Developing language-independent event representations that are inferable from linguistic expressions in large text corpora

DTRA Final Technical Report

Principal Investigator:
William Croft

Research Assistants:
Pavlína Kalm (2015-2021)
Michael Regan (2016-2021)
Meagan Vigus (2019-2021)
Sook-kyung Lee (2019-2020)
Chris Peverada (2019-2020)

University of New Mexico

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Chapter 1

Project Background and Aims (William Croft)

1.1 Project objective

The objective of the project was:

(a) to develop a more language-independent representation of the aspectual and causal structure of events

(b) that is nevertheless based on semantic distinctions encoded in verbs, tense-aspect constructions, and argument structure constructions in English, and

(c) is potentially extendable to other languages,

(d) which can be used to better identify semantic types of events and the roles that their participants play in those events from sentences in corpora.

1.2 Background to the problem

Many semantic representations of events are closely tied to the grammatical structure of the clause that expresses that event in a language such as English. For example, for a sentence such as (1a), the verb is commonly translated by an atomic predicate, and the subject, object and oblique phrases associated with it are translated as arguments corresponding to the participants of the event, as in (1b). In the predicate argument structure in (1b), the order of arguments is the sole indicator of the semantic role of the participants in the event denoted by the verb. In other cases, the arguments are tagged in some way by labels referring to the semantic roles (also called thematic roles) in the event, as in (1c) or in (1d) using an event variable (the representation of referring expressions was not analyzed in the grant research)

(1) a. I opened the safe with a blowtorch.
b. Open(speaker, safe, blowtorch)
c. Open(speaker [Agent], safe [Patient], blowtorch [Instrument])
d. Open(e) & Agent(e, speaker) & Patient(e, safe) & Instrument(e, blowtorch)

In other words, the semantic representation of the event denoted by the verb is very close to the syntactic structure of the target language—in this case, English. Linguists have expressed dissatisfaction with overly simple one-to-one mappings from form to meaning for theoretical reasons, but it is a much more serious problem for practical applications such as the extraction of events of a particular type from a large corpus of text. Event representations such as (1b) or even (1c-1d) do not add much semantic information about the event over and above the syntactic form of the sentence in (1a).

The first fundamental problem is that the mapping between events and their linguistic expression is many-to-many. On the one hand, the same event may be expressed linguistically by constructions other than a simple clause:

(2) a. I opened the safe using a blowtorch.
b. I used a blowtorch to cut open the safe.
c. I took a blowtorch and cut the safe open.

In (2a), two clauses are used to express the relationship between the speaker, the blowtorch and the safe in the event, one a main clause and the other a subordinate clause (*using a blowtorch*). In (2b) a different subordinate clause construction is used, and the purpose clause in addition describes the event with a complex predicate (*cut open*). Finally, example (2c) simply uses two independent sentences to describe the same event.

On the other hand, a simple clause structure as in (3a) may be used to express different types of events, even with the same verb, as illustrated in (3b-3c) (Nemoto, 2005, 125):

(3) a. John trimmed the tree.
b. John trimmed the tree with lights. [decorating/covering event]
c. John trimmed the tree of overgrown branches. [removal event]

Example (3a) could be interpreted with two very different sorts of third participants with different relationships to the subject and object participants, as shown in (3b-3c).

The examples given above illustrate this problem for identifying the type of event in terms of the roles of its participants. The same problem applies to another fundamental semantic structure of events, namely aspect, or how an event unfolds over time. The same temporal phase of an event is represented by different constructions in English, as in (4):

(4) a. The men (suddenly) ran.

b. The men began running.

The inception of the event is expressed by a simple inflected form in (4a) or by a complex sentence consisting of a verb (*began*) combined with a gerund complement (*running*) in (4b).

The event phase denoted by the same construction may be entirely different:

(5) My program ran in less than four minutes.

(6) The kid touched the painting.

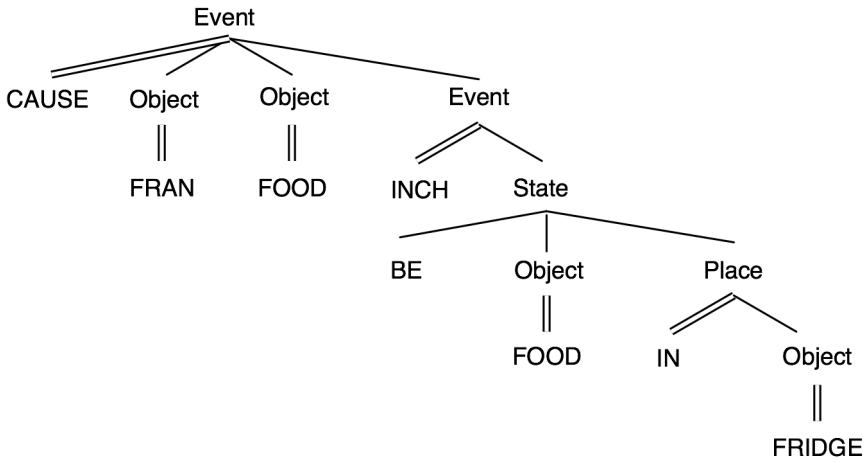
In (5), the event is modified by the adverbial phrase *in less than four minutes*, which specifies the duration of an event. But the event that lasted less than four minutes may be the program's running, or a runup event to the program's starting to run (De Swart 1998, 359; Michaelis 2004, 33). In (6), the kid's finger came into contact with the painting once (and was withdrawn), the kid repeatedly touched the painting in this fashion, or the kid put his finger in contact with the painting and kept it there (Croft, 2012, 83).

In other words, inferring an event and the roles of its participants from its linguistic expression in a clause is an even greater problem than the massive amount of ambiguity that is encountered in interpreting a clause; basic dimensions of event structure are part of the conceptualization of an event in an English sentence (or a sentence in another language). In searching large corpora in order to identify particular types of events, it is critical to use a representation of events that is more independent of their linguistic expression than the predicate-argument representations or tree-like representations widely used in linguistics and computational linguistics. Such a representation would allow a variety of linguistic expressions to be linked to the same event, and the same linguistic expression can be disambiguated in order to correctly identify the event being described.

The commonest approach to the problem of many sentences to one event (the problem illustrated in (2)) is semantic decomposition of the event denoted by the verb. Semantic decomposition allows one to capture the commonalities between different descriptions of the same event in terms of shared components of the event. Typical examples from the linguistics literature include the representations given in (7)-(8):

(7) transitive *break:* [[X ACT$_{<MANNER>}$] CAUSE [BECOME [Y <*BROKEN*>]]]
(Rappaport Hovav and Levin, 1998, 116)

(8) Fran put the food in the fridge.



(Jackendoff, 2002, 366)

The semantic decompositions in (7)-(8) are not in the form of predicate calculus formulae, but the type of information they contain can be fairly easily translated into predicate calculus, and computational theories that follow this tradition of semantic decomposition do use predicate calculus representations. The event decompositions in (7)-(8) represent the typical semantic analyses of events in linguistics. (There is another tradition in formal semantics in which predicates remain atomic, and the information found in these decompositions are instead represented by entailments; see Levin and Rappaport Hovav 2005, 74-75 and Croft 2012, 217-19 for arguments supporting decompositional analyses.)

These event decompositions share a number of analytical features. All of them use atomic (primitive) symbols such as ACT (**do** for Van Valin), CAUSE, BECOME (INCH for Jackendoff) and BE to represent semantic properties of events such as causal relations between participants (CAUSE) and aspectual properties of how events unfold over time (ACT/**do**, BECOME/INCH, BE). Certain semantic relationships between participants in events remain implicit in the order of arguments in the representation in (8) (the relation between Fran and the food). Finally, what we might consider to be the specific, substantive content of the event remains as an atomic representation (<*BROKEN*> in (7); IN in (8)). This seemingly irreducible part of verb meaning is called the VERBAL ROOT (Levin and Rappaport Hovav, 2005, 71). Finally, none of the representations explicitly represent the semantic roles of the participants in the event with atomic labels such as Agent, Instrument or Patient. In all cases, the semantic role is defined by the position of the argument in the complex event structure, relative to the configuration of the atomic symbols for causal and aspectual properties.

The decompositional analysis allows for the ability to map different sentences into the same event, and therefore recognizes the one-to-many mapping between events and their linguistic expression. However, it does so in a somewhat ad hoc way, by the use of atomic symbols to represent conceptual categories such

as time, change and causation. These symbols essentially leave the representation too language-like. Conceptual categories like time, change and causation should be represented in a natural, non-linguistic way that allows inferences, in particular between linguistic expressions denoting events that are conceptually related but vary on one of these dimensions, for example between *The men were running* and *The men suddenly ran.*

At least as serious a problem is that the one-to-many mapping between linguistic expressions and events is not recognized. That is, verbs encode different types of events, even when occurring in the same grammatical construction as in (3a), (5) and (6). As a result, there is a proliferation of verb senses or of semantic classes of verbs (or both) in standard analyses. This complex picture can be simplified by recognizing that much of event structure consists of aspectual and force-dynamic IMAGE SCHEMAS (see sections 1.3.2, 1.4) that construe events in different ways. These image schemas are constrained by tense-aspect and argument structure constructions, although they are not fully determined by them. Separating image schemas from verb meanings not only puts some order in the complexity of event structure, but it also makes for a more flexible representation that allows for nonce uses of verbs in unexpected constructions, and accommodates some of the variation in metaphorical mappings of predicates.

Section 1.3 describes this new model of event representation for aspect, which is relatively well understood and worked out in prior work by the project PI (Croft, 2012). Section 1.4 describes this new model of event representation for causal structure, which was less well understood and worked out. A major part of the funded project was to develop this representation for causal structure in order to flesh out this model of event representation.

1.3 Aspect: towards a nonlinguistic representation of event structure

1.3.1 A two-dimensional representation of aspect as change over time

The aspect components found in the event structure representations in (7)-(8) do not express many of the linguistically relevant aspectual distinctions that have been identified in both formal semantics and cognitive linguistics. The representations used in lexical semantics rarely distinguish more than the four basic types presented in Vendler (1967), given in (9):

(9) a. State: *The door is open.* [also durative (temporally extended)]
b. Activity: *The choir is singing.* [also durative]
c. Achievement: *The window shattered.* [punctual and telic (has end result)]
d. Accomplishment: *I read the book.* [durative and telic]

Many other aspectual categories have been identified in the literature. In addition to transitory states in (9b), permanent states such as *Jan is Polish* and point states such as *The sun is at its zenith* occur, distinguished by their extension on the time dimension. Activities may involve directed incremental change, as in *The sunflowers grew*, rather than the undirected change event in (9b). Achievements may be irreversible, as in (9c)—the shattering cannot be undone—or reversible, as in *The door opened*. Achievements are temporally punctual changes of state. However, the semelfactive *The light flashed* (once) is punctual but describes an instantaneous event that reverts back to the initial state (light off). Finally, while accomplishments like reading a book involve incremental directed change towards the end result (finishing the book), other events with an end result such as *repairing a computer* do not involved directed change but undirected actions until the right way to the end result is found.

All of these aspectual types have been observed in the linguistics literature but not incorporated into event representations, perhaps in part because it was not obvious how to do so. But if we move away from language-like representations of verbal semantic structure to a representation truer to the conceptual structure of time and change, then one can represent all of the types found in the literature (and introduced in the preceding paragraph) in a geometrically simple model that generates all of the types.

The way that an event unfolds over time can be represented in two geometric dimensions, time (t) and qualitative states (q) that the participants in the event pass through during the time of the event. The aspectual structure of events can be divided into phases (other phasal models of aspect do not use a qualitative dimension, and are incomplete in the number of phases they posit; see Croft 2012, 47-52). Phases themselves are of four types:

- states (not extended on q, since they are unchanging)
- transitions (punctual changes from one state to another state, e.g. not open to open)
- incremental directed changes (monotonic functions on q)
- undirected changes (nonmonotonic functions on q, represented below by a zigzag line)

A verb in a tense-aspect construction denotes only a subset of the phases as an event unfolds over time. In other words, the full unfolding of an event, from its initial (rest) state to a final state (either a result state or a return to the rest state), functions as the temporal SEMANTIC FRAME for the event. A particular linguistic expression—a predicate plus the tense-aspect construction it occurs in—denotes or PROFILES (Langacker 1987, 183-89; Croft and Cruse 2004, 14-28) just one phase, or a phase and its boundary transitions.

These four phases, defined on the geometric dimensions of t and q, define all of the aspectual types of predicates described in the linguistics literature; the geometric representations are given in Figures 1.1-1.4 (Croft, 2012, 53-66):

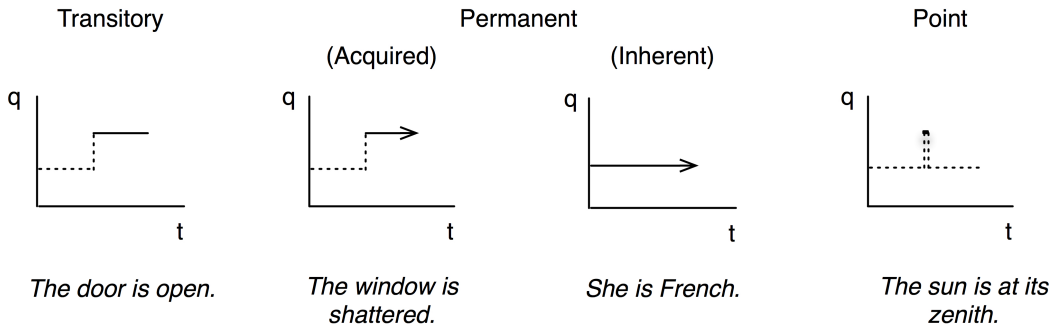


Figure 1.1: Three types of states: transitory, permanent (acquired and inherent), and point

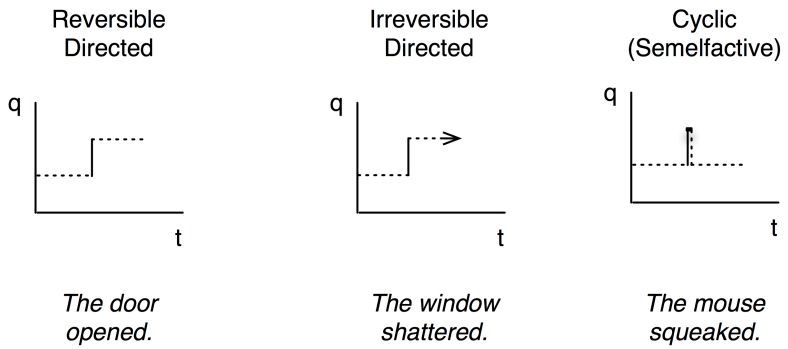


Figure 1.2: Achievements corresponding to the three types of state.

