Construction Grammar and Frame Semantics

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1. Introduction

This chapter provides an overview of Construction Grammar (CxG), a theory of language that was developed as an alternative approach to generative transformational grammar at the University of California, Berkeley during the 1980s and 1990s. One of the main goals of CxG is to account for the entirety of language instead of focusing on only specific phenomena thought to belong to a so-called "core" (as opposed to a so-called "periphery"). On the constructional view, a language consists of a very large inventory of form-meaning pairings (constructions), which are organized in a structured network. In this view, the entirety of language consists of constructions (form-meaning pairings). Research in CxG is not only interested in investigating structural aspects of language, but it also seeks to determine how form and meaning, typically modeled in terms of semantic frames, are related to each other. Thus, this chapter also provides an overview of the sister theory of CxG, Frame Semantics, as well as its practical application in terms of the FrameNet lexicographic database.

2. Historical perspectives

2.1 From Case Grammar to Frame Semantics

The intellectual roots of CxG and Frame Semantics (FS) lie in Charles Fillmore's (1968) seminal paper *The Case for Case*, in which he proposed a limited set of so-called universal deep cases such as Agentive, Instrumental, and Objective (also known as semantic roles), which specify a verb's semantic valency. These deep cases, which are supposed to determine the syntactic distribution of a verb's arguments, were defined independently of verb meanings, they were regarded as unanalyzable, and each syntactic argument should bear only one semantic role. Fillmore's deep cases can be seen as an early version of what later became known as semantic roles, which play a crucial role in representing verb meaning in lexical entries of verbs that interact with constructions (see, e.g., Fillmore & Kay 1993, Goldberg 1995, Croft 2012, Sag 2012).[1]

The years following the publication of Fillmore (1968) saw a growing interest in deep cases (for an overview see Somers 1987, Klotz 2000, Fillmore 2003, Ziem 2008, Boas and Dux 2017). However, during the 1970s, several researchers pointed out problems with the idea of a limited set of deep cases, for example, (1) that there are no systematic tests for determining their status, (2) the grain size of deep cases (or semantic roles as they became known during the 1970s), and (3) the fact that there is a lack of one-to-one correspondence between deep cases and syntactic

[1] In other linguistic frameworks dealing with the interaction between meaning and form, semantic roles also play a crucial role in what is known as Linking Theory (see, e.g., Butt et al. 1997, Levin and Rappaport Hovav 2005, Osswald and Van Valin 2014, and Wechsler 2015).

arguments (see Levin and Rappaport-Hovav 2005 for an overview). Chapin (1972) summarizes his critique of Fillmore's (1968) case roles as follows:

> [I]t is essential that the inventory of cases be not just finite but quite small in number related to the number of predicates in the vocabulary of a single language (...). Furthermore, it is essential that the cases postulated be precisely defined so as to force correct descriptive decisions. A case system which permits the postulation of a new case to handle every problematic instance is not a theory of substantive universals, but a notational system for ad hoc description. (Chapin 1972: 651)

These problems led Fillmore during the 1970s to re-conceptualize his view of semantic roles. More specifically, Fillmore moved away from the idea that semantic roles had to be universal and relatively limited in number. Instead, Fillmore developed the view that semantic roles are situation-specific, or, in his words, that "meaning is relativized to scenes" (Fillmore 1977a: 59). This thinking led Fillmore to a series of publications (1977a, 1977b, 1978, 1979) in which he studied various examples of how cultural and world knowledge motivates and is embedded in linguistic expressions. One of the key proposals of Fillmore's new theory of Frame Semantics (1982, 1985a) was that one should define situation types in their own right by identifying the participants (semantic roles), which define the situations. This was in stark contrast to his earlier proposals, in which verb meanings (or the situations they describe) were defined in terms of the semantic roles of their arguments. Thus, to understand the meaning of a word requires a great deal of underlying knowledge as the following quote from Fillmore (2006) illustrates.

> [W]ords represent categorizations of experience, and each of these categories is underlain by a motivating situation occurring against a background of knowledge and experience. With respect to word meanings, frame semantic research can be thought of as the effort to understand what reason a speech community might have found for creating the category represented by the word, and to explain a word's meaning by presenting and clarifying that reason. (Fillmore 2006: 374-75)

During the 1980s, Fillmore and his associates in Berkeley continued with the development of Frame Semantics (FS) in various ways by working out further details of the theory, but also by applying Frame Semantics to languages other than English and to lexicographic and grammatical questions.

Before turning to an overview of CxG and how it grew out of Fillmore's earlier research of the 1960s, we will turn to a discussion of the practical implementation of FS within the Berkeley FrameNet project. This is for two reasons. First, research on FS in the early 1980s and its subsequent practical implementation in FrameNet proceeded in parallel to that of systematic research on CxG starting in the 1980s. Second, the meaning side of many constructions is typically represented in terms of semantic frames, and FrameNet offers a rich repository of semantic frames. While most research in CxG typically emphasizes form over meaning, this contribution takes an alternative view of constructions by first discussing the meaning side of constructions (see also Boas 2010b, who argues that a comparative and contrastive approach to constructions in multiple languages should begin from the meaning and not the form side of constructions). Third, CxG

grew more or less directly out of Fillmore's research in FS as the following quote from Fillmore suggests:

> If new-style lexical entries for content words were to be seen instead as constructions capable of occupying particular higher-phrase positions in sentences and included both the needed semantic role and the needed specifications of structural requirements (…), we could see such structures as providing expansions of their existing categories. (Fillmore 1985b: 84)

Figure 1 illustrates how both FS and CxG grew out of Fillmore's (1968) paper *The Case for Case* and how subsequently FrameNet grew out of research in FS and the Constructicon (a repository of constructions) grew out of research in CxG. In the following subsection we first discuss FrameNet, then we turn to CxG.

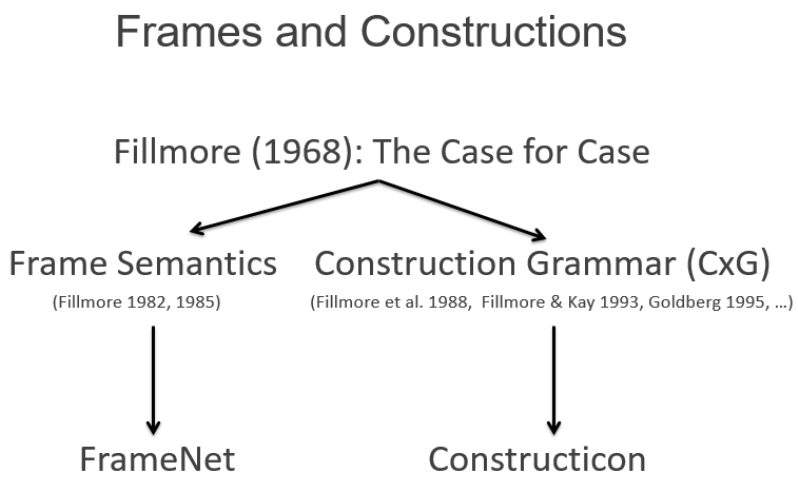

Figure 1. Relationship between Frame Semantics, FrameNet, Construction Grammar, and Constructicon.

2.2 From Frame Semantics to FrameNet

This subsection deals with a specific implementation of FS in terms of a lexicographic database of English structured on the basis of semantic frames.[2] As such, FrameNet can be regarded as an applied version of FS in which researchers apply frame-semantic insights in order to build a lexicographic database and to learn more about how the lexicon of English is structured. Insights from this research, in turn, typically inform the broader theory of FS more generally and they also

[2] Parts of this section are based on Boas & Dux (2017), Boas et al. (2019) and Boas (in press, a).

inform frame-semantic analyses of phenomena in languages other than English (see, e.g., the contributions in Boas 2009a). I have chosen FrameNet to illustrate most of the basic ideas behind FS because it contains thousands of lexical entries of English verbs, nouns, adjectives, and prepositions, together with the semantic frames they evoke. In addition, a good deal of frames in FrameNet lend themselves for the representation of the meaning side of constructions, which we will discuss in Sections 2.3, 4, and 5 below.

In 1997, Fillmore founded the FrameNet project at the International Computer Science Institute in Berkeley, California. FrameNet (http://framenet.icsi.berkeley.edu) is an online lexical database that documents a broad variety of frame-semantic and corresponding valency information for English words. The information contained in FrameNet is the result of a workflow consisting of various steps, see Boas (2017a). Users can search FrameNet online by typing in a word such as *to certify* which evokes the VERIFICATION frame (as in the example sentence in Figure 2, *This note confirms my suspicions*). Clicking on the name of a frame such as VERIFICATION presents the user with a definition of the frame as in Figure 2.[3]

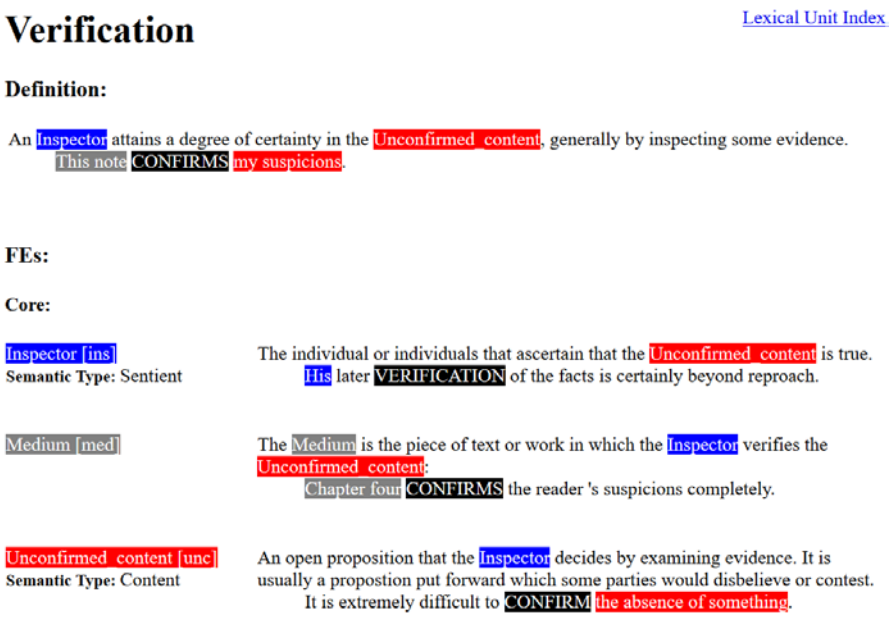

Figure 2. Frame and Frame Element Definitions of the VERIFICATION frame in FrameNet

One of the main concepts of FS (Fillmore 1982, 1985) is the semantic frame, which systematically characterizes the different types of knowledge that language users have about the meanings of words. Within FN, semantic frames serve to organize the lexicon of English by grouping together all the senses of words that evoke the same semantic frame (see below for relations between frames). The semantic frames in FN are the result of a complex workflow in which different groups of lexicographers collaborate to use corpus data to define frames, annotate corpus data, and write lexical entries (see Section 5 for details).

