

What you see is not what you get: Capturing the meaning of missing words with Frame Semantics

Hans C. Boas
The University of Texas at Austin

1 Introduction

This paper presents a unified frame-semantic approach for capturing the meaning(s) of different types of missing words, i.e. words that do not occur overtly, but whose meanings are implicitly understood because of knowledge about the semantic frames that these words evoke.¹ Focusing on examples from English, I discuss examples of lexically licensed missing arguments of verbs as in (1), missing contextual arguments as in (2), missing arguments licensed by specific grammatical constructions as in (3) (from Michaelis and Ruppenhofer 2010: 159), and missing words whose meanings cannot be derived compositionally on the basis of the presence of other words in a sentence as in (4).

- (1) Pat ate too much.
- (2) One of the other members had a quite different reaction.
- (3) The cops arrest when they can, but it's always in small amounts.
- (4) The presents were under the tree.

The paper is structured as follows. Section 2 discusses previous approaches dealing with missing arguments of verbs, pointing out specific problems with such analyses. Section 3 presents the basics of Frame Semantics (Fillmore 1982) as well as its practical implementation in FrameNet (Fillmore and Baker 2010), a lexicographic database for English. Section 4 shows how lexically licensed argument omissions such as in (1) are systematically accounted for in Frame Semantics, and Section 5 demonstrates how the the frame-semantic approach can be extended to analyze the three phenomena in (2)–(4) above. Section 6 presents a summary and discusses avenues for further research.

2 Lexically licensed missing arguments of verbs

One of the key syntactic features differentiating verbs from each other is their ability to occur intransitively or transitively (see, e.g. Pinker 1989, Jackendoff 1990, Levin and Rappaport Hovav 2005). Some approaches to verb classification, such as Levin (1993), claim that verbs sharing particular aspects of meaning also

¹ I would like to thank the audience at CLS 52 and my colleague Marc Pierce for helpful comments and suggestions. The usual disclaimers apply. My gratitude also extends to the Spanish Ministry of Economy and Competitiveness (FFI2013-40517-P) and to the Xunta de Galicia (GRC2015/002 GI-1924), whose financial support made the research possible.

show relatively uniform syntactic behavior. The idea behind this form-meaning correspondence is that it is possible to classify verbs according to their shared syntactic alternations (including the locative alternation, the dative alternation, the causative/inchoative alternation) and other syntactic patterns (including the conative and resultative constructions). As Levin (1993: 5) puts it: “for speakers of English, knowing the meaning of a verb can be a key to knowing its behavior.” For example, specific verbs such as ingestion verbs in (5a), speaking verbs in (5b), and physical impact verbs in (5c) below are claimed to exhibit similar syntactic distributions when compared with verbs of other classes. They differ, for example, in that ingestion verbs usually occur in both intransitive and transitive patterns (cf. *Pat ate / Pat ate the cake*) (*devour* is a lexical idiosyncrasy), while physical impact verbs require a transitive pattern and are typically not able to occur in intransitive patterns, while speaking verbs typically occur intransitively, but not transitively (though they do allow for an array of other syntactic patterns, too).

The concept of a close systematic relationship between form and meaning is not unique to Levin’s (1993) seminal work, but it also occurs in a variety of other approaches to argument realization, including Jackendoff’s (1990) lexical conceptual structures, Goldberg’s (1995, 2006) argument structure constructions, and Rappaport Hovav and Levin’s (1998) event structure templates. The main idea underlying these different approaches is that verbs sharing the same types of meanings typically occur in the same range of syntactic patterns (for overviews, see Croft 2012, Boas 2013, Levin 2015). However, the syntactic distribution of verbs sharing the same meaning is not as systematic, as the following examples illustrate.

- (5) a. Pat {ate/swallowed/drank/chewed/*devoured} too much. (ingestion)
 b. Pat {talked/whispered/yelled/spoke} too much. (speaking)
 c. Pat {?hit/touched/*crushed/*broke} too much. (physical impact)

Each of the sentences contains several members of one of Levin’s (1993) verb classes, and they show that in certain contexts verbs of the same class do not all exhibit uniform syntactic behavior (cf. (5a) and (5c)). In addition, while the type of syntactic context licensing the omission of arguments in (5a)–(5c) remains the same across the various verbs, there is no overt lexical information that would allow a hearer to distinguish systematically between the implied types of arguments of the activities described by the verb. Compare, for example, ingestion and physical impact verbs in (5a) and (5c) with speaking verbs in (5b). While the former have a specific direct object that is omitted in the syntactic context in (5), the latter do not, yet all three classes of verbs are interpreted as describing the overdoing of an activity and a hearer will interpret certain different missing arguments depending on the verb and the context.

Comparing the examples in (5a) with those in (5c), one might also want to know what semantic types of direct objects are omitted: Are the omitted objects in

(5a) and (5c) of the same type? Are they all interpreted as a general coarse-grained semantic role such as patient (Fillmore 1968) or do they perhaps differ from each other systematically, and if yes, how? Finally, consider the uniformity of syntactic behavior of verbs in (5c). Given the assumption that the shared meaning is indicative of a verb's syntactic behavior (and vice versa), one would expect all four physical impact verbs to exhibit the same syntactic behavior, yet they do not.

The problems just pointed out indicate that the relationship between syntactic form and its associated meaning is more complicated than typically assumed. More specifically, the examples above suggest that a more finely-grained approach towards capturing form-meaning correspondences is necessary in order to capture both low-level similarities and differences as well as more abstract patterns and generalizations across various members of a verb class (for similar observations, see also Baker and Ruppenhofer 2002, Boas 2003/2008/2010, Iwata 2008, Faulhaber 2011, and Herbst 2014).

In the following section, I first introduce the theory of Frame Semantics, which captures both low-level similarities and differences between verbs sharing similar meanings as well as higher-level generalizations between these verbs. Then, I show how this theory has been implemented in FrameNet, a lexicographic database of English, whose lexical entries can help determine which verbs allow omission of arguments in specific contexts. This background then serves as the basis for systematically accounting for the meanings of other types of missing words in subsequent sections.

