theory created bearing typological distinctions of languages in mind, which is an asset for a multilingual grammar engineering project. For creating syntactic trees, we use the formalized version of it presented by Osswald and Kallmeyer (2018). In contrast to classical RRG, it uses features for encoding properties of syntactic constituents and for linking them to other dimensions. For representing semantics, we use decompositional frames, as suggested in Lichte and Petitjean (2015). These data structures are well compatible with features in the syntactic dimension. They also allow a fine-grained unification of features, which is important for a precise description of complex linguistic phenomena.

The paper is organized as follows. In Section 2, we describe the scope of the present paper and show examples of the data we use. We also introduce the most important definitions. Section 3 presents the theory and the technical framework used in our study. It also compares the present paper to a similar project realized in another framework. Section 4 presents our analysis of syntactic and semantic derivations in causative and applicative constructions. Finally, Section 5 summarizes our claims and indicates directions for further studies.

2 Data

To explore how morphological derivation influences syntactic and semantic structures, we took a case where this effect can be observed clearly. We decided to focus on valence-increasing affixes attached

[1]This study is funded by an ERC Consolidator Grant awarded to Prof. Laura Kallmeyer.

[2]Abbreviations: 1 = first person, 3 = third person, ACC = accusative, APPL = applicative, C1 = noun class 1, C7 = noun class 7, CAUS = causative, DAT = dative, FOC = focus, FV = final vowel, M = masculine, NOM = nominative, PRS = present, PST = past, SG = singular.

to transitive verbs. Since most core structures are two-argument, the addition of a third one is a particular operation, which can not be confused with other grammatical phenomena. This is the reason why we narrowed our scope to two types of constructions: causative-of-a-transitive and three-argument applicative.

Our data is collected from secondary sources: grammars, field notes, typological studies. We also make use of various typological databases such as Dryer and Haspelmath (2013); Hartmann et al. (2013) and others.

2.1 Causative-of-a-transitive

We follow the typology of causative constructions couched in Dixon (2000) since it pays special attention to causatives derived from transitive verbs. We try to use bases that exhibit high Transitivity (according to (Hopper and Thompson, 1980)), but some other two-argument verb bases are also attested in our data.

A typical example of a three-argument causative construction is given in (1). The newly introduced argument, the causer, becomes the PSA and demotes the causee to another position. Nevertheless, syntactic tests show that it is still within the CORE and does not become a peripheral adjunct.

(1) *Avanu-∅ nana-ge bisket-annu tinn-is-id-anu* KANNADA
3SG-NOM 1SG-DAT biscuit-ACC eat-CAUS-PST-3SG.M

'He fed me a biscuit,' or 'He made me eat a biscuit.' (Foley and Van Valin, 1984, 384)

It is not always easy to determine whether the non-macrorole still remains in the core. Many languages do not allow three-argument cores, and thus, causative verbs derived from transitive bases remain two-argument. We try to exclude these cases from our sample by determining the argumenthood of the participants using syntactic evidence.

2.2 Three-argument applicative

We follow Peterson (2007, 1) and define applicative constructions as those encoding "thematically peripheral argument or adjunct as a core-object argument". With respect to RRG terminology, we are going to explore sentences having three arguments in the CORE.

Three-argument applicative constructions are attested in 81 languages, according to Polinsky (2013). However, not all of them are selected for our study. First, we exclude from our sample the so-called "obligatory applicatives" (Peterson (2007, 46), see discussion in Peterson (2007, 50-51)) since we are interested in having a minimal pair of an alternation. Second, we are interested in valency-increasing and not valency-modifying applicatives. In Peterson's terms, both the applicative object and the base object must demonstrate some object properties (Peterson, 2007, 51-53). Examples of this type of construction can be found in Bantu languages, see (2).

