Chapter 37

HPSG and Construction Grammar

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This chapter discusses the main tenets of Construction Grammar (CxG) and shows that HPSG adheres to them. This discussion includes surface orientation, language acquisition without UG, inheritance networks and shows how HPSG (and other frameworks) are positioned along these dimensions. Formal variants of CxG will be briefly discussed and their relation to HPSG will be pointed out. It is argued that lexical representations of valence are more appropriate than phrasal approaches, which are assumed in most variants of CxG. Other areas of grammar seem to require headless phrasal constructions (e.g., the NPN construction and certain extraction constructions) and it is shown how HPSG handle these. Derivational morphology is discussed as a further example of an early constructionist analysis in HPSG.

This chapter deals with Construction Grammar (CxG) and its relation to HPSG. The short version of the message is: HPSG is a Construction Grammar. It was one right from the beginning and over the years certain aspects were adapted allowing to capture generalizations over phrasal patterns. In what follows I will first say what Construction Grammars are (Section 1), I will explain why HPSG as developed in Pollard & Sag (1987; 1994) was a Construction Grammar and how it was changed to become even more Constructive (Section 1.2.3). Section 2 deals with so-called argument structure constructions, which are usually dealt with by assuming phrasal constructions in CxG and explains why this is problematic and why lexical approaches are more appropriate. Section 3 explains Construction Morphology, Section 4 shows how cases that should be treated phrasally can be handled in HPSG. Section 5 sums up the paper.

Stefan Müller. 2018. HPSG and Construction Grammar. In Stefan Müller, Anne Abeillé, Robert D. Borsley & Jean-Pierre Koenig (eds.), *Head-Driven Phrase Structure Grammar: The handbook*, 621–653. Berlin: Language Science Press. DOI:??

1 What is Construction Grammar?

The first question to answer in a chapter like this is: what is Construction Grammar? While it is relatively clear what a Construction is, the answer to the question regarding Construction Grammar is less straight-forward. Section 1.1 provides the definition for the term *Construction* and Section 1.2 states the tenets of CxG and discusses to what extent the main frameworks currently on the market adhere to them.

1.1 The notion Construction

Goldberg (2006: 5) defines Construction as follows:

> Any linguistic pattern is recognized as a construction as long as some aspect of its form or function is not strictly predictable from its component parts or from other constructions recognized to exist. In addition, patterns are stored as constructions even if they are fully predictable as long as they occur with sufficient frequency. (Goldberg 2006: 5)

She provides Table 1 with examples for Constructions.

BB: I understand her view is that constructions must have a distinctive meaning. I believe Jackendoff argues against this, and Newmeyer and I did here: Borsley & Newmeyer (2009)

Table 1: Examples of constructions, varying in size and complexity according to Goldberg (2009)

Word	e.g., *tentacle*, *gangster*, *the*
Word (partially filled)	e.g., *post*-N, V-*ing*
Complex word	e.g., *textbook*, *drive-in*
Idiom (filled)	e.g., *like a bat out of hell*
Idiom (partially filled)	e.g., *believe* <one's> *ears/eyes*
Covariational Conditional	The Xer the Yer (e.g., *The more you watch the less you know*)
Ditransitive	Subj V Obj1 Obj2 (e.g., *She gave him a kiss*; *He fixed her some fish tacos.*)
Passive	Subj aux VPpp (PPby) (e.g., *The cell phone tower was struck by lightening.*)

If one just looks at the definition of Construction, all theories currently on the market could be regarded as Construction Grammars. As Peter Staudacher pointed out in the discussion after a talk by Knud Lambrecht in May 2006 in Potsdam, lexical items are form-meaning pairs and the rules of phrase structure grammars come with specific semantic components as well, even if it is just functional application. So, Categorial Grammar, GB, GPSG, TAG, LFG, HPSG and even Minimalism would be Construction Grammars. If one looks at the examples of Constructions in Table 1 things change a bit. Idioms are generally not the focus of work in Mainstream Generative Grammar (MGG)[1]. MGG is usually concerned with explorations of the so-called Core Grammar as opposed to the Periphery, to which the idioms are assigned. The Core Grammar is the part of the grammar that is supposed to be acquired with help of innate domain specific knowledge, something the existence of which Construction Grammar denies. But if one takes Hauser, Chomsky & Fitch (2002) seriously and assumes that only the ability to form complex linguistic objects out of less complex linguistic objects (Merge) is part of this innate knowledge then the core/periphery distinction does not have much content and after all Minimalists could adopt a version of Sag's local, selection-based analysis of idioms (Sag 2007; Kay et al. 2015; Kay & Michaelis 2017). However, as is discussed in the next subsection, there are other aspects that really set Construction Grammar apart from MGG.

1.2 Basic tenets of Construction Grammar

Goldberg (2003) names the following tenets as core assumptions standardly made in CxG. form-meaning pairs):

Tenet 1 All levels of description are understood to involve pairings of form with semantic or discourse function, including morphemes or words, idioms, partially lexically filled and fully abstract phrasal patterns. (See Table 1)

Tenet 2 An emphasis is placed on subtle aspects of the way we conceive of events and states of affairs.

Tenet 3 A 'what you see is what you get' approach to syntactic form is adopted: no underlying levels of syntax or any phonologically empty elements are posited.

[1]The term *Mainstream Generative Grammar* is used to refer to work in Transformational Grammar, for example Government & Binding (Chomsky 1981) and Minimalism (Chomsky 1995). Some authors working in Construction Grammar see themselves in the tradition of Generative Grammar in a wider sense, see for example Fillmore, Kay & O'Connor (1988: 501).

Tenet 4 Constructions are understood to be learned on the basis of the input and general cognitive mechanisms (they are constructed), and are expected to vary cross-linguistically.

Tenet 5 Cross-linguistic generalizations are explained by appeal to general cognitive constraints together with the functions of the constructions involved.

Tenet 6 Language-specific generalizations across constructions are captured via inheritance networks much like those that have long been posited to capture our non-linguistic knowledge.

Tenet 7 The totality of our knowledge of language is captured by a network of constructions: a 'construct-i-con.'