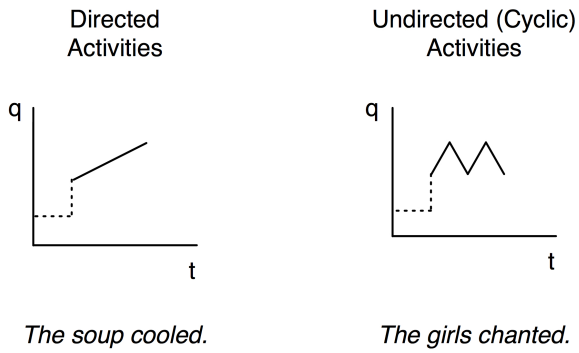


Figure 1.3: Two types of activities: directed and undirected (cyclic)

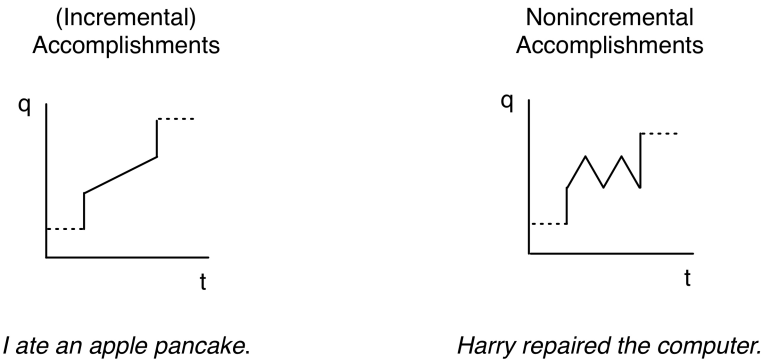
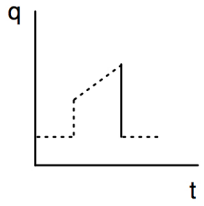


Figure 1.4: Accomplishments (bounded events) corresponding to the two types of activities.

Moreover, the phases allow one to construct more complex ways in which events unfold that are expressed by more complex linguistic constructions, such as (10) (Croft, 2012, 109, ex. 90):

(10) I stopped reading the book.



The two-dimensional geometric representation of how events unfold over time and the generative model of phases allows for a simple representation of the variety of aspectual types of events expressed by simple predicates, and a means for constructing representations of more complex time courses of events that are expressed by complex predicates (or even sequences of clauses). By representing time as a geometric dimension, these event structures may be used for inferences about processes that are not tied to linguistic descriptions but lead to the identification of the processes in question. Finally, the qualitative state dimension represents the first step in analyzing the structure of the verbal root, which is the kernel of concrete event structure that lies beyond the more abstract dimensions of time and causation (see 2.2).

1.3.2 Verbs, constructions and image schemas for the aspectual structure of events

Decompositional analyses, both language-like and language-independent, address the fact that the mapping from events to linguistic constructions is one-to-many, as in (2a-2c) and (4a-4b). Part of the reason for this one-to-many

mapping is that the same event structure can be expressed by different linguistic expressions, some simple and some complex. However, decompositional analyses do not address the fact that one linguistic expression may describe different events, as in (3a), (5) and (6).

As early as Vendler (1967), it was observed that a single predicate has multiple aspectual types depending on context:

(11) a. I see Mount Tamalpais. [transitory state]
b. I reached the crest of the hill and saw Mount Tamalpais. [directed achievement]

This phenomenon is particularly pervasive in English, which has relatively few tense-aspect constructions, such as Past, Present and Progressive. Instead, English is very flexible about putting the same verb root in different constructions; other languages such as Russian use derived verb forms.

A common analysis of this fact was to treat verbs such as *see* as lexically ambiguous (e.g. Vendler 1967). More recently, the rise of construction grammar (Goldberg, 1995) has led to a different analysis, in which the grammatical context—the grammatical construction—also had meaning. The construction defines an aspectual type; a verb takes on the aspectual type required by the construction (this process is called COERCION; see also De Swart 1998). For example, in (12a-12b), the progressive requires an interpretation of *tap* as an undirected activity (repeated taps), whereas the simple past is compatible with a semelfactive (cyclic achievement) aspectual interpretation:

(12) a. She was tapping on the windowpane.
b. She tapped on the windowpane (once/several times).

But the constructional analysis of aspectual meaning—such that the construction, not the verb, determines the aspectual meaning—is not entirely accurate either. The examples in (3a), (5) and (6) show that the aspectual type is underdetermined by the construction as well as being underdetermined by the verb.

Instead, as proposed in Croft (2012) following analyses in cognitive linguistics, the aspectual type of the event expressed in a single clause is a semantic structure independent of both the verb and (to a lesser extent) the tense-aspect construction the verb is found in. The aspectual type represents a CONSTRUAL (conceptualization) of an event in a particular way. The different interpretations of (5) and (6) represent alternative construals of the events of running a program and touching a table respectively. Likewise, examples (11a-11b) and (12a-12b) represent alternative construals of the events of seeing Mount Tamalpais and tapping on a windowpane respectively. In examples (11a-11b) and (12a-12b), there is also a difference in construction (Present vs. Past in (11a-11b) and Progressive vs. Past in (12a-12b)), but the semantic possibilities are the same as with (5) and (6): namely, the same aspectual types illustrated in Figures 1.1-1.4.

In other words, the aspectual types in Figures 1.1-1.4 are actually IMAGE SCHEMAS (Lakoff 1987; Clausner and Croft 1999) that are associated with verbs on the one hand, and constructions on the other, but are partially independent of both. The image schemas represent aspectual construals of events of a particular semantic type. Of course, for the event class denoted by a specific verb (e.g. perception), some aspectual image schemas are more common than others, leading to the impression that a verb "has" an aspectual type. But most if not all events are compatible with alternative aspectual image schemas in different contexts. Likewise, a particular tense-aspect construction (inflection, periphrastic construction or aspectual adverb such as *suddenly* and *in four minutes*) is commonly associated with a specific aspectual image schema, leading to the impression that the construction "coerces" a particular aspectual interpretation on the verb. However, many tense-aspect constructions, such as the English Past Tense, accommodate multiple aspectual image schemas: tense-aspect constructions constrain the applicable image schemas, but they often do not require one specific image schema.

This analysis recognizes the complexity of the problem of interpreting the meaning of an event—in the case of aspect, what happened or didn't happen according to the text. Events do not have an inherent aspectual type. Nor can the type always be unambiguously inferred from the tense-aspect construction containing the verb denoting the event. But recognizing that aspectual image schemas are independent of events (and the verbs that denote them) has the potential for simplifying the semantic analysis of events. First, some distinct verbal semantic classes that have been proposed in the aspect literature are in fact semantic classes which happen to occur commonly as more than one aspectual image schema. For example, the semantic class illustrated in (13a-13b) is called 'active accomplishments' by Valin and LaPolla (1997, 99), but it simply is a semantic domain allowing both undirected activity and incremental accomplishment aspectual construals.

(13) a. Erin ate. [undirected activity]
b. Erin ate the pie. [incremental accomplishment]

Instead of multiplying aspectual semantic classes in terms of possible alternative image schemas for a predicate, we can leave ourselves with SEMANTIC DOMAINS (Croft and Cruse, 2004, ch. 2)—perception, position, etc.—and a small set of aspectual image schemas which form a many-to-many mapping with the semantic domains.

Since the same event content can have different aspectual schemas imposed on it, an important question is: what are the relationships between alternative image-schematic construals of the same event? The different image schemas in (11a-11b) are related through a profile shift, from the transitory state phase in (11a) to the inceptive transition phase in (11b). The different image schemas in (12a-12b) are related through a change in granularity (Hobbs, 1985), from a succession of punctual events to a single undirected activity (alternating contact and no contact):

FINE-GRAINED COARSE-GRAINED

tap the window (once) *tap the window (several times)* *be tapping the window*

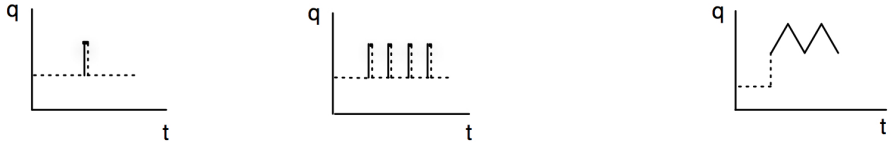


Figure 1.5: Granularity shifts in the alternative image schemas for tapping in (13a-13b)).

These granularity shifts, many of which are described for English and Russian in Croft (2012, 92-125), can only be captured in a geometric representation, since they involve scalar adjustments on largely continuous geometric dimensions.

The semantic representation of the aspectual structure of an event is the aspectual image schema, namely the time dimension, the specific qualitative states of the event on the *q* dimension, the sequence of phases that make up the aspectual semantic frame, and the specification of certain phases as profiled, in the two dimensions of time and change. The two-dimensional geometric representation looks very different from a predicate calculus semantic representation. The two-dimensional representation is essentially a model in the sense of model-theoretic semantics: the model of the real phenomenon into which a logical representation such as a predicate calculus is interpreted. Predicate calculus axioms for orthogonal scalar dimensions and phases such as those in Figures 1.1-1.4 can be constructed, and were done as part of the grant project; see Chapter 9.

1.4 Causal structure of events

The analysis of causal structure in standard decompositional models of events is somewhat different from that of aspect. There is a similar problem of a proliferation of semantic roles of participants, not unlike the large number of aspectual types of events. But most decompositional models of events avoid explicit reference to semantic (thematic) roles such as agent and instrument, which have long been criticized (see e.g. Dowty 1991; Croft 1991). Instead, semantic roles are implicit in the position of the participant in the event structure. This reduces the number of semantic roles, but raises other problems.

The greatest problem is that the semantic roles defined by positions in event structure do not correspond well to grammatical roles. There is indeed an enormous variety of semantic roles in different events, and yet they are grammatically expressed in two core argument roles (subject and object, or their equivalents in other languages), and a small number of nonspatial oblique roles (expressed as prepositional phrases in English), such as Instrument (*with*), Dative (*to*) and a few others. In attempting to capture generalizations about choice of subject

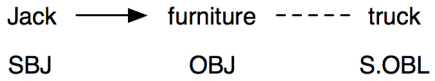
and object, standard models end up using semantic roles again in semantic role hierarchies, such as Agent < Instrument < Patient etc., and do not attempt to predict the coding of oblique roles. The significance of this problem in meaning to form mapping (now called ARGUMENT REALIZATION) will be discussed later in this section.

A number of scholars in the cognitive linguistics tradition have argued for a representation of causation in terms of transmission of force between participants in an event (e.g. Talmy 1976, 1988; Langacker 1987, 1991; Croft 1991). The interactions between participants in a single event is usually modeled as a directed acyclic nonbranching graph structure, called a CAUSAL CHAIN. Croft (1991, 2012) argues that the realization of participants in an event in the grammatical roles of subject and object can be generalized as a transmission of force relationship such that the subject is the initiator and the object is the endpoint of the relationship. This allows one to capture the generalization in subject and object choice across very different semantic classes of events and different types of participants:

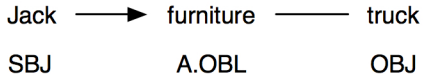
(14) a. I tossed the ball.
b. The key opened the lock.
c. The chair is supporting the shelf.

When there is a third participant, expressed as an oblique phrase, it may occur either antecedent or subsequent to the object participant (OBJ) in the causal chain:

(15) a. Jack loaded the furniture on the truck.



b. Jack loaded the truck with furniture.



The difference between an antecedent and subsequent oblique is consistently expressed by distinct oblique forms in English and other languages; for example, in English the antecedent oblique (A.OBL) is coded by *with* (or *by*) as in (15b), and the subsequent oblique (S.OBL) by *to, for* or spatial prepositions such as *on* (as in (15a)). The verb or main predicate profiles SEGMENTS of the causal chain (causal interactions between a pair of participants) in such a way that the subject and object participants delimit the causal chain profiled by the predicate, indicated by solid arrow and lines in (15a-15b). Thus there is a simple mapping from grammatical roles to participants in an event if one represents causation in terms of a causal chain, and verb meaning in terms of profiling a (possibly proper) subpart of the causal chain. Documentation of this pattern for a wide variety of semantic classes of events in numerous languages is found in Croft (1991, 2012). A full mapping of participant semantic roles

onto grammatical roles, such as [Sbj Obj *with* Obl] in (15b), is an ARGUMENT STRUCTURE CONSTRUCTION (Goldberg, 1995).

There are two basic innovations in representing event structure in Croft (2012). The first innovation is a clear separation of causal structure from aspectual structure. The means by which this separation is achieved is the second basic innovation. Each participant in the event has its own subevent of the overall event expressed by the clause. That is, a participant's subevent describes what happens (or doesn't happen) to that participant in the time course of the event. Aspectual structure is a property of each individual participant's subevent in the event denoted by a verb. Causal structure represents causal interactions between participants over the time course of the event. Thus, there is a one-to-one mapping between participants acting on other participants and (sub)events causing other (sub)events: a participant's subevent causes the subevent of the participant that the first participant is acting on.

Just as the aspectual unfolding of an event over time can be represented by a sequential combination of phases, the causal interactions in an event can be represented by a sequential combination of transmission of force relations between pairs of participants (i.e. the segments of the causal chain). In other words, events need to be decomposed on three distinct dimensions: time; the qualitative state dimension, and the causal dimension.

The event expressed in (1) and its alternative expression in (2b) are represented in Figure 1.6 on the next page. The event representation specifies what each participant (I, safe, blowtorch) undergoes in the event. Each participant's subevent represents the unfolding of qualitative changes on the q dimension over time (t); the qualitative changes are summarized by the black text description. The subevents are linked by their causal relations to each other, indicated by the vertical arrows (specific types of force-dynamic relations are not represented here; see 2.2).

Each linguistic expression profiles part of the event against the base or frame of the event as a whole. The colors indicate what part of the causal structure is profiled by the various parts of the clause—verb (*open*, *cut, use*), preposition (*with*), and secondary predicate (*open* on the right). The solid vs. dotted temporal phases indicate what phase of the unfolding event is profiled by the predicate. Finally, the leftmost column in each representation names the argument structure constructions used (transitive + instrument phrase on the left, transitive verb + infinitival complement on the right).

The causal dimension of event structure, like the aspectual (t/q) dimensions, is also partially independent of verbs and argument structure constructions. That is, the causal dimension represents a FORCE-DYNAMIC IMAGE SCHEMA for the event. The independence of force-dynamic schemas from event semantic class is not widely recognized, but it has been hinted at in more recent work (see Croft 2012, ch. 9).

Most verbs are treated as inherently transitive or intransitive, although in English, many verbs are either transitive or intransitive. In more fine-grained analyses of the argument structure constructions found with verbs, such as Levin's (1993) major survey of English verb classes that forms the basis of

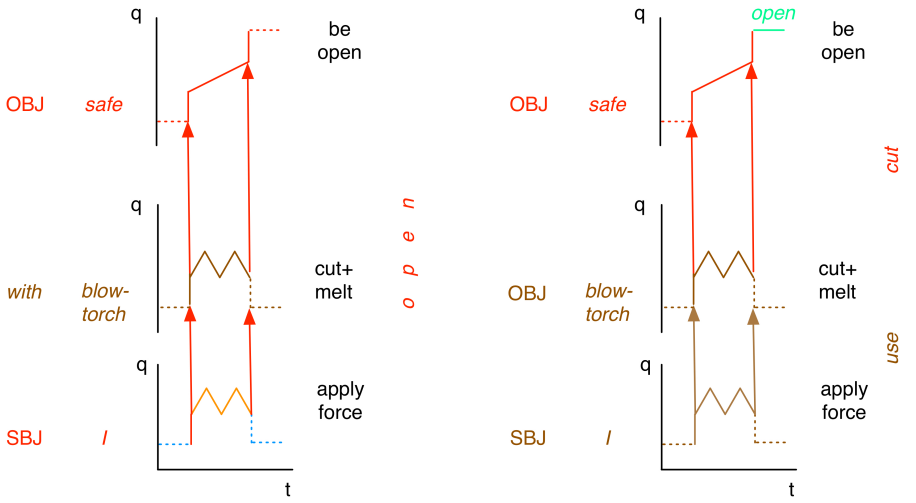


Figure 1.6: Representations of the event expressed differently in examples (1) and (2b).