(2) *N-ä-ï-lyì-í-à m-kà k-élyà* CHAGA
FOC-1SG-PRS-eat-APPL-FV C1-wife C7-food

'He is eating food for his wife' Bresnan and Moshi 1993:49-50 cited in Pylkkänen (2002, p. 17,(2a))

There is one more important difference between applicative affixes that is relevant to this paper. Peterson (2007, 40-45) distinguishes between affixes that mark an applicative construction where the semantic role of the applicative object is determined ("morphologically distinct") and universal ("morphologically non-distinct") markers that appear in several types of applicative constructions. In our study, we work with both types of applicative affixes and treat them differently in Sec. 4

3 Background

This section briefly overviews the theoretical and methodological background of our study. It features only the most relevant concepts related to the present paper.

3.1 RRG

The present paper is driven by Role and Reference Grammar = RRG (Van Valin and LaPolla, 1997; Van Valin, 2005). This theory has been developed with linguistic diversity in mind and thus suits our goals well.

Syntactic representations in RRG are realized as trees, where each layer corresponds to a syntactic entity. Our study will be dealing with CORE structures – syntactic levels comprising the predicate with all its arguments, but nothing more. The predicate is placed in the NUCLEUS, being the essential part of the CORE. A CLAUSE, which is a well-known unit in any linguistic paradigm, is built upon a CORE and also includes PERIPHERY (non-arguments).

We also use the concept of macroroles from the classical RRG (Van Valin, 2005, 60–68). There exist two macrorles – Actor and Undergoer – that, in fact, are extreme generalizations of semantic roles. This approach helps to trace similarities between different grammatical phenomena and across languages.

Usually, in constructions with transitive verbs, the syntactic subject (called PSA = privileged syntactic argument) bears the Actor macrorole and the direct object – the Undergoer. Since there are only two macroroles[3], in three-argument constructions, one participant does not bear any macrorole (= is a non-macrorole participant, NMR). However, syntactic and semantic derivations can lead to macrorole reassignment: for example, in causative constructions like (1), the former actor becomes NMR, since the newly introduced participant is Actor; the Undergoer macrorole remains assigned to the same participant.

For the semantic representations, we use frames in the form of attribute-value matrices as they allow for keeping track of typed features (Lichte and Petitjean, 2015). We follow the approach suggested by (Osswald and Kallmeyer, 2018) (more discussion and comparison with other solutions can be found in (Kallmeyer and Osswald, 2013)). These data structures tell the type of the predication (more or less corresponding to the Aktionsart, see Van Valin (2005, 32-42)), the list of semantic roles of this predication, the correspondence of these roles to macroroles, and, if available, other semantic features. From the technical side, frames are easy to implement in XMG and thus inherit information from each other to reflect generalizations vs. language-specific information.

3.2 XMG

We use the technical framework called XMG = eXtensible MetaGrammar (Crabbé et al., 2013; Petitjean et al., 2016) that has been designed for describing various grammatical structures. The XMG description language is static and declarative. It means that instead of formulating rules that apply consequently, XMG descriptions comprise immutable constituents and constraints that regulate their combinations. With the use of conjunction and disjunction, XMG gets rid of the “ordering and termination issues" often occurring in procedural approaches and offers “monotonic (no information removal)” descriptions ((Crabbé et al., 2013, 597)).

The basic unit of an XMG metagrammar is a class, which can correspond to an entity of any level, from morpheme to sentence. A class can comprise one or several dimensions (syntactic, semantic, morphological, etc.). Within each dimension, one can declare variables and assign them features. The values of these features can be specified or defined as unification constraints (e.g. value of feature f_1 on variable v_1 is required to be equal to value of feature f_1 on variable v_2).

Classes are organized in hierarchies. This is possible due to the inheritance mechanism that allows to borrow the content of one class and add it to the description of another one. Conjunction and disjunction help fine-tuning the borrowing process to ensure the inheritance of necessary fragments only. The inheritance mechanism contributes to the greater modularity of descriptions. For two classes being alike to even a small extent, it is possible to declare the common traits apart and only once in order to inherit them afterwards.

[3]Some discussion about the third macrorole can be found in Van Valin (2007); Haspelmath (2006); Diedrichsen (2012); Kailuweit (2013).