3 Accounting for the meaning of missing arguments

3.1 Frame Semantics

Following earlier research in the 1970s (e.g. Fillmore 1975, 1978), Fillmore (1982, 1985) developed his theory of Frame Semantics in order to characterize systematically the meanings of words in terms of experience-based schematizations of events and objects in the speaker's world (see Petruck 1996, Croft & Cruse 2004, Boas 2013).² On this view, meanings of words are much more complex than what can be covered by check-list theories of meanings or dictionary definitions, because they may refer to multiple layers of background knowledge shared by speakers. As Fillmore and Atkins (1992: 76–77) put it:

A word's meaning can be understood only with reference to a structured background of experience, beliefs, or practices, constituting a kind of conceptual prerequisite for understanding the meaning. Speakers can be said to know the meaning of the word only by first understanding the background

² Parts of this section are based on Boas (in press). See Ziem (2008) and Busse (2011) for more background information on Frame Semantics.

frames that motivate the concept that the word encodes. Within such an approach, words or word senses are not related to each other directly, word to word, but only by way of their links to common background frames and indications of the manner in which their meanings highlight particular elements of such frames.

Consider, for example, the verb *to avenge*. For a speaker of English to be able to interpret a sentence such as *Rick avenged the death of his pet armadillo by killing the coyote*, one must have knowledge about the various events leading up to the point in time when the sentence is uttered. This knowledge is captured by the *Revenge* frame, which is evoked by the Lexical Unit (LU; a “word” in one of its senses³) *to avenge*, as well as other semantically related LUs such as *to revenge*, *revengeful*, *revenger*, etc. The frame definition of a frame is a prose description of a situation involving various participants and other conceptual roles, each of which constitutes a Frame Element (FE), marked in small caps.

The Revenge frame

One person (we call him the OFFENDER) did something to harm another person (what he did we call the INJURY and his victim we call the INJURED_PARTY); reacting to that act, someone (the AVENGER, possibly the same individual as the INJURED_PARTY) acts so as to do harm to the OFFENDER, and what he does we call the PUNISHMENT.⁴

Frames such as the *Revenge* frame capture the rich knowledge that speakers associate with words. Frame Elements (FEs) are situation-specific instantiations of more general semantic roles such as AGENT, PATIENT, INSTRUMENT, etc. (see Van Valin & Wilkins 1996). The AVENGER is the person who enacts revenge (*Rick* in the example above), the OFFENDER is the original offender (not mentioned in the example above), the INJURED_PARTY is the offender’s victim (also not mentioned in the example), the INJURY is the result of the offender’s act (*the death of his pet armadillo*), and the PUNISHMENT is the avenger’s act (*by killing the coyote*). Applying the FE labels to the individual constituents of the example sentence yields the following annotation.

(6) [_{<Avenger>}Rick] avenged^{tgt} [_{<Injury>}the death of his pet armadillo] [_{<Punishment>}by killing the coyote]. [_{<Offender>}DNI] [_{<Injured_Party>} DNI]

The LU evoking the semantic frame is called the target LU, indicated by the superscripted “tgt” following *avenged* in (6). Each constituent representing a FE

³ A LU can also consist of a multi word-expression, such as *give the slip* or *put into words*.

⁴ Please see <http://framenet.icsi.berkeley.edu> for all relevant frame definitions.

of the frame evoked by the target LU is in square brackets, with the name of the FE in subscript following the opening bracket. One important feature of Frame Semantics is that it is also concerned with documenting the types of FEs that can be omitted under certain circumstances (Fillmore 1986). The phenomenon known as Null Instantiation (NI) covers three different sub-types, each of which is relevant for the current discussion.

First, it covers Definite Null Instantiation (DNI), which is lexically specific, understood from discourse, and for which knowledge of the missing material is required for determining the referent. In (6), both OFFENDER and INJURED_PARTY are characterized as DNI, since their identity can be construed from discourse. Second, Indefinite Null Instantiation (INI) involves lexically specific, intransitive uses of transitive verbs such as *eat*, *drink*, *sew*, and *bake*, as well as knowledge about the category of missing material, even if it is not mentioned in the previous discourse or if it is not recoverable from context, as in *John baked again*. Third, Constructional Null Instantiation (CNI) describes situations in which particular grammatical constructions such as the imperative or agentless passive may license the lexical omission. Frame Semantics, and FrameNet, as shown below, document null instantiation properties because they are crucially important for an understanding of how the semantics of frames may be realized syntactically.⁵ I now turn to a discussion of how the principles of Frame Semantic have been applied in the creation of FrameNet, specifically with respect to capturing null instantiation.

3.2 FrameNet

Since 1997, the FrameNet project has been building a corpus-based lexicographic database for English verbs, nouns, adjectives, and prepositions (including multiword expressions) (see framenet.icsi.berkeley.edu). FrameNet, which is freely available for academic research, currently contains about 1,200 frame definitions (including definitions of their respective Frame Elements), together with lexical entries for more than 13,100 Lexical Units evoking frames, more than 200,000 annotated corpus examples from the British National Corpus (BNC), and nearly 1,800 frame-to-frame relations illustrating how semantic frames are connected to each other via a hierarchy. For details regarding the workflow underlying the creation of FrameNet, see Baker et al. (2003), Fillmore et al. (2003), Ruppenhofer et al. (2010), Baker (2012), and Ruppenhofer et al. (2013).

One way of displaying lexical entries in FrameNet involves searching for a particular LU on FrameNet's home page, using the search function. A search for *to avenge* returns a table including the closest match, in this case the frame *Revenge*, which is evoked by *avenge*. In the case of polysemous words, this table includes multiple search results, one per LU / semantic frame. Clicking on the name of the frame leads to the display of the so-called frame report, which

⁵ For further references, see Ruppenhofer & Michaelis (2010) and Lyngfelt (2012).

contains the frame's description, the definition of FEs, and the list of LUs evoking the frame. As can be seen in Figure 1, illustrating the *Revenge* frame, the frame description consists of a few lines of prose text explaining how the individual FEs, which are color coded (here in grey scale), relate to each other in different ways. The frame description is augmented by a few clear examples from the corpus, which are color coded according to the FEs they contain.