I already commented on Tenet 1 above. Tenet 2 concerns semantics and the syntax-semantics interface, which are part of most HPSG analyses. In what follows I want to look in more detail at the other tenets.

1.2.1 Surface orientation and empty elements

Tenet 3 requires a surface-oriented approach. Underlying levels and phonologically empty elements are ruled out. This excludes derivational models of transformational syntax assuming a D-structure and some derived structure or more recent derivational variants of Minimalism. There was a time where representational models of GB that did not assume a D-structure but just one structure with traces (Koster 1978: 1987: 235; Kolb & Thiersch 1991; Haider 1993: Section 1.4; Frey 1993: 14; Lohnstein 1993: 87–88, 177–178; Fordham & Crocker 1994: 38; Veenstra 1998: 58). Some of these analyses are rather similar to HPSG analyses as they are assumed today (Kiss 1995; Bouma & van Noord 1998; Meurers 2000; Müller 2005; 2017a; 2018b). Chomsky's Minimalist work (Chomsky 1995) assumes a derivational model and comes with a rhetoric of building structure in a bottom-up way and sending complete phases to the interfaces for pronunciation and interpretation. This is incompatible with Tenet 3, but in principle Minimalist approaches are very similar to Categorial Grammar, so there could be representational approaches adhering to Tenet 3.

Rui: In Top-down Phase-based Minimalist Grammar (TPMG) as developed by Chesi (2012; 2007), and Bianchi & Chesi (2006; 2012), there is no movement. Rather, wh-phrases are linked to their "in situ" positions with the aid of a short-term memory buffer that functions like a stack. See also Hunter (2010) and Hunter (2018) for a related account where the information about the presence of a wh-phrase is percolated in the syntax tree, like in GPSG/HPSG. These references may be of use here.

A comment on empty elements is in order: all articles introducing Construction Grammar state that CxG does not assume empty elements. Most of the alternative theories do use empty elements: see König (1999) on Categorial Grammar, Gazdar, Klein, Pullum & Sag (1985: 143) on GPSG, Bresnan (2001: 67) on LFG, Bender (2000) and Sag, Wasow & Bender (2003: 464) on HPSG/Sign-Based Construction Grammar. There are results from the 60s that show that phrase structure grammars containing empty elements can be translated into grammars that do not contain empty elements (Bar-Hillel, Perles & Shamir 1961: 153, Lemma 4.1). Grammars with empty elements often are more compact than those without empty elements and express generalizations more directly. See for example Bender (2000) for copulaless sentences in African American Venacular English and Müller (2014) on nounless NPs in German. The argument against empty elements usually refers to language acquisition: it is argued that empty elements cannot be learned since they are not present in the input. However, if the empty elements alternate with visible material it can be argued that what is learned is the fact that a certain element can be left out. What is true though is that things like empty expletives cannot be learned since these empty elements are neither visible nor do they contribute to meaning. Their only purpose in grammars is to keep uniformity. For example, Grewendorf (1993) suggests an analysis of the passive in German that is parallel to the movement-based analysis of English passives. In order to account for the fact that the subject does not move in German, he suggests an empty expletive pronoun that takes the subject position and that is connected to the original non-moved subject. Such elements cannot be acquired without innate knowledge about the IP/VP system and constraints about the obligatory presence of subjects. The CxG criticism is justified here.

A frequent argumentation for empty elements in MGG is based on the fact that there are overt realizations of an element in other languages (e.g., object agreement in Basque and focus markers in Gungbe). But since there is no language internal evidence for these empty elements they cannot be learned and one would have to assume that they are innate. This kind of empty elements is rightly rejected.

1.2.2 Language acquisition without the assumption of UG

Tenet 4 and 5 are basically what everybody should assume in MGG if Hauser, Chomsky & Fitch (2002) are taken seriously. Of course this is not what is done in large parts of the filed. The most extreme variant being Cinque & Rizzi (2010), who assume at least 400 functional heads being part of Universal Grammar (UG) and being present in all grammars of all languages although sometimes invisibly. Such assumptions beg the question why the genera of Bantu languages should be part of our genome and how they got there. Researchers working on language acquisition realized that the Principles & Parameters approach (Meisel 1995) makes wrong predictions. They now talk about Micro-Cues instead of parameters (Westergaard 2014) and these Micro-Cues are just features that can be learned. However, Westergaard still assumes that the features are determined by UG, a dubious assumption seen from a CxG perspective (and from the perspective of Hauser, Chomsky, Fitch and genetics in general (Bishop 2002)).

Note that even those versions of Minimalism that do not follow the Rizzi-style Cartographic approaches are far from being minimalist in their assumptions. Some distinguish between strong and weak features, some assume enumerations of lexical items from which a particular derivation draws its input from, some assume that all movement has to be feature driven. Some assume that derivations work in so-called phases and that a phase once completed is "shipped to the interfaces". Construction of phases is bottom up, which is incompatible with psycholinguistic results (see also Borsley & Müller 2018: Section 5.1, Chapter 33 in this volume). None of these assumptions is a natural assumption to make from a language acquisition point. Most of these assumptions do not have any real motivation in data, the only motivation usually given is that they result in "restrictive theories". But if there is no motivation for them, this means that the respective architectural assumptions have to be part of our innate domain-specific knowledge, which is implausible according to Hauser, Chomsky & Fitch (2002).

As research in computational linguistics shows, our input is rich enough to form classes, to determine the part of speech of lexical items and even to infer syntactic structure thought to be underdetermined by the input. For instance, Bod (2009) shows that the classical auxiliary inversion examples that Chomsky still uses in his Poverty of the Stimulus arguments (Chomsky 1971: 29–33; Berwick, Pietroski, Yankama & Chomsky 2011) can also be learned from language input available to children. See also Freudenthal et al. (2006; 2007) on input-based language acquisition.

HPSG does not make any assumptions about complicated mechanisms like

feature driven movement and so on. HPSG states properties of linguistic objects like part of speech, case, gender and so on and states relations between such features like agreement and government. In this respect it is like other Construction Grammars and hence experimental results regarding and theories of language acquisition can be carried over to HPSG. See also Ginzburg (2018), Chapter 27 of this volume on language acquisition.