[3] Following FrameNet practice, frame labels are in Courier New font and FE labels are in small capital font.

Looking at Figure 2, we see that the definition of the VERIFICATION frame begins with a prose description of the frame, including its Frame Elements (FEs), highlighted in different colors, together with an example sentence. The definitions of the core FEs of the VERIFICATION frame, `Inspector`, `Medium`, and `Unconfirmed_content`, appear below the prose description and the example sentence.[4] The FE `Inspector` is defined as "The individual or individuals that ascertain that the `Unconfirmed_content` is true. The FE `Medium` is defined as "The Medium is the piece of text or work in which the `Inspector` verifies the `Unconfirmed_content`. The FE `Unconfirmed_content` is defined as "An open opposition that the Inspector decides by examining evidence. It is usually a proposition put forward which some parties would disbelieve or context."[5]

Following the frame description and definition of the FEs, users can access information about frame-to-frame relations in order to get a better understanding of how a specific frame is related to other frames in the frame hierarchy. Here, users can learn that the VERIFICATION frame inherits from the SCRUTINY frame and that it also uses the CORRECTNESS frame. The relationship between these frames can also be accessed by using the Framegrapher, a visualization tool within FN that displays frame-to-frame relations. Figure 3 shows how the VERIFICATION frame is related to the SCRUTINY and CORRECTNESS frames.

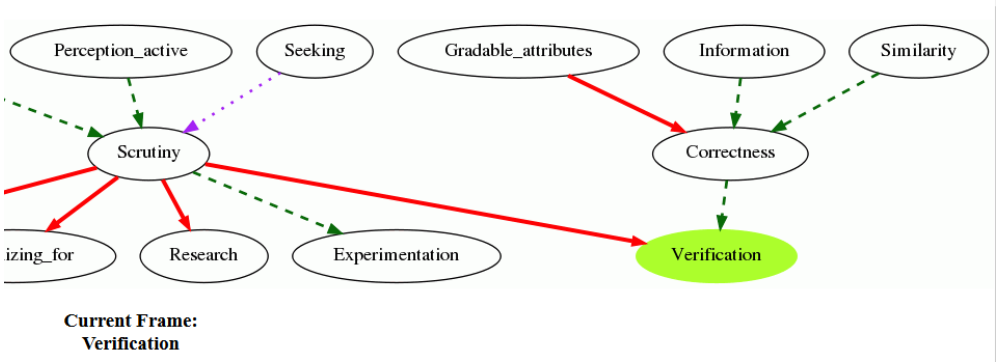

Figure 3. Relations between the VERIFICATION frame and the SCRUTINY and the CORRECTNESS frames.

Frames are related to other frames in the FN frame hierarchy through a variety of frame-to-frame relations, including Subframe, Inheritance, Uses, Perspective_on, and Precedes. For more details on frame-to-frame relations, see Petruck et al. (2004) and Ruppenhofer et al. (2016). As we will see in Section 5 below, constructions can also be organized in hierarchical networks similar to the frame hierarchy, which will be shown to be relevant for the organization of databases with entries for constructions, also known as constructicons.

[4] FN makes a distinction between so-called core FEs that are crucial for the understanding of the frame itself and non-core FEs that do not define the frame but provide additional information such as `Time`, `Place`, and `Manner`. Other non-core FEs of the VERIFICATION frame include `Degree`, `Explanation`, `Instrument`, `Means`, and `Purpose`.

[5] https://framenet2.icsi.berkeley.edu/fnReports/data/frameIndex.xml?frame=Verification&banner=

Following information about frame-to-frame relations, the VERIFICATION frame entry lists the different lexical units (LUs) that evoke it, including the verbs *to certify*, *to confirm*, and *to substantiate*, the nouns *verification* and *confirmation*, and the adjectives *unconfirmed* and *verifiable*. LUs are specific senses of words or multi-word expressions that evoke a specific frame (FN takes a splitting approach to word meanings, see Fillmore & Atkins 2000, Boas 2013a, Boas 2017a). At this point, users can click on specific links for each LU in order to get to their lexical entry reports or their annotation reports (annotated corpus data which form the basis of the lexical entries).

Valence Patterns:

These frame elements occur in the following syntactic patterns:

Number Annotated	Patterns		
1 TOTAL	Condition	Inspector	Unconfirmed_content
(1)	PP[on] Dep	NP Ext	NP Obj
3 TOTAL	Inspector	Time	Unconfirmed_content
(1)	CNI --	AVP Dep	NP Ext
(1)	NP Ext	PP[in] Dep	NP Obj
(1)	NP Ext	PP[in] Dep	Sfin Dep
5 TOTAL	Inspector	Unconfirmed_content	
(2)	CNI --	NP Ext	
(1)	NP Ext	NP Obj	
(1)	NP Ext	Sfin Dep	
(1)	PP[by] Dep	NP Ext	

Clear Sentences Turn Colors Off

[X] The University will CONFIRM receipt on request to the Registry .

Figure 4. Valence patterns of the verbal LU *to confirm* in the VERIFICATION frame in FN.

For example, clicking on the lexical entry report for the verb *to confirm* displays a definition of the verb ("to verify the truth or correctness of something)," followed by a list of FEs and their various types of syntactic realizations in terms of phrase types and grammatical functions.[6] The perhaps most interesting section of a lexical entry in FN is the detailed listing of a LU's valence patterns as in Figure 4, which shows how the semantics of the VERIFICATION frame are realized syntactically in various configurations of FEs (the valence patterns are the result of manually annotated corpus sentences, see Section 5 below). Each line with combinations of FEs in Figure 4 is known as a frame element configuration (FEC). For example, the first line in Figure

[6] https://framenet2.icsi.berkeley.edu/fnReports/data/lu/lu11041.xml?mode=lexentry

4 lists the FEC `Condition, Inspector,` and `Unconfirmed_content` as in the sentence [<Inspector>The University] will confirm*tgt* [<UC>receipt] [<Condition>on request of the Registry]. Below the combination of FEs in the FEC we find the specification of phrase types and grammatical functions: The FE `Inspector` is realized syntactically as an external NP, the FE `Unconfirmed_content` is realized as an object NP, and the FE `Condition` is realized as a dependent PP headed by the preposition *on*.[7]

The valence information contained in FN lexical entries is extremely useful for a number of reasons. First, the valence tables provide detailed information about how the semantics of a FEC can be realized in different ways syntactically. For example, while the first FEC (`Condition, Inspector, Unconfirmed_content`) in Figure 4 only allows for one combinatory realization of FEs at the syntactic level, the second FEC (`Inspector, Time, Unconfirmed_content`) allows for three different syntactic realizations of the same FEC. This type of information is useful when investigating whether and how particular types of semantic information is realized syntactically in some configurations, but not in others (see Boas (2003), Boas (2010b), Dux (2016), and Boas & Dux (2017) for more details).

Second, it allows researchers to compare how different LUs evoking the same frame realize the semantics of the frame differently. For example, a comparison of the FN valence tables of to confirm and to verify shows that while to confirm has a total of only four FECs (with a total of nine syntactic configurations), to verify has a total of 11 FECs (with a total of 22 syntactic configurations). This information is useful for researchers interested in determining how LUs evoking the same frame differ from each other in terms of what perspectives they offer on the scenario encoded in the semantic frame. Comparing how the number and types of FECs in the valence tables for *to confirm* and *to verify* differ from each other, for example, leads to the realization that *to verify* can be used in a much broader variety of contexts representing different viewpoints of the scenario encoded by the VERIFICATION frame than is the case with *to confirm*. This type of information is useful as a basis for research on viewpoint and perspective taking (Langacker 1987).

Third, the information contained in the valence patterns in FN lexical entries can be regarded as constructions in the sense of CxG, that is, a pairing of form with meaning/function. Boas (2003) coined the term mini-constructions for such low-level lexical constructions and in subsequent research has shown, based on insights by Croft (2003) and Iwata (2008), how these mini-constructions can be part of a larger constructional network with higher levels of abstraction and generalization (see Boas (2010b/2011b) for more details).[8]

[7] FN also documents null instantiated FEs, i.e. FEs that are not overtly realized in a sentence but that are conceptually understood as a part of the frame evoked by the relevant LU. There are three types of null instantiation recognized by FN: DNI (definite null instantiation), INI (indefinite null instantiation), and CNI (constructional null instantiation). For details,see Fillmore (1986), Ruppenhofer & Michaelis (2014)), Ruppenhofer et al. (2016), and Boas (2017b).

[8] FrameNet data are used for a variety of computational applications, including automatic role labeling (Gildea & Jurafsky 2002, Das et al. 2010), semantic parsing (Baker et al. 2007), and sentiment analysis (Ruppenhofer & Rehbein 2012).

Since 2003, several research teams have been developing FrameNets for other languages, including Spanish, German, Japanese, Swedish, Brazilian Portuguese, French, Korean, and Chinese (see contributions in Boas (2009a) and Lyngfelt et al. (2018)). The projects differ somewhat in the tools and methods used to create FrameNets for other languages and the degree to which they "recycle" English FrameNet Frames (see Boas et al. (2019) for a discussion), but they all share the same goal(s), namely to create lexical databases for languages other than English. More recently, these multilingual FrameNet efforts have led to an international consortium known as Global FrameNet, a collaborative effort to develop frame-based language resources and applications for multiple languages (see https://www.globalframenet.org/ for more details).[9]

2.3 From Case Grammar and Frame Semantics to Construction Grammar

CxG evolved during the 1980s out of Fillmore's earlier research on Case Grammar and the on-going research on Frame Semantics in Berkeley by Fillmore and his associates. One of the main goals of CxG was to develop an alternative theory of language in contrast to the prevalent reductionist view of syntax and semantics during the 1980s (Chomsky 1981/1989).[10] To this end, Fillmore and his associates aimed to develop a theory that should not only provide an account of the fully regular syntactic structures in language, but also idiomatic and semi-idiomatic syntactic structures.

One of the first case studies of laying the groundwork for the alternative theory, which was later coined CxG, was Fillmore et al.'s (1988) paper on the *let alone* construction in English. Fillmore et al. (1988) propose that a theory of language should not only be able to account for highly regular syntactic structures in language, but that it should also use the same approach in order to provide insights into structures that are not completely regular. To this end, Fillmore et al. (1988: 501) suggest to focus on the traditional concept of grammatical constructions: "The overarching claim is that the proper units of grammar are more similar to the notion of construction in traditional and pedagogical grammars than to that of rule in most versions of generative grammar." In this view, constructions should not be treated differently from words, since they, too, are forms with specific meanings and functions.