The frame description is followed by a list of FE definitions, typically differentiating between core and non-core FEs. Each FE definition is exemplified by a corpus example illustrating the use of the FE in a specific context. Core FEs are those types of FEs that uniquely define a frame, such as the FEs *AVENGER*, *OFFENDER*, and *INJURED_PARTY* in the *Revenge* frame. Non-core FEs are peripheral FEs used to describe aspects of events more generally, such as *TIME*, *PLACE*, and *MANNER*. In contrast, so-called extra-thematic FEs do not conceptually belong to the frame in which they occur, i.e. they situate an event against the backdrop of another state of affairs. For example, in *The Swedish Chef baked the cookies for me*, the PP *for me* is an extra-thematic *RECIPIENT* FE, which is not an important part of a situation in which some edible entity is created (for details, see Fillmore & Baker (2010) and Ruppenhofer et al. (2010)).

Revenge

Definition:

This frame concerns the infliction of punishment in return for a wrong suffered. An *Avenger* performs a *Punishment* on a *Offender* as a consequence of an earlier action by the *Offender*, the *Injury*. The *Avenger* inflicting the *Punishment* need not be the same as the *Injured_Party* who suffered the *Injury*, but the *Avenger* does have to share the judgment that the *Offender*'s action was wrong. The judgment that the *Offender* had inflicted an *Injury* is made without regard to the law.

- (1) They took **REVENGE** for the deaths of two loyalist prisoners.
- (2) Lachlan went out to **AVENGE** them.
- (3) The next day, the Roman forces took **REVENGE** on their enemies.

FEs:

Core:

Avenger [Act]
Semantic Type: Sentient

The **Avenger** exacts revenge from the **Offender** for the **Injury**.
We want to **AVENGE** her.

Injured party [Injd_prt]
[Injd_prt]

This frame element identifies the constituent that encodes who or what suffered the **Injury** at the hands of the **Offender**. Sometimes, an abstract concept such as a person's honour or their blood is presented as the element that has suffered the **Injury**. These also constitute instances of **Injured party**.
Sam's brothers **AVENGED** him.

We will decide later how to **AVENGE** the blood of the fallen.

Figure 1. Description of *Revenge* frame.

Following the definitions of FEs come specifications about so-called frame-to-frame relations, which specify how a particular frame is related to other frames in the FN hierarchy. In the case of the *Revenge* frame, it inherits from a more general frame *Rewards_and_Punishments*. The last part of the frame report

contains a list of LUs evoking the *Revenge* frame, together with links to their lexical entry reports and their annotation reports.⁶ Clicking on the annotation report link for *avenge* displays all sentences that have been annotated with frame-semantic information (color-coded FEs), and which form the basis for the lexical entry report. Clicking on the lexical entry report link for *avenge* opens up a new web page with more details. Figure 2 presents the first part of the lexical entry report of *avenge*.

Lexical Entry

avenge.v

Frame: Revenge

Definition:

FN: inflict harm on somebody in return for an injury or wrong suffered

Frame Elements and Their Syntactic Realizations

The Frame Elements for this word sense are (with realizations):

Frame Element	Number Annotated	Realization(s)
Avenger	(33)	CNI.-- (7) NP.Ext (25) Poss.Ext (1)
Injured party	(14)	NP.Ext (3) NP.Obj (11)
Injury	(21)	NP.Ext (4) PP[for].Dep (1) PP[of].Dep (1) NP.Obj (14) DNI.-- (1)
Instrument	(1)	PP[in].Dep (1)
Offender	(32)	DNI.-- (25) PP[on].Dep (2) INI.-- (4) PP[against].Dep (1)
Punishment	(32)	INI.-- (23) PP[by].Dep (1) PP[ing[by].Dep (6) PP[with].Dep (2)
Purpose	(1)	VPTo.Dep (1)
Time	(1)	AVP.Dep (1)

Figure 2. First part of lexical entry report of *to avenge*.

⁶ FrameNet also documents multiword expressions such as phrasal verbs (e.g. *pick up*, *take off*, *take up*), words with selected prepositional complements (e.g. *depend on*, *object to*, *proud of*, *fondness for*), support constructions (e.g. *take comfort in*, *put emphasis on*, *at risk*, *under arrest*), combinations in which selected prepositional complements are combined with a particle or a noun (e.g. *put up with* (i.e. *tolerate*), *take comfort in*, *take under consideration*), and transparent nouns (e.g. *my gem of a wife*, *in a part of the room*, *on this part of the shelf*) (see Fillmore 2008).

The first lines at the top of the lexical entry report identify the part of speech as verb and the frame it evokes as the *Revenge* frame. The relatively short prose definition is followed by a table illustrating how the FEs of the *Revenge* frame are syntactically realized. The column on the left lists the name of the respective FEs, the middle column displays the total number of annotated example sentences containing that FE found in the annotation report (see below), and the column on the right presents the full range of syntactic realizations for each FE.⁷ For example, the FE *AVENGER* occurs in 33 annotated examples sentences and in these sentences it is realized syntactically either as an external noun phrase (NP.Ext)(e.g. *Swegen is also said to have invaded England later to avenge his brother*), as an external possessor phrase (Poss.Ext) (e.g. *Though Satan's motive for avenging against God is not made quite clear ...*), or it is not overtly realized because it is constructionally null instantiated (CNI) (e.g. *I want Leila avenged*). Clicking on a hyper-linked number will display the annotated example sentence(s) containing that FE in the lower part of the screen. Scrolling down to the second part of the lexical entry report presents the user with a table listing the valence patterns of that LU, as shown in Figure 3.

