1 Introduction

Construction grammar makes two central claims (Hoffmann and Trousdale 2013). The first claim is that linguistic structure consists of conventional pairings of form and meaning, that is, constructions. The second claim is that constructions are integrated into a system, known as the **constructicon** (sometimes written **construct-i-con**; Jurafsky 1991). There is a large body of research on the structure, meaning, acquisition, and change of particular constructions (for reviews, see Hilpert 2014; Hoffmann 2022); but there is relatively little research on the constructicon. As Lyngfelt (2018: 1) noted in a recent paper, although researchers agree that constructions are integrated into a system, "the internal structure of the constructicon is still largely uncharted territory."

In the classical model of construction grammar, the constructicon is an inheritance hierarchy or taxonomy (Fillmore and Kay 1999). Inheritance is a key concept of formal varieties of construction grammar (Fillmore and Kay 1999; Sag 2012) but has also been used by Goldberg (1995) and other cognitive linguists to describe the cognitive organization of grammar. Following the pioneering work of Goldberg, it has become a standard assumption of cognitive linguistics that the constructicon is mainly a taxonomy in which lower-level constructions inherit general properties from higher-level constructions. The inheritance model of the constructicon has dominated research in construction grammar for more than two decades, but recent research in usage-based linguistics argues that, while grammar includes an important taxonomic dimension, constructions are not only taxonomically related. Combining evidence from linguistics with insights from psychology, these studies argue that a person's knowledge of grammar involves multiple types of associations that characterize the constructicon as a multidimensional network (e.g. Kapatsinski 2018; Lyngfeld et al. 2018; Diessel 2019a; Schmid 2020; Sommerer and Smirnova 2020).

The multidimensional network approach presents a radical alternative to the structuralist and generative traditions of linguistic research but also poses new challenges to the constructivist approach. While the classical inheritance model has abandoned key concepts of structuralist and generative linguistics (e.g. the distinction between lexicon and grammar), it has maintained the traditional conception of many syntactic phenomena. The multidimensional network approach takes construction grammar to a whole new level. As we will see, if we think of grammar as an association network shaped by language use, we need new formats of linguistic representation for all linguistic concepts, including the key concept of construction grammar, that is, the notion of construction.

In what follows, I first describe the development of the constructicon from the classical inheritance model to the multidimensional network approach (Section 2) and then expand on three central claims of current research in usage-based construction grammar: (i) the definition of constructions as dynamic networks (Section 3), (ii) the emergence of syntactic categories from different types of associations (Section 4), and (iii) the global organization of the constructicon into paradigms, families, and neighborhoods (Section 5).

2 From Taxonomies to Networks

The classical model of construction grammar was developed by a group of Berkeley linguists in the late 1980s and 1990s. From the very beginning, there were two main varieties of construction grammar: a formal variety, developed by Fillmore and Kay (1999), which was primarily concerned with the development of a formal system for representing constructions, and a cognitive variety, developed by Lakoff (1987) and Goldberg (1995), which was primarily concerned with cognitive aspects of constructions (cf. Boas 2013). Although the two varieties had different goals, they strongly influenced each other during the early stages of construction grammar, with far-reaching consequences for the conception of the constructicon. This Element concentrates on cognitive varieties of construction grammar, which later developed into usage-based construction grammar.[1]

2.1 The Grammar–Lexicon Continuum

It is one of the central claims of traditional linguistic theory that linguistic knowledge comprises two basic components: (i) a lexicon including words and idioms and (ii) grammar including syntactic categories and rules. Construction grammar has challenged this view, arguing that, if we think of linguistic structure in terms of constructions, lexicon and grammar form a continuum rather than two separate components. The reconceptualization of lexicon and grammar as a continuum laid the foundation for the initial conception of the

[1] Formal varieties of construction grammar will not be considered in this Element. Note, however, that some recent computational approaches to construction grammar have extended the formal inheritance model to a multidimensional network approach that shares important properties with the usage-based view of the constructicon (e.g. Steels 2011; van Trijp 2016; Boas 2017; Lyngfelt et al. 2018). It is a task of future research to integrate theoretical and computational research on the constructicon into a unified approach.

constructicon in which words, idioms, and all grammatical patterns are analyzed as constructions.