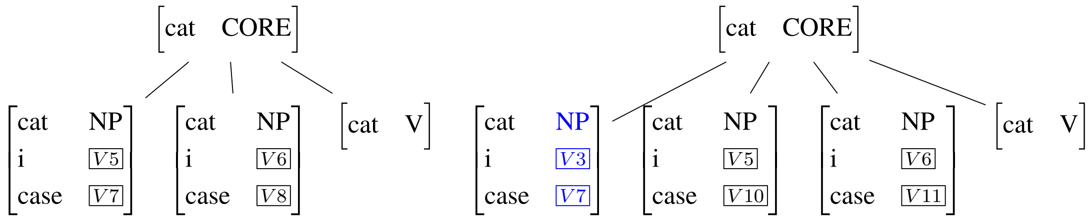

Figure 1: Syntactic trees for a (i) two-argument construction and (ii) the derived three-argument causative construction

3.3 Comparison to Curtis (2018)

A well-developed solution for valence-modifying constructions has been presented in Curtis (2019), and, in more detail, Curtis (2018). It accounts for a small number of typologically varied and genetically unrelated languages, following the typology by **?**. Their project is similar to ours in the respect that it also seeks to decompose complex rules into simpler "building blocks". The difference is that our study is rooted deeper in the typology and does not present benchmark tests (yet).

It is difficult to offer a close comparison of this solution with ours since both the theoretical backgrounds (HPSG vs. RRG) and the used methodologies vary a lot. First of all, Curtis (2019) describes only semantic structures, while one of the key goals of our project is to suggest linked syntactic and semantic representations.

Second, the method in Curtis (2019) is focused on the modification of initial semantic structures. Thus, it suggests "rules" that tell how frame changes have to take place. In contrast, our focus is to determine what morphological items are responsible for what parts of syntactic and semantic derivations. The structures we produce represent the resulting representations and trace all intermediary steps required for their combination.

However, some common traits can be found in both projects. For example, the concept of "axes of variation" (Curtis, 2019, 116-117) implies that each "rule component" (which can be a constituent, a constraint or something else) can have only a limited and pre-defined scope of variation. In our project, limited variation also plays an important role in filtering out ungrammatical structures. But in our architecture, these axes are built with the restriction on the values of features in each XMG class.

4 Analysis

4.1 Syntactic changes

In traditional causative and applicative constructions, the valence-increasing affix adds one argument to the syntactic core of the clause. An example of a tree structure corresponding to the derivation of a three-argument causative construction is shown in Fig. 1, which corresponds to the derivation of 1. Labels $\boxed{V5}$ and $\boxed{V6}$ identify the syntactic arguments of the non-derived two-argument construction. The label $\boxed{V7}$ refers to the case normally used for the PSA (=syntactic subject). It encodes one of the arguments of the non-derived construction and the causer, the added argument in the derived construction (identified as $\boxed{V3}$). Other cases in the derived construction depend on the language and the construction type and are not necessarily identical to those used in the non-derived construction (which is shown by new labels $\boxed{V10}$ and $\boxed{V11}$).

Formally, it could have been realized as (sister) adjunction (Osswald and Kallmeyer, 2018, 362-363). However, the method of adjunction is not suitable for argument addition. It is normally exploited for adding peripheral elements to the core since they do not interact with the part they attach to. In contrast, the procedure of argument addition requires a certain re-analysis of the initial syntactic structure (e. g., macrorole reassignment, change of case marking). Therefore, an intuitively simple derivation through adjunction is not an option for verbal derivation.