The valence table records all the attested combinations of FEs and their various syntactic realizations as they occur in the annotated corpus sentences. The column on the left lists the total number of annotated example sentences illustrating a particular Frame Element Configuration (FEC). Clicking on a hyperlink will display the corresponding annotated example sentence(s) in the lower part of the screen. The valence table for *avenge* lists a total of six FECs, together with their various syntactic realizations. For example, the first FEC consists of [AVENGER, INJURED_PARTY, INJURY, OFFENDER, PUNISHMENT] while the second FEC consists of [AVENGER, INJURED_PARTY, INSTRUMENT, OFFENDER, PUNISHMENT]. Each FEC lists the range of syntactic realizations: The first FEC has two different syntactic realizations, the second FEC has only one particular way in which the FEs are realized syntactically, and the third FEC [AVENGER, INJURED_PARTY, OFFENDER, PUNISHMENT] has a total of four syntactic realizations. The valence table for *avenge* contains a total of 17 different options for the syntactic realization of the *Revenge* frame's FEs (see Fillmore 2007 on the relevance of valence information in FrameNet).

⁷ As a lexicographic database, FrameNet does not provide information about the LU's frequencies.

Valence Patterns:

These frame elements occur in the following syntactic patterns:

Number Annotated	Patterns				
2 TOTAL	Avenger	Injured_party	Injury	Offender	Punishment
(1)	NP Ext	NP Obj	PP[for] Dep	INI --	PPing[by] Dep
(1)	NP Ext	NP Obj	PP[of] Dep	DNI --	PPing[by] Dep
1 TOTAL	Avenger	Injured_party	Instrument	Offender	Punishment
(1)	NP Ext	NP Obj	PP[in] Dep	INI --	INI --
10 TOTAL	Avenger	Injured_party	Offender	Punishment	
(2)	CNI --	NP Ext	DNI --	INI --	
(1)	CNI --	NP Ext	PP[on] Dep	INI --	
(5)	NP Ext	NP Obj	DNI --	INI --	
(1)	NP Ext	NP Obj	DNI --	PPing[by] Dep	
(1)	NP Ext	NP Obj	PP[on] Dep	PPing[by] Dep	
1 TOTAL	Avenger	Injured_party	Time		
(1)	NP Ext	NP Obj	AVP Dep		
18 TOTAL	Avenger	Injury	Offender	Punishment	
(3)	CNI --	NP Ext	DNI --	INI --	
(1)	CNI --	NP Ext	INI --	PP[by] Dep	
(8)	NP Ext	NP Obj	DNI --	INI --	
(2)	NP Ext	NP Obj	DNI --	PP[with] Dep	
(2)	NP Ext	NP Obj	DNI --	PPing[by] Dep	
(1)	NP Ext	NP Obj	INI --	INI --	
(1)	Poss Ext	DNI --	PP[against] Dep	INI --	
1 TOTAL	Avenger	Injury	Offender	Punishment	Purpose
(1)	NP Ext	NP Obj	DNI --	INI --	VPto Dep

Figure 3. Part of valence table of *to avenge*.

Providing such detailed information makes it possible to investigate similarities and differences between LUs evoking the same frame. For example, if one wants to find out how verbal LUs such as *avenge*, *get back at*, *get even*, *retaliate*, and *revenge* realize the Revenge frame's FEs, one can compare the variation of the FE's syntactic realizations in the lexical entries in FrameNet. Such a comparison shows, for example, that there are some general syntactic realization patterns that are shared by all LUs, e.g. the FE AVENGER is realized as the external NP (and it can also be constructionally null instantiated), and the PUNISHMENT can be null instantiated (INI). However, this is where the commonalities between the LUs end. Most syntactic realizations of a particular FE occur with only one, two, or sometimes three verbal LUs. In other words, there is only little overlap between a frame's FEs and how they are realized syntactically with different LUs evoking that frame.⁸

These observations may appear rather tedious at first glance.⁹ However, they have important ramifications for investigating linguistic phenomena such as linking between semantics and syntax (cf. Pinker 1989, Rappaport Hovav & Levin 1998, Boas 2008), profiling of verbal participant roles to account for their syntactic distribution (Goldberg 1995, Nemoto 1998, Boas 2003/2011a, Croft 2012), and verb classification (Levin 1993, Baker & Ruppenhofer 2002, Croft 2003, Boas 2008; 2011, Engelberg et al. 2011, Faulhaber 2011). In other words, the detailed information in the lexical entries of FN offers valuable insights into determining whether semantically related verbs (or adjectives / nouns) exhibit similar syntactic distributions or whether they differ and how. These insights, in turn, have important implications for an understanding of how lexical information is organized and how it interacts with other types of linguistic processes (see Boas 2005/2013 for details).

With the detailed frame-semantic information contained in FrameNet entries, the meanings of the different missing arguments of the verbs discussed in (5) above can now be accounted for. For example, each of the individual LUs in (5a) evoke the *Ingestion* frame, hence the missing arguments are to be interpreted as *INGESTIBLES*, i.e. the entities that are being consumed by the *INGESTOR*.¹⁰ The *INGESTIBLES* are the entities that are being consumed by the *INGESTOR* and as such could include any type of solid or liquid food. Another important feature concerns lexical idiosyncrasies. The FN entry for *to eat* specifies that its FE *INGESTIBLES*

⁸ Even though the BNC is a relatively large corpus, it is not exhaustive. This means that FrameNet does not make any claims about complete coverage, but only about the distribution of LUs as they occur in the BNC.

⁹ The valence tables of LUs evoking frames with many more LUs, such as the *Self_motion* frame, exhibit an even greater degree of variability regarding how FECs may be realized syntactically. See Boas (2008).

¹⁰ *Ingestion* Frame: An *INGESTOR* consumes food or drink (*INGESTIBLES*), which entails putting the *INGESTIBLES* in the mouth for delivery to the digestive system. This may include the use of an *INSTRUMENT*. Sentences that describe the provision of food to others are NOT included in this frame.

can be null instantiated, while the FN entry for *to devour* does not specify any null instantiation properties for the FE *INGESTIBLES*. The LUs in (5b) evoke a variety of different frames: *talk* and *speak* evoke both the *Chatting* and *Statement* frames, while *yell* evokes the *Communication_noise* frame, and *whisper* evokes the *Communication_Manner* frame.¹¹ While all four frames differ from each other (and they share similarities), they all contain a type of *TOPIC FE*, which is typically defined as the subject matter of the communicated message. Each of the lexical entries of these LUs in *FrameNet* specifies that the FE *TOPIC* can be null instantiated. This accounts for the fact that the LUs in (5b) can be used in very similar ways despite them evoking different semantic frames.