1.2.3 Inhertiance networks

This leaves us with Tenet 6 and 7, that is *inheritance networks* and the constructicon. MGG does not make reference to inheritance hierarchies. HPSG did this right from the beginning in 1985 (Flickinger et al. 1985) for lexical items and since 1995 also for phrasal constructions (Sag 1997). LFG rejected the use of types but used macros in computer implementations. The macros were abbreviatory devices and did not play any role in theoretical work. This changed in 2004 where macros were suggested in theoretical work (Dalrymple, Kaplan & King 2004). And although any connection to constructionist work is vehemently denied by some of the authors, recent work in LFG has a decidedly constructional flavor (Asudeh, Dalrymple & Toivonen 2008; 2014).[2] LFG differs from frameworks like HPSG though in assuming a separate level of c-structure. c-structure rules are basically context free phrase structure rules and they are not modeled by feature value pairs (although they could be (Kaplan 1995)). This means that it is not possible to capture generalizations regarding lexical items, lexical rules and phrasal schemata. While HPSG describes all of these elements with the same inventory and hence can use common supertypes in the description of all three, this is not possible in LFG. TAG is also using inheritance in the Meta Grammar (Lichte & Kallmeyer 2017).

citep* yields wrong results here

add reference

Since HPSG's lexical entries, lexical rules and phrasal schemata are all described by typed feature descriptions one could call the set of these descriptions the constructicon. Therefore, tenet 7 is also adhered to.

1.2.4 Summary

If all these points are taken together, it is clear that most variants of MGG are not Construction Grammars. However, CxG had considerable influence on other frameworks so that there are constructionist variants of LFG and TAG. HPSG in the version of Sag (1997) (also called Constructional HPSG) and the HPSG dialect

[2] See Toivonen (2013: 516) for an explicit reference to construction-specific phrase structure rule in the senese of Construction Grammar.

Sign-Based Construction Grammar are Construction Grammars that follow all the tenets mentioned above.

1.3 Variants of Construction Grammar

The previous section discussed the tenets of CxG and to what degree other frameworks adhere to them. This section deals with frameworks that have Construction Grammar explicitly in their name. The following variants are usually named:

- Berkeley Construction Grammar (Fillmore 1988; Kay & Fillmore 1999; Fried 2015)
- Cognitive Construction Grammar (Lakoff 1987; Goldberg 1995; 2006)
- Cognitive Grammar (Langacker 1987; 2000; 2008; Dąbrowska 2004)
- Radical Construction Grammar (Croft 2001)
- Embodied Construction Grammar (Bergen & Chang 2005)
- Fluid Construction Grammar (Steels & De Beule 2006; Steels 2011)
- Sign-Based Construction Grammar (Sag 2010; 2012)

Berkely Construction Grammar, Embodied Construction Grammar, Fluid Construction Grammar, and Sign-Based Construction Grammar are the ones that are more formal. All of these variants use feature value pairs and are constraint-based. They are sometimes also referred to as unification-based approaches. Berkeley Construction Grammar never had a consistent formalization. The variant of unification assumed by Kay & Fillmore (1999) was formally inconsistent (Müller 2006a: Section 2.4) and the computation of construction-like objects (CLOs) suggested by Kay (2002) did not work either (Müller 2006a: Section 3). Berkeley Construction Grammar was dropped by the authors, who joined forces with Ivan Sag, and Laura Michaelis and eventually came up with an HPSG variant named Sign-Based Construction Grammar (Sag 2012). The differences between Constructional HPSG (Sag 1997) and SBCG are to some extent cosmetic: semantic relations got the suffix *-fr* for *frame* (*like-rel* became *like-fr*), phrases were called constructions (*hd-subj-ph* became *subj-head-cxt*) and lexical rules were called *derivational constructions*.[3] While this renaming would not have changed anything in terms of expressiveness of theories, there was another change that was

[3] This renaming trick was so successful that it even confused some of the co-editors of the volume about SBCG (Boas & Sag 2012). See for example Boas (2014) and the reply in Müller & Wechsler (2014b).

not motivated by any of the tenets of Construction Grammar but rather by the wish to get a more restrictive theory: Sag, Wasow & Bender (2003) and Sag (2007) changed the feature geometry of phrasal signs in a way that signs do not contain daughters. The information about mother-daughter relations is contained in lexical rules and phrasal schemata (Constructions) only. The phrasal schemata are more like GPSG phrase structure rules in licensing a mother node when certain daughters are present but without the daughters being part of the mother as it was common in HPSG from 1985 till Sag, Wasow & Bender (2003). This differs quite dramatically from what was done in Berkeley Construction Grammar, since BCxG explicitly favored a non-local approach. Arguments were not cancelled but passed up to the mother node. Adjuncts were passed up as well so that the complete internal structure of an expression is available at the top-most node. The advantage of BCxG (Fillmore, Kay & O'Connor 1988) and Constructional HPSG (Sag 1997) is that complex expressions (e.g., idioms and other more transparent expressions with high frequency) can be stored as chunks containing the internal structure. This is not possible with SBCG, since phrasal signs never contain internal structures. For a detailed discussion of Sign-Based Construction Grammar see Müller (2016: Section 10.6.2).

Rui: Head feature principle, LID from Berkeley CxG

Embodied Construction Grammar (Bergen & Chang 2005) uses typed feature descriptions for the description of linguistic objects and allows for discontinuous constituents. As argued by Müller (2016: Section 10.6.3), it is a notational variant of Reape-style HPSG (Reape 1994) (see Müller 2018: Section 6, Chapter 10 of this volume for discontinuous constituents in HPSG).

Fluid Construction Grammar is also rather similar to HPSG. An important difference is that FCG attaches weights to constraints, something that is usually not done in HPSG. But in principle there is nothing that forbids to add weights to HPSG as well and in fact it has been done (Brew 1995; Briscoe & Copestake 1999; Miyao & Tsujii 2008) and it should be done to a larger extent (Miller 2013). Van Trijp (2013) tried to show that Fluid Construction Grammar is fundamentally different from SBCG but I think he failed in every single respect. See Müller (2017b) for a detailed discussion, which cannot be repeated here for space reasons.

