

Sign-Based Construction Grammar

Editors:

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Contents

Preface vii

- 1 Introducing Sign-Based Construction Grammar 1**
IVAN A. SAG, HANS C. BOAS, AND PAUL KAY
- 2 Making the Case for Construction Grammar 31**
LAURA A. MICHAELIS
- 3 Sign-Based Construction Grammar:
 An informal synopsis 69**
IVAN A. SAG
- 4 The Distribution of *that*-Clauses in English: An SBCG
 Account 201**
GERT WEBELHUTH
- 5 Discontinuous Dependencies and Complex Determiners 227**
PAUL KAY & IVAN A. SAG
- 6 Reconstructing Syntax: Construction Grammar and the
 Comparative Method 257**
JÓHANNA BARÐDAL & THÓRHALLUR EYTHÓRSSON
- 7 The FrameNet Constructicon 313**
CHARLES J. FILLMORE, RUSSELL R. LEE-GOLDMAN, AND
RUSSELL RHODES

1

Introducing Sign-Based Construction Grammar

IVAN A. SAG, HANS C. BOAS, AND PAUL KAY

1.1 Background

Modern grammatical research,¹ at least in the realms of morphosyntax, includes a number of largely nonoverlapping communities that have surprisingly little to do with one another. One – the Universal Grammar (UG) camp – is mainly concerned with a particular view of human languages as instantiations of a single grammar that is fixed in its general shape. UG researchers put forth highly abstract hypotheses making use of a complex system of representations, operations, and constraints that are offered as a theory of the rich biological capacity that humans have for language.² This community eschews writing explicit grammars of individual languages in favor of offering conjectures about the ‘parameters of variation’ that modulate the general grammatical scheme. These proposals are motivated by small data sets from a variety of languages.

A second community, which we will refer to as the Typological (TYP) camp, is concerned with descriptive observations of individual languages, with particular concern for idiosyncrasies and complexities. Many TYP researchers eschew formal models (or leave their development to others), while

¹For comments and valuable discussions, we are grateful to Bill Croft, Chuck Fillmore, Adele Goldberg, Stefan Müller, and Steve Wechsler. We also thank the people mentioned in footnote 7 below.

²The nature of these representations has changed considerably over the years. Seminal works include Chomsky 1965, 1973, 1977, 1981, 1995.

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others in this community refer to the theory they embrace as ‘Construction Grammar’ (CxG).

But CxG can mean very different things to its various practitioners. There is a significant group within the CxG community who call what they do ‘Cognitive Grammar’ (Langacker 2005, 2009b, 2009a). Cognitive Grammar has also played a significant role in the work of Lakoff (1987) and that of Goldberg (1995, 2006) and associates, which grew out of the Berkeley grammar tradition. We will refer to this tradition as ‘Cognitive Berkeley Construction Grammar’ (CBCG), which we will distinguish from the conception of CxG originally developed at Berkeley simply as ‘Berkeley Construction Grammar’ (BCG).³ Others working in CxG have developed specific ideas that are bundled together into such frameworks as ‘Radical Construction Grammar’ (Croft 2001, 2012), ‘Embodied Construction Grammar’ (Bergen and Chang 2009, Feldman et al. 2009), and ‘Fluid Construction Grammar’ (Steels 2011). These research communities are only loosely related, however, and at present very little exists in the way of a generally agreed upon theory of constructions. What unites the researchers who meet at CxG conferences appears to be: (1) their love of interesting and complex data and (2) their dislike of most work in the UG camp, whose theories they regard as distorting the basic nature of individual languages to fit a pre-conceived mold.

Although TYP researchers, and CxG researchers in particular, do address theoretical issues, they seldom address issues about the nature of construction theory. Rather, they tend to focus on ‘getting the facts right’ and providing evidence for certain leading ideas, such as data-driven learning (Barlow and Kemmer 2000, Gries 2012, Hilpert 2012) and lexical/constructional idiosyncrasy (Lambrecht 1984, 1994, Michaelis and Lambrecht 1996, Fillmore et al. 1988, Boas 2008, Bybee 2012), the analysis of which they argue is central to grammatical analysis.

A third morphosyntactic research community, some of whose members also belong to one of the communities already discussed, is the Formal Grammar (FG) camp, which includes researchers in constraint-based, lexicalist frameworks like Head-Driven Phrase Structure Grammar (HPSG), Lexical-Functional Grammar, and Categorical Grammar,⁴ as well as Tree-Adjoining Grammar, *inter alia*.⁵ FG research has led to a mathematically grounded understanding of the relevant mathematical properties of various FG formalisms,

³The idea of using something like the traditional notion of ‘construction’ as the basis for a modern grammar originates with Charles Fillmore in the mid-1980s. Fillmore’s important contribution is sometimes incorrectly attributed to G. Lakoff, perhaps because the earliest published construction-based analysis emanating from Berkeley was the treatment of *there*-constructions included as an appendix to Lakoff 1987.

⁴See, for example, the papers in Borsley and Börjars 2011.

⁵Note that much work in Berkeley Construction Grammar (e.g. Fillmore and Kay 1996, Kay 2002) should be classified as in both the FG and CxG communities.

as well as to computational implementations of significant fragments of natural languages. The FG community includes researchers who have developed precisely formulated and internally consistent analyses of complex data sets within individual languages, but have preferred to advance claims about language universals more cautiously than the UG community.

Perhaps the most important goal of Sign-Based Construction Grammar (SBCG), which has emerged from the FG community, is to provide a formalized framework in which TYP researchers can develop their ideas. With formalization comes more precise empirical prediction, enhanced comparability of analyses across languages, and general theoretical clarity. Hence, our hope is that SBCG will aid TYP researchers of all kinds in their concern for developing testable hypotheses and also that this will lead to increased common ground between TYP, FG, and UG research.

It is worth noting from the outset that certain leading ideas of the various grammatical communities are logically independent of one another, a point that is sometimes lost in linguistic discussions. For example: though construction-based analysis is usually associated with data-driven learning, it need not be. Indeed, researchers such as Jackendoff and Culicover would surely position themselves as part of the UG camp, but they are led to a construction-based conception of grammar (see Jackendoff 2002 and Culicover and Jackendoff 2005), as are Ginzburg and Sag 2000, who would be properly classified as part of the FG community. The pervasive aversion to constructional analysis found in most UG research, as conjectured by Sag (2010a), is in all likelihood a sociological/historical accident.⁶ Moreover, the nature of the interaction in language learning of exposure to data and the biological endowment for language is a question that can be addressed independently of one's assumptions about the role of constructions in grammar.