Another approach is to perceive argument derivation as a nuclear juncture (Van Valin, 2005, 234-239). The core idea is that one postulates two initial predications that merge into a more complex one. This approach has received both support and critique (see Cole (1983); Alsina (1992); Kemmer and Verhagen (1994); Horvath and Siloni (2011) *inter alia*). With relation to valence-increasing constructions formed by morphological means, we find this analysis especially farfetched. The increase of valence is realized by means of an affix, which in most languages is not related to another predicative elements. By all means, once it is fully grammaticalized, there is no morphological clue for construing valence-increasing constructions as complex clauses.[4]

What we actually suggest is to delimit tree-specific and construction-specific properties from each other. One separate XMG class determines the shape of the tree, in particular, the number of arguments and their order. The latter is realized thanks to the unification of the value of the feature `word order` with the value of the same feature in a language description in a separate XMG class.

In turn, classes encoding specific constructions import the respective class from the set of three shapes (e.g., the construction `causative-of-a-transitive` would take the three-argument template) and assign values to other features, namely, morphological cases, macroroles, etc. To ensure that classes describing specific constructions do not match unintended tree shapes, one can use the XMG notion of *family* (Petitjean et al., 2016, 594). Trees belonging to the same family can share structural information with each other, but not with other families.

Thus, we suggest grouping syntactic trees by the number of arguments they have. In this solution, `simple transitive` and `causative-of-an-intransitive` would fall into the same family as being two-argument constructions, while, for example, `causative-of-a-transitive` would be in a different, three-argument family.

Using this solution, we approach the very question of syntactic derivation differently. The derivation now does not consist in modifying the initial structure. The derived structure with an increased number of arguments has to be accessed through a different family. To achieve this, one has to ensure that the combination of the verbal stem and the derivational affix indicates the family the resulting tree belongs to unambiguously. This is possible due to the unification of feature values between classes describing the verbal stem, the derivational affix and the resulting derived construction.

This is illustrated in Fig. 2. In both tree structures, on the CORE level, there are boolean features `trans (transitive)` and `caus (causative)`. In the model shown in Fig. 2, they determine the tree shape (other features being omitted for the sake of example's clarity, feature values on arguments are determined as if illustrating one particular language). Thus, the transitive non-causative (upper) tree has only two arguments. The causative-of-a-transitive (lower) tree is more complex. The value of the feature `trans` is defined on the verbal stem and percolates upwards to the V (verb) node and then to the CORE. The feature `caus` is defined on the causative affix since its value is negative in the absence of this affix. It also percolates upwards, and the two positive values at the CORE level make this structure match the three-argument tree shape.

So, the combination of features at the core level determines the construction class, which, in turn, belongs to a single family. This ensures the selection of the appropriate syntactic derivation.

In terms of syntactic mechanisms, all valence-increasing constructions look alike. Moreover, valence-reducing constructions are represented in our solution similarly: stems and affixes are assigned features whose combination is unique for describing a construction and conditions the selection of the correct tree shape.

In the next section, we will show how the semantic derivation is realized and the differences between causative and applicative valence-increasing constructions.

4.2 Semantic changes

As already mentioned, we use decompositional frames to represent semantic structures. Similar to syntactic structures, they comprise features that are assigned values. Moreover, feature values can be unified across dimensions, i. e., syntactic features can share their values with semantic features and vice versa.

[4]Nevertheless, one can perform syntactic tests to attest whether a construction demonstrates some properties of a bi-clausal entity.