What makes SBCG different from other Construction Grammars is that SBCG assumes a strongly lexicalist stance (Sag & Wasow 2011): argument structure is encoded lexically. A ditransitive verb is a ditransitive verb since it selects for three NP arguments. This selection is encoded in valence features of lexical items. It is not assumed that phrasal configurations can license additional arguments as it is in Radical Construction Grammar, Embodied Construction Gram-

mar and in Fluid Construction grammar. The next section discusses phrasal CxG approaches in more detail. Section 4 then discusses patterns that should be analyzed phrasally and which are problematic for entirely head-driven (or rather functor-driven) theories like Categorial Grammar, Dependency Grammar and Minimalism.

2 Valence vs. phrasal patterns

Much work in Construction Grammar starts from the observation that children acquire patterns and get more abstract leaving slots to be filled in in later acquisition stages (Tomasello 2003). The conclusion that is drawn from this is that language should be described with reference to phrasal patterns. Most Construction Grammar variants assume a phrasal approach to argument structure constructions (Goldberg 1996; 2006; Goldberg & Jackendoff 2004), Constructional HPSG and SBCG being the two exceptions.

Boas

I argued in several publications that the language acquisition facts can be explained in lexical models as well (Müller 2010: Section 6.3; Müller & Wechsler 2014a: Section 9). While a pattern-based approach claims that (1) is analyzed by inserting *Kim*, *loves*, and *Sandy* into a phrasal schema stating that NP[nom] verb NP[acc] or subject verb object are possible sequences in English, a lexical approach would state that there is a verb *loves* selecting for an NP[nom] and an NP[acc] (or for a subject and an object).

(1) Kim loves Sandy.

Since objects follow the verb in English (modulo extraction) and subjects precede the verb, the same sequence is licensed in the lexical approach. The lexical approach does not have any problems with accounting for patterns in which the sequence of subject, verb and object is discontinuous. For example, an adverb may intervene between subject and verb:

(2) Kim really loves Sandy.

In a lexical approach it is assumed that verb and object may form a unit (a VP). The adverb attaches to this VP and the resulting VP is combined with the subject. The phrasal approach has to assume that either adverbs are part of phrasal schemata licensing cases like (2) (see Uszkoreit (1987: Section 6.3.2) for such a proposal in a GPSG for German) or that the phrasal construction may license discontinuous patterns. Bergen & Chang (2005: 170) follow the latter approach and assume that subject and verb may be discontinuous but verb and object(s)

have to be adjacent. While this accounts for adverbs like the one in (2), it does not solve the general problem since there are other examples showing that verb and object(s) may appear discontinuously as well:

(3) Mary tossed me a juice and Peter a water.

Even though *tossed* and *Peter a water* are discontinuous in (3), they are an instance of the ditransitive construction. The conclusion is that what has to be acquired is not a phrasal pattern but rather the fact that there are dependencies between certain elements in phrases. I return to ditransitive constructions in Section 2.3.

I discussed several phrasal approaches to argument structure and showed where they fail (Müller 2006a,b; 2007; 2010; Müller & Wechsler 2014a,b; Müller 2018a). Of course the discussion cannot be repeated here but I want to repeat two points showing that lexical valence representation is necessary. The first two are problems that were around at GPSG times and basically were solved by abandoning the framework and adopting a new framework which was a fusion of GPSG and Categorial Grammar: HPSG.

fix me, add point

2.1 Derivational morphology and valence

The first argument (Müller 2016: Section 5.5.1) is that certain patterns in derivational morphology refer to valence. For example, the *-bar* 'able' derivation productively applies to transitive verbs only, that is to verbs that govern an accusative.

(4) a. unterstützbar
supportable

b. * helfbar
helpable

c. * schlafbar
sleepable

Note that *-bar* 'able' derivation is like passive: it surpresses the subject and promotes the accusative object: the accusative object is the element adjectives derived with *-bar* 'able' derivation predicate over. There is no argument realized with the adjective *unterstützbaren* 'supportable' attaching to *Arbeitsprozessen* 'work.processes' in *unterstützbaren Arbeitsprozessen*.[4] Hence one could not claim that the stem enters a phrasal construction with arguments and *-bar* attaches to

[4] Adjectives realize their arguments preverbally in German:

this phrase. It follows that information about valency has to be present at the stem.

Note also that the resultative construction interacts with *-bar* 'able' derivation. (5) shows an example of this construction in which the accusative object is introduced by the construction: it is the subject of *leer* 'empty' but not a semantic argument of the verb *fischt* 'fishes'.

(5) Sie fischt den Teich leer.
she fishes the pond empty

So even though the accusative object is not a semantic argument of the verb, the *-bar* 'able' derivation is possible and an adjective like *leerfischbar* can be derived. This is explained by lexical analyses of the *-bar* 'able' derivation and the resultative construction since if one assumes that there is a lexical item for *fisch-* selecting the accusative object and the result predicate then this item may function as the input for the *-bar* 'able' derivation. See Section 3 for further discussion of *-bar* 'able' derivation and Verspoor (1997), Wechsler (1997), Wechsler & Noh (2001), Müller (2002: Chapter 5) for lexical analyses of the resultative construction in the framework of HPSG.

2.2 Partial verb phrase fronting

The second argument concerns partial verb phrase fronting (Müller 2016: Section 5.5.2). (6) gives some examples: in (6a) the bare verb is fronted and its arguments are realized in the middle field, in (6b) one of the objects is fronted together with the verb and in (6c) both objects are fronted with the verb.

(6) a. Erzählen wird er seiner Tochter ein Märchen können.
tell will he his daughter a fairy.tale can

b. Ein Märchen erzählen wird er seiner Tochter können.
a fairy.tale tell will he his daughter can

c. Seiner Tochter ein Märchen erzählen wird er können.
his daughter a fairy.tale tell will he can

'He will be able to tell his daughter a fairy tale.'