In addition, the precise formalization of grammar fragments need not separate the FG camp from the others. One can hope that once suitable formal tools are developed, practitioners of all approaches will see increased value in the FG methodology of developing large, internally consistent, grammatical descriptions of individual languages. Finally, UG researchers are not alone in their search for universal properties of language and the biological linguistic endowment. The differences among approaches to grammar are more about strategies, methodologies, and the interpretation of evidence. Thus, despite the lack of understanding across camps (or even enmity) that can sometimes

⁶In the notation of 1950s-style Transformational Grammar, each transformational rule was provided with its own structural condition and structural change. Hence, when multiple transformations exhibited similar or identical properties, each transformation made mention of similar or identical formal specifications. Sag conjectures that this notational redundancy, in the absence of attempts to introduce simplifying cross-transformational notations, created the impression that construction-specific transformations were theoretically redundant, and hence undesirable.

be observed, the logical independence of key ideas and methodologies suggests that we should be optimistic about finding some kind of rapprochement among researchers. This volume attempts to take one step towards achieving this goal.

The remainder of this chapter is structured as follows. Section 2 discusses the historical origins of SBCG, while section 3 provides a preliminary look at the basics of the SBCG theory. Section 4 addresses the commonalities shared between SBCG and other constructional approaches while at the same time pointing out a few significant differences. In particular, it shows how accounts of constructional phenomena couched in other constructional approaches can be ‘translated’ into SBCG. Section 5 presents an overview of the individual chapters in this volume.

1.2 The Roots of SBCG

Researchers in BCG and HPSG began a dialogue in the San Francisco Bay area in the late 1980s,⁷ one which led to certain refinements of BCG and to the constructional version of HPSG developed in Sag 1997 and Ginzburg and Sag 2000. In both of these theories, constructions were constraints that licensed certain recursive structures, modeled in BCG as trees with feature structures labeling the nodes, and in CX-HPSG as directed graphs (feature structures with reentrancy).

The first presentation of SBCG (Sag 2001) was made at the HPSG conference in Trondheim, Norway,⁸ and researchers in HPSG and BCG have continued discussions and collaboration over the ensuing decade. This long-term discussion and collaboration was made possible because of the many common assumptions that underlie work in BCG and HPSG, including those shown in Figure 1. Over the years, This BCG/HPSG group discussed many issues which were raised directly by the BCG work of Fillmore and Kay. Some of these are listed in Figure 2.

1.2.1 Construction Interaction

At the foundational level, the evolution from BCG to SBCG involved replacing a partially fixed hierarchy of constructions with the total type hierarchies familiar from the HPSG literature. That is, BCG began with a more fluid conception of construction interaction, where ‘any number of compatible con-

⁷This dialogue included various discussions among Charles Fillmore, Andreas Kathol, Paul Kay, Laura Michaelis, and Ivan Sag, which at times also included other members of the (extended) Berkeley and Stanford linguistics communities: Farrell Ackerman, Emily Bender, Tony Davis, Dan Flickinger, Mark Gawron, Jean-Pierre Koenig, Rob Malouf, Susanne Riehemann, Tom Wasow, Gert Webelhuth, and many others.

⁸The content of this unpublished presentation is further developed in Sag 2007, 2010b, to appear.

1. Linguistic objects are modeled in terms of feature structures (representable as attribute-value matrices or directed graphs).
2. Feature values can be complex, even recursive.
3. A language consists of a set of *signs*; a sign is an abstract entity that is the locus of constraints on the interface of form and meaning.
4. A grammar is a system of constraints that work together to license and delimit the signs of a given language.
5. *Constructions*, the constraints on classes of signs and their components, are organized into a regime (a lattice-like array of types and subtypes) that allows generalizations of varying granularity to be stated simply.
6. The distinction between lexical and grammatical entities is blurry, motivating a uniform conception of lexical and constructional constraints.

FIGURE 1 Common Assumptions of BCG and HPSG.

Construction Interaction: How do constructions interact? Do constructions freely combine when compatible? Are some constructions optional? Are some constructions obligatory? How does a grammar guarantee that the ‘right’ set of constructions apply to a given example?

Nonlocal Dependencies: How are nonlocal dependencies to be analyzed? Do constructions need to refer to elements embedded within phrases (or boxes) at arbitrary depth?

The Limits of Underspecification: Can the various argument-structure constructions be analysed in terms of underspecification of valence in a single lexical entry? Can determinerless noun phrases (with plural or mass head nouns) be given a uniform account via feature underspecification?

Particular Analyses: How should certain phenomena (primarily in English) be analyzed? For example, subcategorization, filler-gap dependencies, idioms of various kinds, genitive NPs, determiners, conditionals, control, raising, unexpressed arguments, ellipsis, and reflexive binding.

FIGURE 2 Issues Arising from the Common Assumptions of Figure 1

structions' could apply to produce a well-formed sentence, including those introduced by 'on-line type construction' (OLTC), yet some constructions were forced into the picture by requirements stating that certain constructions 'inherit' others.⁹ But this gave rise to unclarity about how many (and which) constructions had to apply to license a well-formed structure and which constructions were 'optional'. This issue is inextricably intertwined with the matter of construction inheritance, discussed below.

OLTC also led to analytic redundancy. For example, Koenig (1999) found that it was necessary to introduce the features ARGUMENT-LIST, SEMANTIC-ARGUMENTS, and ADDITIONAL-ARGUMENTS (in addition to ARGUMENT-STRUCTURE), in order to reconcile his carefully formulated OLTC analysis with the observed properties of extraposition, raising and expletive constructions in French. This appears to be an inevitable consequence of trying to 'scale up' an analysis that employs OLTC.

In the evolution from BCG to SBCG, the more fluid conception of construction interaction gave way to a regime (well established in the HPSG literature) where the application of grammatical constructions relies on a fixed organization of linguistic objects specified in terms of a hierarchy of types provided by the grammar's 'signature'.¹⁰ This regime, summarized in (1), uses the type hierarchy to clarify the nature of construction interaction:

- (1) A linguistic object
 - a. must be a well-formed instance of some maximal type,
 - b. must obey all constraints associated with that type (the most specific construction), and
 - c. must obey the constraints associated with all of that type's super-types (the 'inherited' constructions).¹¹

The view of constructions as constraints pervades SBCG, where all feature structures must instantiate a maximal type, as well as obeying all relevant type constraints. Moreover, the effect of OLTC can usually be achieved under these

⁹See Fillmore and Kay 1996, Kay and Fillmore 1999, Koenig 1999, Koenig and Jurafsky 1994, Michaelis and Ruppenhofer 2001, and the references cited there.