VerbNet, the argument structures are presented as alternations between two possibilities for a given verb, as in the long-discussed 'spray/load' alternation in (16a-16b).

(16) a. Jack sprayed paint on the wall.
b. Jack sprayed the wall (with paint).

However, Baker and Ruppenhofer (2002, 28) argue that in fact *spray* belongs to two different semantic frames: (16a) is an instance of *spray* in the Placing frame, while (16b) illustrates *spray* in the Filling frame. Semantic frames, implemented in FrameNet, are defined in lexical semantic terms, but in this case, Baker and Ruppenhofer correlate the semantic difference to a difference in argument structure construction.

What is the proper semantic analysis of *spray*? Levin's analysis suggests that *spray* has a unitary semantics, while Baker and Ruppenhofer's analysis implies that *spray* is ambiguous in meaning (since it occurs in two frames), and suggests that the semantic difference, at least in this case, is associated with a difference in the argument structure that *spray* occurs in. Goldberg (1995) argues that semantic structures such as, placing, filling, transfer and directed motion are properties of construction meanings, not verb meanings. But as was seen in example (3a), a single argument structure construction may represent alternative frames.

The solution proposed here, as for the analysis of aspect, is that there are force-dynamic image schemas for events, which give alternative force-dynamic construals of particular events. Like aspectual image schemas, force-dynamic image schemas are partially independent of verb meaning, and partially con-

strained by argument structure constructions. Thus, (16a-16b) represent two different force-dynamic image schemas, which we may call application (placing) and covering/filling. In fact, *spray* occurs in other argument structure constructions, which represent yet other force-dynamic image schemas (Iwata, 2005, 389):

(17) a. Water sprayed onto the lawn. [directed motion]
b. The broken fire hydrant sprayed water all day. [substance emission]

Trang Hoa Dang and Rosenzweig (1998) analyze what they call intersective Levin classes, where they form the intersections of verbs occurring in the pairwise construction alternations in Levin (1993), demonstrating that many verbs occur in multiple force-dynamic schemas (as we would describe the phenomenon). They give the example of *push* (Trang Hoa Dang and Rosenzweig, 1998, 295-96):

(18) a. Nora pushed the package to Pamela. [directed motion]
b. Nora pushed at/against the package. [force exertion]
c. Nora pushed the branches apart. [separation]

Force-dynamic schemas such as application, directed motion, separation, emission and force exertion are not inherent properties of particular semantic event classes, but image schemas that provide alternative construals of the roles that individual entities are playing in an event.

The separation of force dynamics from verb meanings allows for a more natural analysis of a number of difficult phenomena in the semantic analysis of verbs and arguments. While events are more likely to occur in particular force-dynamic configurations (image schemas), they may occur in more unusual force-dynamic image schemas if an interpretation is plausible, as with the frequently cited invented example in (19), where a body process verb is construed in a removal image schema (Goldberg, 1995, 154):

(19) Frank sneezed the napkin off the table.

Also, alternative force-dynamic schemas may employ a complex predicate construction in contrast to a simple predicate construction:

(20) a. The blade scratched the glass. [change of state (glass is scratched)]
b. The blade made a scratch in the glass. [creation (of the scratch)]

Finally, the metaphorical uses of verbs may or may not preserve the force-dynamic image schema. For example, the verb *feed* occurs in a conative (incomplete effect) force-dynamic image schema in its metaphorical meaning (21a) as well as its literal meaning (21b; Croft 2009, 20):

(21) a. Their rage feeds on the budget debate that threatens to shut down the government.

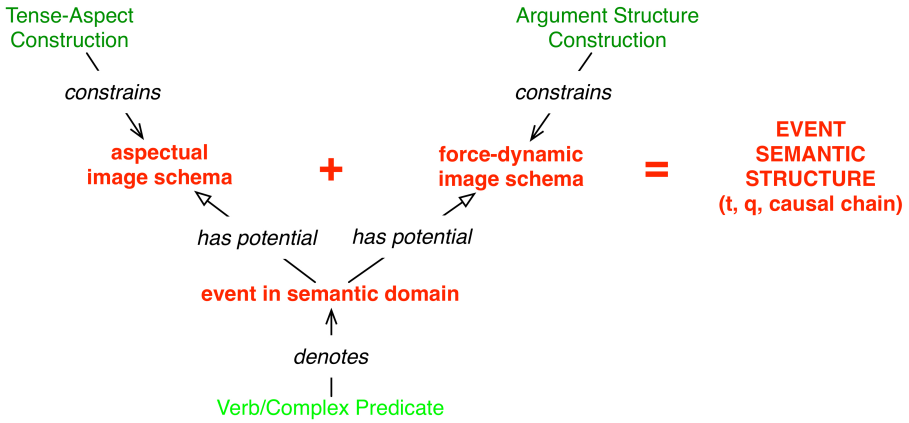


Figure 1.7: Event semantic structure and its inference from linguistic expressions.

b. Broadbills are brightly colored birds that feed on insects. . .

However, in other metaphors, *feed* occurs with a directed motion force-dynamic image schema (22a) that is unnatural in the literal meaning (22b; Croft 2009, 24):

(22) a. . . . engineering data that would allow us to feed back into the space station design process.

b. ??The ice cream fed into the boy in less than five minutes.

The metaphorical shift of *feed* to the target semantic domain allows for a different set of force-dynamic image schemas than is found in its source semantic domain.

As in the case of aspect, the positing of force-dynamic image schemas independent of event (verbal) semantics acknowledges the complexity of the semantic interpretation of verbs in context. However, it simplifies the analysis of verb meaning by teasing apart the force-dynamic image schemas from the verb meanings. This allows us to avoid multiplying lexical semantic classes, as for example in FrameNet II, which imports more image-schematic distinctions into its semantic frames than earlier version of frame semantics did.

The model of event semantic structure described here is summarized in Figure 1.7.

An event in a semantic domain, such as spraying, has the POTENTIAL to be construed in terms of a range of aspectual and force-dynamic image schemas in different contexts of use. These image schemas jointly determine the semantic structure of the event in a specific context of use. From the point of view of inferring event semantics from the grammatical structure of sentences in corpora, three elements of a sentence are necessary: the tense-aspect construction, the argument structure construction and the verb (or complex predicate). The

tense-aspect and argument structure constructions constrain the possible aspectual and force-dynamic image schemas respectively for the event in a particular context of use. The verb or complex predicate provides more specific semantic content that is conceptualized via the image schemas. For example, all of the instances of *spray* in (16a-16b) and (17a-17b) all involve expulsion of (prototypically) droplets of liquid in different force-dynamic contexts.

Chapter 2

Contributions to Event Semantic Representation and Interpretation (William Croft and Pavlína Kalm)

2.1 The analysis of event types in terms of force-dynamic relations and qualitative change to the participant

In Chapter 1, we argued that the relationship between verbs and the ARGUMENT STRUCTURE CONSTRUCTIONS (ASCs) that the verb occurs in is many-to-many. A single verb may occur in multiple argument structure constructions, and, of course, a single argument structure construction allows for many different verbs.

In the literature on argument structure, events are categorized into types of events, for example, application, covering, caused motion, emission and so on. The major theoretical goal of this project was to develop the analysis of causal structure to the same level of detail as the analysis of aspectual structure, in particular developing a semantic analysis of event types such as application, caused motion and so on. These event types are largely left unanalyzed in the semantic literature, in particular the component of the event called the verbal root (see section 1.2). Our basic approach is to distinguish different force transmission relations between participants, and different ways in which a participant undergoes a qualitative change in the course of the event.

Talmy (1976; Croft 1991, 166-68; Croft 2012, 199) identifies four basic types of transmission of force defining an asymmetric interaction between initiator and endpoint:

- physical causation: physical object → physical object: *The rock broke the*

window.

- volitional causation: volitional individual → physical object: *Johnny broke the window.*
- affective causation: physical object → sentient individual: *The dog frightened me.*
- inducive causation: volitional individual → sentient individual: *Sarah persuaded me.*

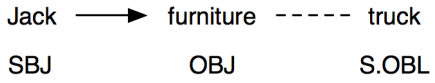
In addition, many interactions between participants in events are not causal, but spatial, possessive or even other types of relations (Croft, 1991):

(23) a. They hung pictures on the wall. [pictures (figure) → wall (ground)]
b. We gave apples to the boys. [apples (possessum) → boys (possessor)]

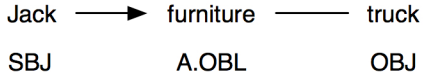
Causal, spatial and possessive segments of the causal chain (broadly interpreted) are the most common ones found in events. Across languages, there is a consistent pattern of construing the asymmetric relation between figure and ground and between possessum and possessor, as indicated in (23a-23b) (Croft 1991, 198-212, Croft 2012, 226-33. Some other relations do not have a consistent construal across languages; for example, the substitution relation construes the new item as initiator in English, but as endpoint in Japanese (Croft, 2012, 249-50).

Consider the representations of the force-dynamic image schema for examples (15a-15b) from section 1.4, repeated below:

(24) a. Jack loaded the furniture on the truck.



b. Jack loaded the truck with furniture.



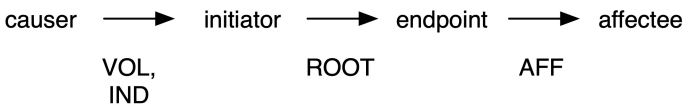
The sentences in (24a-24b) are examples of the application image schema. However, the representations in (24a-24b) are not specific to the application image schema. For example, the representation in (24a) could also be used for the caused-motion event *Jack pushed the furniture off the truck.*

The basic force-dynamic representation captures very general argument structure patterns, namely the expression of participants as subject, object and either antecedent or subsequent oblique—the cross-linguistic evidence supporting this analysis is documented in Croft (1991, 2012). The basic force-dynamic representation does not capture the distinction between application and caused motion. As such, it does not capture semantic distinctions that are relevant to linguistic

analysis as shown in the work of Levin and Rappaport Hovav, Goldberg, and others. What is desired is a force-dynamic analysis that is more specific than the highly general force-dynamic relation "X acts on Y", but not so specific that the analysis applies only to a particular verbal semantic class, and so is better thought of as an analysis of the verb meaning, not of a force-dynamic image schema. The remainder of this section presents such an analysis.

A schematic representation of the causal chains expressed by a typical verb is given in (25):

(25) Typical verbal causal chain:



The basic "core" of an event expressed by a verb is the verbal root. It may be intransitive or transitive; the transitive variant is shown in (38). An event may have an external causer distinct from the initiator of the root event. The force-dynamic relation between the external causer and the participant initiating the verbal root segment may be volitional or inducive. An event may also have another participant, an affectee that is affected experientially by the event, positively or negatively. These semantic role names are used for convenience; the roles are defined by their position relative to a force-dynamic relation such as VOL or AFF in the causal chain.

The different types of force-dynamic image schema that we wish to distinguish are basically different types of root events. Root events are generally left unanalyzed in verbal semantic analyses. A relatively comprehensive list of force-dynamic image schemas is given in (26):

(26) a. maintain, contact, contact by impact, exertion
b. application, removal, covering/filling, uncovering, combination, separation
c. directed motion, ballistic motion
d. change of state
e. creation, formation
f. location
g. emission, ingestion
h. transfer

The image schemas are divided into categories in (26) in the way that they will be analyzed here; examples of each type will be given below.

The first category, (26a), can be analyzed in terms of the force-dynamic distinction introduced in Talmy (1988). Talmy proposes a model of causation involving force applied by an Antagonist and resistance, successful or not, by an Agonist. In addition, there is an inherent tendency towards action or rest on the part of both Antagonist and Agonist. In the prototypical case, the Agonist has

Application	Removal
She smeared grease on the pipe.	*She wiped the dust off the table.*
Covering	Uncovering
He sprayed the wall with paint.	*I stripped the trees of bark.*
Combining	Separating
I stirred the milk into the soup.	*They were sifting rocks out of the soil.*

Table 2.1: Six force-dynamic image schemas.

a tendency towards rest, the Agonist has a tendency towards action, and the Antagonist successfully overcomes the Agonist, that is, the Antagonist causes the Agonist to undergo a change by a transmission of force. This is called "billiard ball causation" by Langacker.

The image schemas in (26a) represent different types of nonprototypical force dynamics. In the maintain schema (27a-27b), the Agonist has a tendency towards action, the Antagonist towards rest, and the Antagonist causes the Agonist to stay at rest:

(27) a. She [Antagonist] held the jewels [Agonist] in her hands.
b. They [Antagonist] restrained the protestors [Agonist].

In contact (197b), contact by impact (29) and force exertion (30), the Agonist has a tendency towards rest, the Antagonist has a tendency towards action, but the Agonist resists the Antagonist's force more or less successfully.

(28) He [Antagonist] tapped the windowpane [Agonist].

(29) The car [Antagonist] struck the tree [Agonist].

(30) They [Antagonist] pushed against the door [Agonist].

When the outcome is stasis, the clause can profile either the Antagonist applying force to the Agonist, as in (30), or the Agonist resisting the Antagonist, which is construed as a constrain event: *The door resisted them.*

The remaining force-dynamic image schemas in (26b-26g), are examples of prototypical billiard-ball causation, where the Antagonist successfully overcomes the Agonist and the Agonist undergoes a change. In other words, they all have the same force-dynamic relation between the two participants, the initiator and the endpoint. In order to distinguish them, we must turn to the types of change that are undergone by the participants themselves, i.e. the initiator and the endpoint in (25). We start with the most complex set of image schemas, those in (26b), because the distinctions among them allow us to factor out semantic distinctions that are verb-specific from the semantic distinction that applies to force-dynamic image schemas. The schemas in (26b) and examples for each are given in Table 2.1:

An obvious semantic contrast between the force-dynamic image schemas is that removal, uncovering and separating are reverses of application, covering and combining. That is, the former reverse the qualitative change described by the latter—although the reverse process is a rather different process (Cruse, 1986, 226). This distinction is primarily a feature of verb meaning.

If we look at all of the image schemas, we can see that they all describe two material entities that are in an essentially spatial interaction. The differences among particular verbs and spatial oblique prepositions has to do largely with the differences in the spatial relation between the material entities. These differences can best be described in terms of the IN-ON continuum described by Bowerman and Pederson (see Bowerman 1996, 156-60) and illustrated with the BowPed picture stimuli (see Levinson et al. 2003; Croft 2010).