The *let alone* construction (e.g. *Kim doesn't like shrimp let alone squid*) is interesting, because it is idiomatic, yet at the same time highly productive, and it specifies "not only syntactic, but also lexical, semantic, and pragmatic information" (Fillmore et al. 1988: 501). As such, the *let alone* construction exhibits aspects of both regular syntactic structures and idiomatic aspects that set it apart from other coordinating conjunctions which are not "fully predictable from independently known properties of its lexical makeup and its grammatical structure."[11] (Fillmore et al. 1988: 511) The pragmatic meaning associated with the let alone construction "allows the speaker to simultaneously address a previously posed proposition, and to redirect the addressee to

[9] See Boas (to appear, b) on the question of whether semantic frames may be universal (or not).
[10] Parts of this section are based on Boas & Ziem (2018a), Boas et al. (2019), and Boas (to appear, a).
[11] See Wulff (2013) and Bybee (2013) for a discussion of idiomaticity in CxG.

a new proposition which will be more informative." (Fillmore et al. 1988: 513). Fillmore et al. (1988) argue that generative transformational approaches have issues with dealing with idiomatic constructions such as let alone, because they regard mechanisms for pragmatic interpretation of syntactic structures as separate from their syntactic-semantic rule pairs. In contrast, CxG makes the relationship between form and meaning/function explicit by stating that the basic unit of language are constructions (pairings of form with meaning/function) and that language consists of a large network of constructions at various levels of abstraction and schematicity (see Section 3 below for details).

Fillmore et al.'s seminal (1988) paper can be regarded as one of the foundational constructional papers articulating the basic concepts of CxG (see also Fillmore (1985a/1988) and Lakoff (1987)). Even though it focuses on only one specific construction, the detailed case study of the *let alone* construction shows that it is possible to aim for a comprehensive coverage of all linguistic phenomena (instead of only focusing on the so-called "core", cf. Chomsky 1981) using a common framework built on the notion of construction as the basic unit of language. In this view, constructions are conventional pairings of form and meaning/function at varying levels of abstraction and complexity that must be learned.[12]

The years following the publication of Fillmore et al. (1988) saw a few other papers articulating the new evolving constructional framework, each focusing on a case study of a specific type of construction (e.g. Fillmore 1988/1989, Zwicky 1994/1995). Goldberg's (1995) monograph was the first major book publication solely devoted to CxG, more specifically a particular type of CxG that later became known as Cognitive Construction Grammar (see Boas 2013b). Goldberg's (1995) book is important because it spelled out, for the first time, in a book-length format the various concepts and ideas underlying CxG, including her definition of a construction.[13]

> C is a CONSTRUCTION iff$_{def}$ C is a form-meaning pair <F_i, S_i> such that some aspect of F_i or some aspect of S_i is not strictly predictable from C's component parts or from other previously established constructions (Goldberg 1995: 4).

Goldberg's definition of construction reflects the basic idea of CxG, namely that all of language consists of constructions. This idea, in turn, is the foundation of most other concepts in CxG, including the lexicon-syntax continuum, the organization of constructions in terms of a network, the reliance on usage-based data, and the commitment to analyze all aspects of a language instead of focusing only on selected aspects while ignoring other aspects. Section 3 below takes up these issues in more detail.

The concept of construction in CxG as a pairing of form with meaning goes back to Saussure's (1916) notion of linguistic sign (Goldberg 1995: 4). This means, for example, that form

[12] Note that this view is in contrast to the generative-transformational approach, which proposes that children growing up are not exposed to rich enough data to acquire every feature of their language ("poverty of the stimulus") (Chomsky 1988).

[13] For other definitions of constructions see Croft (2001: 17-21) and Fried & Oestman (2004: 18-23).

and meaning/function are always tied together and cannot be separated from each other. Note that on this view, form does not only mean syntactic form, but it also includes other aspects such as morphological and phonological information. Similarly, meaning is not just limited to semantic properties, but it also includes pragmatic and discourse-functional properties.

Given Goldberg's (1995) definition of construction and the intimate relation between form and meaning also implies that a difference in form also indicates a difference in meaning. In other words, when trying to identify, describe, and determine the status of a construction and how it might differ from other types of constructions, constructionists pay special attention to the question of whether a difference in form also implies a difference in meaning (and vice versa). Figure 5 illustrates how form and meaning are related to each other in a construction.

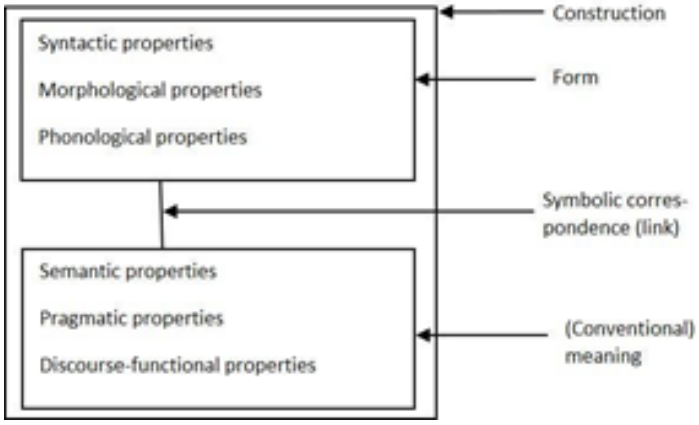

Figure 5. Types of information in constructions (Croft 2001: 18)

3. Critical issues and topics[14]

3.1 The lexicon-syntax continuum

One of the central topics of Goldberg (1995) is the question of how and why certain verbs can occur in specific types of rather unusual patterns. Consider, for example, sentences such as *Bernie coughed the paper off the table* (caused-motion construction), *Christian talked himself blue in the face* (resultative construction), *Claire elbowed her way through the crowd* (*way* construction), and *Lena baked Sophia a cake* (ditransitive construction). Prior research in other frameworks proposed, among other things, different rules or mechanisms that would take the lexical entry of a verb such

[14] Since the early 2000s, more and more researchers have adopted CxG as a linguistic framework. Besides an ever-growing number of publications on CxG, a number of new venues have emerged for presenting constructional research, including the biannual *International Conference on Construction Grammar* (which started in Berkeley in 2001), the journal *Constructions and Frames* (https://www.benjamins.com/catalog/cf), the book series *Constructional Approaches to Language* (https://www.benjamins.com/catalog/cal), as well as specific theme sessions on CxG at conferences such as the *International Conference on Cognitive Linguistics*, the Conference of the *German Society of Cognitive Linguistics* (DGKL), and the Conference of the *French Association for Cognitive Linguistics* (AFLiCO).

as intransitive *to cough* and turn it into a new lexical entry that could then licence novel patterns such *Bernie coughed the paper off the table.* According to Goldberg, however, such an approach would lead to a proliferation of additional verb senses, which would enlarge the lexicon unnecessarily.

To solve this problem, Goldberg (1995) proposes abstract meaningful Argument Structure Constructions (ASCs), which, given the right conditions, can fuse with lexical entries of verbs in order to provide them with additional constructional roles that then in turn are realized syntactically.[15] For example, Goldberg (1995) suggests that there is an independent resultative construction which has a patient and a result argument that can be added to a verb's semantics when the construction fuses with the verb to yield sentences such as *He talked himself blue in the face* (Goldberg 1995: 189). The lexical entry of the intransitive verb to talk contains frame-semantic information about the semantic role (talk < **talker** >).[16] Goldberg proposes that the resultative construction, whose semantics consists of three semantic roles (agent, patient, result goal), which are encoded syntactically by a [NP V NP PP/AP] frame, adds the patient and result arguments to *talk* to yield a resultative semantics of *to talk* as in (talk < **talker patient** result-goal>). Recognizing the existence of meaningful constructions has the advantage of avoiding the problem of positing implausible verb senses, as Goldberg points out. Moreover, it is possible to "avoid the claim that the syntax and semantics of the clause is projected exclusively from the specifications of the main verb" (Goldberg 1995: 224).

Following Fillmore et al. (1988) and Fillmore and Kay (1993), Goldberg (1995) proposes a view of the relationship between the lexicon and syntax (and of language more generally) that is quite different from that of the prevalent generative-transformational view of the 1980s and 1990s. While formal theories of grammar, such as Government-and-Binding (Chomsky 1981), propose a strict separation of modules such as lexicon, syntax, and phonology, with rules and mechanisms deriving syntactic structures through a series of different operations (transformations, movement, etc.), Goldberg argues that this separation into distinct modules does not hold up to empirical evidence. As earlier work by Fillmore et al. (1988) shows, certain idiomatic constructions such as the *let alone* construction cannot be analyzed in a strictly modular fashion, because the specific semantic, pragmatic, and syntactic constraints on the realization of syntactic arguments would have to be part of a very extensive lexical entry.[17]

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[15] When entries of verbs and ASCs fuse with each other, they have to adhere to the *Semantic Coherence Principle.* Only roles which are semantically compatible can be fused. Two roles r_1 and r_2 are semantically compatible if either r_1 can be construed as an instance of r_2, or r_1 can be construed as an instance of r_1. For example, the kicker participant of the *kick* frame may be fused with the agent role of the Ditransitive construction because the kicker role can be construed as an instance of the agent role. Whether a role can be construed as an instance of another role is determined by general categorization principles.) and the *Correspondence Principle* (Each participant role that is lexically profiled and expressed must be fused with a profiled argument role of the construction. If a verb has three profiled participant roles, then one of them may be fused with a construction's nonprofiled argument role) (Goldberg 1995: 50).

[16] Semantic roles represented in bold are profiled arguments, i.e. entities in a verb's semantics that are "obligatorily accessed and function as focal points within the scene, achieving a special degree of prominence (Langacker 1987)." (Goldberg 1995: 44).

[17] Coercion is an important concept determining which verbs can occur in certain constructions under specific conditions. See Michaelis (2004), Boas (2011a), and Van Trijp (2015).

This means that in CxG, there is no strict separation between modules such as the lexicon and syntax, but instead there is a continuum of grammatical constructions that differ in their complexity and level of schematicity/abstraction.[18] These constructions are basically the same type of declaratively represented data structure that pair form with meaning (see Goldberg 1995: 7). As Goldberg (2006: 18) puts it: "it's constructions all the way down."

Subject-predicate agreement	NP VP-*s* (e.g. *Kim walks*)
Imperative	VP! (e.g. *Go home!*, *Buy that book!*)
Passive	Subj AUX V_{PP} (PP_{by}) (e.g. *The chocolate was eaten by the neighbors*)
Ditransitive	e.g. Subj V Obj_1 Obj_2 (e.g. *Lena baked Sophia a pizza*)
Covariational Conditional	e.g. The Xer the Yer (e.g. *the more you run the fitter you get*)
Idiom (partially filled)	e.g. *Pat doesn't like cake, let alone brownies*
Idiom (filled)	e.g. *hit the road, a penny for your thoughts*
Complex word (partially filled)	e.g. [N-s] (for regular plurals)
word	e.g. *pizza, to walk, icy, but*
morpheme	e.g. *un-, -able, -ment*

[18] See Boas (2008b), who argues that in Goldberg's (1995) approach there still is a de facto separation of the lexicon and syntax, because lexical entries as separate entities fuse with ASCs, which are a different type of data structure.