The LUs *hit*, *touch*, *crush*, and *break* in (5c) differ from the LUs in (5a) and (5b) in two major ways. First, they evoke different frames: *Hit* and *touch* evoke the *Impact* frame, while *break* evokes the *Cause_to_fragment* frame and *crush* the *Reshaping* frame.¹² As such, the missing FEs can be interpreted according to the frames which they evoke (e.g., *IMPACTEE*, *WHOLE_PATIENT*, and *PATIENT*). Second, *hit*, *touch*, *crush*, and *break* differ from the LUs in (5a) and (5b) in that they do not all allow null instantiation of their direct objects. The specification regarding which argument can be null instantiated is part of the lexical entries of these LUs in *FrameNet*.¹³

3.3 Interim summary

In this section I have shown that FN differs from other methods for structuring the English lexicon as follows: (1) FN employs the notion of semantic frame as an external device for structuring the lexicon. This differs from other approaches that rely on syntactic criteria (Levin 1993), event structure (Rappaport Hovav and Levin 1998) or lexical relations (Fellbaum 1998); (2) FN employs a splitting approach that takes as its basic unit the lexical unit, a word in one of its meanings, where each LU evokes a distinct semantic frame; (3) Lexical entries in FN contain detailed information about how the semantics of a frame are realized syntactically. This includes information about null-instantiated FEs and captures both broad-scale generalizations and lexical idiosyncrasies. With this background in mind, I now turn to the question of how to account for the other types of missing words.

4 Interpreting other types of missing words using semantic frames

¹¹ For the definitions of these frames, please consult *FrameNet*. Note that *FrameNet* takes a splitting approach when it comes to identify separate senses of a word. Thus, one word may consist of various lexical units (LUs), with each LU evoking a separate frame. *Talk* and *speak* evoke both the *Chatting* and *Statement* frames.

¹² Each of these verbs may also evoke other frames besides the ones discussed here.

¹³ The lexical specifications regarding null instantiation can also be overridden by certain grammatical constructions (see Section 3).

I begin with the question of how to categorize and account systematically for missing contextual arguments as in *One of the other members had a quite different reaction*.¹⁴ The interpretation of this sentence requires a significant amount of background knowledge that is only retrievable from context in combination with the information encoded in the frames evoked by the LUs of the sentence.

I first address cases of definite null instantiation (DNI). Consider the LU *members*, which evokes the `Membership` frame, which in FN is defined as “A MEMBER is a semi-permanent part of a socially constructed GROUP.” In the example sentence, the FE GROUP is not overtly mentioned in this sentence, but it is implicitly understood and should be recoverable in context based on previous sentences. The LU *other* evokes the `Increment` frame, which is defined as “A member or members of a CLASS have just been mentioned or are present in the discourse setting and now a different instance (or group of instances) of the same class is referred to.” Here, too, is a case of definite null instantiation, in which the relevant FE CLASS of the `Increment` frame is not overtly mentioned in the example, but should be retrievable from the previous context. Next, consider the LU *different*, which evokes the `Similarity` frame¹⁵ without overtly mentioning other frame-relevant FEs. More specifically, the FE `DIFFERENTIATING_FACT` is null instantiated and must also be recovered from the previous context. Finally, consider the LU *reaction*, which evokes the `Response` frame (An AGENT performs a RESPONSE action in consequence of a TRIGGER event. In many cases, a non-agentive RESPONDING_ENTITY causes the RESPONSE after the TRIGGER occurs.). As in the other cases of definite null instantiation, no FEs of the frame are overtly realized, and the reader has to rely on contextual information preceding the sentence in order to identify the exact FE TRIGGER of the `Response` frame, which has led to the specific reaction.

Having covered the various cases of definite null instantiation, I now turn to a case of indefinite null instantiation (INI), in which a frame-relevant FE is not overtly mentioned, but which will receive further elaborations in the later parts of the text.¹⁶ The LU *different*, which evokes the `Similarity` frame (see above),

¹⁴ I thank Charles Fillmore for this example.

¹⁵ FN definition of the `Similarity` frame: Two or more distinct entities, which may be concrete or abstract objects or types, are characterized as being similar to each other. Depending on figure/ground relations, the entities may be expressed in two distinct frame elements and constituents, `ENTITY_1` and `ENTITY_2`, or jointly as a single frame element and constituent, `ENTITIES`. The similarity may be based on appearance, physical properties, or other characteristics of the two entities. However, no such `DIMENSION` has to be specified explicitly. The `ENTITIES` may be like each other to a greater or lesser `DEGREE`. Rather than specifying the `DIMENSION` of difference, a `DIFFERENTIATING_FACT` may be mentioned.

¹⁶ I do not address the indefinite status of entire phrases such as *one of the other members* and *a quite different reaction* here, which are indefinite phrases that receive further elaborations in later parts of the text. In contrast to the definite and indefinite null instantiations, these indefinite

does not overtly occur with the FE DIMENSION in the same sentence. Hence, the FE DIMENSION is an indefinite null instantiation (it is not known what the exact DIMENSION of difference is) that will receive elaborations in the later parts of the text.

With this short background on definite and indefinite null instantiation, the reader might wonder why and how it may be relevant. To answer this question, let us conduct a detailed comparison of null instantiation properties of related LUs evoking the same semantic frame, such as the *Similarity* frame. Consider the lexical entries of the various frame-evoking adjectival LUs *alike*, *different*, *discrepant*, *disparate*, *dissimilar*, *distinct*, *like*, *similar*, and *unlike*. Different windows can be opened up on a computer screen to compare the different lexical entries of these LUs, showing how the same FEs of the *Similarity* frame are realized syntactically. Because of space limitations, I focus on the entries of only three adjectival LUs, namely *alike*, *like*, and *similar* and extract the relevant information about how FEs are realized syntactically and put them into a table to facilitate the comparison.