But what all the image schemas have in common is that the process of change is MEREOLOGICALLY INCREMENTAL when it takes place over an interval of time. That is, the entity that is moved—the grammatical Object—moves piece by piece or part by part over time (the entities are often liquid or granular). This is one type of incremental theme as described by Dowty (1991). The force-dynamic image schemas in (26b) all involve a mereological (incremental) theme. The different spatial relations, and direct vs. reverse process, are characteristic of the verb meaning. The difference between application/removal and covering/uncovering is that the mereological change is associated with the spatial figure in the former (grease, dust) and with the spatial ground in the latter (wall, trees), according to Dowty (1991). Combining and separating represent a more symmetrical relation between the two material entities. We can thus unify the different types in (26b) as a single force-dynamic image schema involving mereological change to the relevant participant, which we will call the MEREOLOGICAL THEME following Dowty.

Most of the remaining force-dynamic image schemas correspond to different types of incremental themes described by Dowty. (Dowty actually reduces all of them to variations on a mereological incremental theme, but if they are kept separate, then the force-dynamic image schemas can all be distinguished. We will keep them separate for this reason.)

Directed motion (31) or ballistic motion (32) is motion of a whole entity on a path:

(31) The car screeched around the corner.

(32) She tapped the ball into the pocket.

Dowty describes the moving object as a holistic theme for this reason; the process is defined by incremental motion of the whole object on the spatial path. We call a participant undergoing this type of change a MOTION THEME.

Change of state is change in a property of the entity as a whole, such as size, age, color and so on. If the property is a scalar property, then the process can be incremental over time:

(33) The clothes dried in the sun.

(34) The pond froze solid.

Dowty did not distinguish this type of incremental change, but Hay et al. (1999) argue that it is a distinct type of incremental change from mereological change. We call a participant undergoing this type of change a PROPERTY THEME.

Dowty distinguishes one other type of theme, which he calls a 'representation-source theme', as in (35):

(35) Some student scanned my book!

We believe that this is an instance of a more general phenomenon of processes pertaining to an object's identity, usually in some sort of creation process: either creation proper as in (36), formation as in (37) (creation constructed out of other entities which are construed as a "participant" in the event), or replication as in (35) above (creation based on the structure of a source):

(36) She baked a cheesecake.

(37) She built a shelter out of dead tree branches.

We call a participant undergoing this type of change a DESIGN THEME.

All of the themes described above involve some sort of incremental change that leads to a new state for the theme. There are many events, however, that involve some sort of internal change that is undirected, as in (38) and (39):

(38) a. The flag fluttered.
b. Jerome glowered.

(39) a. The flag fluttered over the fort.
b. Jerome glowered in the corner of the room.

An internal process is often used to express a static location (not motion), as in (39a-39b). Levin calls these "modes of existence". We will describe the events in (38a-38b) and (39a-39b) as instances of the EXISTENCE force-dynamic image schema. If location is asserted without an internal process as in (40), we also describe the image schema as an EXISTENCE schema.

(40) The boxes are in the garage.

However, we will distinguish the theme type depending on whether there is an internal change happening to the theme or not. If there is an internal change, we will call the theme an INTERNAL THEME. If there is no internal change—that is, no change to the participant whatsoever as a participant in the event—we will describe the participant as an EXISTENCE THEME.

There is an unusual alternative argument structure construction in English for events of internal change with a location theme that reverses the expression of figure and ground in location:

(41) a. Bees are swarming in the garden.
b. The garden is swarming with bees.

Dowty (2000, 2001) describes the force-dynamic image schema in (41b) as DYNAMIC TEXTURE: the ground is construed as having a "texture" that is changing, due of course to the activity of the figure.

Table 2.2 summarizes the types of change undergone by the participant that distinguishes force-dynamic image schemas, and Table 2.3 summarizes how the different types of event fit into the semantic analysis of force-dynamic image schemas:

Type of change	**Definition**	**Example**
Property	change in a (typically scalar) property of an entity	*The clothes dried/ He dried the clothes*
Motion	change in location of a figure relative to a ground	*They ran into the house.*
Mereology	change "part by part" of a figure's location relative to a ground	*We spread sand over the pavement.*
Design	change in the identity of an entity	*They build a shelter out of mud.*
Existence	internal change/mode of existence of an entity, sometimes relative to a ground	*A flag fluttered (over the fort).*

Table 2.2: Types of qualitative change to the theme participant in an event.

Theme Type	***Direct***	***Reverse***
Property	Change of State (COS)	
Path	Motion	
Mereology (figure)	Apply	Remove
(ground)	Cover	Uncover
Design	Create	
	Form	
Existence	Internal	
Location (figure)	Location	
(ground)	Dynamic Texture	

Table 2.3: Force dynamics in the root causal segment.

The analysis of the root causal segment in this section does not include the force-dynamic image schemas of emission, ingestion or transfer in (26g-26h). Emission and ingestion are more complex events, involving two image schemas.

In emission, the emitter creates the emission, and the emission moves away from the emitter. In ingestion (primarily eating and drinking), the ingester moves the ingested entity away from its location (cup, plate, etc.) towards themselves and then causes a change of state of the ingested entity (i.e., consumes it). The analysis of ingestion will be discussed in sections 2.2.2-2.2.3, and transfer in Chapter 6.

2.2 Constructional causal chains and verbal networks

2.2.1 Introduction

Our representation of event structure is derived from the semantics of argument structure constructions and verb meaning. It's a two-tier representation which explicitly distinguishes verb meaning from the meaning that is contributed by the argument structure construction. Constructional semantics is depicted as a 'causal chain' (discussed in section 2.2.2) and verbal semantics is depicted as a 'verbal network' (discussed in section 2.2.3). The two types of representations use the same inventory of force-dynamic image schemas and participant subevent labels, which allows for a direct mapping between causal chains and verbal networks (see section 2.2.4).

2.2.2 Representing constructional semantics as causal chains

Constructional semantics is represented by causal chains. Causal chains consist of one or more force-dynamic relations concatenated to each other. An example of a constructional representation is shown in Figure 2.1. The causal chain represents the semantics of an example *Pat kicked the football into the stadium.* Pat, a volitionally acting agent, is assigned the label "VOL", which is used when a volitional entity uses physical FORCE. Pat exerts FORCE on the football by kicking it and, as a result of the action, the football, a figure entity, moves with respect to the stadium, a ground entity. The football is identified as a Motion "MOT" theme in the event structure. The event describes a path of motion in which the theme moves holistically along a trajectory (Dowty's 1991 "holistic theme"). The stadium doesn't undergo any change and is therefore an existence theme.

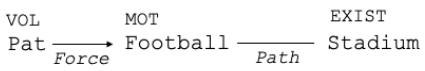


Figure 2.1: A causal chain representation for *Pat kicked the football into the stadium.*

Each segment of a causal chain corresponds to a force-dynamic image schema.

A force-dynamic image schema is a semantic 'primitive' in that it describes the smallest part of the causal chain that is expressible by a main verb in an argument structure construction. For example, in Figure 2.1 the segment of the causal chain that describes a FORCE relation between the Agent and the Theme can be expressed by a Force verb such as *hit*, as in *He hit the table*. The image schema in the second segment of the causal chain describes a Motion event between a figure and a ground. A Motion image schema can be expressed by a Motion verb such as *fly*, as in *The football flew into the stadium*.

Constructional causal chains are directed, acyclic, and nonbranching. Evidence shows that events lexicalized by simple verbs are construed as directed and acyclic, whether the interactions between participants in the real world may be bidirectional or cyclic (e.g., reciprocal) (Croft, 2012, 220). As Croft (2012, 222) notes, the directed and acyclic construal follows from the notion of "transmission of force [which] is asymmetric: one participant applies force to another participant." The causal chain is nonbranching: a participant cannot be construed as an initiator of more than one causal relation at a time.

The causal chain representation of the constructional semantics provides an incomplete analysis of an event structure on its own. A verb may occur in various semantically distinct argument structure constructions and some construals may be semantically quite different from the verb meaning. Using constructional semantics to represent the event structure associated with such examples provides a limited understanding of the event structure as it doesn't take into account the contribution of verb meaning. For example, the causal chain for a double object "Transfer" argument structure construction with a ballistic motion verb *kick* (e.g., *Pat kicked Bob the football*), uses social domain force-dynamic relations, as shown in Figure 2.2. The causal chain describes an event in which Pat causes Bob to have control over the football. However, the causal chain representation does not supply important information about how the transfer event happened, i.e., that the transfer event resulted from a forceful contact between the agent and the theme. This additional layer of information about the event structure must be obtained from a verbal semantic representation.

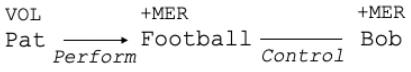


Figure 2.2: A causal chain representation for *Pat kicked Bob the football*.

Additionally, a causal chain associated with constructional semantics may give a simplified description of the event structure. Certain types of verbs, such as verbs of ingestion, require a more detailed event structure representation. The relations between participants in ingestion events are more complicated than what is depicted in the causal chain. For instance, a constructional causal chain associated with an ingestion example *Jill ate the chicken with chopsticks* gives an incomplete representation of the event structure. As shown in Figure 2.3, the argument structure construction describes a change of state event in which

the Agent, 'Jill', eats the Patient, 'the chicken'. The utensil 'the chopsticks' is syntactically realized as an instrumental *with*-phrase and is therefore analyzed as an Instrument participant in the causal chain. However, the semantic role of the chopsticks in the event is different from that of a more prototypical Instrument participant, such as a hammer, in a breaking event (e.g., *Tony broke the window with a hammer*). Unlike the hammer which breaks the window, the chopsticks do not eat the chicken. The hammer directly causes the breaking of the window; however, the chopsticks cause the eating of the chicken only indirectly. The Agent causes the consumption of the chicken, and the chopsticks are used to facilitate the event by moving the food to the Agent's mouth.

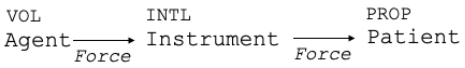


Figure 2.3: A causal chain associated with a Change of State example (e.g., *Jill ate the chicken with chopsticks* or *Tony broke the window with a hammer*).

The distinct semantic roles of the two instruments are reflected in their use in argument structure constructions. The hammer can be expressed as a subject with the verb break in the absence of an agent (e.g., *The hammer broke the window*). However, a utensil cannot be a subject in argument structure constructions with ingestion verbs (**The chopsticks ate the chicken*). The causal chain for the change of state [SBJ V OBJ *with*-OBL] argument structure construction does not capture this fine-grained semantic difference between the two Instrument roles. Supplementing constructional causal chains with verbal semantic representations provides a richer model of event structure.

2.2.3 Representing verbal semantics as networks

Our verbal semantic representation uses a network model. Verbal networks consist of participants, force-dynamic relations between participants, and participants' subevents, not unlike causal chains. However, many verbal networks include richer information about the event structure that is not necessarily evoked by argument structure constructions. Verbal networks are directed and non-branching but may be cyclic, as shown in Figure 2.4.

The verbal network evoked by Ingestion verbs in Figure 2.4 is cyclic: the Agent uses an Instrument to move the Patient entity into their mouth. This part of the event structure is depicted by a FORCE relation between the Agent and the Instrument and a FORCE relation between the Instrument and the Patient. We use FORCE to describe an asymmetrical causal relation between two entities in the physical domain. The FORCE relation subsumes events of manipulation or handling of an instrument, events in which one entity comes into physical contact with another entity, or other contact by impact events. It is also used to describe the force-dynamic relation between an external initiator of an event (e.g., an Agent) and the theme. The PATH relation between the Patient and the Agent

represents the motion of the Patient to the Agent's mouth. When the Patient is moving towards the Agent, it is also moving away from its original location (Source_loc), such as a dish or a table. The simultaneity of the movement towards the Agent and away from the Source location is represented by a box notation around the two participants and a single PATH relation between them and the Patient. The Agent's consuming the Patient is depicted by a FORCE relation between the two participants.

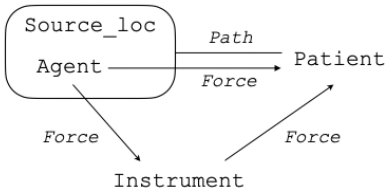


Figure 2.4: Ingestion network.

The verbal network represents a richer event structure in which there is a direct causal relation between the Agent and the Patient. It clearly shows that the role of the Instrument is to facilitate the ingestion event rather than directly cause the consumption of the food, as could one incorrectly infer from the constructional causal chain in Figure 2.3. As such, a verbal network representation supplies additional information about the event structure represented by constructional causal chains.

The cyclicity of relations in complex networks can lead to a representation that is not easily interpretable. The direction and ordering of causal relations between participants in such networks is more clearly represented when the event structure is depicted in a linear fashion, similarly to causal chains. We "unthread" complex verbal networks into acyclic causal chain representations to better display the sequence of causal relations. The unthreaded version also specifies the subevent labels for each participant based on the causal relation that they are engaged in. As shown in Figure 2.5, the unthreaded version of the Ingestion network includes the Agent and Patient twice since they are involved in more than one relation in the event. A detailed description of the semantics of ingestion events can be found in Chapter 4.

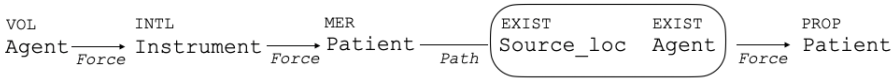


Figure 2.5: Unthreaded version of the Ingestion network.

Verbal networks include participants that are obligatorily evoked by verbal semantics. To determine network participants, we consult FrameNet's (Fillmore et al., 2003) and VerbNet's (Kipper et al., 2007) analysis of event participants

(i.e., Roles in VerbNet and Core Frame Elements in FrameNet). The labels for event participants in verbal networks are chosen based on the participant's role in the event structure (not unlike Frame Elements in FrameNet); they are not meant to be interpreted as semantic role labels.

Our representation of verbal semantics may include additional participants, particularly when the presence of a participant in the event structure introduces cyclicity to the network or when including the participant in a network helps explain the role of that participant in an argument structure construction. Beside the obligatorily evoked participants, i.e., an Agent and a Patient, the Ingestion network also includes an Instrument and a Source_loc. The Instrument is included in the network because it shows the distinct role that the Instrument has in ingestion events when compared to the more prototypical Instrument with other Change of State verbs.

We also include a Source_loc as a participant in the network because it helps clarify its role in the event structure when it is expressed as a subsequent oblique in an argument structure construction (e.g., *He ate crumbs off of the table*). The network representation explains the role of the Source_loc in the event and why it is possible to construe eating as a removal event in which food undergoes motion when it is removed from a dish. The constructional semantics of this example and its mapping to the network is discussed in more detail in section 2.2.4.

2.2.3.1 Event types and verbal network overlaps

Verbal networks consist of a "core segment" which corresponds to a particular 'event type.' The core segment determines what type of event the verb describes on a more schematic level. For instance, the Ingestion network describes a "Change of State" event type because its core segment consists of a Property theme. In other networks, the core segment may consist of two participants and the force-dynamic relation between them. For example, Motion networks share a core segment which consists of two participants: a figure and a ground. The relation between the participants is defined as PATH. Verbal networks are grouped into event types based on their shared core segments. Networks in event types are closely related, i.e., their event structures overlap to various extents.