(i) der [seiner Frau treue] Mann
the his wife faithful man
'the man who is faithful to his wife'

unterstützbaren 'supportable' does not take an argument it is a complete adjectival projection like *seiner Frau treue*.

The problem with sentences such as those in (6) is that the valence requirements of the verb *erzählen* 'to tell' are realized in various positions in the sentence. For fronted constituents, one requires a rule which allows a ditransitive to be realized without its arguments or with one or two objects. This basically destroys the idea of a fixed phrasal configuration for the ditransitive construction and points again into the direction of dependencies.

Furthermore, it has to be ensured that the arguments that are missing in the prefield are realized in the remainder of the clause. It is not legitimate to omit obligatory arguments or realize arguments with other properties like a different case, as the examples in (7) show:

(7) a. Verschlungen hat er es nicht.
devoured has he.NOM it.ACC not
'He did not devour it.'

b. * Verschlungen hat er nicht.
devoured has he.NOM not

c. * Verschlungen hat er ihm nicht.
devoured has he.NOM him.DAT not

The obvious generalization is that the fronted and unfronted arguments must add up to the total set belonging to the verb. This is scarcely possible with the rule-based valence representation in GPSG. In theories such as Categorial Grammar, it is possible to formulate elegant analyses of (7) (Geach 1970). Nerbonne (1986) and Johnson (1986) both suggest analyses for sentences such as (7) in the framework of GPSG which ultimately amount to changing the representation of valence information in the direction of Categorial Grammar. With a switch to CG-like valence representations in HPSG the phenomenon of partial verb phrase fronting found elegant solutions (Höhle 2018: Section 4; Müller 1996; Meurers 1999).

reference to UDC chapter?

2.3 Coercion

An important observation in constructionist work is that in certain cases verbs can be used in constructions that differ from the constructions they are normally used in. For example, verbs that are usually used with one or two arguments may be used in the ditransitive construction:

(8) a. She smiled.
b. She smiled herself an upgrade.[5]

[5] Douglas Adams. 1979. *The Hitchhiker's Guide to the Galaxy*, Harmony Books. Quoted from Goldberg (2003: 220).

c. He baked a cake.
d. He baked her a cake.

The usual explanation for sentences like (8b) and (8d) is that there is a phrasal pattern with three arguments into which intransitive and strictly transitive verbs may be entered. It is assumed that the phrasal patterns are associated with a certain meaning (Goldberg 1996; Goldberg & Jackendoff 2004). For example, the benefactive meaning of (8d) is contributed by the phrasal pattern (Goldberg 1996; Asudeh, Giorgolo & Toivonen 2014: 81).

page number

The insight that a verb is used in the ditransitive pattern and thereby contributes a certain meaning is of course also captured in lexical approaches. Briscoe & Copestake (1999) suggested a lexical rule-based analysis mapping a transitive version of verbs like *bake* onto a ditransitive one and adding the benefactive semantics. This is parallel to the phrasal approach in that it says: three-place *bake* behaves like other three-place verbs (e.g., *give*) in taking three arguments and by doing so it comes with a certain meaning (see Müller 2018a for a lexical rule-based analysis of the benefactive constructions working for both English and German despite the surface-differences of the respective languages). The lexical rule is a form-meaning pair and hence a construction. As Croft put it 15 years ago: Lexical rule vs. phrasal schema is a false dichotomy (Croft 2003).

BB: You quote Croft as saying that "lexical rule vs. phrasal schema is a false dichotomy". This might suggest that you think there is no real issue here, but of course you have argued that there is.

Briscoe & Copestake (1999) paired their lexical rules with probabilities to be able to explain differences in productivity. This corresponds to the association strength that van Trijp (2011: 141) used to relate lexical items to phrasal constructions of various kinds.

2.4 Non-predictability of valence

The last subsection discussed phrasal proposals of coercion that assume that verbs can be inserted into constructions that are compatible with the semantic contribution of the verb. Müller & Wechsler (2014a: Section 7.4) pointed out that this is not sufficiently constrained. Müller & Wechsler discussed the examples in (9), among others:

(9) a. John depends on Mary. (*counts, relies,* etc.)
b. John trusts (*on) Mary.

While *depends* can be combined with a *on*-PP, this is impossible for *trusts*. Also the form of the preposition of prepositional objects is not always predictable from semantic properties of the verb. So there has to be a way to state that certain verbs go together with certain kinds of arguments and others do not. A lexical specification of valence information is the most direct way to do this. Phrasal approaches sometimes assume other means to establish connections between lexical items and phrasal constructions. For instance, Goldberg (1995: 50) assumes that verbs are "conventionally associated with constructions". The more technical work in Fluid CxG assumes that every lexical item is connected to various phrasal constructions via coapplication links (van Trijp 2011: 141). This is very similar to Lexicalized Tree Adjoining Grammar (LTAG, Schabes, Abeillé & Joshi 1988), where a rich syntactic structure is associated to a lexical anchor. So, the phrasal approaches that link syntactic structure to lexical items are actually lexical approaches as well. As in GPSG some means makes sure that the lexical items enter into correct constructions. In GPSG this was taken care of by a number. I already discussed the GPSG shortcomings in previous subsections.

Concluding this section, it can be said that there has to be a connection between lexical items and their arguments and that a lexical representation of argument structure is the best way to establish such a relation.