¹⁰The signature of an HPSG/SBCG grammar specifies the general space of linguistic objects in which the grammar constraints and lexicon are defined. The objects are all modeled as feature structures (atoms or functions) that are grouped into classes instantiating particular linguistic types. These types are organized in terms of a hierarchy specified within the grammar signature, which also specifies of each functional feature structure class – what features are in its domain, what type of feature structure each feature takes as value, and so forth. For a more technical discussion, see Sag this volume.

¹¹Here we leave aside the issue of defaults, which can be added to any constraint-based framework, including SBCG, to simplify the formulation of constraints. Default constraints also provide a way of formalizing prototype effects. For some discussion of prototype effects in natural language, see Lakoff 1987 and Langacker 2008, 2009b.

assumptions without any special mechanisms. This happens whenever a *listeme* (the notion generalizing ‘lexical entry’) or construction is underspecified in such a way as to be compatible with more than one maximal type. For example, a listeme can be compatible with two distinct maximal lexeme types, in which case it may license feature structures of both those types, as long as each such feature structure obeys the constraints of its own maximal type and all its supertypes. This is illustrated in Sag’s (this volume) discussion of ditransitives and *spray-load* alternations, where a single underspecified *give* listeme may be compatible both with the constraints of the Ditransitive Construction and with those of the *To*-transitive Construction (though these are mutually incompatible). The result is that both ditransitive *give*-lexemes and *to*-transitive *give*-lexemes are licensed by a single *give*-listeme.

1.2.2 Nonlocal Dependencies

Many human languages exhibit unbounded dependencies. For example, in English *wh*-interrogatives, a clause-initial interrogative *wh*-expression is paired with the existence of a ‘gap’ whose location can be arbitrarily deep within the body of the clause, as is well known:

(2) [Which aunt] did they say (it was likely that ...) she had visited __ ?

Within both BCG and HPSG it is possible to state a constraint that ‘reaches’ arbitrarily far down into these structures, making reference to both the ‘filler’ and the gap. For example, a construction licensing *wh*-interrogatives could allow an appropriate filler (a phrase containing a *wh*-interrogative word) to combine with a clausal structure only if the latter contained a suitable gap – either an phonologically empty element or simply the absence of some dependent of a lexical governor.

Although it was possible to formulate such constructions in terms of ‘long-distance’ constraints that made reference to the filler and the gap directly, this approach was pursued in BCG (paralleling ideas originating in Lexical-Functional Grammar¹²), but not in HPSG. The latter tradition¹³ proceeded instead via feature specifications present at each level of structure between the filler and the gap. The relevant feature, called variously SLASH or GAP, was used to provide a local encoding of information about the gap that extended all along the ‘extraction path’. That is, the feature-based theory of nonlocal dependencies encodes the property of containing a particular kind of depen-

¹²The proposal developed in Kaplan and Zaenen 1989 makes use of ‘functional uncertainty’. This technique states constraints in terms of regular expressions, e.g. GF^+ (one or more grammatical functions), to allow a gap to be (GF-)embedded at an arbitrary depth. The BCG approach employed the regular expression notation to represent a gap at an arbitrary depth of ‘valence embedding’ (Kay 1994, Kay and Fillmore 1999).

¹³See Gazdar 1981, Gazdar et al. 1985, Pollard and Sag 1994, Ginzburg and Sag 2000, Bouma et al. 2001, and Levine and Hukari 2006.

dent element (in this case, a gap of the appropriate category) as a grammatical property of all phrases along the extraction path (those phrases that contain the gap without containing the filler).

Analyses of the latter sort enjoy considerable independent motivation from the need to adequately account for languages where words or constructions that appear along the extraction path are sensitive to the presence (or absence) of a nonlocal dependency. For example, the so-called ‘Stylistic Inversion’ (SI; Kayne and Pollock 1978) pattern of modern French is well known:

- (3) a. Avec qui a prétendu Marie que sortirait Jean
With whom has claimed Marie that would-leave Jean
‘Who did Marie claim that Marie would leave with?’
b. Quand Marie a-t-elle déclaré qu’ était mort? Paul
When Marie has-she claimed that was dead Paul
‘When did Marie claim that Paul died?’

Since SI is only possible along an extraction path (the part of the analysis tree connecting the filler with the gap), both (3a,b) are unambiguous – the filler is associated with the embedded clause. This is because the subject is ‘inverted’ in both the matrix and embedded clause, indicating a long extraction path. By contrast, examples like (4) are ambiguous:

- (4) Quand Marie a-t-elle déclaré que Paul était mort?
When Marie has-she claimed that Paul was dead
‘When did Marie claim that Paul died?’

Like the English gloss, this sentence can be used to ask about the time of Marie’s inquiry or the time of Paul’s death. That is, since the embedded clause does not exhibit SI, it need not be, but may be part of the extraction path; hence the sentence has two grammatical analyses.

What examples like these show is that the notion of ‘gap-containing phrase’, recursively defined, is necessary in order to analyze the French SI construction and the numerous phenomena in other languages that have been discovered over the last forty years.¹⁴ Thus, by abandoning the BCG view of filler-gap constructions (e.g. the treatment of ‘Left-Isolate’ constructions in Fillmore and Kay 1996 and Kay and Fillmore 1999) in favor of a feature-based treatment, we can obtain an analysis of all the cross-linguistic phenomena associated with extraction domains.¹⁵

¹⁴Complementizer choice (Irish), verb morphology (Chamorro), tonal downstep suppression (Ewe), expletive choice (Icelandic), or verb-subject inversion (French, Spanish, Yiddish) can all be sensitive to the presence or absence of an extraction path. For discussion, see Hukari and Levine 1995, and the references cited in Sag 2010a.

¹⁵Feature-based accounts of phenomena like this also avoid the introduction of otherwise unmotivated and potentially problematic ‘intermediate traces’, which play an essential role in competing movement-based proposals.