The notion of construction has a long history in linguistics that predates the rise of construction grammar. Traditionally, the term "construction" refers to particular clause or sentence types, such as the passive or questions, that are analyzed by **construction-particular rules**, that is, rules that are exclusively needed to explain a particular structural pattern or construction. Active declarative main clauses are traditionally excluded from constructional analysis as they do not seem to involve construction-particular rules. To illustrate, a passive sentence, such as *He was invited by John*, has idiosyncratic properties that can be explained by construction-particular rules: A passive sentence encodes the patient as grammatical subject, includes a special verb form that does not appear in any other sentence type, and may express the agent in a *by*-phrase. In contrast to the passive, active declarative main clauses are usually seen as fully regular grammatical patterns that do not involve construction-particular rules. An active sentence, such as *She opens the door*, for example, instantiates the SVO word order pattern that also appears in many other clause and sentence types, accords with general phrase structure rules, and is semantically predictable from its lexical components.

In the classical version of generative grammar, constructions, such as the passive and questions, were derived from underlying representations of active declarative main clauses by syntactic transformations (Chomsky 1965). Later versions of generative grammar abandoned syntactic transformations and analyzed all syntactic structures, including those that are traditionally regarded as constructions, by the same set of syntactic categories and structure-building operations such as "merge" and "move." As Chomsky (1995: 4) put it in *The Minimalist Program*: "The notion of grammatical construction is eliminated, and with it, construction-particular rules."

Construction grammar has taken the opposite route and has extended the notion of construction from the analysis of particular clause and sentence types to all syntactic patterns including basic declarative main clauses. There were several reasons for this (for discussion, see Hilpert 2014; Hoffmann 2022), but of particular importance was that researchers began to recognize that natural language abounds with idiomatic and formulaic sequences. In an important paper, Fillmore et al. (1988) showed that idiomaticity is a matter of degree that concerns all clause and sentence types (Nunberg et al. 1994). Since there is no clear division between regular and idiomatic forms, these researchers argued that syntactic structure is best analyzed by a general notion of construction that applies to all clause and sentence types including basic declarative main clauses.

Table 1 Examples of different types of constructions (cf. Goldberg 2006: 5)

Construction type	**Examples**
Morpheme	*un-*, *-ize*, *-ed*
Word	*banana*, *return*, *but*
Complex word	*motorway*, *armchair*
Complex word (partially filled)	[V-*ize*], [N-*ment*]
Idiom (filled)	*kick the bucket*, *pull a fast one*
Comparative correlative	*the* Xer *the* Yer
Resultative construction	SUBJ V OBJ A/PP_{result}
Passive construction	SUBJ aux VPPTC (PP*by*)

Abandoning the categorical distinction between regular and idiomatic expressions, Fillmore and colleagues defined constructions as **signs**, or symbols, that combine a particular form with meaning, similar to words or lexemes. A transitive sentence, for example, can be seen as a complex linguistic sign that maps a particular structural pattern (i.e. SVO) onto a particular semantic representation of a transitive event. Assuming that syntactic structure consists of signs, many construction grammarians use the notion of construction not only for syntactic patterns but also for lexical expressions and even for bound morphemes (Table 1).[2] On this view, a person's knowledge of language consists of nothing but constructions (Hilpert 2014: 2), or as Goldberg (2003: 223) put it in an oft-cited phrase: "it's constructions all the way down."

If language consists of nothing but constructions, it is just consequent to abandon the traditional distinction between lexicon and grammar in favor of a more uniform approach in which all linguistic signs, for example morphemes, words, phrases, and clause-level constructions, are represented within the same system that has become known as the constructicon. But how is this system organized? What is the structure of the constructicon?

2.2 Inheritance Networks

2.2.1 The Classical Inheritance Model

In the classical model of construction grammar, the constructicon is an inheritance hierarchy or taxonomy (Goldberg 1995: 67). The term **inheritance** was borrowed from computer science, notably from object-oriented programing,

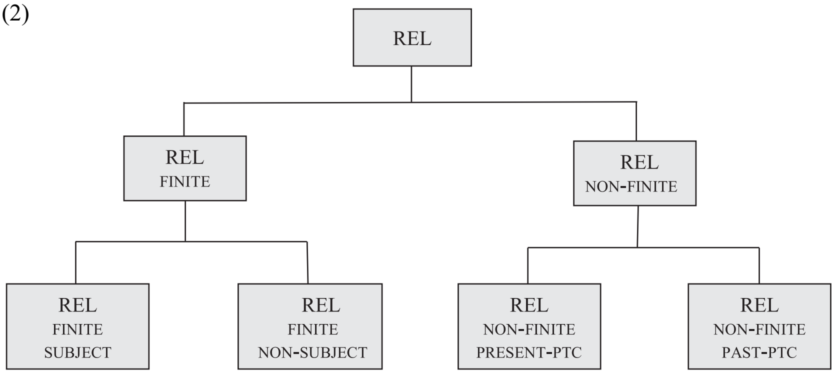
[2] The status of morphemes as constructions is a matter of debate (for discussion, see Ungerer and Hartmann 2023).