	DEGREE	DIFFERENTIATING_FACT	DIMENSION	ENTITIES	ENTITY_1	ENTITY_2
NP.Dep		<i>like</i>			<i>similar</i>	<i>like</i>
PP[<i>in</i>].Dep		<i>alike</i>				
A.Dep	<i>similar</i> , <i>alike</i>					
AJP.Dep	<i>similar</i> , <i>alike</i>					
AVP.Dep	<i>similar</i> , <i>alike</i>		<i>similar</i>			
DNI			<i>like</i>		<i>similar</i>	<i>like</i> , <i>similar</i>
INI			<i>like</i> , <i>similar</i>			
PP[<i>in</i>].Dep			<i>alike</i> , <i>similar</i>			
PP[<i>for</i>].Dep			<i>similar</i>			
PP[<i>on</i>].Dep			<i>similar</i>			
PP[<i>to</i>].Dep						<i>similar</i>
N.head				<i>like</i> , <i>similar</i>	<i>like</i> , <i>similar</i>	
NP.Ext				<i>alike</i>	<i>like</i> , <i>similar</i>	
NP.head					<i>similar</i>	
NP.Obj						<i>like</i>

Table 1. Frame Elements of the *Similarity* frame and their syntactic realizations with *alike*, *like*, and *similar*.

phrases are not instances of lexically determined null instantiations that are documented as a part of a FN lexical entry.

Table 1 shows the variation in how the six FEs of the *Similarity* frame are realized differently by the three LUs *alike*, *like*, and *similar*. The comparison shows that there is a significant amount of variation in how these FEs are realized syntactically (not only with respect to definite (DNI) and indefinite null instantiation (INI)), and a broader analysis of the FN lexical entries of all nine adjectival LUs evoking the *Similarity* frame would show an even greater amount of variation. Data such as these demonstrate that the ability to properly use and understand these LUs in context the speaker and hearer must have lexically-specific details about which FEs can be realized by different syntactic realizations. This type of information cannot be deduced using general mechanisms, rules, or templates, and must therefore be stored within lexical entries.¹⁷

Consider now the question of how frame-semantic knowledge is relevant for licensing missing arguments of specific grammatical constructions. Besides definite (DNI) and indefinite null instantiations (INI), Fillmore (1986) also discusses so-called constructional null instantiations (CNI), i.e. cases in which specific arguments can be omitted because of a specific grammatical construction. One example is the passive construction, which regularly allows the omission of the FE AGENT as in *The station was never built*, in which the LU *to build* evokes the *Building* frame (consisting of the FEs AGENT, COMPONENTS, CREATED_ENTITY, INSTRUMENT, and MANNER, among others). This type of CNI occurs with all verbal LUs evoking the *Building* frame, including *assemble*, *build*, *construct*, *erect*, *glue*, *raise*, and *weld*. The lexical entries of these LUs all list a CNI option for the FE AGENT. As such, one could arrive at a generalization across all entries of the verbal LUs of this frame and postulate a general passive construction allowing omission of AGENT FEs. Such a generalized construction would then be its own independent entity listed in an extension to FrameNet, the so-called Constructicon (see Fillmore et al. 2012 and Boas 2014).

Ruppenhofer & Michaelis (2010) discuss a range of null instantiation patterns that are more idiosyncratic than the passive construction. While it is beyond the scope of this paper to review them in detail, I only cite a few specific examples illustrating the relevance of frame-semantic information for licensing missing arguments. In other words, frame-semantic information are crucial for ensuring that different types of grammatical constructions have access to the proper types of lexical information in order to license particular types of null instantiation. Consider, for example, instructional imperatives (*Blend all the ingredients in an electric blender. Serve Ø cold.*), label statements (*Ø Contains alcohol*), diary style (*Ø read Michelet; Ø wrote to Desmond*), match reports (*He hammered Ø wide of Gary Walsh's exposed net*), and judgment-expressing quotative verbs (*Nice work,*

¹⁷ It is still possible to arrive at certain types of generalizations regarding how particular aspects of a semantic frame are realized syntactically, but these types of generalizations do typically not allow us to ignore most of the lexically-specific properties regarding the syntactic realizations of FEs. See Boas (2010) for details.

boys, she praised \emptyset with a light smile) (Ruppenhofer & Michaelis 2010: 160). In the examples discussed by Ruppenhofer & Michaelis (2010), the verbs typically require an argument, but the specific grammatical constructions allow them to be null instantiated. The lexical entries in FN contain, among other things, exactly the types of frame-semantic information relevant for constructional null instantiation.

5 Missing words without overt lexical material evoking a frame

So far, the discussion has focused primarily on systematically capturing and documenting the distribution of a variety of different missing arguments. In each of these cases, an omitted argument was licensed by specific frame-semantic information evoked by a different overt LU or grammatical construction in a sentence. But what about cases in which there is no specific frame-evoking LU or a grammatical construction whose pairing of a particular form with a specific meaning will enable the hearer to interpret a missing argument?

To illustrate, consider example (6) above: *The presents were under the tree*. When hearing this sentence, people familiar with Western customs and culture will most likely have a very particular image in their mind, namely that of Christmas. But there is no LU evoking a specific Christmas frame: presents can be given on other occasions, too, and placing objects under trees is not a Christmas-specific activity. The syntactic form of the sentence does also not contain any helpful hints that would reveal the overall background described by the sentence: the pattern [NP V PP] does not give away any relevant meaning aspects and, when interpreted compositionally, can encode a wide variety of events: *The gifts were under the tree*, *The car was in the garage*, *The cats were on the sofa*, etc. In short: there is no specific overt LU that could be analyzed and documented in order to write a FN-type lexical entry pointing us to a specific semantic frame. In other words, this example is different from other cases involving missing words discussed above in that an exact semantic frame that is evoked by a particular LU cannot be pinpointed. Instead, this is a highly conventionalized and culture-specific scenario involving a variety of different frames that are evoked simultaneously by the scene described by the sentence as a whole.