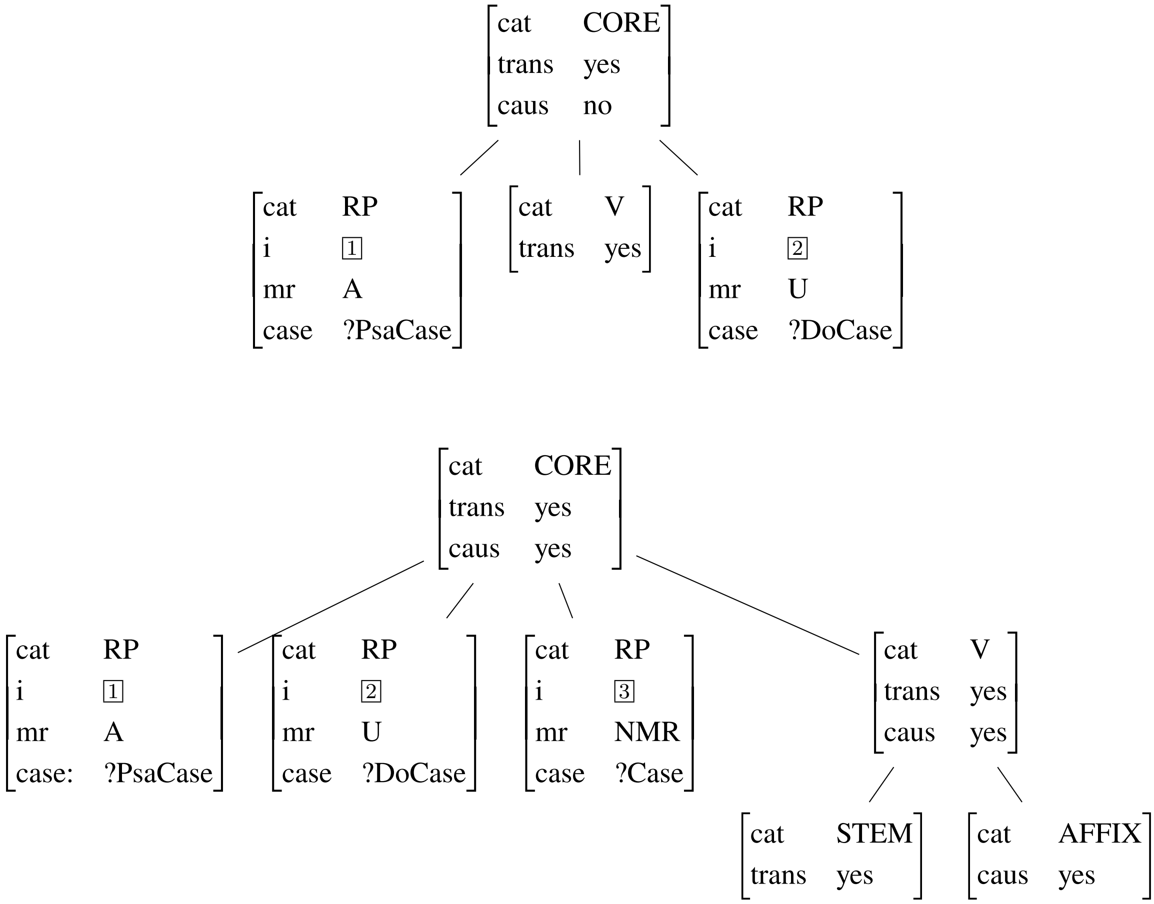

Figure 2: Features percolating up to the CORE level in a (i) simple transitive construction, (ii) causative-of-a-transitive construction

The semantic derivation of a causative construction requires the composition of a complex frame from elementary subframes, see 3. The *effect* being the frame of the base verb with its role structure (we use generalized terms to label two different participants). The *cause* subframe encodes the activity of causation and the participant responsible for it, i. e., the causer. In all languages, the sole participant of the *cause* subframe becomes the Actor of the resulting construction (see label below subframes), while the Undergoer macrorole can be assigned to either participant of the *effect* subframe depending on the language.

In XMG, frames can be inherited from other classes and combine with each other. Since the *effect* subframe encodes the role structure of the base verb, it is clear that it is assigned to the verbal stem in the Lexicon. The *cause* subframe is assigned to the derivational causative affix. They combine in a single frame at the level of the V (Verb) node, and the participant labels are specified at the level corresponding to the CORE (once all participants are already known).