where it describes a mechanism whereby lower-level (child) objects inherit general information from higher-level (parent) objects (Shieber 2003). The linguistic use of the term "inheritance" is related to its use in computer science. In particular, formal varieties of construction grammar use the notion of inheritance in a way similar to that in computer science (Fillmore and Kay 1999; Sag 2012). The general idea behind linguistic inheritance is simple. Linguistic generalizations are represented in schematic parent constructions from which lower-level child constructions inherit shared features. For example, English has many different types of relative clauses that vary with regard to a wide range of features, for example word order, verb form, and the syntactic function of the nominal head in the relative clause (1a–d).

(1)
a. The man [who talked to me] . . . finite, subject
b. The man [(who) I talked to] . . . finite, nonsubject
c. The picture [showing John] . . . nonfinite, present participle
d. The picture [shown to John] . . . nonfinite, past participle

What (almost) all relative clauses have in common is that they modify a noun or noun phrase of the main clause that serves a syntactic function (and semantic role) inside of the relative clause. Relative clauses can, thus, be represented in a taxonomy in which specific types of relative clauses inherit shared features from more abstract representations (2).

(2)



Formal construction grammar uses feature matrices to explain how constructions of different degrees of specificity are connected by inheritance relations (Fillmore and Kay 1999; Sag 2012). Cognitive construction grammar makes little use of feature matrices but adopts the general notion of inheritance to explain how linguistic generalizations are represented in the constructicon. There is abundant evidence from psycholinguistics that knowledge of grammar includes both local and global generalizations (Bates and MacWhinney 1989), which cognitive linguists represent by constructions at different levels of abstraction that are connected by inheritance relations (Goldberg 1995). In other words, cognitive construction grammar uses the term "inheritance" as some kind of cognitive or psychological concept, which must not be confused with the notion of inheritance in computer science and formal grammar.

Nevertheless, although cognitive inheritance is not identical to the formal mechanism of inheritance, the latter had a significant impact on cognitive research on the constructicon. Both formal grammar and computer science distinguish between two different inheritance models: (i) the **impoverished entry model**, in which shared information is stored only once at the highest level of abstraction, and (ii) the **full entry model**, in which shared information is represented at multiple levels of the inheritance hierarchy. Considering the two formal inheritance models, Goldberg (1995: 74) argued that, from a cognitive perspective, the full entry model is more adequate as linguistic information about structure and meaning is often stored redundantly at different levels of abstraction (see also Langacker 1987, who refers to this as the **rule–list fallacy**).

Another distinction that Goldberg and other cognitive linguists adopted from computer science and formal grammar is the distinction between complete and default inheritance. In the **complete mode of inheritance**, child objects are fully consistent with their parents; but in the **default mode of inheritance**, there can be some minor conflict in value between child and parent objects. Fillmore and Kay (1999) used the complete mode of inheritance to build a formal model of construction grammar; but if we think of constructions as cognitive entities, the default mode of inheritance seems to be more adequate as it provides a mechanism to account for grammatical exceptions (Goldberg 1995: 73–74). "All grammars leak" (Sapir 1921: 38), that is, all grammatical generalizations have some exceptions, which is difficult to reconcile with the complete mode of inheritance but consistent with default inheritance since the default mode of inheritance allows lower-level constructions to override higher-level constructions if they are not fully consistent with their specifications (Lakoff 1987; Langacker 2000). For example, earlier in this section we said that relative clauses modify a noun, but this generalization does not hold for sentential relatives, which modify, or elaborate, a whole clause (cf. *He passed the exam, which surprised us*). Table 2 summarizes the previous discussion and provides an overview of the various types of inheritance models considered in early research on the constructicon.