3 Construction Morphology

The first publication in Construction Morphology was the masters thesis of Riehemann (1993), which later appeared as Riehemann (1998). Riehemann called her framework *Type-Based Derivational Morphology* since it was written before influential work like Goldberg (1995) appeared and before the term *Construction Morphology* (Booij 2005) was used. Riehemann did a careful corpus study on adjective derivations with the suffix *-bar* '-able'. She noticed that there is a productive pattern that can be analyzed by a lexical rule relating a verbal stem to the adjective suffixed with *-bar*.[6] The productive pattern applies to verbs governing an accusative as in (10a) but is incompatible with verbs taking a dative as in (10b):

(10) a. unterstützbar
supportable

b. * helfbar
helpable

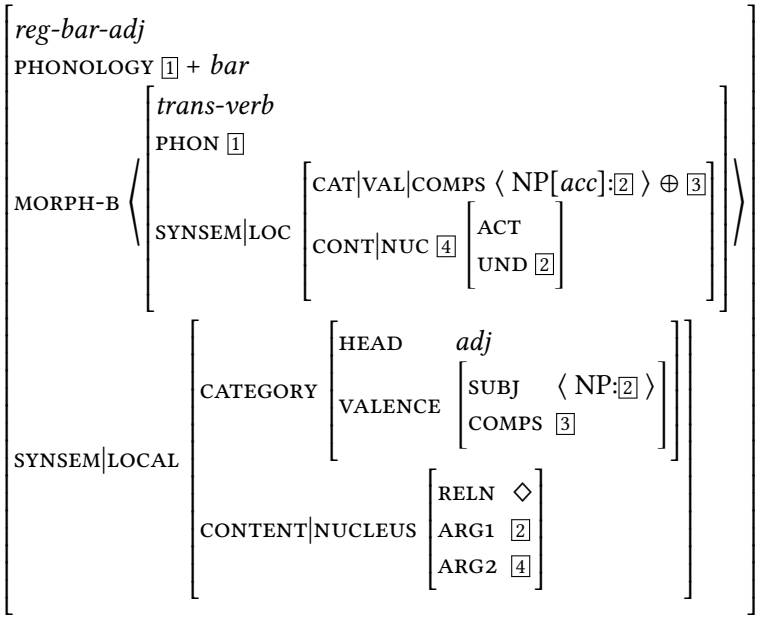
[6]She did not call her rule lexical rule but the difference between her template and the formalization of lexical rules by Meurers (2001) is the naming of the feature MORPH-B vs. DTR.

c. * schlafbar
sleepable

Intransitive verbs are also excluded as (10c) shows. Riehemann suggests the schema in (11):

fix page number

(11) Schema for productive adjective derivations with the suffix *-bar* in German according to Riehemann (1998: 17):



MORPH-B is a list that contains a description of a transitive verb (something that governs an accusative object which is linked to the undergoer role (2) and has an actor.[7] The phonology of this element (1) is combined with the suffix *-bar* and forms the phonology of the complete lexical item. The resulting object is of category *adj* and the semantics of the accusative object of the input verb (2) is identified with the one of the subject of the resulting adjective. The semantics of

[7] Note that the specification of the type *trans-verb* in the list under MORPH-B is redundant since it is stated that there has to be an accusative object and that there is an actor and an undergoer in the semantics. Depending on further properties of the grammar the specification of the type is actually wrong: productively derived particle verbs may be input to the *-bar* 'able' derivation and these are not a subtype of *trans-verb* since the respective particle verb rule derives both transitive (*anlachen* 'laught at somebody') and intransitive verbs (*loslachen* 'start to laugh') (Müller 2003: 296). *anlachen* does not have an undergoer in the semantic representation suggested by Stiebels (1996). See Müller (2003: 308) for a version of the *-bar* 'able' derivation schema that is compatible with particle verb formations as input.

the input verb (4) is embedded under a modal operator in the semantics of the adjective.

While the description of *-bar* 'able' derivation given so far captures the situation quite well, there are niches and isolated items that are exceptions. According to Riehemann (1998: 5), this was the case for 7 % of the adjectives she looked at in her corpus study. Examples are verbs ending in *-ig* like *entschuldigen* 'to excuse'. The *-ig* is dropped in the derivation:

(12) entschuldbar
excuseable

Other cases are lexicalized forms like *essbar* 'safely edible', which have a special lexicalized meaning. Exceptions of the accusative requirement are verbs selecting a dative (13a), a prepositional object (13b), reflexive verbs (13c), and even intransitive, mono-valent verbs (13d):

(13) a. unentrinnbar
inescapable

b. verfügbar
available

c. regenerierbar
regenerable

d. brennbar
inflammable

To capture generalizations about productive, semi-productive and fixed patterns/items Riehemann suggests a type hierarchy, parts of which are provided in Figure 1. The type *bar-adj* stands for all *-bar* adjectives and comes with the

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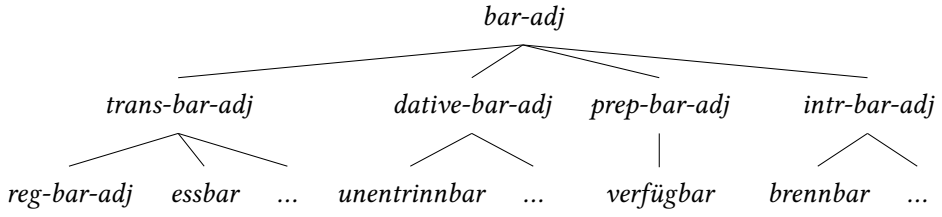

Figure 1: Parts of the type hierarchy for *-bar* 'able' derivation adapted from Riehemann (1998: 15)

constraints that apply to all of them. One subtype of this general type is *trans-bar-adj*, which subsumes all adjectives that are derived from transitive verbs. This

includes all regularly derived *-bar*-adjectives, which are of the type *reg-bar-adj* but also *essbar* 'edible' and *sichtbar* 'visible'.

As this recapitulation of Riehemann's proposal shows, the analysis is a typical CxG analysis: V-*bar* is a partially filled word (see Goldberg's examples in Table 1). The schema in (11) is a form-meaning pair. Exceptions and subregularities are represented in an inheritance network.

4 Phrasal patterns

Section 2 discussed the claim that Constructions in the sense of CxG have to be phrasal. I showed that this is not true and that in fact lexical approaches to valence have to be preferred under the assumptions usually made in non-transformational theories. However, there are other areas of grammar that give exclusively head-driven approaches like Categorial Grammar, Minimalism, and Dependency Grammar a hard time. In what follows I discuss the NPN construction and various forms of filler gap constructions.

4.1 The N-P-N Construction

Matsuyama (2004) and Jackendoff (2008) discuss the NPN Construction, examples of which are provided in (14):

(14) a. Student after student left the room.
b. Day after day after day went by, but I never found the courage to talk to her. (Bargmann 2015)

The properties of the NPN construction (with *after*) are summarized by Bargmann (2015) in a concise way and I will repeat his examples and summarization below to motivate his analysis in (22).