Frames allow the introduction of additional purely semantic features. For example, some languages distinguish between factual, permissive, prohibitive and other constructions where the causation activity receives some additional semantics. These properties can be introduced to the semantic frame of the causation by using the feature *manner* (see Generalova (2020) for details). Importantly, this feature can be introduced at any level. If two constructions with different semantics are derived by means of different verbal affixes, the *manner* feature is going to be part of the frame stored for the respective affix in the Lexicon. If constructions differ at a syntactic level, additional features can be introduced in the construction class (at the level corresponding to the syntactic CORE).

$$\begin{bmatrix} \textit{causation} & \\ \text{CAUSE} & \begin{bmatrix} \textit{activity} & \\ \text{EFFECTOR} & \boxed{1} \end{bmatrix} \\ \text{EFFECT} & \begin{bmatrix} \textit{predicate} & \\ \text{ACTOR-LIKE} & \boxed{2} \\ \text{UNDERGOER-LIKE} & \boxed{3} \end{bmatrix} \\ \text{Actor} & \boxed{1} \\ \text{Undergoer} & \boxed{3} \end{bmatrix}$$

Figure 3: Generalized frame for causative construction

Applicative constructions are more complicated in this respect since the derivation does not involve a second frame. The applicative morpheme does not bear a (sub)frame by itself but operates on the frame of the base verb. Nevertheless, the basic mechanism of splitting features between the verbal stem and the derivational affix can still be applied.

As demonstrated in Sec. 2, there are two main types of applicative affixes. First, some languages have families of applicative constructions, where the suffixes indicate the role of the applied object. In this situation, the postulation of a boolean feature (like `caus: yes`) for applicative constructions is insufficient. Indeed, there is only one way of frame modification introduced by the causative affix, but several different applicative constructions. Therefore, we suggest postulating a categorical feature `applied object` that would take as its value the semantic role of the applicative object (e.g., `ben` in (2)).

A more complicated case is the “morphologically non-distinct applicative construction marker" (Peterson, 2007, 43), i. e. a marker that encodes several constructions. This kind of affixes can not bear the precise semantic role of the applicative object.

One possibility is to list all the semantic roles that can be assigned to the applicative object in a construction with a given suffix is a disjunction. Thus, each applicative verb is potentially the head of the whole family of applicative constructions. The semantic frame with the correct semantic role is thus selected at the latter stage (corresponding to the core level), where all participants are already in the sentence.

However, this approach is problematic since it is difficult to determine the semantic role of the participant in the applicative construction from its syntax. For precise diagnostics, additional lexical features have to be defined in the Lexicon for each noun. Without that, one could only tell that the frame comprises an applied object without specifying its role. Actually, this latter logic is used in our project, while the elaboration of optimal feature sets is the next step of our research.

5 Conclusion

In this paper, we examined constructions where morphological derivation entails syntactic and semantic changes. By exploring three-argument causative and applicative constructions, we demonstrated that the syntactic effect of both types of affixes is fairly similar. In contrast, mechanisms of semantic derivation used in causative constructions differ from those taking place in applicative constructions. We formalized our analysis using Role and Reference Grammar and eXtensible MetaGrammar. Without going deep into technical details, we demonstrated mechanisms of class inheritance and feature unification that result in producing linked syntactic and semantic representations of three-argument constructions.

The present paper is a part of a larger project. Within its scope, the next steps would be to refine the treatment of morphologically non-distinct applicative affixes and extend the methodology to handle not only valence-increasing constructions.

References

Alex Alsina. 1992. On the argument structure of causatives. *Linguistic inquiry* 23(4):517–555.

Peter Cole. 1983. The grammatical role of the causee in universal grammar. *International Journal of American Linguistics* 49(2):115–133.

Benoit Crabbé, Denys Duchier, Claire Gardent, Joseph Le Roux, and Yannick Parmentier. 2013. Xmg: extensible metagrammar. *Computational Linguistics* 39(3):591–629.

Christian Curtis. 2019. A parametric approach to implemented analyses: Valence-changing morphology in the lingo grammar matrix. In *Proceedings of the Second International Workshop on Resources and Tools for Derivational Morphology*. pages 111–120.

Christian Michael Curtis. 2018. *A parametric implementation of valence-changing morphology in the LinGO Grammar Matrix*. Master's thesis, University of Washington.

Elke Diedrichsen. 2012. What you give is what you get? on reanalysis, semantic extension and functional motivation with the german bekommen-passive construction .