For example, we have identified eight major verb types in the physical domain: Change of State, Creation, Motion, Mereological, Location, Force, Internal, and Manipulate. Each verb type is associated with a specific theme type (e.g., Change of State verbs are associated with a Property theme, Creation verbs are associated with a Design theme, etc.) and are discussed in more detail in Chapter 4. The analysis of verbs in the social domain distinguishes similar event types.

Participants in overlapping networks are given the same labels, as long as they have the same roles in their respective event structures. For example, the Property theme in Change of State event types is labeled "Patient." When the verbal semantics evokes a human initiator, the participant is labeled "Agent."

In all other cases, the initiator of the event structure is labeled "Physical_entity" to allow either for a volitional or non-volitional initiator.

Figure 2.6 shows an example of two overlapping networks that belong to the Change of State verb type: Ingestion (a) and Feeding (b). The force-dynamic relations between participants in these networks are identical. The difference between them lies in the identity of the Agent. In the Ingestion network, the Agent is the Eater, hence there is not a separate "Eater" participant with Ingestion verbs. With Feeding verbs, the Agent and the Eater are represented as two distinct participants in the network.

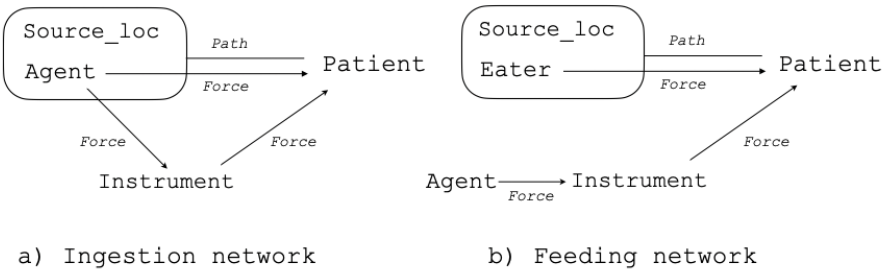


Figure 2.6: Ingestion and Feeding networks.

We discuss each verb type and the networks associated with it separately in this report. The majority of verbal networks describe acyclic non-branching event structures. Networks that describe cyclic structures in the physical domain include Vehicular Motion verbs (e.g., *drive, ride,* etc.), Search verbs (e.g., *look for* or *hunt*) or Emission verbs (e.g., *flash* or *gush*). Mental domain networks that describe cyclic event structure include Perception verbs (e.g., *look, watch*, or *listen*). Physical events are discussed in Chapter 4 and mental events are discussed in Chapter 5.

2.2.4 Mapping causal chains to verbal networks

A comprehensive representation of an event structure associated with verbal semantics in an argument structure construction includes a mapping between a causal chain and a verbal network. Argument structure constructions may evoke only part of the verbal network; i.e., causal chains may evoke only a subset of participants and relations represented in the network. In many cases, there is a considerable overlap in the two types of representations, i.e., there is a one-to-one mapping between the causal chain and the network. Commonly, this is the case when the syntactic construal matches the semantics of the verb (e.g., when a Force verb occurs in a force construal) or when the verbal event structure is not represented by a complex network. However, the mapping between the two representations becomes more complicated when the syntactic construal doesn't match the semantics of the verb, such as the use of a Force verb in a

motion construal (e.g., *Pat kicked the football into the stadium*), or the causal chain is mapped into a complex network that contains additional participant relations that are not expressible in argument structure constructions, such as the Ingestion network.

Figure 2.7 demonstrates a mapping between the causal chain associated with the ingestion example *Jill ate the chicken with chopsticks* and the unthreaded Ingestion network. Participants in the causal chain are mapped to participants in the network by their subevents and the relations that they are engaged in. For example, Jill in the causal chain is mapped to the first occurrence of the Agent in the network because she acts volitionally in the constructional semantics. Chopsticks maps to the Instrument participant because they are both identified as undergoing Internal ("INTL") subevents. The chicken is linked to the second occurrence of the Patient in the network. This linking is motivated by the construal of the food as a Property theme in the causal chain and the corresponding role of the food as a Property theme at the end of the verbal network.

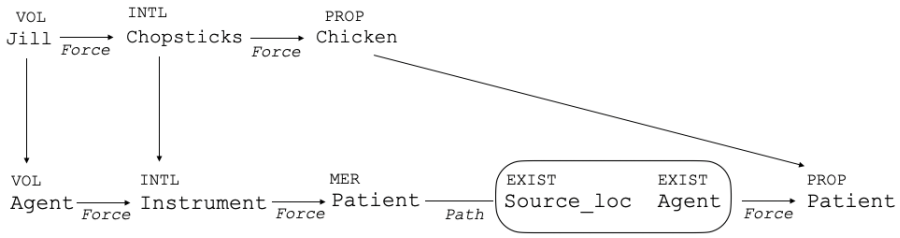


Figure 2.7: Mapping of a Change of State causal chain to the Ingestion network.

The sequence of causal relations in the causal chain and in the network must follow the same order. The dotted arrows that link participants in the causal chain to the participants in the network are not to cross each other. For example, when an Ingestion verb occurs in a Remove construal in which the Source_loc is syntactically expressed (*He ate crumbs off the table*), the food maps to the first occurrence of the Patient in the network, as shown in Figure 2.8. The food is construed as a mereological theme when the Source_location is part of the causal chain. The constructional semantics focuses on the removal of the food from a location. Consequently, the crumbs in the causal chain maps to the Patient that is labeled mereological ("MER") in the network. Mapping the food to the Property theme in the network would not be semantically compatible with its role in the event. Additionally, it would violate the rule that causal segments in both types of representations must follow the same order and would result in arrows crossing each other.

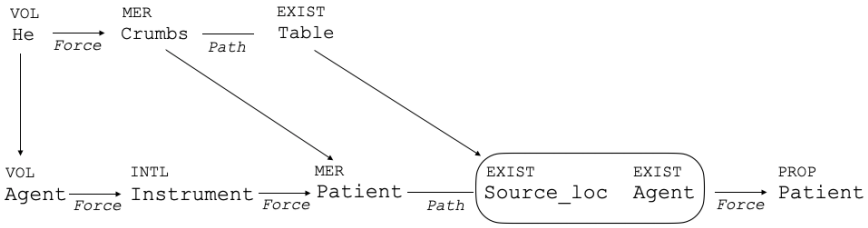


Figure 2.8: Mapping of a Remove causal chain to the Ingestion network.

2.2.5 Representing construals

A two-tier representation of event structure provides a more comprehensive representation of verbal semantics for examples in which a verb is used in different construals. For example, in *Pat kicked the football into the stadium* a Force verb *kick* occurs in a ballistic motion argument structure construction. A constructional representation distinguishes this construal from the prototypical force argument structure construction by identifying the football as a Motion theme. However, it does not reveal that the verb itself describes a force event, rather than a motion event. This additional layer of information about the event structure comes from the verbal representation.

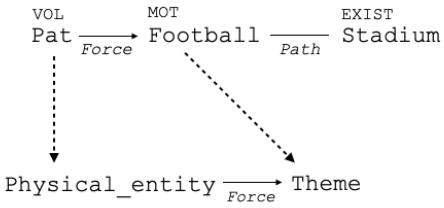


Figure 2.9: An event structure representation for a Force verb in a Motion construal.

As demonstrated in Figure 2.9, the first segment of the causative motion argument structure construction *Pat kicked the football into the stadium* describes a force event in which the initiator Pat makes forceful contact with the football. The result of the force event is the motion of the theme towards a destination. *Kick* is compatible with the motion construal because the core segment in the network matches the first segment of the causal chain. In both representations, there is a FORCE relation between two entities. Pat maps to the Physical_entity in the Force network. The subevent of the Physical_entity in the network is unspecified to accommodate different types of initiators, including entities that are not volitional. The football maps to the Theme participant in the network. The subevent of the Theme participant in the network is also unspecified. The

endpoint of FORCE may or may not undergo a change in the event. Considering that this information is determined either syntactically or contextually, we do not define the subevent of the Theme in the verbal network.

This example shows another important advantage of having a separate representation for constructional and verbal semantics. The two-tier representation clearly shows the separate contribution of the verbal and constructional semantics to the event structure. This is also particularly crucial for representing events in which a verb is used in a metaphorical argument structure construction that originates with verbs in a different domain.

2.2.5.1 Representing metaphorical construals

The metaphorical use of argument structure constructions with verbs in different domains is quite common in English and cross-linguistically. For example, English possession verbs such as *give, take, supply* or *rob* use physical domain argument structure constructions associated with *place* verbs (42a), *remove* verbs (43a), *cover* verbs (44a), or *uncover* verbs (45a). Communication verbs such as *tell* or *call* use the *place* (42c) and *cover* (44c) argument structure constructions.

(42) a. Linda taped the picture to the wall.
b. Jerry loaned his skateboard to his brother.
c. I told a bedtime story to his son.

(43) a. Doug removed the smudges from the table.
b. He stole money from me.

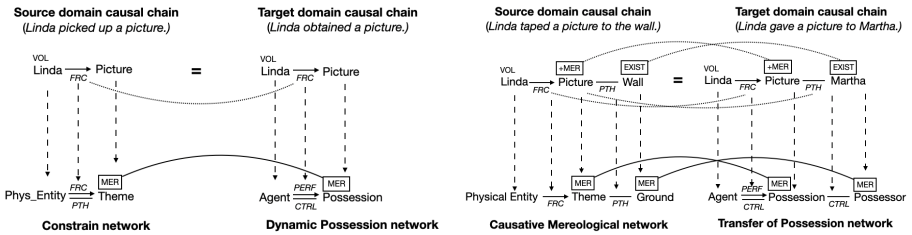
(44) a. Leslie covered the bed with blankets.
b. The Russians supplied Syrians with firearms.
c. She called me with the information.

(45) a. Doug cleaned the table of dishes.
b. She robbed him of his wallet.

The event structure representation for events in which an argument structure construction is used metaphorically with a verb from a different domain (or "constructional metaphor") contains more information compared to the representation in Figure 2.9. The event structure of constructional metaphors requires a mapping between the 'source' domain, in which the semantics of the argument structure originates, and the 'target' domain, to which the argument structure is extended. In the above examples, the 'source' domain is the physical domain and the 'target' domain is the social possession domain.

The mapping between the verbal networks in the 'source' and 'target' domains shows a set of semantic correspondences that motivate the metaphorical extension of the argument structure construction. For example, in Figure 2.10, the theme in both verbal networks is identified as "MER." A structural overlap between the physical and social domain networks does not immediately yield

a metaphorical analysis but it shows that verbs in distinct domains share abstract semantic features in their representations. Common semantic features frequently motivate the use of constructional metaphors.



(a) Metaphorical Constrain Mapping (b) Metaphorical Place Mapping

Figure 2.10: Metaphorical Mapping Representations

Figure 2.10 shows the semantic motivations for metaphorical mappings observed with possession verbs. The mappings show the source and target domain verbal networks, the correspondences between them, and the constructional causal chains that are metaphorically extended to the target domain.

A metaphorical mapping of the Constrain causal chain onto the Dynamic Possession network is shown in Figure 2.10a. The Constrain metaphor is frequently used to describe events with Possession verbs which prototypically occur in the transitive argument structure construction. As shown in Figure 2.10a, the participants in the Constrain network and the Possession network undergo the same type of internal change. The correspondences between the two semantic domains are sufficient to motivate a metaphorical mapping in which the transitive Constrain argument structure construction is extended to Possession verbs.

Figure 2.10b demonstrates that the Application and Transfer verbal networks also share semantic features in their representations. The participants undergo the same type of internal change over the course of these semantically distinct events. Both networks consist of an initiator which is external to the non-causal relation between participants.

As shown in Figure 2.10, social domain force-dynamic relations are metaphorically construed as physical relations. In particular, the social PERFORM relation maps to the source domain physical FORCE relation and the social CONTROL relation maps onto the physical PATH relation. The mapping between force-dynamic relations across domains in metaphorical construals is not random: the causal and non-causal relations in the target domain map to the causal and non-causal relations in the source domain, respectively. Additional motivations for linking relations across domains may exist. For example, the CONTROL relation is frequently associated with a physical co-location relation between the Possession and the Possessor, which further motivates the metaphorical mapping to physical PATH.

The mapping between the source and target domain causal chains and net-

works provides a structured representation of the event structure and the semantic motivations that lead to constructional metaphors. When we discuss metaphorical construals with physical and social domain verbs in Chapters 6, we do not include such a detailed representation as shown in Figure 2.10. We only include the mapping of the source domain causal chain to the target domain verbal network. The semantic motivations for the metaphor are explained in prose of the text.

Chapter 3

Event Nominals: Events as Arguments (Meagan Vigus and William Croft)

In mental events (perception, cognition, emotion, and desire/intention) and social events (involving interpersonal interactions), we find that events (states of affairs) and propositions function as semantic arguments of the main predicate. Events/propositions as arguments are realized in English and other languages as event nominals (also called action nominals) and as complements, including infinitival complements.

Event arguments are not generally discussed in analyses of argument realization.[1] However, the model of event structure presented in section 1.4 offers a natural extension of argument realization rules to event arguments. We propose three hypotheses regarding the argument realization of event nominals:

(I) Event nominals express participant subevents

(II) Event nominals follow the same argument realization rules as ordinary nominals, in terms of realization as subject, object, antecedent oblique or subsequent oblique

(III) If both a participant and its subevent are realized as distinct arguments of a predicate, then the subevent, expressed as an event nominal, is construed as subsequent to its participant

Our basic hypothesis (I) is that event arguments correspond to participant subevents. The second hypothesis (II) is that event nominals and complements,

[1] Grimshaw (1990) does discuss event nominals in terms of argument realization, arguing for a distinction between *process* nominals that have argument structure and *result* nominals that do not. We have found, however, that the distinction between process and result nominals does not appear to be relevant to the realization of participants and their subevents with antecedent or subsequent obliques.

to the extent that the latter allow oblique adpositions or case marking, should behave with respect to the argument realization rules just like the participants whose subevents they correspond to. The second hypothesis relies on the veracity of the first: event nominals must correspond to participant subevents in order to be able to ascertain whether they follow the same argument realization rules as participants. The converse, however, is not true: event nominals may express participant subevents, but not follow the same argument realization rules. Our final hypothesis (III) is that a subevent is construed as subsequent to its associated participant.

The first and second hypotheses fall out from the event semantic representation presented in section 1.4: if force dynamic relations exist not between participants, but between participant/subevent pairs, it follows that either a participant or its subevent may be expressed in a particular context.[2] Furthermore, the participant and its subevent should follow the same argument realization rules. That is, whether the participant or the subevent is directly expressed in a sentence, it refers to both the participant and its subevent; therefore, the same argument realization rules are expected to apply.

In this section, we test these hypotheses against verbs in the verb classes in VerbNet (Kipper-Schuler, 2005; Palmer et al., 2017), an online resource of verbal semantic classes and the argument structure constructions that realize them, that take event arguments. We were able to analyze 192 examples sentences from VerbNet that take event arguments.