Table 1. Constructions at various levels of size and abstraction (cf. Goldberg, 2006)[19]

Table 1 presents an overview of a variety of different constructions at different levels of size, complexity, and abstraction. At the bottom of the table we find the very specific types of constructions which are located at the lexical end of the syntax-lexicon continuum such as words and morphemes. In the middle we find more complex and abstract types of constructions such as the ditransitive and the covariational conditional, while at the very top we find highly abstract and schematic types of constructions such as the subject-predicate agreement construction.

Note that Table 1 only displays the form side of the constructions but it does not provide information about their meaning/function side. The meaning of most words and some morphemes can be represented in terms of semantic frames. For example, *pizza* evokes the INGESTION frame while *to walk* evokes the SELF_MOTION frame. Other more abstract constructions such as the ditransitive construction evoke the GIVING frame and the *way* construction evokes the SELF_MOTION frame. Whether all constructions have meaning is a matter of debate (see Fillmore (1999) and Goldberg (2006) on the meaning of the subject auxiliary inversion construction), and whether the meaning side of all types of constructions can be represented using semantic frames is still an open question (see Boas et al. 2019).

3.2 Developing and going beyond English ASCs

The first phase of constructional research of the late 1980s and early 1990s primarily focused on specific idiomatic constructions and a few ASCs in English.[20] But in the decade following Goldberg (1995), what I call the second phase of research in CxG, constructional research was extended in various ways. First, research on English ASCs intensified, resulting in publications such as Israel (1996) on the *way*-construction, Jackendoff (1997) on *twistin the night away*, Goldberg (2000) on patient arguments of causative verbs, Boas (2003a/2005c) and Goldberg and Jackendoff (2004) on the resultative construction, Boas (2003b), Iwata (2005) and Nemoto (2005), on the locative alternation, and Kay (2005) on the architecture of ASCs more generally.

Second, research on English constructions in the decade following Goldberg (1995) extended beyond ASCs, focusing on other types of constructions as well. These include Michaelis and Lambrecht (1996a) on exclamative constructions, Michaelis and Lambrecht (1996b) on nominal extraposition, Fillmore (1999) on the subject auxiliary inversion construction, Kay and

[19] Note that there is some disagreement on whether morphemes are the smallest constructional units. While Goldberg (2006:5) assigns morphemes the status of constructions, Booij (2010: 15) argues that morphemes should not be assigned constructional status. See Booij (2017) for details.

[20] Recall that constructional research started out by focusing on semi-productive idiomatic constructions (while keeping in mind more "regular" constructions, too), i.e. those types of structures that in generative-transformational approaches such as that of Chomsky (1981) were thought of belonging to the co-called "periphery" instead of the so-called "core grammar." In CxG, there is no such systematic differentiation between a "core" and the "periphery", because it is not clear on what empirical grounds such a distinction could be made. See Boas & Ziem (2018b: 14-15) for more details.

Fillmore (1999) on the WXDY construction, Kay (2002) on subjectless tagged sentences, Boas (2004) on *wanna*-contraction, and Goldberg (2006) on the subject auxiliary inversion construction (among other constructions).

Third, in the decade following Goldberg (1995), constructional research extended beyond English to include other languages, such as Czech (Fried 2004), Finnish (Leino 2005), French (Lambrecht 2004, Lambrecht and Lemoine 2005), German (Hens 1996, Michaelis and Ruppenhofer 2001, Boas 2002), Icelandic (Bardahl 1999), and Japanese (Fujii 2004, Ohara 2005, Tsujimura 2005). In subsequent years, the number and variety of constructional research on languages other than English has grown even more.[21]

Fourth, the late 1990s and early 2000s saw an interesting development that led to the emergence of different flavors of CxG. While the original research on CxG, growing out of Fillmore's earlier work on deep cases, evolved into what is now known as Berkeley Construction Grammar (Fillmore 2013), Goldberg's (1995) type of CxG, which was heavily influenced by the work of George Lakoff, became known as Cognitive Construction Grammar (Boas 2013b). Another strand of CxG emerging in the early 2000s is Croft's (2001) Radical Construction Grammar, an approach that also takes typological aspects of language into consideration (see Croft 2013). Similarly, Bergen & Chang (2005) propose Embodied Construction Grammar, a specific flavor of CxG that is employed, among other things, for simulation-based language understanding. Each of the different strands of CxG comes with its own objectives and particular interests motivating the linguistic issues addressed and the methodological requirements needed for approaching them appropriately (see Boas & Ziem 2018b: 20). However, at the same time, all flavors of CxG share a basic set of concepts: constructions are the basic building blocks of language, they are pairings of form with meaning/function, they are organized in structured networks, there is no strict division between the lexicon and grammar, they follow a usage-based methodology, and there are no different levels of representation as in other formal theories. See Section 5 below for a further discussion of the similarities and differences between the various strands of CxG.

Fifth, various researchers applied Goldberg's (1995) proposals to broader data sets and different types of ASCs. Of particular interest here is the interaction between verbs and constructions. Boas (2003a) is the first corpus-based investigation of the resultative construction based on extensive data extracted from the British National Corpus (BNC). He shows that Goldberg's (1995) characterization of the interactions between lexical entries and grammatical constructions faces some of the same difficulties as the interactions between lexical entries and transformational rules in the Chomskyan framework. Based on a fine-grained analysis of more than 6,000 sentences from the BNC, Boas employs the concepts of collocational restrictions,

[21] Note that this section cites only a limited number of relevant publications in the decade following Goldberg (1995). Its purpose is to provide an overview of how CxG evolved out of a relatively small group of researchers at or with links to UC Berkeley during the second phase of constructional research. It is difficult to provide a substantial overview of all the many different phenomena and languages investigated by constructional researchers during what I call the third phase of constructional research in the years since 2005. For an overview of the relevant literature see the contributions in Hoffmann & Trousdale (2013).

frequency, analogy and productivity to encode different types of semantic, pragmatic, and syntactic information (Boas 2003a/2008a).

These types of information are specified in terms of so-called mini-constructions, which represent specific senses of verbs, which allows Boas to account for a given utterance from a comprehension perspective as well as a production perspective. On this view, some of Goldberg's independently existing abstract meaningful ASCs such as the resultative and caused-motion constructions are an epiphenomenon caused by the great number and frequency of specific verbs occurring with resultatives. In contrast, the mini-constructions in Boas (2003a) allow researchers to provide an exact account about the contexts in which resultatives may be licensed and when they are ruled out (for the role of coercion see Michaelis 2005 and Boas 2011a).[22] This includes collocational restrictions on the resultative phrase (cf. *They shot him dead / to death*).

In this view, most resultatives are conventionalized and directly licensed in terms of mini-constructions. Non-conventionalized resultatives, in contrast, are licensed through analogical extension of already existing conventionalized mini-constructions. Thus, a sentence such as *Tom sneezed the napkin off the table* is licensed because the meaning of *to sneeze* is analogically extended based on the close association with *to blow*, whose mini-construction already conventionally combines the specific form with the specific resultative/caused-motion meaning/function.[23]

Other researchers also seek to delimit the power of Goldberg's ASCs, because it is not always clear how the fusion of verbal semantics and constructional semantics can be constrained in order to rule out unattested sentences. For example, Croft (2003) makes a principled distinction between verb-class and verb-specific construction in order to arrive at a more accurate account of the types of verbs capable of occuring in the ditransitive construction. Similarly, van der Leek (2000), Iwata (2005) and Nemoto (2005) show that Goldberg-type ASCs are not capable of delimited the range of verbs that occur in the locative alternation (see Sankoff 1983; Levin 1993; Iwata 2008). Instead, they shift the focus of analysis to the lexical level where specific lexical constructions (similar to Boas' mini-constructions) serve to license the locative alternation.

3.3 Families and networks: ASCs and other constructions

One of the central assumptions of CxG is the idea that language consists of a network of constructions (pairings of form with meaning/function). This idea goes back to research in Cognitive Grammar, in which constructions are described by families of constructional schemas characterized at varying levels of specificity (Langacker 2000: 31).[24] Langacker (2000: 34)

[22] For an alternative account to Boas (2003a) see Goldberg & Jackendoff (2004) as well as Boas (2005a).

[23] This approach also integrates insights from historical linguistics about lexical change. With respect to how new words and patterns occur in language over time and how repeated analogical extensions influence the emergence of new constructions, Hilpert (2013: 471) notes the following: "Repeated analogical extensions may over time lead to the emergence of a general schema (...) which invites further additions to the range of expressions occurring in this now partly schematic idiom."

[24] This research in Cognitive Grammar, in turn, has been influenced by earlier research on prototype categorization (Rosch & Mervis 1975).

proposes at least two different types of networks, namely a constructional network and a lexical network, both of which are organized in terms of different levels of schematicity and specificity. Figure 6 shows on the right side how the verb *to send* is conventionally associated with different types of subschemas, including [[send] [NP] [NP]], which in turn also belongs to a network of constructional schemas describing its grammatical behavior.

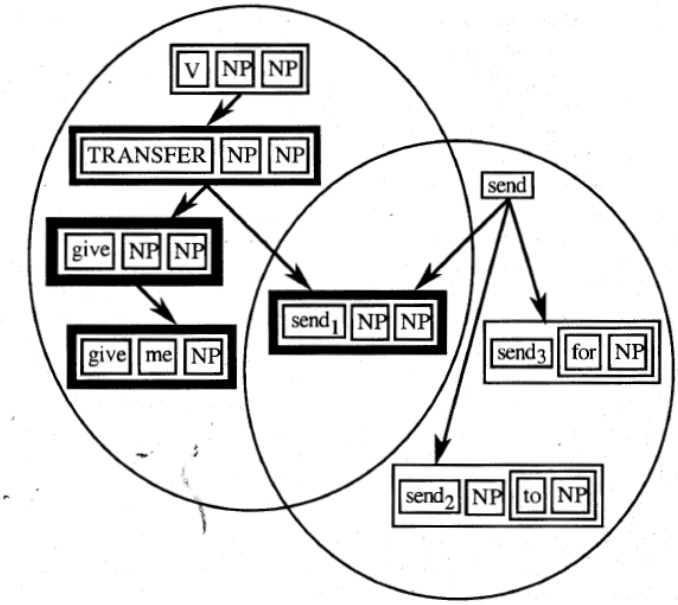

Figure 6. Constructional and lexical networks (Langacker 2000: 34).