2.2.2 Different Types of Inheritance Relations

In addition to standard inheritance links (sometimes called **instance links**), Goldberg (1995: 75–89) proposed three other, more specific types of inheritance

Table 2 Models of inheritance

Inheritance models	**Impoverished entry model**	**Full entry model**
	Shared information is stored only once at the highest level	Shared information is stored redundantly at multiple levels
Mode of inheritance	**Complete mode**	**Default mode**
	High- and low-level representations are fully compatible with each other	Low-level representations override high-level representations if there is a conflict

relations: (i) polysemy links, (ii) metaphorical links, and (iii) subpart links. **Polysemy links** and **metaphorical links** designate semantically motivated inheritance relations between semantic subtypes of the same construction. For example, the caused-motion construction (NP V NP PP_{LOC}) designates an act of transfer whereby an agent causes an object to move somewhere (3a–b) (Goldberg 1995: 152–179).

(3) a. He pushed me into the car. [X causes Y to move Z]
b. She shoved it into the drawer.

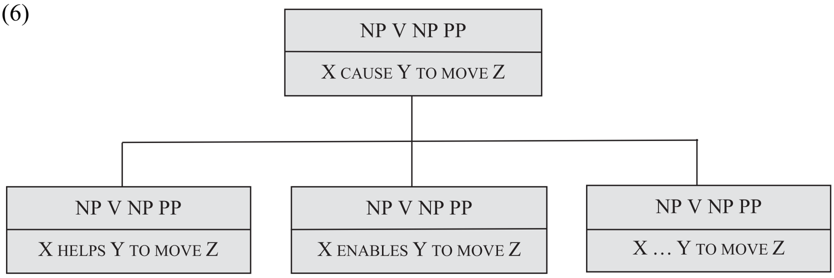
Yet, in addition to encoding transfer, the caused-motion construction occurs with several other related meanings, which Goldberg (1995) described as extensions of its basic meaning. For example, the sentences in (4a–b) designate a scene in which an agent helps another person to move somewhere, and the sentences in (5a–b) designate a scene in which an agent enables another person to move somewhere.

(4) a. He helped him into the car. [X helps Y to move Z]
b. She guided him through the terrain.

(5) a. He allowed Bob out of the room. [X enables Y to move Z]
b. She let him into her office.

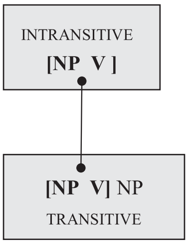
Considering these uses, Goldberg (1995: 161–174) argued that the caused-motion construction is polysemous. Or more generally, she maintained that argument-structure constructions, such as the caused-motion construction, are organized in semantic networks in which the various subtypes of a construction inherit general semantic properties from its basic meaning and use (6).

(6)



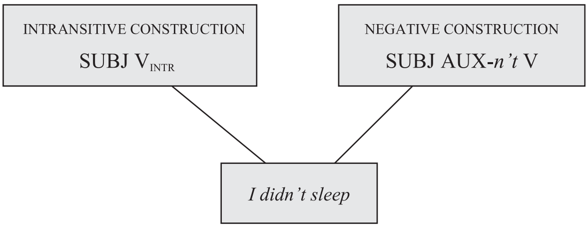
Subpart links are considered only briefly in Goldberg (1995: 78–79) and defined as follows: "A subpart link is posited when one construction is a proper subpart of another construction and exists independently." For example, transitive and intransitive argument-structure constructions are related by a subpart link, according to Goldberg, as the intransitive construction constitutes a proper subpart of a corresponding transitive construction (7).

(7)



Subpart links have also been proposed in a few other studies (Croft 2001; Booij 2010; Hilpert 2014), but there is no systematic discussion of subpart links anywhere in the construction-based literature. Several studies used the term "subpart link" in conjunction with **multiple inheritance** (Hilpert 2014: 62–63), a phenomenon whereby a lower-level construction inherits properties from "multiple parents" (Croft 2001: 25). For example, Croft (2001) argued that the sentence *I didn't sleep* inherits properties from (at least) two schematic parent constructions: (i) the intransitive construction and (ii) a negative construction that is defined by the occurrence of an auxiliary, a negative marker, and the semantic feature of negation (8) (adapted from Croft 2001: 26).

(8)



Multiple inheritance accounts have also been proposed for English relative clauses (Sag 2012), argument-structure questions (Croft 2001: 26), and syntactic amalgams (Michaelis and Lambrecht 1996; Hilpert 2014). For example, Hilpert (2014: 63–64) argued that the sentence in (9) includes a syntactic amalgam that inherits properties from two interlaced constructions: (i) the nominal attribute construction (e.g. *an important song*) and (ii) the *enough-to* infinitive construction (e.g. *is important enough to put on*).