We focus here primarily on event nominals. Event nominals are defined in the typological literature as forms derived from verbs that denote events and allow for a broad, if not full, range of case marking (case inflections or adpositions) (Comrie, 1976; Koptjevskaja-Tamm, 1993). This definition of event nominals includes English gerunds, which take a range of prepositions. We take a morphologically broader view of event nominals: any nominal referring to an event, regardless of whether it is derived from a verb (e.g., *incident*). The identification of a nominal as an event nominal is not based solely on the lexical item, but the context as well. Example (46) below illustrates how the same lexical item may or may not be interpreted as an event nominal.

(46) a. One student spilled coffee on their **exam**.
b. It took the students 3 hours to finish the **exam**.

In (46a), the context makes it clear that *exam* refers to a physical object; therefore we would not consider this an event nominal. In (46b), *exam* is described by its duration and therefore clearly refers to an event; we would consider this an event nominal.

The following sections explain and illustrate the three hypotheses, and later sections discuss more difficult cases.

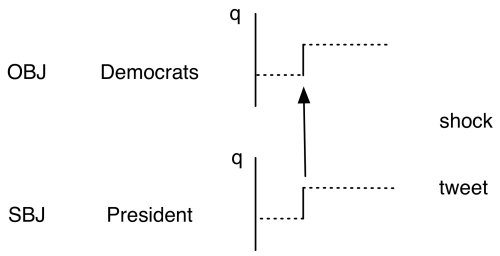
[2]We do not put forth any generalizations about *when*, or under which circumstances, an event nominal corresponding to a participant's subevent may be expressed instead of a nominal referring to the participant. As mentioned above, it appears that event nominals tend to occur more often as arguments of mental or social predicates, however an in-depth study would be necessary in order to propose more solid generalizations.

3.1 Event nominals as participant subevents

The first hypothesis is that event nominals express the subevent of a participant in the clause. As described above, each participant is associated with a subevent that represents the qualitative phases of that participant during the event in the main clause. Examples (47) and (48) below illustrate this hypothesis. Both the event nominal and its associated participant are in bold.

(47) a. The **clown** amused the children.
b. The **clown's antics** amused the children. (VerbNet)

(48) a. The **President** shocked the Democrats.
b. The **President's tweets** shocked the Democrats.
c. The **tweets** shocked the Democrats.



Examples (47) and (48) demonstrate how event nominals, like *antics* or *tweets*, are used to refer to the subevent associated with a participant in the sentence. That is, *antics* refers to the clown's subevent and *tweets* refers to the President's subevent, as can be seen in the representation. In cases like (47) or (48), the construction allows for either the participant or its subevent to be expressed as an argument, without a drastic change in meaning. Whether the participant or the subevent is expressed, essentially, they both refer to the combination of participant and subevent, i.e. the bottom portion of the causal-aspectual representation.

There are examples in VerbNet in which event nominals are not the subevent of an expressed participant in the clause.

(49) The enemy soldiers submitted to **demands**. (VerbNet)

In (49), the initiator of the event nominal *demands* is not expressed in the clause. However, it is likely that the identity of the demanders would be present in the discourse context. This would be an example of null anaphora, or Definite Null Instantiation, following the theory of null instantiation in construction grammar (Fillmore, 1986; Lambrecht and Lemoine, 2005; Lyngfelt, 2012). The null-instantiated, i.e. unexpressed, participant is definite, or known, in the context. The same is probably true of example (50).

(50) I interrogated him about **the incident**. (VerbNet)

There are other examples in VerbNet where it is not clear that the participant associated with the subevent would be known in the discourse context. These can be seen below in examples (51)-(53).

(51) I learned about **the drinking**. (VerbNet)

(52) They tolerate **smoking**. (VerbNet)

(53) **Success** requires **hard work**. (VerbNet)

In example (51), the participant associated with the *drinking* subevent, the drinker(s), may or may not be known in the discourse context. That is, (51) may be uttered in either of the two contexts shown below:

(54) How is John doing? I learned about **the(/his) drinking**.

(55) I found someone's empty bottles in the break room; that's how I learned about **the drinking**.

In (59), the drinker is mentioned in the discourse context and therefore *the drinking* is easily replaced with a definite pronoun, *his drinking*. In (55), the participant associated with *drinking* corresponds to the indefinite pronoun *someone* and therefore is not known in the discourse context. This represents what is called free null instantiation (FNI) of the identity of the drinkers; the identity of the null-instantiated participant may or may not be available in the discourse context.[3] Finally, examples (52) and (53) are more general statements and they represent examples of what Lyngfelt calls generic null instantiation (GNI). That is, the null-instantiated participant corresponds to a generic "people".

There are certain types of events which tend to have event nominals as arguments with null instantiated participants, such as communication events, shown in examples (56)-(58).

(56) John discussed **his own presentation**.

(57) John discussed **Bill's presentation**.

(58) John discussed **the presentation**.

In communication events, the topic or subject matter is often expressed by an event nominal, such as *presentation*. In some cases, the participant whose subevent is expressed by the topic event nominal may also be the speaker in the communication event, as in (56). However, this is not necessarily the case: in (57), the event nominal *presentation* corresponds to Bill's subevent; Bill may or may not be a participant in the communication event. Often, the participant whose subevent is expressed by the event nominal is null instantiated, as in (58); this appears to be a case of FNI.

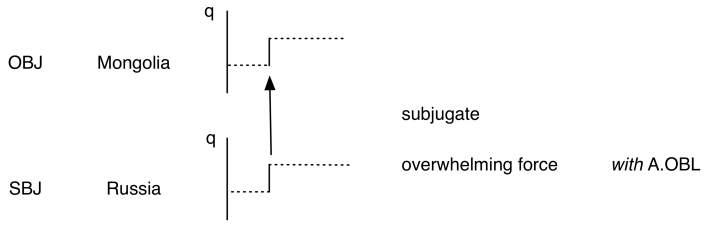
[3]This example also shows indefinite null instantiation (INI) of what is drunk, conventionally interpreted as an alcoholic drink.

3.2 Event nominals and the argument realization rules

The second hypothesis predicts that subevents follow the same argument realization rules as their participants. That is, subevents are ordered in the causal chain along with their participants. Other participants (and subevents) in the causal chain are ordered with respect to subevents in the same way as they are with participants. This can be seen in examples (59) and (60) below.

(59) **John** confronted it with **emergency measures**. (VerbNet)

(60) **Russia** subjugated Mongolia with **overwhelming force**. (VerbNet)

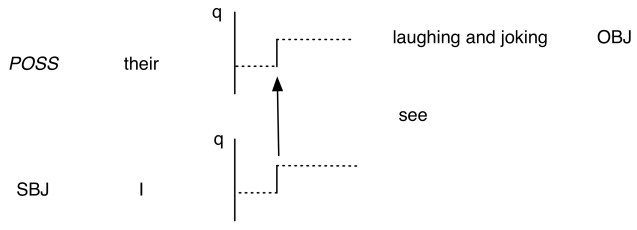


In (59) and (60), the initiators of the causal chains, *John* and *Russia*, are realized as subject and the endpoints of the causal chain, *it* and *Mongolia*, as object. As can be seen in the representation in (60), the event nominal represents a subevent associated with the initiator of the causal chain. Therefore, the event nominals, *emergency measures* and *overwhelming force*, are expressed by the antecedent oblique (*with*). Since the event nominal represents the subevent of the initiator, it follows the argument realization rules in that it is realized as antecedent to the object in the causal chain.

In examples (61) and (62) below, the event nominal expresses the subevent associated with the endpoint of the causal chain (as opposed to the initiator in 59 and 60).

(61) I needed **his cooking**. (VerbNet)

(62) I saw **their laughing and joking**. (VerbNet)



In examples (61) and (62), the initiators of the causal chains, both *I*, are realized as subject and the endpoints, *their* and *his*, as possessors of the event argument. The event arguments, *laughing and joking* and *cooking*, are realized

as object. Since the event argument is associated with the participant at the endpoint of the causal chain, it is realized as object, subsequent to the initiator of the causal chain realized as subject.

In 192 VerbNet examples, there is no exception to the generalization that event arguments follow the same argument realization rules as ordinary nominals. Event arguments correspond to participant subevents, and are construed to occur at the same position in the causal chain as the participant whose subevent they express, relative to other participants/subevents. That is, subevents associated with the initiator of the causal chain will be construed as antecedent to the endpoint of the causal (and its subevents). Subevents associated with the endpoint of the causal chain will be construed as subsequent to the subject (and its subevents). If both a participant and its subevent are expressed in a single clause, then the subevent will be construed as subsequent to the participant.

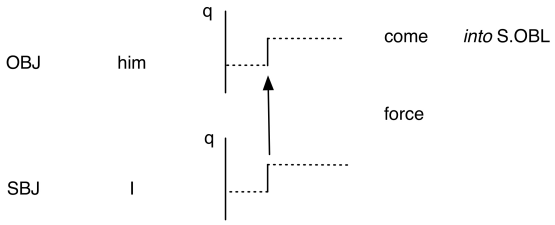
3.3 Participants and their subevents both expressed as arguments

In many VerbNet examples, both the participant and the participant's subevent are realized as arguments of the main predicate, as in (63)-(65) below.

(63) **He** managed **the climb**. (VerbNet)

(64) **I** tried **exercising**. (VerbNet)

(65) I forced **him** into **coming**. (VerbNet)



Since both the participant and the participant's subevent are arguments, one can ask if there is a regular construal of the two participants with respect to argument realization. The third hypothesis predicts that event arguments are realized as subsequent to the participant whose subevent they express. That is, a participant's subevent is construed as subsequent to the participant itself.

In examples (63) and (64) above, the participants, *he* and *I*, are realized as subject and their subevents, *climb* and *exercising*, as object. In example (65), *he* is realized as the direct object and the event he is engaged in, *coming*, is expressed as a subsequent oblique, *into*. In (66) and (67) below, the subevents, *task* and *waking up*, are realized with a subsequent oblique, *on* and *to*, and the participants, *they* are *he*, are realized as subject. Lastly, in (68), the subevent,

hard work, is realized as the object, with the participant, *us*, realized with the antecedent oblique *from*. These examples show the different ways that the construal of participant as antecedent to subevent (or, subevent as subsequent to participant) can be grammatically realized.

(66) **They** worked on **the task**. (VerbNet)

(67) **He** adapted to **waking up early**. (VerbNet)

(68) Success requires **hard work** from **us**. (VerbNet)

It is also possible that, grammatically, the relative position of the subevent and its participant is indeterminate. This occurs when the participant is realized as subject, with the event nominal/subevent as an antecedent oblique, as in (69) below.

(69) **He** managed with **dealing** the cards. (VerbNet)

Antecedent obliques are only ordered with respect to the object, and not the subject, and therefore these types of examples are also compatible with the construal of subevent as subsequent to its participant. This is similiar to the comitative use of *with* as in *Johan wrote the paper with Carla*, in which Carla is co-located in the causal chain with Johan.

We describe the relation between a participant and its subevent, when both are expressed as arguments, as an Engage relation. It is not really a force dynamic relation, which exists only between subevents. It expresses a different kind of semantic relation, but it is integrated into the pattern by which participants/subevents are realized grammatically in argument structure.

Of the 192 VerbNet examples analyzed, 13 appear problematic for the third hypothesis. That is, it is not clear that the participant is realized as antecedent to its subevent. These problematic cases fall into two types.

The first type involves event nominals realized with obliques that may be antecedent in other types of constructions, as in (70) and (71).

(70) I suspected **him** of **lying**. (VerbNet)

(71) I helped **him** with **homework**. (VerbNet)

In both of these examples, the participant associated with the event nominal, *him* in both examples, is realized as object. The event nominals are realized with *of* and *with*, respectively. If *of* and *with* are considered antecedent obliques, then these constructions would construe the subevent as antecedent to its participant. Although there are constructions in which *of* or *with* may be considered antecedent obliques, there are also constructions in which they are not. Both *of* and *with* may be used to co-locate an argument in the causal chain. This can be seen with *of* in partitive constructions (*bowl of soup*) and with *with* in associative constructions (*She ordered spaghetti with mushrooms*). Thus, *of* and *with* may be analyzed as co-locating the participant with its subevent, and therefore not a direct violation of the third hypothesis.

The other type of problem case concerns a particular type of causation. This can be seen below in examples (72)-(74).

(72) The rules forbid **us** from **smoking**. (VerbNet)

(73) They excluded **us** from **going** to the party. (VerbNet)

(74) **He** withdrew from **the trip**. (VerbNet)

In both (72) and (73), the participant is realized as object and its subevent with the preposition *from*. Thus, the subevent/event nominal appears to be construed as antecedent to the participant. This construal is based on the event expressed by the main predicate, namely that it is preventing the participant from taking part in the subevent expressed by the event nominal. Example (74) also expresses that the participant will not be taking part in the subevent expressed by the event nominal, *the trip*. We propose that there is a distinct relationship expressed in examples (72)-(74): the participant is NOT engaged in the expressed subevent. We call this relationship Refrain. It is a different type of metaphorical extension of spatial relations, where the allative spatial relation is used for the positive relationship between participant and subevent (Engage), and the ablative spatial relation is used for the negative relationship between participant and subevent (Refrain).

3.4 Multivalent event nominals

For monovalent event nominals, the generalizations and examples presented above work fairly straightforwardly. However, many event nominals describe bivalent, or more generally multivalent, events. For bivalent events, the event nominal may either refer to the subevent of the initiator of the causal chain or the endpoint of the causal chain, as can be seen in (75) and (76) below.

(75) **The doctor** performed **the surgery**.

(76) **The patient** underwent **surgery**.

Examples (75) and (76) both contain the event nominal *surgery*, which is a bivalent event. We therefore analyze surgery as involving two subevents, the doctor's subevent or the patient's subevent. Examples (75) and (76) demonstrate that the bivalent event nominal *surgery* may refer to either subevent. In (75), *surgery* is construed as the doctor's actions during the surgery. In (76), *surgery* is construed as the change(s) that the patient undergoes during the surgery. These illustrate that event nominals, even if they are not monovalent, still refer to a single participant's subevent.

For multivalent or bivalent event nominals, we tentatively suggest the following rule to account for how an event nominal of a multivalent event is associated with a single participant's subevent.

(i) Associate nominals of multivalent events with the one expressed participant.

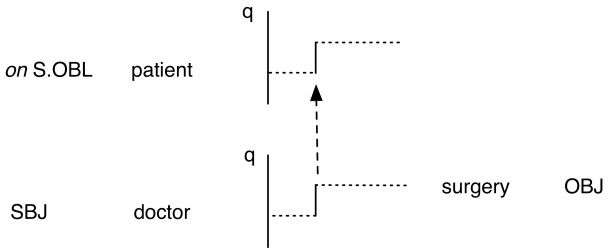
(ii) If two participants are expressed as dependents of the main clause, associate the nominal of the multivalent with the initiator (unless a patient-oriented predicate such as *undergo* is present).

(iii) If two participants are expressed as dependents of the main clause, one by a possessive phrase and the other by an oblique phrase, associate the nominal of the multivalent event with the core participant.