The idea that constructions that share certain aspects of their form and/or their meaning/function with other constructions and that these form some type of families of constructions that are best represented in constructional networks re-occurs in a great deal of constructional research. Goldberg (1995), for example, proposes extensions from the central sense of the ditransitive construction, forming a radial set model in which each subconstruction is related to and directly derived from the core sense, which is defined as the actual successful transfer of a material entity between a volitional Agent and a (willing) Recipient (Goldberg 1995: 151). Each of Goldberg's six extensions from the ditransitive construction's central sense (including metaphorical extensions) is related to the central sense in terms of inter-constructional polysemy links. As such, the ditransitive construction and its related subconstruction form a family of constructions whose relations are captured in terms of a constructional network.[25]

One of the central questions surrounding constructional families and their representations in terms of networks is how these networks are organized and structured, and how specific networks are related to other networks. For example, while Goldberg (1995) proposes a core sense

[25] See Boas (2002a) for an alternative proposal suggesting that constructional polysemy is unnecessary for analyzing ASCs, because it appears as if constructional polysemy is an epiphenomenon that replicates lexical polysemy at a more abstract and schematic level.

and six sense extensions to cover the various realizations of ditransitives, Kay (2005) argues that only three monosemous subconstructions are necessary to account for the ditransitive.[26] Colleman & De Clerck (2008) show that Kay's (2005) proposal is problematic because it does not cover all verbs occuring in the ditransitive, including *envy* and *forgive*. This leads Colleman & De Clerck (2008: 190) to argue for a multidimensional analysis that identifies conceptual links between different senses of the ditransitive construction and the verbs occurring in it. On this view, the polysemy of the ditransitive construction is due to co-occurring semantic shifts along various dimensions. Each of these semantic shifts correspond to the components of the prototype, thereby forming the basis for the various sense extensions.[27]

With respect to a different ASC, the resultative construction, Boas (2011b) proposes to combine the results of different accounts in order to arrive at a network representation of different resultatives. This network analysis builds on Goldberg's (1995) account, which suggests that resultatives are independently existing meaningful abstract constructions that are capable of fusing with lexical entries of verbs. Taking Goldberg's (1995) proposals and combining them with Boas' (2003a) account of resultatives in terms of mini-constructions leads Boas (2011b) to develop a network of resultative constructions with different levels of abstraction and specificity, as in Figure 6, which contains four distinct levels of abstraction.[28]

At the very top of Figure 6 we find an abstract construction at Level I that combines the syntactic specifications [[NP] [V] [NP][XP]] with a non-descript semantics specifying only the Agent role of a verb. This abstract construction is inherited by different types of less abstract constructions, including the resultative at Level II in Figure 6, which pairs the syntactic specifications [[NP] [V] [NP][XP]] with resultative semantics (as in Goldberg 1995). At Level III in Figure 6, the abstract resultative semantics is specified in greater detail in terms of the different syntactic configurations needed to realize the resultative (i.e. whether the resultative phrase is realized as an NP, AP, or PP). These more concrete resultative constructions, together with the mini-constructions at Level IV at the bottom of Figure 6 representing individual specifications of verb senses (with respect to their syntactic, semantic, and pragmatic restrictions), form the basis of fully specified resultative sentences at the sentence ("Satz") level in between Levels III and IV.[29] This network analysis of the resultative has the advantage that it combines the strengths of both Goldberg's (1995) and Boas' (2003a) accounts of the resultative.

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[26] For an earlier proposal, see Fillmore & Kay (1993), who propose an abstract ABC-construction with seven sub-constructions (Recipient, Benefactive-Ditransitive, Caused Motion, Resultative, Immobility, Caused Location, and Fill/Empty), which all inherit from the abstract ABC-construction, thereby forming a constructional network. Croft (2003) notes that there are also autonomous verb-specific constructions of ditransitives, which he claims are independently represented in the mind.

[27] See also Boas (2010c) and Colleman & De Clerck (2011) for details on how specific semantic classes of verbs may occur in the ditransitive.

[28] See also Goldberg & Jackendoff (2004) and Luzondo (2014) for related proposals.

[29] For a similar but more coarse-grained approach, see Traugott (2008), who proposes so-called micro-constructions, meso-constructions, and macro-constructions to account for the different levels of abstraction and specificity of constructions. For an overview of other proposals of how resultatives constructions are organized in terms of constructional families, see Peña (2017).

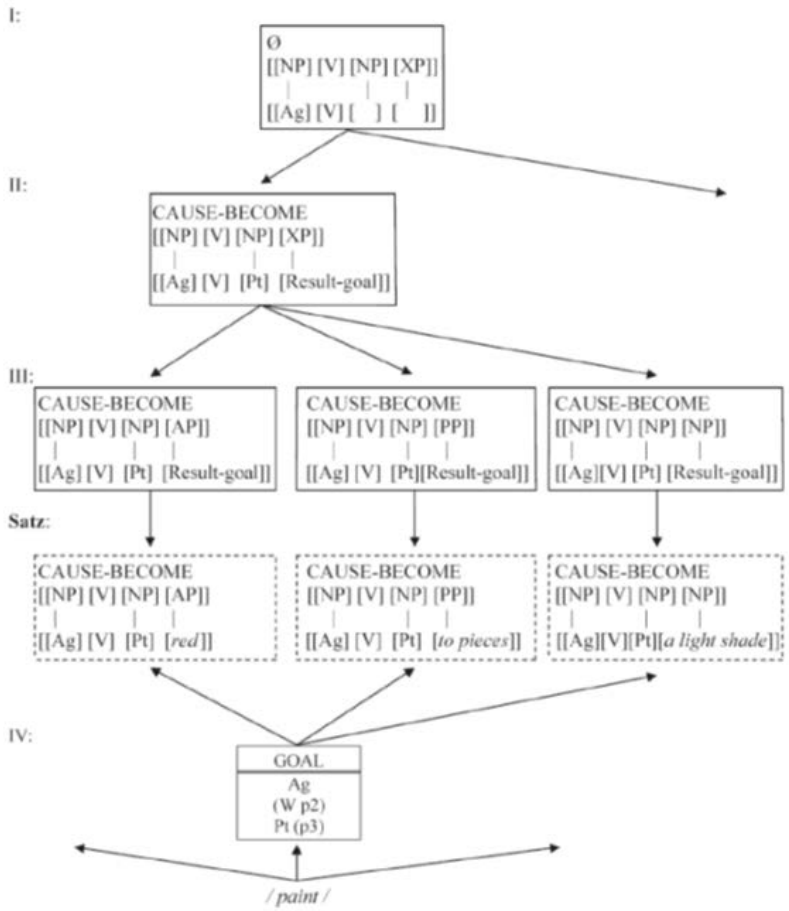

Figure 6. Constructional network of resultative construction with various levels of abstraction (Boas 2011b: 58)

Constructional networks have not only been posited for ASCs, but also for other types of constructions at different levels of schematicity, from rather abstract to very specific types of constructions. These include, among many others, passives (Ackerman & Webelhuth 1998, Lasch 2016), conatives (Medina 2017), subject-auxiliary inversion (Fillmore 1999, Goldberg 2006), support verb constructions (Zeschel 2008), meso-constructions (Domínguez Vázquez 2015), datives (De Knop & Mollica 2017), *search*-constructions (Proost 2017), XPCOMP constructions (Gonzálvez-García 2017), relative clause constructions (Diessel 2019), and the V-*that* construction (Perek & Patten 2019).[30]

This brief overview of how (families of) constructions can be organized in terms of networks has shown that almost all research in this area is focused on specific types of constructions. In other words, more and more researchers are describing and analyzing more constructions to find out, among other things, how they are organized in networks. While this effort is in the spirit of usage-based linguistics, there are so far no overarching proposals about

[30] For a discussion of the architecture of different types of networks, see Boas (2013b)

how these different types of networks are related to each other or how one can account for the entirety of a language with one overarching network of constructions.[31]

One major step towards achieving this goal is presented by Diessel (2019), who combines insights from different approaches towards developing networks of constructions. He proposes a dynamic network model of grammar in which all aspects of linguistic structure, including core concepts of syntax (e.g., phrase structure, word classes, grammatical relations), are analyzed in terms of associative connections between different types of linguistic elements. There are two major types of relations in Diessel's grammar network. The first characterize signs as networks in terms of symbolic relations (associations between form and meaning), sequential relations (associations between linguistic elements in sequence), and taxonomic relations (associations between representations at different levels of specificity). The second characterize networks of signs and include lexical relations (associations between lexemes), constructional relations (associations between constructions), and filler-slot relations (associations between particular items and slots of constructions). In Diessel's model, both constructions and lexemes are analyzed as nodes of a symbolic network and each node in the network is also analyzed as some kind of network. See Section 4.3 below for a further discussion of how the concept of network has been applied to the compilation of a so-called constructicon, a structured inventory of construction entries parallel to lexical entries of the type found in FrameNet.

3.4 Productivity of constructions

Constructions differ a great deal in how productive they are, which partially depends on what types of restrictions they impose on their open slots.[32] For example, while the resultative construction is very restrictive and appears to place so many constraints on the postverbal constituents that it is more accurate to state those restrictions at the level of low-level mini-constructions (cf. Boas 2003a), other ASCs such as the ditransitive construction impose fewer restrictions on their slots (see Goldberg 1995: 143-150; Goldberg 2006b: 412-418). Other ASCs impose even fewer restrictions on their open slots, such as the *way*-construction (Goldberg 1995, Israel 1996), whose only restrictions include that the verb occuring in it designate a repeated action or unbounded activity, that the motion must be self-propelled, and that the motion must be directed (Goldberg 1995: 212-214).[33] Other, more schematic constructions such as passive and relative clause

[31] A related issue is the question of how different constructions (presumably from different sub-networks of the larger network of a language) interact with each other in order to license specific utterances. This is an underexplored area of research. Without going into any details, Goldberg (2019: 49) proposes that "the forms and the functions of constructions that are combined must be compatible. When they are not, the resulting utterances are judged to be unacceptable to varying degrees, depending on the degree of incompatibility." Clearly, this issue needs to be addressed in much greater detail by future research.

[32] Parts of this section are based on Boas & Ziem (2018b).

[33] Note that the discussion of constructional productivity here focuses primarily on ASCs. Other types of constructions such as partially filled idioms (e.g. *to drive someone {crazy/bonkers/up the wall/dizzy}* (see Boas 2003a, Bybee 2013)), the WXDY construction (Kay & Fillmore 1999) or passive constructions (Ackerman & Webelhuth 1998, Lasch 2016) also exhibit different degrees of productivity.

constructions impose even fewer restrictions on their open slots. The productivity of constructions is thus organized on a continuum, ranging from fully productive constructions to semi- and non-productive constructions (Goldberg 2006, Barðdal 2008, Boas & Ziem 2018b).

The types and amounts of restrictions imposed by constructions, together with how abstract and schematic a construction is, have a direct influence on a construction's productivity (Bybee 1985, Goldberg 1995, Dabrowska 2008). Hoffmann (2013: 315), following research by Barðdal (2008, 2011), among others, summarizes the status of productivity as follows: "[t]he productivity of abstract constructions can be seen as an inverse correlation of type frequency and semantic coherence, with highly abstract macro-constructions only arising if the underlying meso-constructions have a high type of frequency and a high degree of variance in semantic distribution."

Type frequency is important, because it has been shown to strengthen the representation of a constructional schema in memory, which in turn determines the availability of that schema for categorizing novel items. When ASCs are associated with a large number of verb types they tend to be more easily extensible to new items than ASCs that are only associated with a few verb types (see Goldberg 2006, Barðdal 2008, Diessel 2019). In contrast, token frequency typically restricts the extension of constructional schemas to new items, thereby also affecting the productivity of constructions. For example, Bybee (1985/1988) demonstrates that linguistic expressions with high token frequency are deeply entrenched in memory and thus typically resist the influence of analogical change. This is known as the "preserving effect" of high token frequency (see also Bybee (2010: 66-73) and Diessel (2019: 131-132)).