In other words, the existence of extraction-path dependencies of the sort just illustrated clearly suggests a theory of grammar where all long-distance dependencies are analyzed in terms of feature specifications that are locally realized along the dependency path. Analyses of this kind are naturally expressed in a theory where all syntactic constructions involve constraints on mothers and their daughters (rather than the daughters of their daughters). That is, the existence of extraction-path dependencies suggests grammars whose rules (constructions) have the same local character as rules in a Context-Free Phrase Structure Grammar. The way to enforce CFG-locality in BCG would be a restriction requiring that constructions may make reference to properties of their inner boxes, but not to any boxes within those boxes. But no such stipulation is required in the version of SBCG presented in this volume, where locality follows directly from the fact that the well-formedness of signs is stated in terms of constructs (local trees), which include a mother (a sign) and its daughters (also signs), without access to any of the signs that were used to construct those daughters (the ‘granddaughters’).¹⁶ Sag (this volume) also shows that this approach can preserve the insights of Kay and Fillmore’s (1999) analysis of the ‘What’s X doing Y?’ Construction, the poster child for the BCG treatment of filler-gap dependencies.

1.2.3 The Limits of Constructional Inheritance

Some practitioners of Construction Grammar, perhaps most notably Adele Goldberg (1995, 2003, 2006), have proposed analyses that press lexical underspecification and ‘inheritance’ into service as the primary way that constructions interact. This follows ideas developed in early BCG (see, for example, Fillmore and Kay 1996), where a given lexical construction could inherit the Directed Motion Construction or the Resultative Construction and also either the Passive Construction or else the Active Construction. This theory of construction interaction is succinctly summarized by Goldberg (2009:97):

Constructions are combined (unified) freely to form actual expressions as long as they don’t conflict.

All of the properties of an expression thus follow from constraint inheritance: a given form is simultaneously classified via some set of constructions and hence must simultaneously satisfy all the constraints that those constructions impose.

¹⁶This is not the only way to formulate SBCG-theory. For example, Richter and Sailer (2009) suggest that an adequate treatment of German ‘phraseological clauses’ should make use of nonlocal (biclausal) constraints. If this can be shown for any linguistic phenomenon, then the licensing of signs in SBCG would have to be modified so as to make reference to full analysis trees, rather than local trees. However, the data discussed by Richter and Sailer can be reanalyzed within the more predictive localist framework assumed here, as argued by Kay and Sag (ms). For a discussion of other apparent challenges to localist analysis, see Sag 2010b, to appear.

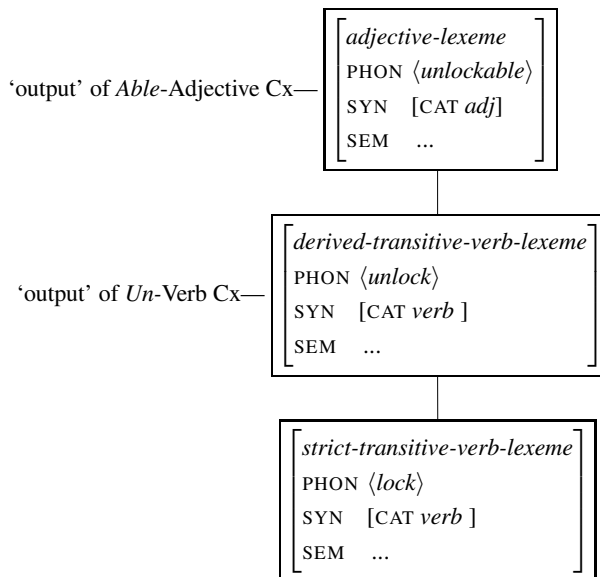
However, recent attempts to work out significant domains of construction-based analysis of lexical processes have moved away from analyses based on inheritance and lexical underspecification. For example, in his sign-based reanalysis of Goldberg's (1995) prototype-based network of ditransitive argument structure constructions, Kay (2005) argues for replacing the familiar system of lexical underspecification and OLTC that Goldberg assumed with a set of unary 'two-level' constructions, i.e. constructions that involve a mother and a single daughter. Motivation for this analytic shift comes from many sources. For example, Kay observes that argument structure constructions sometimes add arguments, e.g. the well-studied applicative constructions in various languages. A lexical verb like *throw* also does not require a goal or recipient argument, but allows one in a sentence like *Pat threw Tracy the beanbag*. To augment the valence (syntactic and semantic) of lexical *throw* by unification with a construction that contains a recipient element absent in the lexical entry is at best awkward to represent formally in a one-level underspecification-plus-inheritance approach. It is, however, a straightforward matter in a two-level approach, where the mother, the derived lexical item, may have some properties that are inconsistent with those of the daughter.¹⁷

A similar argument (due originally to J.-P. Koenig) concerns derivational argument structure constructions that eliminate arguments present in the lexical verb. An example is the subtype of French reflexivization that inchoativizes a lexically causative-transitive verb. *Améliorer*, the underived lexical item, means 'to cause to be better' and selects an agent. *S'améliorer* (the derived, inchoative form) means 'to get better', not 'to make oneself better'; the agent argument of *améliorer* is simply not present. This kind of subtractive derivational process stands as a formidable challenge to any underspecification-plus-inheritance analysis. However, it is straightforwardly representable in a two-level treatment.

The limitation of underspecification-plus-inheritance analysis in general has also been demonstrated forcefully by Müller (2006, 2010), who shows that resultative constructions and other phenomena must be analyzed in terms of embedding, i.e. in terms of two-level lexical constructions that interact via 'input-output' ('daughter-mother') relations of the sort shown in Figure 3.¹⁸ What interactions of this kind demonstrate is that many phenomena require a

¹⁷There are reasons other than those discussed by Kay for questioning Goldberg's proposed analysis of argument structure constructions. As shown by Croft (2003), such analyses fail to accommodate the idiosyncrasies of verb classes and of individual verbs. There is every reason to be optimistic, however, about SBCG's ability to provide a natural account of both phenomena. See also Boas 2003, Iwata 2008, Cristofaro 2008, and Barðdal et al. 2011.

¹⁸Note the abbreviations used here and throughout: PHON(OLOGY), SYN(TAX), CAT(EGORY), SEM(ANTICS).

FIGURE 3 The *Un-Verb* Construction Feeding the *Able-Adjective* Construction

two-level analysis where an intermediate expression is constructed to serve as the input to the construction that used to build the final expression. This contrasts with an ‘all-at-once’ (or one-level) analysis where a given lexical input must simultaneously satisfy the constraints imposed by two constructions.