The examples in (14) show that the N-after-N Construction has *NP distribution*.

As (15) shows, the construction is *partially lexically fixed*: *after* cannot be replaced by any other word (Matsuyama 2004: 73).

(15) Alex asked me question { after / * following / * succeeding } question.

The construction is *partially lexically flexible*: The choice of Ns is free, except for that the Ns must be identical (16a), the Ns must be count nouns (16b), Ns must be in the singular (16c), and the Ns must be bare (16d).

(16) a. * bus after car (N1 ≠ N2)

b. * water after water (Ns = mass nouns)
c. * books after books (Ns = plurals)
d. * a day after a day (Ns have determiners)

The construction is *syntactically fixed*: N-after-N cannot be split by syntactic operations as the contrast in (17) shows (Matsuyama 2004):

(17) a. Man after man passed by.
b. * Man passed by after man.

If extraposition of the *after*-N constituent were possible, (17b) with an extraposed *after man* should be fine but it is not, so NPN seems to be a fixed configuration.

There is a syntax-semantics mismatch: while N-after-N is singular, syntactically as (18) shows, it is plural semantically as (19) shows:

(18) Study after study { reveals / *reveal } the dangers of lightly trafficked streets.

(19) a. John ate { apple after apple / apples / *an apple } for an hour.
b. John ate { *apple after apple / *apples / an apple } in an hour.

Furthermore there is an aspect of semantic sequentiality: N-after-N conveys a temporal or spatial sequence: as Bargmann (2015) states the meaning of (20a) is something like (20b).

(20) a. Man after man passed by.
b. First one man passed by, then another(, then another(, then another(, then …))).

The Ns in the construction do not refer to one individual each, rather they contribute to a holistic meaning.

The NPN construction allows adjectives to be combined with the nouns but this is restricted. N1 can only be preceded by an adjective if N2 is preceded by the same adjective:

(21) a. bad day after bad day (N1 and N2 are preceded by the same adjective.)
b. * bad day after awful day (N1 and N2 are preceded by different adjectives.)
c. * bad day after day (Only N1 is preceded by an adjective.)
d. day after bad day (Only N is preceded by an adjective.)

Finally, *after* N may be iterated to emphasize the fact that there are several referents of N as the example in (14b) shows.

This empirical description is covered by the following phrasal construction, which is adapted from Bargmann (2015):[8]

(22)

$$\left[\begin{array}{l}
\textsc{phon} \langle \ldots N \ldots, \textit{after}, \ldots N \ldots \rangle \\
\textsc{ss|loc|cat} \left[\begin{array}{ll} \textsc{head} & \left[\begin{array}{ll} \textit{noun} & \\ \textsc{count} & - \\ \textsc{agr} & \textit{3rdsing} \end{array}\right] \\ \textsc{val} & \left[\begin{array}{ll} \textsc{spr} & \langle\rangle \\ \textsc{comps} & \langle\rangle \end{array}\right] \end{array}\right] \\
\textsc{sr}\ \lambda P.\exists X.|X| > 1 \,\&\, \forall x \in X\colon N'(x) \,\&\, \exists R^{order} \subseteq X^2 \,\&\, P(x) \\
\textsc{dtrs} \left\langle \left[\begin{array}{l} \textsc{phon} \langle \ldots N \ldots \rangle \\ \textsc{ss|l|c} \left[\begin{array}{ll} \textsc{head} & \left[\begin{array}{ll} \textit{noun} & \\ \textsc{count} & + \\ \textsc{agr} & \textit{3rdsing} \end{array}\right] \\ \textsc{val} & \left[\begin{array}{ll} \textsc{spr} & \langle \textsc{Det} \rangle \\ \textsc{comps} & \langle\rangle \end{array}\right] \end{array}\right] \\ \textsc{sr} \ldots \lambda x.N'(x) \ldots \end{array}\right], \left(\left[\begin{array}{l} \textsc{phon} \langle \textit{after} \rangle \\ \ldots \textsc{head} \textit{ prep} \\ \textsc{sr}\ \exists R^{order} \subseteq X^2 \end{array}\right], \left[\begin{array}{l} \textsc{phon} \langle \ldots N \ldots \rangle \\ \textsc{ss|l|c} \left[\begin{array}{ll} \textsc{head} & \left[\begin{array}{ll} \textit{noun} & \\ \textsc{count} & + \\ \textsc{agr} & \textit{3rdsing} \end{array}\right] \\ \textsc{val} & \left[\begin{array}{ll} \textsc{spr} & \langle \textsc{Det} \rangle \\ \textsc{comps} & \langle\rangle \end{array}\right] \end{array}\right] \\ \textsc{sr} \ldots \lambda x.N'(x) \ldots \end{array}\right] \right)^{+} \right\rangle
\end{array}\right]$$

There is a list of daughters consisting of a first daughter and an arbitrarily long list of *after* N pairs. The '+' means that there has to be at least one *after* N pair. The nominal daughters select for a determiner via SPR, so they can be either bare nouns or nouns modified by adjectives. The semantic representation, non-standardly represented as the value of SR, says that there have to be several objects in a set X ($\exists X.|X| > 1$) and for all of them the meaning of the $\overline{\text{N}}$ has to hold ($\forall x \in X : N'(x)$). Furthermore there is an order between the elements of X as stated by $\exists R^{order} \subseteq X^2$.

[8] Jackendoff and Bargmann assume that the result of combining N, P, and N is an NP. However this is potentially problematic as Matsuyama's example in (22) shows (Matsuyama 2004: 71):

(i) All ranks joined in hearty cheer after cheer for every member of the royal family …

As Matsuyama points out the reading of such examples is like the reading of *old men and women* in which *old* scopes over both *men* and *women*. This is accounted for in structures like the one indicated in (ii):

(ii) hearty [cheer after cheer]

Since adjectives attach to $\overline{\text{N}}$s and not to NPs this means that NPN constructions should be $\overline{\text{N}}$s. Of course (ii) cannot be combined with determiners, so one would have to assume that NPN constructions select for a determiner that has to be dropped obligatorily. This is also the case for mass nouns with a certain reading.