The role of type and token frequency with respect to the productivity of constructions is illustrated by Clausner & Croft (1997) as in Figure 7. On the left side of Figure 7 we see a construction in a productive schema, which is entrenched, together with a set of different instances instantiating the construction. In the middle of Figure 7 we find a semi-productive schema, where only a limited set of instances instantiate the construction (token entrenchment). On the right side in Figure 7 we see a non-productive schema (with a single token entrenched) where there is only one instance of a particular token and no productive schema in which a construction may instantiate more than just one instance.

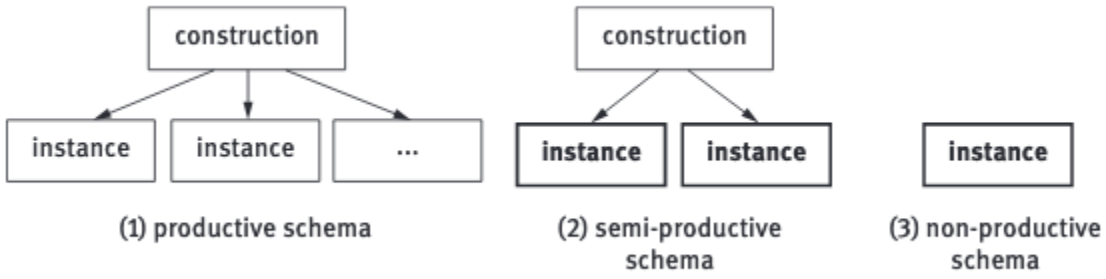

Figure 7. Constructional productivity (based on Clausner & Croft 1997: 271).

4. Current contributions and research

4.1 Different flavors of CxG

The first phase of research on CxG coming out of UC Berkeley from the mid-1980s to the mid-1990s was primarily concerned with analyzing, from a synchronic point of view, semi-idiomatic constructions and ASCs, as well as a few more abstract types of constructions.[34] This led to two related and compatible constructionist approaches that came to be known as Berkeley Construction Grammar (Fillmore & Kay 1993, Kay & Fillmore 1999, Fillmore 2013) and Cognitive Construction Grammar (Goldberg 1995/2006a, Boas 2013b). While both constructionist approaches agree on a basic set of core concepts, e.g. that the architecture of language is non-modular and non-derivational, and that constructions are learned on the basis of input, there are a number of differences that set Berkeley Construction Grammar (BCxG) apart from Cognitive Construction Grammar (CCxG).

One difference is the status and role of motivation and frequency in language. CCxG, like other research in Cognitive Linguistics (see Broccias 2013), aims to offer a psychologically plausible account of language by determining how various general cognitive principles serve to structure the inventories of constructions (Boas 2013b). On this view, constructions are assumed to be motivated by more general properties of cognition and interaction. Frequency also plays a central role in CCxG, leading to the idea that even fully regular patterns may be stored alongside abstract schematic constructions when they occur with sufficient frequency (Goldberg 2006: 45-65). In contrast, BCG, while not denying the role of motivation and frequency in language, does not explicitly employ these concepts to develop constructional analyses. Instead, BCG aims to find maximal generalizations without redundancies, typically employing strict inheritance in its constructional networks. For differences and similarities in how CCxG and BCG analyze the same phenomena, see Fillmore (1999) and Goldberg (2006) on the English subject-auxiliary inversion construction.

Another difference between different flavors of CxG concerns the role played by notation and formalization. While Radical Construction Grammar (Croft 2001/2013) does not use any formal notation, CCxG uses a simple box notation to represent the form and meaning side of ASCs, together with an open slot in which lexical entries represented by a minimal frame-semantic representation (e.g. verb: <agent, patient>) can fuse. The lack of detailed formalization in CCxG is motivated by the with to represent linguistic knowledge in such a way that it an interface transparently with theories of processing, acquisition, and historical change (Goldberg 2006: 215). BCG, as well as its close relative, Sign-based Construction Grammar (Boas & Sag 2012, Sag 2012, Michaelis 2013), is more focused on detailed unification-based formalisms using Attribute-Value Matrices (AVMs) to represent constructions. Even though the different approaches to formalizing linguistic insights might be bewildering at first sight, there is an advantage as Boas & Fried (2005) point out:

[34] Parts of this section are based on Boas (2013b), Boas (2017), and Boas & Ziem (2018b).

> This apparent lack of superficial uniformity might seem frustrating to the outsider, especially to one who is used to the representational discipline of generative syntax. However, many construction grammarians actually see the relative freedom in the formalism as a reflection of the fundamental tenet of the model, which is that linguistic analysis should not be an exercise in accommodating predetermined formal structures consisting of predetermined abstract variables, but, rather, an enterprise in extracting relevant structures and categories from the data patterns at hand (argued for convincingly and formulated most succinctly in Croft 2001. (Boas & Fried 2005: 3)

A third major difference between the various flavors of CxG concerns the application of the theory. As already pointed out, CCxG is particularly keen on developing a psychologically plausible account of language, while BCG and SBCG are more concerned with strict formatlizations. Radical Construction Grammar comes out of Croft's research on linguistic typology and is interested, among many other things, in determining typological differences and similarities between linguistic phenomena in different languages. On Croft's view, each language should be described and analyzed using only its own categories instead of re-using categories from other languages. Embodied Construction Grammar (Bergen & Chang 2013) and Fluid Construction Grammar (Steels 2013) have a particular focus on computational simulation and implementation.

4.2 Fields of inquiry beyond the English synchronic syntax-lexicon continuum

Most constructional research in the 1980s and 1990s was primarily concerned with providing synchronic accounts of English constructions along the syntax-lexicon continuum. One of the main goals was to develop an alternative theory of language capable of accounting for all aspects of language, not just for a few chosen syntactic phenomena. This focus broadened considerably in the 2000s and beyond, when more and more researchers got interested in applying constructional insights and methodologies to phenomena beyond the synchronic syntax-lexicon continuum, including morphology (Booij 2013), idioms (Croft & Cruse 2004, Wulff 2013), and information structure (Lambrecht 1994, Fried 2003, Leino 2013).

At the same time, there has been a growing interest in applying constructionist insights to a range of different linguistic subdisciplines. One such field is first language acquisition, in which grammar is regarded as a dynamic system of constructions that is acquired by children based on domain-general learning mechanisms such as automatization, analogy, and entrenchment (Tomasello 2003, Dabrowska 2004, Diessel 2004). In this usage-based bottom-up view of language acquisition, there is no assumption, as in the Chomskyan framework, that syntax is an autonomous module of language and that syntactic structures are derived from primitive categories. Instead, grammatical development begins with specific formulas that children gradually decompose and, based on processing large amounts of linguistic data, elaborate to more complex and schematic units. The outcome of this learning process is, on the constructionist view, a network of constructions that is immediately grounded in their linguistic experience (e.g. Diessel

2013, Ellis et al. 2016).[35] Closely related is the field of second language acquisition, in which constructionist insights are applied to determine how second language learners acquire constructions and how determinants, such as input frequency, form, and function influence the acquisition of L2 constructions (e.g. Ellis 2013, Madlener 2015, Behrens & Pfaender 2016, Achard 2018, Wulff et al. 2018). Constructionist insights into the processes underlying second language acquisition have, in turn, influenced research on applied aspects of L2 acquisition, i.e. language pedagogy in the classroom (see the contributions in De Knop & Gilquin (2016), Herbst (2017), and Garibyan et al. (2019)).

Historical linguistics is another field applying constructionist insights to understand how languages change over time. One major area of interest is grammaticalization, which "does not merely seize a word or morpheme (...) but the whole construction formed by the syntagmatic relations of the element in question." (Lehmann 1985) Applying the constructionist usage-based methodology to grammaticalization has led to the proposal that constructions are the locus of change and that grammaticalization more generally should be understood in terms of "constructionalization." Of particular interest in this context is the gradual nature of constructionalization, the emergence of functional polysemies, the role of context (semantic and pragmatic triggers of novel interpretations), and, more generally, the motivation for change. For more details, see Bergs & Diewald (2008), Fried (2009/2013), Diewald & Smirnova (2010), Hilpert (2013a,b), Traugott & Trousdale (2013), Barðdal et al. (2015), Sommerer (2018), and Traugott (2019). Constructionist insights have also been applied to historical-comparative reconstruction in order to determine prehistoric stages of languages. While research in this area has traditionally focused on lexical, phonological, and morphological comparisons, constructionists are also interested in syntactic reconstruction (see Barðdal 2013/2015, Vázquez-González et al. 2019).

Constructionist insights have also been applied to investigating the nature of language variation (and its relation to language change). The paradigmatic shift introduced by Weinreich et. al (1968) brought the methods and findings of the study of change in progress to the attention of the broader linguistics community (see Labov 2019, Pierce & Boas 2019). When seen from a constructionist perspective, the introduction of quantitative and structural methods to the study of language variation appears to be very illuminating, because it allows for a more systematic approach to understanding the variability of constructions, the basic units of language, in different dialects. However, there have so far only been a few case studies investigating how constructionist insights can inform a more general theory of language variation, including Hollmann & Siewerska (2006, 2011) and Mukherjee & Gries (2009). For more details, see Hollmann (2013), Östman & Trousdale (2013), Ziem (2015), and Hilpert (2017).[36]

[35] For an overview of how constructionist insights have been applied in psycholinguistics and neurolinguistics, see Bencini (2013) and Pulvermüller et al. (2013).

[36] CxG has also been applied to the analysis of spoken language, see Auer (2006), Deppermann et al. (2006), Günthner/Imo (2006), Bücker et al. (2015), and Imo (2013).

Closely related to language change and variation is the field of language contact (see Thomason (2019) for an overview). Höder (2014a) proposes Diasystematic Construction Grammar (DCxG), a novel framework for analyzing language contact phenomena by applying insights from CxG. According to Höder, language contact phenomena such as borrowing, code-switching, convergence, etc. should be thought of as resulting from situations in which the linguistic knowledge of multilinguals consists of a common repertoire of elements and structures (i.e. constructions) for all of their languages and varieties. In DCxG, the multilingual repertoire can be regarded as a set of linguistic structures consisting of idiosyncratic subsets on the one hand (containing elements that solely belong to onle language or variety) and common subsets on the other (containing elements that are common to several or all languages within the repertoire) (Boas & Höder 2018b). DCxG allows researchers to systematically address a large range of language contact phenomena, i.e. different types of transference phenomena (Clyne 2003) at the lexical, phonological, morphological, syntactic, semantic, and pragmatic levels. For details, see Höder (2012/2014b/2016) and the contributions in Boas & Höder (2018a/to appear).