What Müller shows is that several argument structure phenomena in English, German, and Persian cannot be analyzed within an underspecification-plus-inheritance (one-level) view of construction interaction.¹⁹ That is, in order for an adjective like this to be well-formed with the intended ‘able to be un-Verb-ed’ meaning, there must be a verb *unlock* with the appropriate meaning. Because there is no verb *unclean*, for example, there is no adjective *uncleanable* meaning ‘able to not be cleaned’. Hence English grammar must countenance morphological structure.²⁰

¹⁹It is worth noting that the approach to construction interaction that Müller defends is the traditional one. In fact, the view that morphological processes at least sometimes involve embedding the output of one construction as an input to another is shared by other practitioners of Construction Grammar, e.g. by Koenig (1999), P. Kay (2005), and Croft and Cruse (2004).

²⁰Of course *unlockable* and *unreadable* both are well formed on a ‘not able to be Verb-ed’ interpretation, which involves a different structure where *un-* is prefixed to the adjectives *lockable* and *readable*. For more discussion, see Müller 2010, Sag this volume.

To see the importance of this argument, consider attested examples like German *Vorvorvorversion*²¹ ‘preprepreversion’. As argued by Krieger and Nerbonne (1993),²² examples like these show that aspects of German derivational morphology are recursive in nature. The semantics required here is also recursive in nature, with a *Vorvorvorversion* being a version that is available before the *Vorvorversion*, which in turn is a version available before the *Vorversion*, and so forth. It should be noted that the depth of some recursive processes is limited, making it possible to describe them in one-level terms by introducing an additional feature (see Koenig 1999, Müller 2010). The addition of such ‘junk’ features²³ can render an analysis consistent with the inheritance-based model of construction interaction, but truly recursive phenomena, which make essential reference to a grammatically unbounded number of intermediate stages of construction and meaning, require an analysis formulated in terms of recursive devices, such as SBCG’s combinatoric constructions. Moreover, as Müller demonstrates, attempts to treat English and German resultatives via construction inheritance fail to predict the observed interactions of resultatives with other well studied constructions.

Much the same point could be made with respect to English prefixation with *anti-*, *ex-*, *pre-* or *post-*. In addition, as Müller and Samvelian (in preparation; see also Müller 2010) show in considerable detail, proposals (like that of Goldberg 2003) to treat Persian complex predicates via construction inheritance encounter similar difficulties. By contrast, the two-level analysis Müller and Samvelian develop, which is fully compatible with SBCG, avoids these problems entirely. Finally, it should be observed that phenomena of this kind, which are perhaps somewhat restricted in more familiar Indo-European languages, are found with full productivity in agglutinative languages like Turkish or Hungarian.

Further examples of constructional feeding relations, motivating a two-level analysis, can be supplied at will. For example, the Directed Motion Construction or intransitive instances of the Resultative Construction provide a direct object NP that can feed lexical constructions like passivization, creating passive VPs like those bracketed in (5):

- (5) a. A parody, sung to the tune of “On Top of Old Smokey,” tracing the meanderings of a meatball that was [sneezed off a plate of spaghetti].²⁴

²¹<http://www.sgaf.de/viewtopic.php?t=21551&postdays=0&postorder=asc&start=0> (25 September 2006).

²²This point was made earlier by Kay (1973), whose argument for recursive lexical derivations is based on English kinship terms (e.g. *great great...grandmother*).

²³On junk features, see Ait-Kaci 1984 and Carpenter 1992.

²⁴<http://www.paulbrettjohnson.com/Books.htm> (May 25, 2011)

- b. We had the only napkin [sneezed off a table by a member of the royal family].
- c. The sneakers have been [run threadbare by my 10-year old].

And of course many idioms allow a similar interaction with passivization:

- (6) a. However, very little advantage was [taken of this land (for school purposes anyway)], and...²⁵
- b. Otherwise, you'll see your emotional strings getting [pulled] every time someone does or says something you dislike.²⁶

Finally, an adequate grammar of English must allow basic and idiomatic verbs to interact with resultatives, directed motion, passivization, filler-gap constructions and modification constructions in such a way as to predict complex feeding relations:

- (7) a. How many napkins did Kim end up [sneezing off the table]?
 - b. The socks that you claim had been [run threadbare by your 10-year old]...
 - c. ...or the level of cynical advantage that had been [taken of the most stoical, courageous and professional troops in the world].²⁷
 - d. It's her way of passing off any misunderstanding about any strings that some people may have thought were [pulled for her] as a result of her grandfather and great uncle...²⁸
- (8) a. The only napkins [sneezed off the table] were in your mind.
 - b. A pair of socks [run threadbare by our 10-year old] were sitting on the table.
 - c. The Globe also explored the question of whether he got into the National Guard through strings [pulled for him] as the son of a U.S. Congressman.²⁹

For all these reasons, it seems clear that analyses stated in terms of lexical underspecification and constructional inheritance, though widely utilized in BCG and readily available within SBCG, are not the right solution to a large

²⁵http://myflorida.custhelp.com/app/answers/detail/a_id/469/~/when-was-the-public-school-system-established-in-florida%3F (May 25, 2011)

²⁶<http://www.businessstoolchest.com/articles/data/20040907004754.shtml> (May 25, 2011)

²⁷http://4freedoms.ning.com/group/EDL/forum/topics/bradford-speech-british?xg_source=activity (May 25, 2011)

²⁸<http://paris-lifestyle.aeroportsdeparis.fr/en/carrousel/lea-seydoux-une-parisienne-a-hollywood/> (May 25, 2011).

²⁹<http://www.truthorfiction.com/rumors/b/bush-desert.htm> (May 25, 2011).

number of well studied problems. Considerations of this kind become relevant with regard to dative and locative alternations; see Sag this volume (secs. 3.7.2,3.7.3).

1.3 What is Sign-Based Construction Grammar?

SBCG embodies a strong commitment to psycholinguistic plausibility, in fact adhering to a stronger version of Chomsky's (1965) competence hypothesis than is customary in the field. This means that the mechanisms of grammar are motivated not by descriptive economy, lack of redundancy, or mathematical abstractions of questionable direct relevance to linguistic science (e.g. Gold's (1967) 'language identification in the limit').³⁰ Rather, linguistic proposals are motivated and evaluated in terms of how well they comport with models of language use (e.g. production and comprehension), language learning, and language change (Croft 2000, 2001, Tomasello 2003, Goldberg 2006, Langacker 2000, 2009b).

Because partial meanings are computed incrementally in language comprehension, a psycholinguistically realistic grammar must be shown to be embeddable within a model of human sentence parsing that allows the semantic throughput of the grammar to be incrementally determined. As argued by Sag and Wasow (2011), this aspect of sentence comprehension motivates grammars that are model-theoretic (a monotonic system of declarative constraints), sign-based, surface-oriented, and strongly lexicalist. Grammars expressible within the SBCG framework have these three properties. Various instances of 'redundant' encoding may also be psycholinguistically plausible. While these are not necessary properties of an SBCG grammar, they are easily incorporated, e.g. by allowing listemes that redundantly analyze certain signs that are also constructionally licensed (see below). Similarly, semantic underspecification, e.g. of quantifier scope, is naturally expressed within SBCG. This may also be psycholinguistically motivated (see Sag this volume).