Robert M. W. Dixon. 2000. A typology of causatives: form, syntax and meaning. In Robert M. W. Dixon and Alexandra Y. Aikhenvald, editors, *Changing valency: Case studies in transitivity*, Cambridge University Press, Cambridge, chapter 2, pages 30–83.

Matthew S. Dryer and Martin Haspelmath, editors. 2013. *WALS Online*. Max Planck Institute for Evolutionary Anthropology, Leipzig. https://wals.info/.

William Foley and Jr. Robert D. Van Valin. 1984. *Functional syntax and universal grammar*. Cambridge University Press.

Valeria Generalova. 2020. Towards a cross-linguistic description of morphological causatives: issues in syntax-semantics linking. In Alexandra Pavlova, editor, *Proceedings of the ESSLLI & WeSSLLI Student Session 2020*, Brandies University, pages 55–66.

Valeria Generalova and Simon Petitjean. 2020. A prototype of a metagrammar describing three-argument constructions with a morphological causative. *Typology of Morphosyntactic Parameters* 3(2):2951.

Iren Hartmann, Martin Haspelmath, and Bradley Taylor, editors. 2013. *Valency Patterns Leipzig*. Max Planck Institute for Evolutionary Anthropology, Leipzig. http://valpal.info/.

Martin Haspelmath. 2006. Ditransitive constructions towards a new role and reference grammar. *Investigations of the Syntax Semantics Pragmatics Interface* 105:75.

Paul J Hopper and Sandra A Thompson. 1980. Transitivity in grammar and discourse. *language* pages 251–299.

Julia Horvath and Tal Siloni. 2011. Causatives across components. *Natural Language & Linguistic Theory* 29(3):657–704.

Rolf Kailuweit. 2013. Radical Role and Reference Grammar (RRRG). In Brian Nolan and Elke Diedrichsen, editors, *Linking Constructions into Functional Linguistics: The role of constructions in grammar*, John Benjamins Publishing, volume 145 of *Studies in Language Companion Series*, pages 103–142.

Laura Kallmeyer and Rainer Osswald. 2013. Syntax-driven semantic frame composition in lexicalized tree adjoining grammars. *Journal of Language Modelling* 1(2):267–330.

Suzanne Kemmer and Arie Verhagen. 1994. The grammar of causatives and the conceptual structure of events. *Cognitive linguistics* 5(2):115–156.

Timm Lichte and Simon Petitjean. 2015. Implementing semantic frames as typed feature structures with xmg. *Journal of Language Modelling* 3(1):185–228.

Rainer Osswald and Laura Kallmeyer. 2018. Towards a formalization of Role and Reference Grammar. In Rolf Kailuweit, Eva Staudinger, and Lisann Künkel, editors, *Applying and expanding Role and Reference Grammar (NIHIN Studies)*, Freiburg: Albert-Ludwigs-Universität, Universitätsbibliothek, pages 355–378.

David A. Peterson. 2007. *Applicative constructions*. Oxford University Press.

Simon Petitjean, Denys Duchier, and Yannick Parmentier. 2016. Xmg 2: describing description languages. In *International Conference on Logical Aspects of Computational Linguistics*. Springer, pages 255–272.

Maria Polinsky. 2013. Applicative constructions. In Matthew S. Dryer and Martin Haspelmath, editors, *The World Atlas of Language Structures Online*, Max Planck Institute for Evolutionary Anthropology, Leipzig.

Mariliina Pylkkänen. 2002. *Introducing arguments*. Ph.D. thesis, Massachusetts Institute of Technology.

Jr. Robert D. Van Valin. 2005. *Exploring the syntax-semantics interface*. Cambridge University Press.

Jr. Robert D. Van Valin. 2007. The role and reference grammar analysis of three-place predicates. *Suvremena lingvistika* 33(63):31–63.

Jr. Robert D. Van Valin and Randy J. LaPolla. 1997. *Syntax: Structure, meaning, and function*. Cambridge University Press.