As noted above, the first phase of research in CxG during the 1980s and 1990s was primarily concerned with analyzing English without making any specific claims about language universals or cross-linguistic generalizations. However, this focus on English did not mean that constructionists were not interested in how their insights could be applied to other languages as the quote from Fillmore & Kay (1993) illustrates:

> We will be satisfied with the technical resources at our disposal, and with our use of them, if they allow us to represent, in a perspicuous way, everything that we consider to be part of the conventions of the grammar of the first language we work with. We will be happy if we find that a framework that seemed to work for the first language we examine also performs well in representing grammatical knowledge in other languages. (Fillmore & Kay 1993: 4-5)

In fact, the decade following the publication of Goldberg (1995) saw a substantial body of constructionist research on other languages, including Chinese, Cree, Czech, Danish, Finnish, French, German, Icelandic, Japanese, Swedish, and Spanish (for an overview, see Boas 2010b). In the second decade of the 21st century, constructionist research expanded even more, analyzing linguistic phenomena in an even broader variety of languages. It is not clear, however, to what degree constructionist insights (beyond the basic concepts of CxG) could be applied from one language to another language. To this end, Croft (2001) argues that constructions *per se* are language specific and that linguistic categories in a language are defined in terms of the constructions they occur in. In this view, there are still universals, but these are only "found in semantic structure and in symbolic structure, that is, the mapping between linguistic function and linguistic form" (Croft 2001: 61).

A slightly different view regarding cross-linguistic comparisons and the applications of constructionist insights from one language to another is presented by the papers in Boas (2010a), who offer a contrastive view of constructions. Applying principles from contrastive linguistics (Weigand 1998, Altenberg and Granger 2002) and Frame Semantics (Fillmore 1982, Fontenelle

1997, Fillmore & Atkins 2000, Boas 2002), these papers focus on comparing and contrasting constructions in only two languages (English with Swedish, Spanish, Japanese, Thai, Finnish, Russian, among others) in order to determine their similarities and differences (see Boas to appear, b). Using semantic frames as a *tertium comparationis*, each of the papers show that it is indeed possible to compare constructions across languages, thereby arriving at insights about what English constructions and their counterparts in other languages have in common and how they differ. As the following section shows, this contrastive approach to constructionist analysis has subsequently been applied and expanded to systematically document and compare constructions across different languages.

4.3 Constructicography

The idea for a so-called constructicon, a repertory of constructions, grew, among other things, out of Fillmore's decade-long work on FrameNet, which made him realize the limitations of lexical analysis when dealing with a larger range of linguistic phenomena such as multiword expressions, complex idioms, and schematic syntactic patterns conveying rich meaning.[37] Parallel to the work on FrameNet, which can be regarded as an applied implementation of Frame Semantics, Fillmore (2008) proposes to employ the insights from two decades of research on CxG for the creation of a database of English construction entries as an extension to the lexical FrameNet database.

The one-year long pilot project "Beyond the Core" at the FrameNet project in Berkeley extended the architecture of the FrameNet database and developed a corpus-based workflow similar to that of lexical FrameNet to discover, annotate, and document a broad variety of different types of grammatical constructions, including frame-bearing constructions, valence-augmenting constructions, constructions without meaning, pumping constructions, and exocentric and headless constructions. Parallel to FN-terminology, the components of a construction are labeled construct elements (CEs) with mnemonic labels, and in some cases constructions have a construction evoking element (CEE), similar to frame-evoking target LUs in FN (for details, see Fillmore et al. 2012). For example in a sentence such as [$_{\text{Theme}}$*We*] *sang our way*$^{\text{CEE}}$ [$_{\text{Path}}$*across Europe*], the combination of the verb *to sing* with a possessed *way*-headed NP (the CEE) creates what functions as a multiword verb evoking the MOTION frame. Here, *we* functions as the CE Theme and *across Europe* functions as the CE Path, while *our way* is the CEE.

The pilot project resulted in an unstructured list of about 75 construction entries in the extended FN database that all share the same format: A definition of the construction in prose (sometimes including references to the literature), a list of construction elements (and their definitions), specification of a construction evoking element (if present), the construct's properties, and the evoked frame (if present). A construction entry also contains a list of annotated example

[37] Two decades earlier, Fillmore (1988: 37) proposed the idea for a reportory of constructions as follows: "The grammar of a language can be seen as a repertory of constructions, plus a set of principles which govern the nesting and superimposition of constructions into or upon one another." See Jurafsky (1992: 18), who coins the term "constructicon" in reference to the term "lexicon." See Goldberg (2019: 36) on how the constructicon can be conceptualized in terms of a network of constructions.

sentences as well as a realization table (parallel to the valence table in lexical FN) showing how the various combinations of CEs are realized syntactically (for details, see Boas (2017a) and Lee-Goldman & Petruck (2018)).

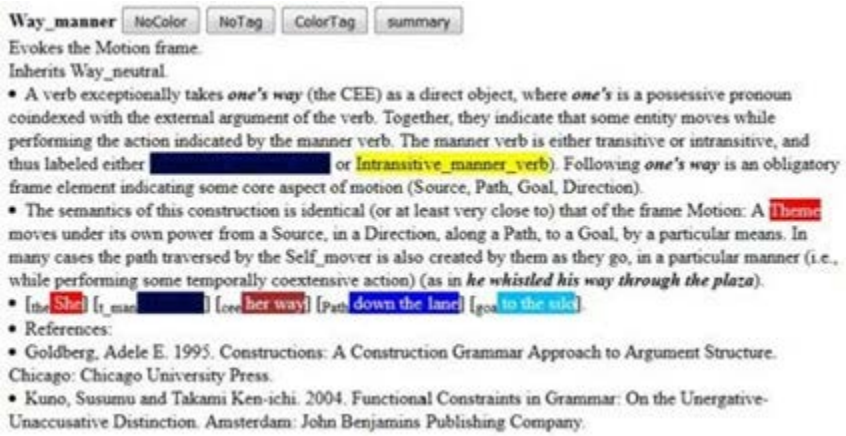

Figure 4. First part of *Way_manner* construction entry (Boas 2017a)

Applying insights from CxG to the creation of a constructicon consisting of construction entries has become known as constructicography (parallel to lexicography) (see Lyngfelt 2018). At the same time, insights gained from constructicographic research, in turn, informs the mother theory of CxG, because it forces constructionist analyses to go beyond families of constructions into the enterprise of describing a coherent CxG of a language (Boas et al. 2019). The Berkeley Constructicon for English has inspired a number of constructicon projects for other languages, including Swedish, Brazilian Portuguese, Japanese, German, and Russian (see the contributions in Lyngfelt et al. 2018). While the projects for these different languages all share the goal of compiling constructicons for individual languages, they differ in their methodologies, tools, corpora, format of construction descriptions, and integration of FrameNet frames in their construction entries (see Boas 2017a, Lyngfelt 2018, and Boas et al. 2019 for a discussion).

5. Main research methods

5.1 Usage-based methodology

Research in CxG builds on the usage-based conception first proposed by Langacker (1987) and then expanded upon in Langacker (1988). In this view, grammar should be conceptualized as non-reductive, bottom-up, and maximalist in order to recognize a number of general psychological phenomena that are essential to language. This means that language learning involves a great deal of actual learning while minimizing the postulation of innate structures specific to language and that it can thus be viewed as the cognitive organization of one's experience with language (Bybee

2006). This view of grammar is in stark contrast to the assumptions of the Chomskyan framework (Chomsky 1961)[38], which analyzes grammar in a minimalist, reductive, and top-down fashion, and which tries to minimize what a speaker has to learn and mentally represent in acquiring a language ("economy") (see Langacker (2000) and Broccias (2013), as well as the contributions in Barlow and Kemmer (2000)).[39]

The usage-based approach to analyzing language has influenced constructional research in a number of ways. The most prominent influence has probably been in the way that constructions are defined. Unlike in Goldberg's (1995) definition of a construction (see Section 2.3 above), her latest definition includes the concept of frequency, which is one of the crucial components of a usage-based constructionist approach that "capitalizes on the fact that learners attend to and retain aspects of both the form and interpretation of utterances" (Goldberg 2019: 64).[40]

> 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)[41]

On the usage-based view, the role of frequency is crucial because it allows us to capture the concept of entrenchment, which results in increasing familiarity, i.e. the idea that more frequent formulations are more accessible and are thus preferred (see Langacker 2000, Stefanowitsch 2008, Bybee 2010, Ellis 2013). Other important concepts informing a usage-based approach include analogy and similarity, exemplars, and chunking (see Bybee 2010/2013).[42]

5.2 Use of corpus data

[38] Chomsky (1961: 130) proposes that "it is absurd to attempt to construct a grammar that describes observed linguistic behavior directly."

[39] The usage-based approach attempts to circumvent the rule/list fallacy, which assumes that rules and lists are mutually exclusive. In this view, the grammar may include both rules and instantiating expressions (for more details, see Langacker 2000: 2-3).

[40] On the difference between token and type frequency see Bybee (2013: 59-63). For details on frequency effects, see Diessel (2019).

[41] Note that the notion of what exactly "sufficient frequency" means is open to interpretation. For example, more recently Goldberg (2019: 64) points out the following: "The semantic, formal, sound, and social dimensions associated with each construction are formed by generalizations across the partially abstracted exemplars that have been witnessed." Clearly, the notion of "sufficient frequency" (and possible rankings of factors from different dimensions) need to be worked out by further research.

[42] Research in Fluid Construction Grammar (FCG) (Steels 2013) and Embodied Construction Grammar (ECG) (Bergen & Chang, 2013) have led to computational implementations of constructional insights based on usage-based data. FCG' formalism allows researchers to take constructional insights and formulate them in a precise way that allows for the testing of hypotheses in the context of parsing, production, and learning. ECG captures the cognitive and neural mechanisms that underlie human linguistic behavior computationally. For the differences between FCG and SBCG, see Van Trijp (2013).

Much linguistics research up to the 1990s relied primarily on anecdotal and introspective data.[43] Fillmore (1991) proposes to move beyond this methodology by combining linguistic intuitions with corpus linguistics in order to arrive at a more adequate methodology for developing insights into the nature of language. What Fillmore (1991) calls "computer-aided armchair linguistics" roughly describes the workflow of the FN project and its parallel projects for other languages as well as, to some degree, the workflow of the various constructicon projects. In other words, most of the applied research on framenets and constructicons for different languages rely on a combination of observational and introspective data. The same can be said for on-going research in CxG and Frame Semantics more generally.

Building on earlier research by Gilquin & Gries (2009), Gries (2013) discusses a broad variety of different data and methods relevant to research in CxG. These include the following: First, introspective judgements used for early constructionist research in the 1980s and 1990s. Second, observational approaches using different types of corpus data for different languages, modes and registers, varieties, and synchronic, diachronic, and experimental data. These quantitative corpus-based approaches seek to explore, among other things, concepts such as frequencies of (co-)occurrence, conditional probabilities (unidirectional), association strengths (bidirectional), and multifactorial and multivariate approaches. Third, research in CxG also relies on experimental data of different kinds (see Gries 2013: 101-106) as well as computational and machine-learning approaches (see Gries 2013: 106-107)).