The following brief discussion focuses on only a few selected frames evoked by the example sentence (there are probably many more). The first frame is the *Calendric_Unit* frame, which is evoked by words describing a variety of temporal schemas, often realized as specific constructions (see *FrameNet* for details). For the Christmas scene described in the example, the frame would identify the morning of December 25th as the relevant time unit.¹⁸ The second

¹⁸ Note that the morning of December 25th is specific to Anglo-American culture. In contrast, many Texas Germans, who are 5th and 6th generation descendants of German settlers who immigrated to Texas in the 19th century (Boas 2009), find their gifts under the tree on the evening

frame evoked by the example sentence is the `Expectation` frame, which have to do with a `COGNIZER` believing that some `PHENOMENON` will take place in the future. In this case, it is the expectation from the children's perspective that Santa Clause has brought some specific presents that the children had hoped for. Another frame evoked by the example sentence is the `Giving` frame, which describes situations in which a `DONOR` transfers a `THEME` from a `DONOR` to a `RECIPIENT` (for details, see `FrameNet`).

The discussion of the various frames evoked by the example sentences is only the beginning of a much needed investigation into discovering, analyzing, and documenting the types of frames evoked by entire phrases and sentences whose regular compositional meaning does not yield the conventionalized interpretation. Another example illustrating this issue is a sentence such as *Kim does not eat meat*, which, without the conventionalized knowledge that there are people called vegetarians, would yield a regular compositional interpretation. Clearly, much research remains to be done on how to systematically account for frames that are evoked by entire phrases or sentences and not individual frame-evoking LU.

6 Conclusions

This paper has shown how `Frame Semantic` can be used to systematically analyze and document the meanings of missing words. More specifically, I have argued that the types of lexical information contained in the `Berkeley FrameNet` database are crucial for determining what types of words can be omitted because of a lexical unit's null instantiation properties. It has also been shown that grammatical constructions have similar mechanisms for allowing certain types of arguments to be null instantiated, but that null instantiation may also be a lexically idiosyncratic property captured by a lexical entry. Finally, I discussed an example illustrating how frames can be evoked not by individual frame-evoking LUs, but instead by entire sentences.

Future research is required to investigate the relative importance of possible generalizations across the entries of LUs evoking the same frame. Similarly, it remains an open question of how to systematically account for the various frames evoked by whole sentences and not by individual LUs. The goals of the present paper have been more modest: to show how `Frame Semantics` can be used systematically to analyze and document the meanings of a variety of missing words.

of December 24th. This is a reflection of their cultural heritage, which has direct repercussions for how the event described by the example sentence is located in time.

References

- Baker, C. 2012. FrameNet, current collaborations and future goals. *Language Resources and Evaluation* 46, 269–286.
- Baker, C., C. J. Fillmore & B. Cronin. 2003. The Structure of the FrameNet Database. *International Journal of Lexicography* 16, 281–296.
- Baker, C. & C. Fellbaum. 2009. WordNet and FrameNet as complementary resources for annotation. In Association for Computational Linguistics (ed.), *Proceedings of the Third Linguistic Annotation Workshop*, Singapore, 125–129.
- Baker, C. & J. Ruppenhofer. 2002. FrameNet's Frames vs. Levin's Verb Classes. In J. Larson and M. Paster (eds.), *Proceedings of the 28th Annual Meeting of the Berkeley Linguistics Society*, 27–38. UC Berkeley: Berkeley Linguistics Department.
- Boas, H. C. 2003. *A constructional approach to resultatives*. Stanford: CSLI Publications.
- Boas, H. C. 2005. From theory to practice: Frame Semantics and the design of FrameNet. In *Semantik im Lexikon*, ed. by S. Langer & D. Schnorbusch, 129–160. Tübingen: Narr.
- Boas, Hans C. 2008. Determining the structure of lexical entries and grammatical constructions in Construction Grammar. *Annual Review of Cognitive Linguistics* 6, 113–144.
- Boas, H. C. 2009. *The life and death of Texas German*. Durham: Duke University Press.
- Boas, H.C. 2010. Linguistically relevant meaning elements of English communication verbs. *Belgian Journal of Linguistics* 24, 54–82.
- Boas, H. C. 2011. A frame-semantic approach to syntactic alternations with *build*-verbs. In *Morphosyntactic alternations in English*, ed. by P. Guerrero Medina, 207–234. London: Equinox.
- Boas, H. C. 2013. Wie viel Wissen steckt in Wörterbüchern? Eine frame-semantische Perspektive. *Zeitschrift für Angewandte Linguistik* 57, 75–97.
- Boas, H. C. 2014. Zur Architektur einer konstruktionsbasierten Grammatik des Deutschen. In *Grammatik als Inventar von Konstruktionen? Sprachliches Wissen im Fokus der Konstruktionsgrammatik*, ed. by A. Ziem & A. Lasch, 37–63. Berlin/New York: de Gruyter.
- Boas, H. C. In press. Computational resources: FrameNet and Constructicon. In *The Cambridge Handbook of Cognitive Linguistics*, ed. by B. Dancyger. Cambridge: CUP.
- Busse, D. 2012. *Frame-Semantik. Ein Kompendium*. Berlin/New York: Mouton de Gruyter.
- Croft, W. 2012. *Verbs*. Oxford: Oxford University Press.
- Croft, W. and A. Cruse. 2004. *Cognitive Linguistics*. Cambridge: Cambridge University Press.
- Engelberg, S., König, S., Proost, K., & E. Winkler. 2011. Argumentstrukturmuster als Konstruktionen? In *Sprachliches Wissen zwischen Lexikon und Grammatik*, ed. by S. Engelberg, A. Holler, & K. Proost, 71–112. Berlin/New York: De Gruyter.
- Faulhaber, S. 2011. *Verb valency patterns*. Berlin/New York: Mouton de Gruyter.
- Fellbaum, C. (ed.) 1998. *WordNet*. Cambridge, Mass.: MIT Press.
- Fillmore, C. J. 1968. The case for case. In *Universals in Linguistic Theory*, ed. by E. Bach & R. Harms, 1–90. New York: Rinehart & Winston.
- Fillmore, C.J. 1975. An alternative to checklist theories of meaning. *Proceedings of the First Annual Meeting of the Berkeley Linguistic Society (BLS)*, 123–131.
- Fillmore, C. J. 1978. On the organization of semantic information in the lexicon. *Papers from the Parasession on the Lexicon, Chicago Linguistic Society*, 148–173.
- Fillmore, C. J. 1982. Frame Semantics. In *Linguistics in the Morning Calm*, ed. Linguistic Society of Korea, 111–38. Seoul: Hanshin.
- Fillmore, C. J. 1985. Frames and the Semantics of Understanding. *Quaderni di Semantica* 6, 222–254.
- Fillmore, C. J. 1986. Pragmatically controlled zero anaphora. *Proceedings of the Berkeley Linguistics Society*, 95–107.
- Fillmore, C. J. 2007. Valency issues in FrameNet. In *Valency: theoretical, descriptive, and cognitive issues*, ed. by T. Herbst & K. Götz-Vetteler, 129–160. Berlin/New York: Mouton de Gruyter.