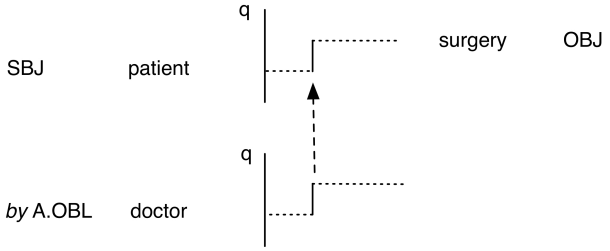
That is, multivalent event nominals will be associated with whichever participant is expressed. If more than one of the event nominal's participants is expressed, then the event nominal is usually associated with the initiator. The first rule is illustrated in (75) and (76) above. Since only one participant is expressed in each example, the event nominal refers to the respective participant's subevent.

The other participant can be expressed by an oblique in the same clause, as in (77) and (78) below.

(77) **The doctor** performed **the surgery** on the patient.



(78) **The patient** underwent **surgery** by the doctor.



In both cases, the event nominal does NOT express the subevent associated with the participant realized in the oblique phrase. More generally, our tentative proposal associates the subevent realized by the event nominal with the highest expressed participant in the grammatical relations hierarchy (subject, object, oblique), including participants expressed in the main clause.

Both *patient* in (77) and *doctor* in (78) follow the realization rules of the Causal Order Hypothesis. In example (77), the patient is realized with the subsequent oblique *on*. In example (78), the doctor is realized with the antecedent oblique *by*.

3.5 Participants expressed as dependents of event nominals

The situation becomes even more complex when multivalent event nominals have participants expressed as dependents of the event nominal. This can be seen in examples (79)-(82) below.

(79) I accepted **their writing novels**. (VerbNet)

(80) I saw **her bake the cake**. (VerbNet)

(81) **I** succeeded in **climbing the mountain**. (VerbNet)

(82) I used the **cupboard** to **store food**. (VerbNet)

There are three basic grammatical realizations of event argument dependents found in the VerbNet examples, possessives as in (83), objects as in (84), and dependent obliques as in (85).

(83) I saw **their** laughing and joking. (VerbNet)

(84) We promoted writing **novels**. (VerbNet)

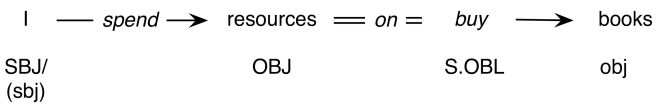
(85) They excluded us from going **to the party**. (VerbNet)

Event arguments and their dependents may be analyzed as subordinate clauses that create subchains which are embedded within the main clause causal chain. Possessives may be used for both initiators and endpoint participants of the event expressed by an event nominal, but objects (of gerunds) and dependent obliques are only used with endpoints of the subevent expressed by the event nominal. Although (some of) the participants are realized as dependents of the event nominal, they still follow the second rule above: the event nominal is associated with the initiator of the subevent it expresses. The endpoints of the subevent expressed by the event nominal are expressed as objects of the event nominal. These objects are the endpoints of the subchain created by the event nominal and its dependents.

Examples (86) and (87) below illustrate how these subchains will be analyzed and embedded in the causal chain expressed by the main clause and the main clause argument phrases. In the notation below, participants are represented as nodes in roman face and subevent arguments as nodes in italics. The argument roles are displayed underneath the nodes. Argument roles in all capitals represent the argument phrases in the main clause; argument roles in lower case represents argument phrases in the subordinate clause. The = symbol represents an Engage (or Refrain) relation between a participant and its subevent. The labels on the arrow, lines, and Engage relation indicate the predicate or adposition that expresses the relation.

The notation is illustrated for example (86) below:

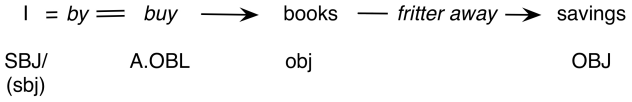
(86) I spent **the resources** on **buying books**. (VerbNet)



The full causal chain expresses a relationship between a buyer, money, and the goods of the value that the money can buy. The main clause expresses the buyer as subject, the money as object, and an event nominal, *buying*, as a subsequent oblique. The event nominal realizes the subevent of the resources (cf. *Fifty dollars will buy you three books*). The resources are in an Engage relation with the buying subevent. The realization of the resources as object and the buying subevent as the subsequent oblique (with *on*) conforms to the hypothesis that a participant is construed as antecedent to its subevent. The books is realized as an object dependent of the gerund *buying*, that is, it forms a subchain of the full causal chain. This subchain is then embedded in the main causal chain, formed by the main predicate *spent*, by means of the Engage relation between *resources* and *buying*.

Example (87) shows an alternative construal of the event in (86).

(87) **I** frittered away all my savings by **buying books**.



In this example, the construal is that my actions caused the loss of my savings, whereas in (86) the main goal is buying books and spending resources was the means to achieve the goal. Therefore, in (87), there is an Engage relation between the initiator of the main causal chain, *I*, and the subevent expressed by *buying* (cf. *I bought the books*), expressed by the antecedent oblique *by*. The Engage relation here specifies that the main clause initiator's subevent is overtly expressed by the means clause predicate, *buying*. As in (86), *books* is a dependent of an event argument and is therefore part of a subchain embedded within the main causal chain.

When participants are dependents of the event argument and not the main verb, their realization need not conform to the main causal chain, but only to their (subordinate) clause's subchain. Each of those sets of participants and their subevents (i.e., each causal subchain) has to conform to the Causal Order Hypothesis, but the Causal Order Hypothesis does not apply to all participants realized in different clauses/event nominal phrases in a single sentence at once. While the examples shown so far are fairly straightforward, we will now show how this subchain analysis is necessary to analyze more complex examples with more participants and subevents.

Croft and Vigus (2017) presents an analysis of the RISK frame (Fillmore and Atkins, 1992) as involving both participants and their subevents. The main elements of the Risk frame are shown below (Croft and Vigus, 2017, 150):

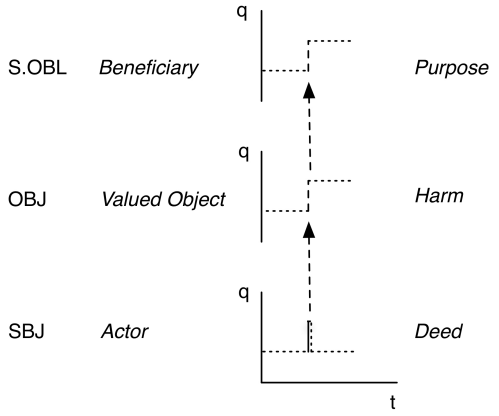


Figure 3.1: Risk frame participants and subevents

(88) **Actor**: entity that performs the Deed
Deed: action that brings about the potential of Harm to the Valued Object
Valued Object: entity that may be hurt, lost, or otherwise damaged if the Harm occurs
Harm: potential negative outcome of the Deed
Purpose: potential positive outcome of the Deed

These elements are combined into the causal-aspectual representation shown below in Figure 3.1 (Croft and Vigus, 2017, 151, Figure 4). Each participant is paired with a subevent: the Actor with the Deed, the Valued Object with the Harm, and the Beneficiary with the Purpose. The Actor's Deed causes the possibility of Harm to the Valued Object, and also the possibility of the Purpose subevent for the Beneficiary. Both the Harm and Purpose subevents are unrealized (or, at least not necessarily realized). Semantically, the risk event may be more of a branching causal chain because it is possible for the Purpose subevent to be realized without the Harm subevent. However, it is consistently realized grammatically as a non-branching chain with the Valued Object/Harm subevent antecedent to the Beneficiary/Purpose subevent. Therefore, Figure 3.1 below represents the linguistic construal of the RISK event.
Both participants and subevents can be realized as arguments. In example (89) below, only participants are realized as arguments.

(89) Why did he risk his life for a man he did not know? (Fillmore and Atkins, 1992, 88)

The Actor, *he*, is realized as subject, the Valued Object *his life* as object and the Beneficiary *a man* with the subsequent oblique *for*.

However, sentences can also express a mixture of participants and subevents,

as in (90) below. (The labels of the links in the causal chain have been suppressed to save space.)

(90) He had risked two of his submarines by sending them to the edge of the American beaches. (Fillmore and Atkins, 1992, 90)

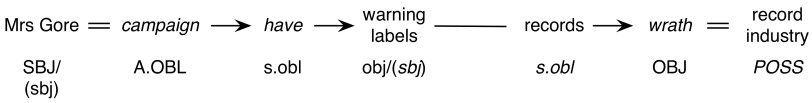
The Actor, *he*, is realized as subject of the main clause. The Actor is in an Engage relation with the event nominal *sending*, for which it functions as the unexpressed subject. The means subordinate clause corresponds with the Deed subevent. The Engage relation is between the Actor and the Deed, as it should be following Figure 3.1. The event nominal *sending* is expressed by the antecedent oblique *by*, since the Deed subevent is antecedent to the Valued Object's subevent, which is realized as the object of the main clause.

The Harm—the Valued Object's subevent—is left implicit. However, the submarines are also involved in the Deed subevent, expressed by *them* in the means subordinate clause. Therefore, submarines also appear in the subchain as the object of the event argument *sending*. That is, the same participant (the submarines) is involved in two subevents (the Deed and the Harm), and there is a causal relationship between the two subevents: sending the submarine causes its loss, if the Harm is realized. This is a cycle in the causal chain; but the causal chains expressed by individual clauses in example (90) are individually acyclic.

There is also another participant involved in the Deed subevent, *beaches*, that is realized with the subsequent oblique *to* and is a part of the means subordinate clause's subchain. This demonstrates how these subchains work: *beaches* is realized with a subsequent oblique because it is subsequent to the object of the subordinate clauses's subchain. It is not, however, subsequent to the object of the main clause chain; in fact it is antecedent because it is part of the Deed subevent.

Example (91) below is even more complex, with multiple subordinate clauses.

(91) Mrs. Gore even risked the wrath of the record industry by campaigning to have warning labels put on particularly offensive records. (FrameNet)



The Actor, *Mrs. Gore*, is realized as the subject of the main clause. The Harm, *wrath*, is realized as the object of the main clause. The participant *record industry* is in an Engage relation with the *wrath* subevent and is realized as a possessive of the event nominal (we use italicized capitals to distinguish this phrase dependent on the event nominal *wrath* from dependents of other

event nominals in the sentence). As with the submarines in the causal chain in example (90), Mrs. Gore appears twice in the causal chain, but in different causal subchains. In the wrath subchain, Mrs. Gore is the unexpressed stimulus of the emotional state experienced by the record companies.

In the means clause subchain, on the other hand, Mrs. Gore is in an Engage relation with the event argument *campaigning*, expressed by the antecedent oblique *by*. The subordinate clause introduced by the antecedent oblique *by* expresses the Deed. The Deed itself involves both participants (*Mrs. Gore, warning labels, records*) and subevents (*campaigning, have, put on*). The subchain represented by this subordinate clause realizes the *have* subevent with a subsequent oblique, as it is subsequent to the *campaigning* subevent. The participants in this subchain also follow the realization rules: *warning labels* is realized as object of the purposive infinitive subevent realized by *to have*, hence subsequent to the unexpressed agents who Mrs. Gore wants to act. The warning labels are in turn antecedent to the records in the subchain. The warning labels are the implicit subject of the passive participle complement *put* which is a subevent dependent on *have*. The records are realized as a subsequent oblique phrase of *put*.

By allowing for subordinate clauses to represent subchains of the main causal chain, even more complex examples, like (90) and (91), can be represented with a non-branching causal chain. However, these causal chains allow cycles, represented by re-entrant nodes in the causal chains in examples (90) and (91). Instead, the subordinate clauses introduce subchains, with their own ordering of participants and subevents, that then themselves fit into the main causal chain of the main clause.

Chapter 4

Physical Domain Verbs (Pavlína Kalm)

4.1 Introduction

Physical domain verbs describe events in which participants interact with each other on a physical level. The interactions between participants may be causal or non-causal. In causal interactions (e.g., *He cut the bread*), the endpoint undergoes a change of state. The causal relation that defines this and other types of causal interactions in the physical domain is identified as FORCE. In non-causal interactions (e.g., *The ball rolled down the hill*), two physical entities are in a spatial relation with each other. The event may be dynamic or static. We use a PATH relation to define a spatial non-causal relation between two entities in the physical domain.

There are nine event 'types' associated with events in the physical domain. Each event type corresponds to an image schema (or core event) that is shared by the semantics of a broader class of verbs. Verbs in an event type evoke the same core event participants and a force-dynamic relation between them. The physical event types are: Force verbs (section 4.2), Change of State verbs (section 4.3), Motion verbs (section 4.4), Mereological verbs (section 4.5), Creation verbs (section 4.6), Location verbs (section 4.7), Internal verbs (section 4.8), and Manipulate verbs (section 4.9).

4.2 Force verbs

Force verbs describe events in which there is a causal FORCE relation between two participants. One participant is the initiator of FORCE, the other participant is the endpoint. We have identified two networks associated with the Force schema: A Force network (discussed in section 4.2.1) and a Constrain network (discussed in section 4.2.2). The Constrain network elaborates on the event

structure of the Force network. In the Constrain event structure, the initiator of the FORCE relation is also in a PATH (or a "co-location") relation with the theme. The participant that initiates the event constrains the motion of the theme by being proximally co-located with it.

4.2.1 General Force verbs

Force verbs describe events in which one entity uses physical force and another entity is affected by it (92). The extent to which the endpoint's property changes or does not change as a result of FORCE is variable. It may be specified contextually, lexically, or constructionally. For example, in (92a), the change is implied by the physical characteristics of the initiator, the needle, and the endpoint, the cloth, which point to a reading in which the cloth was poked all the way through. In other contexts, the poking event may be understood to be only a forceful contact, as in *He poked him in the shoulder*. Some verbs, such as *touch* in (92c) always imply physical contact and no further change in the endpoint. In (92d), the extent to which the fly was affected by the event is implied constructionally by using the result phrase *dead*.

(92) a. The needle poked the cloth.
b. Paula hit the wall.
c. Carrie touched the cat.
d. Paula swatted the fly dead with a dishcloth.

The event structure associated with Force verbs is shown in Figure 4.1. We do not specify the subevent of the Physical_entity or the Theme. The Physical_entity can thus map to a volitional (92b) or a non-volitional initiator (92a). Not specifying the subevent of the Theme allows us to map to it various examples that describe different types of changes in the theme.

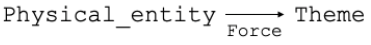


Figure 4.1: Force event structure.

Force verbs occur in the following VerbNet classes: bump-18.4, carve-21.2, hit-18.1, pelt-17.2, poke-19, push-12, spank-18.3, swat-18.2, and touch-20.

4.2.2 Constrain verbs

We distinguish a separate Constrain network for verbs that describe events of "extended causation of rest" (Talmy 1988) in which the initiator physically constrains the motion of a theme by being spatially co-located with it (93). Such events are commonly expressed as *hold* and *grasp* verbs in English. For example, in (93a), the agent's holding the book (i.e., their hands being spatially co-located with the book) prevents the book from falling as a result of gravitational forces.