Employing these different types of data to inform research in CxG is in contrast to the Chomskyan framework, in which researchers continue to aim to capture the competence of an idealized native speaker based primarily on introspective data. Another way in which constructionist research differs fundamentally from the Chomskyan paradigm is in its use of various statistical methods that use empirical data.

5.3 Statistical methods

The availability of large corpora makes it possible to use a variety of statistical methods in constructionist research. One of the most prominent methods is the co-called collostructional analysis (a blend of collocation and construction), which allows researchers to quantify association strengths between different elements in an utterance (Stefanowitsch 2013/Hilpert 2014). Based on collocational approaches developed in corpus linguistics, the collostructional analysis offers different ways of determining association strengths to arrive at rankings of how much words and particular slots of constructions attract each other: collexeme analysis (Stefanowitsch & Gries 2003), distinctive collexeme analysis (Gries & Stefanowitsch 2004), and co-varying collexeme analysis (Stefanowitsch & Gries, 2005). For more details, including the use of inferential statistics, choice of statistics, the applications of collostructional analysis, and other statistical methods, see

[43] In psycholinguistics, experimental data also plays an important role. Sampson (2003) argues that the preoccupation with speakers' hazy intuitions about language structures are often sharply at odds with the nature of their actual usage and that such an approach towards developing theories of language is rather unscientific (for a similar view, see Hanks 2013).

Stefanowitsch (2013), Perek (2015), Zeschel (2015), Yoon & Gries (2016), Gries (2017/2019), and Engelberg (2018).

6. Future directions

6.1 Types of constructions

Early research in CxG during the 1980s and 1990s focused on semi-idiomatic constructions and then on ASCs. Since then, constructionists have expanded their research areas considerably to cover a range of other types of constructions such as passives (Ackerman & Webelhuth 1998, Lasch 2016), relative clauses (Webelhuth 2012), filler-gap constructions (Sag 2010), and many others. However, we still do not know how many (types of) constructions there are in a language, how these constructions are organized in terms of similar or different networks using different types of inheritance (see Sag et al. 2012), and how the various networks of a language are related to each other in one large network (see Diessel 2019). Closely related to these issues are open questions about language universals, i.e. which properties of constructions could be considered as language universals while at the same time excluding other properties? These are questions that need to be answered by future research.

6.2 Interactions of constructions

Another open question concerns the interaction of constructions. Most research in CxG currently focuses on analyzing specific constructions and their relationship to other constructions. However, it is still not entirely clear how constructions interact with each other in order to license a specific utterance. Recall that CxG does not assume multiple levels of representation, but instead focuses on surface forms ("what you see is what you get"). Thus, it seeks to account for the licensing of utterances by simultaneously recruiting different constructions from a language's constructicon and combining them. To illustrate, consider the following sentence.

(1) The donuts taste yummy.

The intransitive construction licensed by the one-place predicate *to taste* sets out the overall sentence structure, comprising an NP and VP construction, whereby the first is complex in itself such that it consists of a definite pronoun and a noun. Lexical constructions make up the lexical material combined into phrases. Again, lexical constructions may be simple in cases in which the items do not inflect (*the*, *two*, *cold*) or complex (*to taste*, *donut*). The latter instantiate morphological constructions, such as plural constructions (*donuts*) or other inflection constructions specifying number, tense and mood (*to taste*).

Types of constructions	Instances

Intransitive construction [[X]$_{NP}$ [Y]$_{V}$]	[[*The donut*]$_{NP}$ [*taste*]$_{V}$]
VP construction [[X]$_{V}$ ([Y]$_{NP}$) ([Z]$_{PP}$)]	*taste*
AdvP construction [[x]$_{Adv}$ ([y]$_{Adv}$)]	*yummy*
NP construction	[[*the*]$_{def\text{-}Pr.}$ [*donut*]$_{N}$]
Plural construction [[X]$_{N\text{-}root\text{-}morph}$ [-y]$_{infl\text{-}morph}$]]	[[donut]$_{root\text{-}morph}$ [-s]$_{infl\text{-}morph}$]
Verb-inflection construction [[X]$_{V\text{-}root\text{-}morph}$ [Y]$_{Infl}$]	[*taste*] [-Ø]]
Lexical constructions	[*taste*], [*the*], [*donut*], [*yummy*]

Table 2: Constructions instantiated by *The donuts taste yummy*.

The example in (1) appears to be relatively straightforward, because we are (only) dealing with an intransitive declarative clause in the active voice. But how do constructions interact to license more complicated utterances including different semi-idiomatic constructions, passives, long-distance dependencies, ellipsis, conditionals, raising, and control? To this end, Sag et al. (2012: 5) ask the following questions: “Do constructions freely interact when compatible? Are some constructions optional? Are some constructions obligatory? How does a grammar guarantee that exactly the ‘right’ constructions apply to a given context?” These questions are still left largely unanswered and need to be addressed by future research.

6.3 Discovering and analyzing constructions and frames

Another issue is the question of how to systematically identify and analyze constructions in an empirical way. To date there has been very little systematic research on how to empirically

determine the full range of constructions in a language, let alone describing these constructions and analyzing how they fit into the larger constructional network of a language. Put differently, research in CxG appears to be led by the types of constructions in which researchers are interested in analyzing. In a way, this "discovery procedure" is similar to the workflow of FN, in which lexicographers pick and choose the words, frames, and domains they wish to explore.

One way in which this approach has evolved in FN is to annotate a complete text with all the semantic frames evoked by specific LUs. This corpus-based effort is aimed to show how Frame Semantics can contribute to text understanding and to show how different types of frame-semantic information may overlap in the same sentence (see Fillmore & Baker (2001) and Scheffcyzk et al. (2010)).[44] Subsequently, Ziem et al. (2014) show how complete sentences in a running text can be annotated with grammatical constructions and semantic frames. Analyzing a newspaper text, the authors systematically dissect each sentence to determine which grammatical constructions are needed to license each sentence and which frames are evoked by the individual frame-evoking LUs in the text. The results of Ziem et al.'s (2014) analysis demonstrate the complexity of interactions between different constructions licensing a sentence and the semantic frames evoked by the LUs in these sentences.

More recently, Boas (2019) proposes a systematic procedure for discovering and documenting constructions in a corpus in order to build up a constructicon. Inspired by Hanks (2013: 4), who proposes that a "corpus-driven approach (...) will provide methods and benchmarks against which the theoretical speculations in all these approaches to language can be checked, tested, and in some cases improved", Boas (2019) takes Goldberg's (1995: 4) classic definition of a construction as the basis for his full-text approach to systematically discovering and analyzing constructions in a corpus from beginning to end in order to compile construction entries for each construction appearing in the corpus. Figure 5 below illustrates the workflow underlying the discovery and analysis of each construction.

[44] For details, see https://framenet.icsi.berkeley.edu/fndrupal/fulltextIndex.

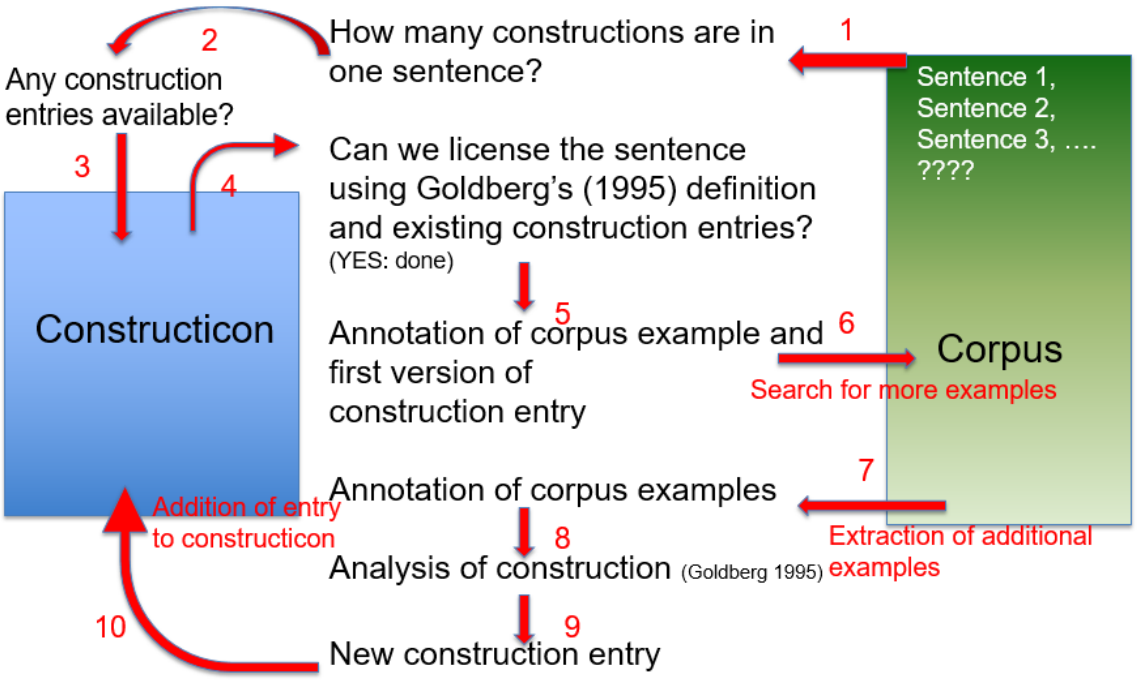

Figure 5. Full text analysis of a corpus to determine construction entries needed to license each sentence (Boas 2019: 255)

The procedure begins with the first sentence of the corpus (top right in Figure 5) by asking the question how many constructions are needed to license the first sentence. Then, one looks if there are any construction entries available in the constructicon (step 2), represented by the box on the left side in Figure 5 (step 3). If it is possible to license the sentence based on construction entries that already exist in the constructicon, then no further entries are needed (step 4) and one is done with analyzing that sentence. Then, one moves on to the second sentence and begins again with the first step at the top right in Figure 5.

However, if there are no construction entries available to license the sentence, or if combining existing construction entries to license the first sentence does not work, then it becomes necessary to analyze and annotate the corpus sentence in detail in order to arrive at preliminary versions of construction entries needed to license the sentence (step 5) and look for additional corpus sentences that will provide additional examples of the construction(s) under analysis (steps 6 and 7). These additional corpus examples will then be annotated (step 8) and analyzed (step 9), eventually leading to the formulation of a new construction entry that is then added to the constructicon (step 10). Once this procedure is completed, researchers move on to the next sentence in the corpus to follow the same workflow.

How the implementation of the procedure outlined in the preceding paragraphs works still remains an open question, especially when applied to a larger corpus. Clearly, this workflow is time intensive and can be sped up in a number of ways. For example, before starting with a full text analysis of an entire corpus one could populate the constructicon with construction entries informed by the results of constructionist research over the past three decades. This would already

provide researchers with some building blocks for discovering the relations between constructions in the constructicon and to ensure that construction descriptions are compatible with other construction descriptions. At the same time, it could lay the groundwork for developing a first systematic account of a broad variety of constructions, how these constructions interact, and whether all constructions are in fact meaningful, as assumed by many practitioners of CxG.

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