From looking at this construction it is clear that it cannot be accounted for by standard $\overline{X}$ rules. Even without requiring $\overline{X}$ syntactic rules, there seems to be no way to capture these constructions in head-based approaches like Minimalism, Categorial Grammar or Dependency Grammar. For simple NPN constructions one could claim that *after* is the head. *after* would be categorized as 3rd singular mass noun and select for two $\overline{N}$s. It would (non-compositionally) contribute the semantics stated above. But it is unclear how the general schema with arbitrarily many repetitions of *after* N could be accounted for. If one assumes that *day after day* forms a constituent, then the first *after* in (23) would have to combine an N with an NPN sequence.

(23) day after [day [after day]]

This means that we would have to assume two different items for *after*: one for the combination of $\overline{N}$s and another one for the combination of $\overline{N}$ with NPN combinations. Note that an analysis of the type in (23) would have to project information about the $\overline{N}$s contained in the NPN construction since this information has to be matched with the single $\overline{N}$ at the beginning. In any case a lexical analysis would require several highly idiosyncratic lexical items (prepositions projecting nominal information and selecting items they usually do not select). It is clear that a reduplication account of the NPN construction as suggested by G. Müller (2011) does not work since patterns with several repetitions of PN as in (23) cannot be accounted for as reduplication. G. Müller (p. 241) stated that reduplication works for word-size elements only (in German) and hence his account does not extend to the English examples given above. (24) shows an attested German example containing adjectives, which means that G. Müller's approach is not appropriate for German either.

(24) Die beiden tauchten nämlich geradewegs wieder aus dem heimischen
the two surfaced namely straightaway again from the home
Legoland auf, wo sie im Wohnzimmer, schwarzen Stein um
Legoland PART where they in.the living.room black brick after
schwarzen Stein, vermeintliche Schusswaffen nachgebaut hatten.[9]
black brick alledged firearms recreated had
'The two surfaced straightaway from their home Legoland where they had recreated alledged firearms black brick after black brick.'

This subsection showed how a special phrasal pattern can be analyzed within HPSG. The next section will discuss filler-gap constructions, which were ana-

[9] taz, 05.09.2018, p. 20

lyzed as instances of a single schema by Pollard & Sag (1994) but which were later reconsidered and analyzed as a family of subconstructions by Sag (2010).

4.2 Specialized sub-constructions

HPSG took over the treatment of nonlocal dependencies from GPSG (Gazdar 1981) (see also Flickinger, Pollard & Wasow (2018), Chapter 2 of this volume on the history of HPSG and Borsley & Crysmann (2018), Chapter 14 of this volume on unbounded dependencies). Pollard & Sag (1994: Chapters 4 and 5) had an analysis of topicalization constructions like (25) and an analysis of relative clauses. However, more careful examination revealed that more fine-grained distinctions have to be made. Sag (2010: 491) looked at the following examples:

(25) a. [My bagels,] she likes. (topicalized clause)
b. [*What* books] do they like? (*wh*-interrogative)
c. (the person) [*who* (*se* book)] they like (*wh*-relative)
d. [*What a* play] he wrote! (*wh*-exclamative)
e. [*the more* books] they read … (the-clause)

As Sag shows, the fronted element is specific to the construction at hand:

(26) a. * [*Which* bagels] / [*Who*], she likes. (topicalized clause)
b. * [*What a* book] do they like? (*wh*-interrogative)
c. % the thing [[*what*] they like] (*wh*-relative)
d. * [*Which* bagels] / [*What*] she likes! (*wh*-exclamative)
e. * [*which* books] they read, the more they learn. (the-clause)

A topicalized clause should not contain a *wh* item (26a), a *wh*-interrogative should not contain a *what a* sequence as known from *wh*-exclamatives (26b) and so on.

Furthermore, some of these constructions allow non-finite clauses and others do not:

(27) a. * Bagels, (for us) to like. (topicalized clause)
b. * It's amazing [what a dunce (for them) to talk to]. (*wh*-exclamative)
c. * The harder (for them) to come, the harder (for them) to fall. (the-clause)
d. I know how much time (* for them) to take. (*wh*-interrogative)
e. The time in which (*for them) to finish. (*wh*-relative)

So there are differences as far as fillers and as far as sentences from which something is extracted are concerned. Sag discussed further differences like invertion/non-invertion in the clauses out of which something is extracted. I do not repeat the full discussion here but refer the reader to the original paper.

In principle there are several ways to model the phenomena. One could assume empty heads as Pollard & Sag (1994: Chapter 5) suggested for the treatment of relative clauses. Or one could assume empty heads as they are assumed in Minimalism: certain so-called operators have features that have to be checked and cause items with the respective properties to move. Borsley (2006) discussed potential analyses of relative clauses involving empty heads and showed that one would need a large number of such empty heads and since there is no theory of the lexicon in Minimalism, generalizations are missed (see also Borsley & Müller (2018), Chapter 33 of this volume). The alternative suggested by Sag (2010) is to assume a general Filler-Head Schema of the kind assumed in Pollard & Sag (1994) and then define more specific sub-constructions. To take an example, the wh-exclamative is a filler-head structure, so it inherits everything from the more general construction, but in addition it specifies the filler daughter to contain a *what a* part and states the semantics that is contributed by the exclamative construction.

reference

5 Summary

This paper summarized the properties of Construction Grammar or rather Construction Grammars and showed that HPSG can be seen as a Construction Grammar. I showed why lexical analyses of argument structure should be preferred over phrasal ones and that there are other areas in grammar where phrasal analyses are superior to lexical ones. I showed that they can be covered in HPSG while they are problematic for proposals assuming that all structures have to have a head.

6 Appendix: Sign-Based Construction Grammar

Acknowledgements

I thank Bob Borsley, Rui Chaves, and Jean-Pierre Koenig for comments on the outline for this chapter and for discussion in general.

I thank Bob Borsley and Rui Chaves for comments on an earlier version of this paper.

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