Because the rules, listemes, and general principles of SBCG are all given as constraints (this is what it means to be a constraint-based, rather than, e.g. a derivation-based, framework), it is a natural step to consider probabilistic versions of SBCG, which would provide a basis for expanding the explanatory scope of linguistic theory to include priming, frequency biases, and numerous other pervasive aspects of language use that are considered irrelevant to the UG enterprise. Though this idea has not moved beyond the speculation stage with respect to SBCG, there have been several interesting attempts to implement stochastic versions of closely related versions of HPSG. See, for

³⁰On 'strong' competence models, see Kaplan and Bresnan 1982, Sag et al. 1986, 2002, and Sag and Wasow 2011. For discussion of learnability in Gold's sense, as well as related, more realistic notions, see Pullum and Scholz 2005 and, especially, Clark and Lappin 2011.

example, Brew 1995, Toutanova et al. 2005, and Miyao and Tsujii 2008.³¹

The notion of ‘grammatical construction’ has been used rather informally by the various groups that make up the CxG community, but these uses all build on Saussure’s notion of ‘sign’ in one way or another. Of course constructions are sometimes schematic, in order to accommodate ‘slots’ that can be filled by many distinct signs, e.g. the ‘X’ of *give X a break* or the ‘X’ and ‘Y’ in *What’s X doing Y?*. In the case of many phrasal (combinatoric) constructions like the Subject-Predicate Construction, the construction’s effect is entirely schematic, that is, no particular form is being paired with a meaning. In BCG, grammatical constructions were defined as ‘any conventionalized pairing of form and meaning’, and hence were postulated only for structures that are at least partially unanalyzable (Fillmore 1988, Fillmore et al. 1988, Goldberg 1995, Kay and Fillmore 1999). The concept has sometimes been expanded, however, to include not only non-compositional and partially arbitrary units, but also fully predictable stored patterns, as long as they occur with sufficient frequency (Goldberg 2006, 5). For other definitions of construction, see Croft 2001, 17-21 and Fried and Östman 2004, 18-23.

Because the form-meaning correspondence in SBCG is mediated by signs, the way conventional form-meaning correspondences are defined is slightly different. Signs have the basic structure sketched in (9):

$$(9) \left[\begin{array}{ll} \text{PHON} & /kim/ \\ \text{SYN} & \text{PN} \\ \text{SEM} & \text{‘the intended person named Kim’} \end{array} \right]$$

The grammar will include a set of ‘listemes’, that directly license the basic signs of the language, some of which correspond to what are usually referred to as ‘multiword expressions’, e.g. *by and large*, *attorney general*, and *The Hague*. This kind of licensing is straightforward: a sign is ‘listemically’ licensed only if there is some listeme that characterizes it accurately. Since all feature structures belong to some maximal type, and hence must satisfy the constraints appropriate for objects of that type, the listemes can be streamlined, pushing off all more general properties of classes of lexical signs to constraints on more general lexical types.

Any such constraint characterizing a lexical class is called a ‘lexical-class construction’.³² A lexical-class construction always has the form:

³¹Further information about the LINGO Redwoods project (Stanford University, Center for the Study of Language and Information) is available at <http://lingo.stanford.edu/redwoods/>. For more on the development of the Enju parser by members of the Tsujii laboratory (University of Tokyo, Department of Computer Science), see <http://www-tsujii.is.s.u-tokyo.ac.jp/enju/#publication>.

³²These are essentially equivalent to what Croft (2003) refers to as ‘verb-class specific constructions’, though of course they are not restricted to verbal lexemes.

- (10) $\tau \Rightarrow D$
 (All feature structures of type τ must satisfy D , where τ is a lexical type and D is a feature-structure description)

Each lexeme class has a corresponding construction, which defines its distinctive properties. A lexical sign is licensed (well-formed) if it satisfies some listeme, instantiates some maximal lexical type, and satisfies all relevant lexical-class constructions. Examples of lexical-class constructions include the Ditransitive, Transitive-Locative, Strict-Transitive, and Proper-Name constructions.

‘Listemic licensing’ of this kind is the direct embodiment of the simple notion that construction grammars contain constraints on the relation between form and meaning. But SBCG, like other FG systems, including BCG, also recognizes the fundamental generative insight that a natural language is a recursive system. Thus in addition to listemes and lexical-class constructions, SBCG countenances ‘combinatoric’ constructions, which define the characteristic properties of the modes of combination within a given language. Some English combinatoric constructions are stated informally in (11):

- (11) a. Combine a subject and a finite VP³³ to form a clause whose meaning is a proposition. (Subject-Predicate Construction)
 b. Combine a lexical head and all of its complements except its subject to form a phrase whose meaning is a predicate. (Predicational Head-Complement Construction)
 c. Combine an invertible (hence finite) auxiliary verb with all its valents (subject, then complements) to form an interrogative clause whose meaning is a polar question. (Polar Interrogative Construction)
 d. Combine a *wh*-interrogative expression (the filler) with a clause missing an expression of the same type as the filler to form an interrogative clause whose meaning is a nonpolar question. (*Wh*-Interrogative Construction)

In SBCG, each informal statement in (11) gives rise to a corresponding combinatoric construction formulated as indicated in (12):

- (12) a. *subject-predicate-construct* \Rightarrow ...
 b. *predicational-head-complement-construct* \Rightarrow ...
 c. *polar-interrogative-construct* \Rightarrow ...
 d. *wh-interrogative-construct* \Rightarrow ...

³³More precisely, a finite verbal word or a verbal phrase whose finite lexical head has already combined with all its nonsubject complements.

Each of these constructions is an implicational constraint of the general form indicated in (10). Just as the lexical-class constructions impose constraints that characterize a class of lexical signs, these constructions characterize the conventionally licensed classes of mother-daughter configurations, i.e. constructs. Thus each type name in (12) corresponds to a family of constructs whose characteristic properties are defined by the particular construction. The family of subject-predicate constructs is infinite and it includes all those shown in (13):³⁴

- (13) a.

<i>subject-predicate-construct</i>																		
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³⁴Following Sag (this volume), constructs (but not the constructions that license them) are displayed in boxes.