- Fillmore, C. J. 2008. Border Conflicts: FrameNet meets Construction Grammar. *Proceedings of the XIII EURALEX International Congress* (Barcelona, 15–19 July 2008), 49–68.
- Fillmore, C. J. & B.T.S. Atkins. 1992. Toward a Frame-based Lexicon: The Semantics of RISK and its Neighbors. In *Frames, Fields and Contrasts: New Essays in Semantic and Lexical Organization*, ed. by A. Lehrer & E. Kittay, 75–102. Hillsdale: Erlbaum.
- Fillmore, C. J. and C. Baker. 2010. A frames approach to semantic analysis. In *The Oxford Handbook of Linguistic Analysis*, ed. by B. Heine & H. Narrog, 313–340. Oxford: Oxford University Press.
- Fillmore, C. J., Johnson, C., and M.R.L. Petruck. 2003. Background to FrameNet. *International Journal of Lexicography* 16, 235–251.
- Fillmore, C., Lee-Goldman, R., & R. Rhomieux. 2012. The FrameNet Constructicon. In *Sign-based Construction Grammar*, ed. by H.C. Boas & I. Sag, 309–372. Stanford: CSLI Publications.
- Goldberg, A. 1995. *Constructions: A Construction Grammar Approach to Argument Structure*. Chicago: University of Chicago Press.
- Goldberg, A. 2006. *Constructions at work*. Oxford: Oxford University Press.
- Herbst, T. 2011. The status of generalizations: Valency and argument structure constructions. In T. Herbst and A. Stefanowitsch (eds.), *Argument structure: valency and/or construction?* Special issue of *Zeitschrift für Anglistik und Amerikanistik* 59.4, 347–367.
- Herbst, T. 2014. The valency approach to argument structure constructions. In *Constructions – Collocations – Patterns*, ed. by T. Herbst, H.-J. Schmid & S. Faulhaber. Berlin: de Gruyter Mouton.
- Iwata, S. 2008. *Locative alternation: a lexical-constructional approach*. Amsterdam/ Philadelphia: John Benjamins.
- Jackendoff, R. 1990. *Semantic Structures*. Cambridge, Mass.: MIT Press.
- Levin, B. 1993. *English verb class and alternations*. Chicago: Chicago University Press.
- Levin, B. 2015. Semantics and pragmatics of argument alternations. *Annual Review of Linguistics* 1, 63–83.
- Levin, B. & M. Rappaport Hovav. 2005. *Argument Realization*. Cambridge: Cambridge University Press.
- Lyngfelt, B. 2012. Re-thinking FNI. On null instantiation and control in Construction Grammar. *Constructions and Frames* 4.1, 1–23.
- Nemoto, N. 1998. On the polysemy of ditransitive SAVE: The role of frame semantics in Construction Grammar. *English Linguistics* 15, 219–242.
- Nemoto, N. 2005. Verbal polysemy and Frame Semantics in Construction Grammar: some observations about the locative alternation. In *Grammatical Constructions. Back to the Roots*, ed. by M. Fried and H.C. Boas, 119–138. Amsterdam/Philadelphia: John Benjamins.
- Petruck, M.R.L. 1996. Frame Semantics. In *Handbook of Pragmatics*, ed. by J. Verschueren, J-O Östman, J. Blommaert & C. Bulcaen, 1–13. Amsterdam: Benjamins.
- Pinker, S. 1989. *Learnability and Cognition*. Cambridge, Mass.: MIT Press.
- Rappaport Hovav, M. & B. Levin. 1998. Building Verb Meaning. In *The Projection of Arguments* ed. by M. Butt & W. Geuder, 97–134. Stanford: CSLI Publications.
- Ruppenhofer, J. & L. A. Michaelis. 2010. A Constructional Account of Genre-Based Argument Omissions. *Constructions and Frames*, 2, 158–184.
- Ruppenhofer, J., M. Ellsworth, M.R.L. Petruck, C. Johnson & J. Scheffczyk. 2010. *FrameNet II: Extended theory and practice*. Available at [<http://framenet.icsi.berkeley.edu>].
- Ruppenhofer, J., Boas, H. C., and C. Baker. 2013. The FrameNet approach to relating syntax and semantics. In *Dictionaries. An International Encyclopedia of Lexicography*, ed. by R.H. Gouws, U. Heid, W. Schweickhard, & H.E. Wiegand, 1320–1329. Berlin/New York: Mouton.
- Van Valin, R. D. Jr. & D.P. Wilkins. 1996. The Case for ‘Effector’: Case Roles, Agents, and Agency Revisited. In *Grammatical Constructions*, ed. by M. Shibatani & S. Thompson, 289–322. Oxford: Oxford University Press.
- Ziem, A. 2008. *Frames und sprachliches Wissen*. Berlin/New York: Mouton de Gruyter.