(9) It was **[an important] enough [song] to put on** the last single.

Polysemy links, subpart links, and multiple inheritance links are useful for analyzing particular aspects of the constructicon; but note that Goldberg (1995: 75–81) described all of these links as inheritance relations. In the classical model of construction grammar, the constructicon is a taxonomy or hierarchy of constructions that are connected by "different types of inheritance relations" (Goldberg 1995: 75).

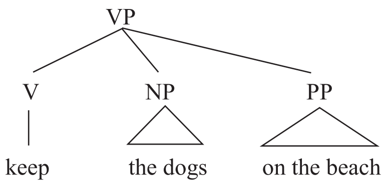
An important extension of the taxonomic conception of the constructicon is **Radical Construction Grammar**, developed by Croft (2001). Radical Construction Grammar approaches the analysis of constructions from a cross-linguistic perspective and extends the constructivist view of linguistic structure to syntactic categories, for example word classes and syntactic functions. We will discuss the contributions of Radical Construction Grammar to the development of the constructicon in Section 4. In the remainder of the current section, we consider how the classical inheritance model of the constructicon, as devised by Goldberg (1995), has been extended into a multidimensional network approach in which constructions are related by different types of associations. The development is closely related to the rise of the usage-based model (Langacker 2000; Bybee 2006, 2010) and the quantitative turn in cognitive linguistics (Janda 2013).

2.3 The Usage-Based Model

The usage-based model has evolved from several strands of research in functional and cognitive linguistics (Hopper 1987; Langacker 2000; Bybee 2010) and related research in cognitive psychology (Bates and MacWhinney 1989; Tomasello 2003) and cognitive science (Elman et al. 1996; Steels 2015). In the structuralist and generative traditions of linguistics, grammar is a closed deductive system consisting of primitive categories and algorithmic rules similar to categories and rules in mathematics or formal logic. Challenging this view, usage-based linguists have characterized grammar as a **dynamic system** in which categories and rules, or constructions, are shaped by domain-general processes of language use. **Domain-general processes** are cognitive processes that are operative not only in language but also in other cognitive domains, for example in vison or nonlinguistic memory (Ibbotson 2020). Examples of domain-general processes include categorization, analogy, and social cognition. All of these processes have been studied independently of language in general psychological research on human cognition (Anderson 2005). Since domain-general processes are sensitive to frequency of use, usage-based linguists emphasize the importance of **usage frequency** for grammatical analysis (e.g. Bybee and Hopper 2001; Diessel 2007; Diessel and Hilpert 2016; Divjak 2019). In the usage-based approach, grammar is a probabilistic system in which categories and constructions are constantly updated, restructured, and reorganized under the influence of language use (for reviews, see Bybee and Beckner 2010; Diessel 2017).

There are various proposals to model the effect of usage on grammar. One popular approach is **stochastic grammar**, which consists of two components: (i) a formal grammar including categories and rules as in traditional phrase structure grammar and (ii) a probabilistic component that augments the elements of formal grammar by probability scores based on their frequency in a corpus (Manning and Schütze 1999). Stochastic grammars are widely used in natural language processing to resolve structural ambiguities. For example, the sentence *Paul kept the dogs on the beach* is structurally ambiguous between two interpretations: The clause-final PP can be an adjunct (attached to VP) or a noun modifier (attached to NP). Stochastic grammars weigh the two interpretations by assigning probability scores to phrase structure rules and valency patterns, as illustrated in (10a–b) adapted from Jurafsky (1996: 28).

(10) a.

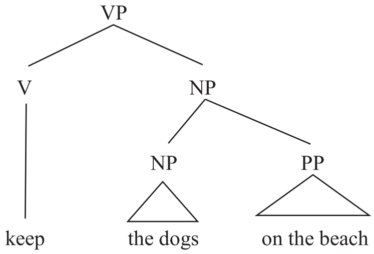


VP -> V NP PP = [.15]

keep <NP PP> = [.81]

Total probability: [.15] * [.81] = **.126**

b.



VP -> V NP = [.39]

NP -> NP PP = [.14]

keep <NP PP> = [.19]

Total probability: [.39] * [.14] * [.19] = **.010**