SBCG thus includes a second way of licensing signs: a sign is ‘constructionally’ licensed only if it is the mother of some well-formed construct.

An SBCG grammar thus has three parts: (1) a grammar **signature** that delineates the general space of linguistic objects and specifies the high-level properties of each class, (2) a **lexicon** – an inventory of listemes, each of which describes a particular class of lexemes, words or phrases that form the finite basis of the language in question, and (3) a **constructicon** – a set of constructions specifying the characteristic properties of particular lexical classes and the particular patterns (or ‘modes of combination’) used to build complex expressions. An expression (a sign) is well-formed only if it is licensed by some listeme or built by some construction.

Notice that we draw a distinction between the **framework** of SBCG, which includes the three components just sketched, and the **formalism** in which this framework is expressed, which is the formalism of typed feature structures (and an associated logic).³⁵ For a linguist, of course, the action and the interest is in the details of analyses developed within the framework – the specific linguistic constraints that are proposed, their descriptive adequacy, the generalizations that they embody, and their potential for explaining cross-linguistic patterns and language learning. The present volume contains a number of interesting linguistic proposals, all of which are presented within the general framework of SBCG.

1.4 Varieties of Construction Grammar

The SBCG framework is meant to be compatible with most linguistic analyses that have been developed within CxG of all kinds. Here, however, it would be a daunting task indeed to do more than simply raise certain high-level issues that unite the CxG community and to sketch how key ideas from particular proposals might be implemented within SBCG.

Signs: First, it should be noted that the sign-based nature of grammar, which is made formally explicit in SBCG, is generally recognized within the CxG community. The importance of semantics to grammar is a current running throughout the CxG community that is systematically accommodated by SBCG. Listemes, lexical-class constructions, and combinatoric constructions, the three cornerstones of a grammar, all describe classes of signs, and hence together characterize the form-meaning relation. This is not to say that every listeme or construction must make mention of some semantic property, only that all such linguistic descriptions have the potential to do so and, of course, most often do. This is in accord with Langacker’s (1987, 56) notion that ‘grammatical structure is inherently symbolic’.

³⁵See, for example, Carpenter 1992, King 1994, and Richter 2004.

Building Blocks: Construction Grammarians all emphasize the importance of ‘starting big’, i.e. allowing units larger than the word as the building blocks of syntactic analysis (see, e.g. Langacker 1987, Kay and Fillmore 1999, Croft 2001, Goldberg 2006).³⁶ This is often discussed as one of the most important differences between CxG and other approaches to grammar. This point is fundamental to SBCG as well, but here it is made clear that there is more than one way to start big. A multiword expression (MWE) could, for example, simply be learned as a listeme, in which case none of its internal parts can ever be modified or quantified; nor can any of its components be realized at a distance from the others – the complex expression is syntactically inert. Alternatively, an idiomatic expression like *pull strings* can be learned as two separate lexemes – one whose form is *pull*, which is lexemically specified to select a direct object NP whose lexical identifier is **i-strings-fr**, the idiomatic ‘strings’ frame; and a second whose form is *strings* and whose lexical identifier is this same **i-strings-fr**. The effect of this analysis is fourfold:

1. All the morphological constructions that apply to nonidiomatic *pull* also apply to this lexeme, allowing for the words *pulls*, *pulled*, and *pulling*, as well as *pull*.
2. The word *strings* can be modified or quantified, as in *pulled too many strings*, *pulled no strings*, *pulled some political strings*, etc.
3. Passive variants like *no strings got pulled* are allowed.
4. Unbounded separation of *strings* and *pull* is permitted in, e.g. relativization: *the strings that Sandy said ... had been pulled to get Pat the job*.

In addition, there are various ways of restricting the lexemic analysis of MWEs so as to allow intermediate degrees of syntactic flexibility.³⁷ Thus, SBCG provides the means for refining this fundamental insight of the CxG community and to enhance its descriptive capabilities. Finally, SBCG also allows the possibility of multiple analyses, including the inclusion in a grammar of a listeme that can also be constructed via combinatoric constructions. This kind of analysis might be used for examples like *red herring*, *can you*, *why don't you*, *shall we?*, and *go figure*, among many others. Given this, it is possible to explore hypotheses within SBCG about the relation of this kind of ‘double’ encoding to frequency (see Goldberg 1995, 2006, Langacker 2000, Boas 2011, and Bybee 2012).

Universals: In his ‘Radical Construction Grammar’, Croft (2001, 2012) argues for a minimization of representational commitments, stressing that cat-

³⁶Indeed, there is evidence for the importance of this concept in language learning. See, for example, Aron to appear, Bannard and Matthews 2008, and Aron and Snider 2010.

³⁷For further discussion, see Sag et al. 2002, Sag this volume, and Kay and Sag ms.

egories should be built up on the basis of language-internal generalizations, rather than a presumed universal inventory.³⁸

This perspective is compatible with SBCG. The types that are posited for any individual language need not be drawn from any universal inventory, though it is also possible to explore the hypothesis that some types and their associated constraints might be universal (or perhaps ‘default’ universals or ‘universal prototypes’).³⁹ Similarly, the type hierarchy for a given language can very naturally provide a hierarchical classification that distinguishes, for example, *common-noun* from *gerund* or other subtypes (see Malouf 2000). Multiple inheritance hierarchies also permit cross-classification of linguistic entities, based on generalizations about orthogonal properties. For example, part-of-speech classification is naturally separated from argument-structure (or valence) classification, allowing an SBCG grammar to treat transitive verbs and transitive prepositions as a natural class while at the same time distinguishing the class of verbs from the class of prepositions. Features and types often work together to optimize the description of such cross-classifications.

At the same time, it should be possible to arrive at construction-based cross-linguistic generalizations that can be formalized in SBCG. For example, the papers in Boas 2010 argue that it is possible to arrive at constructional generalizations across languages. Each of these papers discusses a well-described constructional phenomenon in English in relation to constructional counterparts in other languages such as Finnish, Swedish, Russian, Spanish, Thai, and Japanese. This approach shows that the semantic description (including discourse-pragmatic and functional factors) of an English construction can be regarded as a first step towards a *tertium comparationis* that can be employed for comparing and contrasting the formal properties of constructional counterparts in other languages. In this way, constructions serve as descriptive and analytical tools for cross-linguistic comparisons that capture both language-specific (idiosyncratic) properties and cross-linguistic generalizations.

Semantics: SBCG is compatible with a number of different approaches to semantic analysis, including (Barwise/Perry-style) Situation Semantics (Ginzburg and Sag 2000), (Montague-style) Possible World Semantics (Sag 2010a) and Frame Semantics (Fillmore et al. this volume, Sag this volume). Although it is widely believed that semantic theories such as Cognitive Semantics (Langacker 1987, Lakoff 1987, Talmy 1988) are sufficiently distinct from any of the approaches just mentioned that formalization using familiar logical methods is impossible, this appears not to be the case. In particular,

³⁸See also Dryer 1997 and Barðdal 2011.

³⁹For a number of analyses using default constraint inheritance in phrasal constructions, see Ginzburg and Sag 2000 and Malouf 2003. Although neither of these makes specific proposals about universal prototypes, the techniques developed there, employing the ‘nonpersistent’ defaults of Lascarides and Copestake (1999), are suggestive in this regard.

as shown in detail by Gärdenfors (2000), one can define a model theory for linguistic expressions in terms of regions and vectors. The model-theoretic interpretations of linguistic entities (or the symbolic expressions involved in their semantic analysis) are then not the objects familiar from Tarskian model theory, but rather spatial objects subject to certain axiomatic constraints (e.g. convexity).

Gärdenfors' suggestion is a simple analytic move with far-reaching consequences, in terms of semantic expressivity and also in terms of cognitive modeling. That is, one can provide verbs with a symbolic representation (perhaps via feature structures that include features such as *TRAJECTOR* and *LANDMARK*), and these have a model-theoretic interpretation (in what Gärdenfors (2000) calls the domain of 'conceptual representations'; cf. Jackendoff's (1983, 1990, 2002) 'Conceptual Structure'). In processing, one sometimes stays at the symbolic level and sometimes evaluates semantic symbols by 'pushing down' to their conceptual representation. It is in the latter case that certain imagistic properties become psychologically active.⁴⁰ Gärdenfors (2000, 176ff.) also suggests that metaphors can be analyzed in his framework as identities in topological or geometrical structure between different domains, allowing a formal treatment of various proposals made within Cognitive Semantics (e.g. Lakoff and Johnson 1980, Lakoff 1987). In sum, Gärdenfors has pioneered a conceptualization of many of the insights of Cognitive Semantics that renders them compatible with SBCG.

1.5 SBCG at Work

The chapters in this book center around three themes. The first set of chapters place SBCG in a broader theoretical context and provide a synopsis of the theory. In Chapter 2, **Making the Case for Construction Grammar**, Laura Michaelis debunks some common misconceptions about CxG, e.g. that it is non-rigorous, does not offer generalizations, that it is obsessed with linguistic marginalia, that it is opposed to compositional semantics, that it is not constrained, and that it does not provide a universal framework for syntax. She also argues that SBCG offers a coherent theory of language that avoids a number of problematic concepts assumed by much work in the generative-transformational tradition. In Chapter 3, **Sign-Based Construction Grammar: An informal synopsis**, Ivan Sag presents and explains the basic concepts of the theory, such as feature structures, signs, argument structure, constructs and constructions, and conditions on well-formed feature structures. The chapter proceeds by discussing a broad range of grammatical problems that have been addressed in the literature – both the transformational liter-

⁴⁰This also seems convergent with some of the ideas developed within Embodied Construction Grammar (Bergen and Chang 2009, Feldman et al. 2009).

ature and the now extensive bodies of work in both Construction Grammar and HPSG, including multiword expressions, extended valence constructions, syntactic alternations, auxiliary phenomena, and filler-gap constructions. This chapter shows how the SBCG framework provides consistent and comprehensive linguistic descriptions that are also well-suited to express insights from other strands of CxG. It closes with an appendix containing parts of the English grammar signature.

The second set of chapters presents detailed SBCG analyses of a range of difficult phenomena. In Chapter 4, **The Distribution of *that*-clauses in English: An SBCG-Account**, Gert Webelhuth discusses the distribution of English *that*-clauses, e.g. in *That John would show up, no one was aware of*, which have an intriguingly restricted syntactic distribution. Based on a review of a broad range of data, Webelhuth analyzes a complex grammaticality paradigm in terms of the interaction of a single construction, namely the Initial-*that*-Clause Construction, with a small number of constraints. Webelhuth's account of *that*-clauses demonstrates the advantages of a constructional view of language in providing a succinct account of the relevant data, where the category of the filler and the gap element are mismatched. In Chapter 5, **Discontinuous Dependencies and Complex Determiners**, Paul Kay and Ivan Sag analyze the interrelation of two understudied phenomena of English, namely the discontinuous modifier phenomenon (*more ready for what was coming than I was*), and the complex pre-determination phenomenon (*How hard a problem was it?*). Based on the observation that these two phenomena can also occur intertwined (*so lovely a melody that some people cried*) Kay and Sag propose a simple SBCG analysis. In contrast to other proposals, which have had to rely on syntactic movement, their constraint-based account not only captures the relevant linguistic generalizations, but also accounts for a set of idiosyncratic exceptions.

In Chapter 6, **Reconstructing Syntax: Construction Grammar and the Comparative Method**, Jóhanna Barðdal and Thórhallur Eythórsson demonstrate that the analytical tools of Construction Grammar can be effectively used to reconstruct grammar based on form-function pairings. Adopting the SBCG formalism for their analysis, the authors discuss a wealth of data illustrating the distribution of case and argument structure constructions in Old Germanic, Latin, Ancient Greek, Lithuanian, and Russian. This discussion leads the authors to various insights, including the observation that case alignment in Proto-Indo-European must have been semantically determined to some degree. They argue further that the sign-based nature of SBCG provides a solid basis for extending the Comparative Method into syntax. Finally, in Chapter 7, **The FrameNet Constructicon**, Charles Fillmore, Russell Lee-Goldman, and Russell Rhodes demonstrate the utility of SBCG for creating databases of constructional analysis and annotation. Based on a short re-

view of the FrameNet project,⁴¹ a lexicographic database of English based on Frame Semantics (Fillmore 1985), the authors offer SBCG as a flexible, fully formalized framework for research in construct-based grammatical analysis. More precisely, they propose to extend the FrameNet methodology for lexical description so that it can also be used to recognize and catalogue grammatical constructions. The end result is to display the relevant properties of constructional phenomena in an abbreviated format, alongside a representative sample of English sentences annotated to display the properties claimed for each construction.

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⁴¹For more information about FrameNet, see Fillmore et al. 2003, Fillmore and Baker 2010 and the material available at <http://framenet.icsi.berkeley.edu>.

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