Similarly, in (93b), the action of wearing the dress causes it to stay on the agent's body. The initiator of the constrain event does not have to be a volitional entity. Inanimate entities can be initiators of constrain events, as well (93c).

(93) a. Paula held a book.
b. She wore the purple dress.
c. The pillars supported the bridge.

Figure 4.2 shows our representation of the event structure of Constrain verbs. There is a FORCE relation and a PATH relation between the Physical_entity and the Theme. The FORCE relation represents the physical force that the initiator has to use to keep the Theme constrained in a place. The PATH relation represents the spatial relation between the Theme and the Physical_entity. The Theme functions as a Figure and the Physical_entity as a Ground in the event. The Theme is spatially co-located with the Physical_entity. The PATH relation is thus causally subsequent to the FORCE relation. The subevent of the Theme is specified as EXIST since the Theme doesn't undergo any change in the event. The subevent of the Physical_entity is unspecified in order to accommodate examples in which the initiator is either a volitional (93a) or a non-volitional entity (93c).

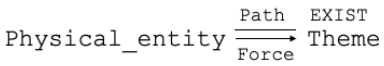


Figure 4.2: Constrain event structure.

Constrain verbs are found in support-15.3, contain-15.4, and simple_dressing-41.3.1 classes in VerbNet.

4.2.3 Syntactic realization of participants with General Force and Constrain verbs

The Physical_entity is syntactically realized as a subject and the Theme is realized as a direct object with Force and Constrain verbs. The same argument realization of participants in these two types of events led us to use the same FORCE relation between the initiator and the endpoint. The FORCE relation is a superordinate schema that subsumes the force-dynamic relations between participants in force and constrain events. Though we do distinguish the semantics of these verbs by having separate verbal networks, we do not distinguish the constructional semantics when they occur in a simple transitive argument structure construction. There is no syntactic motivation in English to distinguish these force-dynamic types from each other.

4.2.4 Semantics of argument structure constructions with General Force and Constrain verbs

Force and Constrain verbs evoke a FORCE schema in which there is a FORCE relation between two entities. The argument structure associated with this schema is a simple transitive [SBJ V OBJ] construction, e.g., *Paula hit the ball*. The semantics of this example is depicted by the causal chain in Figure 4.3. The initiator Paula is identified as a volitional (VOL) entity. The ball's subevent label is not specified since contextual information is not available to tell us what change (if any) the ball underwent in the event.

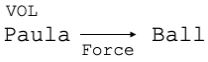


Figure 4.3: Causal chain for the example *Paula hit the ball*.

The annotation for this causal chain is Volitional (FD1) Force (FD2). The core event describes a Force schema (FD2) and the initiator acts volitionally.[1]

Force events may be initiated by an agent who uses an instrument as an intermediary participant in the event (e.g., *Paula swatted the fly with a dishcloth* or *Paula hit the stick against/on the fence*). In some cases, only the instrument may be syntactically expressed (e.g., *The needle poked the cloth*). Instruments are causally antecedent to the Theme but subsequent to the agent who manipulates them. In the absence of an agent in a causal chain, the instrument is construed as the initiator of the event.

A causal chain associated with the example *Paula swatted the fly with a dishcloth* is shown in Figure 4.4. The initiator Paula uses FORCE to manipulate the instrument dishcloth which then makes forceful contact with the fly. The instrument is labeled "INTL" in the causal chain because it undergoes internal motion when it is handled by the agent.

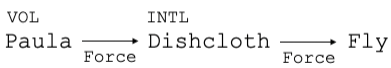


Figure 4.4: Causal chain for the example *Paula swatted the fly with a dishcloth*.

The causal chain in Figure 4.4 is annotated Instrument (FD1) Force (FD2). The Instrument FD1 label signals that the core event is preceded by an additional causal segment in which an agent uses an instrument. In examples in which the instrument (or some other non-agentive entity) is construed as the initiator and syntactically expressed as the subject (e.g., *The needle poked the cloth*), the causal chain is annotated Physical (FD1) Force (FD2). We use the label Physical for events in which the external initiator is a non-physical entity.

[1]Note to Bill: I raised this issue before: the label "Volitional" is not really accurate for Force events since the initiator is internal to the core event.

4.2.4.1 Change of State construal

Force verbs may occur in a change of state construal when a result phrase, such as *open* or *to pieces*, is used to specify the change that the Theme underwent in the event (94). In such argument structure constructions, the force event results in a change of state of the Theme. For example, the property of the door in (94a) changes from shut to open. In (94b), the window changes from not broken to broken.

(94) a. The stick knocked the door open.
b. Paul hit the window to pieces.
c. Paula sliced the bag open.

The causal chain associated with a change of state construal corresponding to the example in (94c) and its mapping to the Force network is shown in Figure 4.5. The causal chain (in the upper part of the figure) describes a volitionally initiated change of state event in which Paula is the initiator of the FORCE relation and the bag undergoes property (PROP) change as the endpoint. Paula maps to the Physical_entity and the bag maps to the Theme in the verbal network.

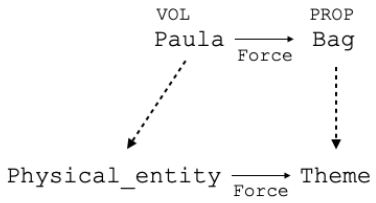


Figure 4.5: Mapping of *Paula sliced the bag open* to the Force network.

The annotation of the causal chain for *Paula sliced the bag open* is Volitional (FD1) COS (FD2). The Volitional label signals that Paula is an external initiator and the COS label tells us that the core event describes a change of state.

4.3 Change of State verbs

We have identified six verb types that evoke event structures in which the theme undergoes a change of state. The events associated with these verb types are quite different though all networks share the same theme participant, a Patient, which is identified as a Property (PROP) theme. The simplest of the change of state networks is the General Change of State network (section 4.3.1) which describes an event structure with a single participant: the Patient. The Causative Change of State network (section 4.3.2) includes an additional participant, distinct from the Patient, who initiates the event. Ingestion (section 4.3.5) and

Feeding (section 4.3.6) networks describe events in which the Patient undergoes a change of state by being consumed. In the Absorb network (section 4.3.7), the Patient is a substance that undergoes a change of state when it is absorbed. The Hurt network (section 4.3.8) describes events of bodily harm in which an agent hurts their body.

4.3.1 General Change of State verbs

General Change of State (or "General COS") verbs describe events in which a Patient undergoes a change in their property (95). For example, in (95a), the rod's property goes from being straight to being bent. In (95b), the property that changes in the event is not only specified by the verb but also by the result phrase *wrinkled*. In (95c), the bridge loses its integrity and function in the event. We analyze events of destruction (or dying) as describing a change in a property of the Patient. In some cases, the event of destruction may result in the Patient losing its full integrity that defines it as an object (e.g., a bridge collapsing may mean that the remains of the bridge do not resemble a bridge any more). In other cases, as with *break* in (95d), the dishwasher no longer functions but it still exists as an object.

(95) a. The rod bent.
b. The clothes dried wrinkled.
c. The bridge gave way.
d. The dishwasher broke.

The verbal network associated with the semantics of COS verbs is shown in Figure 4.6. The verbal network consists of just the Patient as an obligatorily evoked participant. The network is non-relational in that the verbal semantics doesn't specify a force-dynamic relation between the Patient and another participant.

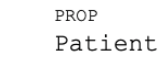


Figure 4.6: Change of State event structure.

VerbNet classes with COS verbs are: bend-45.2, break_down-45.8, break-45.1, calibrate_cos-45.6, die-42.4, entity_specific_cos-45.5, knead-26.5, other_cos-45.4, suffocate-40.7, turn-26.6.1, change_bodily_state-40.8.4, cut-21.1, and shake-22.3-1-1.

4.3.1.1 Syntactic realization of participants with Change of State verbs

The Patient is expressed as a subject when the event is not externally initiated (95). When an external initiator is added to the constructional causal chain

(e.g., *The pliers bent the rod* or *Tony broke the window*), the initiator is syntactically realized as the subject and the Patient is the direct object. The semantics and annotation of argument structure constructions with General COS verbs is discussed in section 4.3.9.

4.3.2 Causative Change of State verbs

Causative Change of State (or "Causative COS") verbs obligatorily evoke an external initiator that causes the Patient's property to change in the event. The external initiator may be volitional (96a-96d) or non-volitional (96e).

(96) a. Claire painted the wall.
b. Carol cut the bread.
c. Jennifer baked the potatoes.
d. Brutus murdered Julius Caesar.
e. The bomb destroyed the building.

The verbal network associated with the semantics of Causative Change of State verbs is shown in Figure 4.7. The network describes an event in which a Physical_entity initiates a causal FORCE relation with another entity, i.e., a Patient. As a result of the FORCE relation, the Patient undergoes a change of state and is identified as a Property (PROP) theme. Labeling the initiator of the FORCE relation as a Physical_entity and not specifying the subevent label of this participant allows us to map either volitional or non-volitional initiators from the constructional semantics.

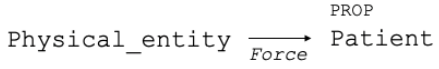


Figure 4.7: Causative Change of State event structure.

VerbNet classes with Causative COS verbs are: braid-41.2.2, coloring-24, cooking-45.3, cut-21.1, destroy-44, floss-41.2.1, groom-41.1.2, murder-42.1, poison-42.2, remedy-45.7, render-29.90, and shake-22.3-2.

4.3.3 Cooking verbs

Cooking verbs are analyzed as describing a Causative COS event structure despite the observation that many cooking events involve more than two participants in the event structure. Prototypically, cooking events include an agent (i.e., a cook), a patient (i.e., the food), and the heat source (e.g., an oven). In many cases, an instrument such as a pan or a pot or some other cooking container may also be specified. However, only two participants are obligatorily evoked by the semantics of cooking verbs: the heat source and the food. The agent and the instrument are not obligatory to the event structure: one can grill

something directly on the fire, in which case an instrument is not used, or the sun can cook the tomatoes on the vine, in which case an agent is not evoked.

4.3.4 Syntactic realization of participants with Causative Change of State verbs

The initiator of the physical FORCE relation is syntactically realized as the subject, the Patient is realized as a direct object. It is common for events with Causative COS verbs to include an instrument (e.g., *Bill repaired the tractor with duct tape* or *Carol cut the bread with a knife*). The instrument is typically expressed as a *with*-phrase.

4.3.5 Ingestion verbs

Ingestion verbs describe events in which food is consumed by an agent (97). In some examples, the food, i.e., the Patient, is overtly expressed (97b-97c), in others it is not (97a). We do not distinguish the semantics of the transitive and intransitive argument structure construction despite our general aim not to include null instantiated participants in constructional causal chains. This analysis is motivated by the fact that it is not common for change of state verbs to occur in construals in which the Patient is not overtly expressed. Additionally, intransitive argument structure constructions with ingestion verbs have been analyzed as containing an Indefinite Null Instantiated (INI) participant in the linguistics literature (e.g., Petruck 2019). INI participants have been identified as a "lexically specific licensed omission" (Petruck, 2019, 123). The missing object that is not syntactically expressed is easily recoverable without having to refer to a larger context within the discourse. Therefore, we include INI participants in causal chains with Ingestion verbs.

(97) a. Cynthia ate.
b. Cynthia ate the peach.
c. Cynthia gobbled the pizza up.

Ingestion verbs evoke a complex verbal network in which the Agent and the Patient are engaged in more than one relation at a time. The Agent uses an instrument to move the Patient entity (i.e., food) into their mouth. The Agent is engaged in a FORCE relation with the Instrument, a PATH relation with the Patient, and a FORCE relation with the Patient. The Patient undergoes a Property change as an endpoint of FORCE when it is consumed by the Agent. The network also specifies the original location of the food ("Source_loc"), which is usually a plate or some other surface that the food is located on prior to being handled by the Agent. For a more detailed discussion of the force-dynamic relations evoked by the Ingestion event structure, please see Chapter 2.2.

The complex network associated with Ingestion verbs can be "unthreaded" into a linear causal chain representation in which the causal ordering of force-dynamic relations between participants is more easily interpretable. As shown

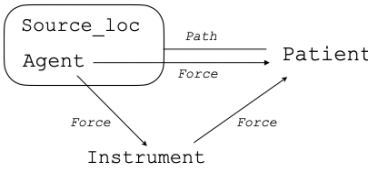


Figure 4.8: Ingestion event structure.

in Figure 4.9, the Agent and the Patient are included in the unthreaded representation twice: the Agent is the initiator of the event structure and it is also the initiator of the FORCE relation that causes the Patient to undergo a change of state. The Patient is a Mereologically incremental theme when it is in a PATH relation with the Source_loc and the Agent, and it is a Property theme as an endpoint of the FORCE relation initiated by the Agent.

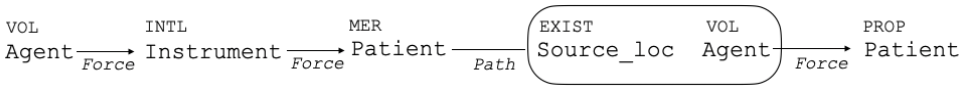


Figure 4.9: An "unthreaded" version of the Ingestion event structure.

VerbNet classes with Ingestion verbs are: chew-39.2, devour-39.4, dine-39.5, eat-39.1, gobble-39.3, gorge-39.6.

VerbNet does not have a class that contains examples of animals eating. The Ingestion network presented above is not meant to be a superordinate network for consumption verbs in general. It represents the event structure of eating verbs associated with humans as consumers. A separate simplified verbal network would be needed for verbs that evoke an event structure associated with animals' eating habits, that is, an event structure that doesn't include an instrument (= a utensil).

4.3.5.1 Syntactic realization of participants with Ingestion verbs

The Agent is syntactically realized as the subject and the Patient is a direct object. The Source_loc is usually expressed as a *from/out of/off of*-oblique (e.g., *He drank out of the goblet*) and the event is construed as a metaphorical remove event. A detailed discussion of the semantics of argument structure constructions with change of state verbs can be found in section 4.3.9.

4.3.6 Feeding verbs

Feeding verbs describe a causative Ingestion event structure in which an agent causes another entity to consume food. Similarly to argument structure constructions with Ingestion verbs, the food may or may not be overtly expressed (98).

(98) a. Teresa bottlefed the baby.
b. Teresa bottlefed the baby soy milk.

The verbal network evoked by Feeding verbs describes a similar event structure to Ingestion verbs. An Eater causes a change of state event by consuming the Patient. However, unlike the Ingestion network, the Feeding network is not initiated by the Eater himself, it is initiated by an Agent who is distinct from the Eater. As shown in Figure 4.10, the Agent uses physical FORCE to manipulate an Instrument by which the food is moved into the Eater's mouth. Similarly to the Ingestion network, we define a PATH relation between the Patient and the Eater and Source_loc.

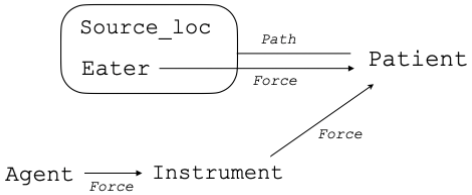


Figure 4.10: Feeding event structure.

The Feeding network can be unthreaded into a linear causal chain like the Ingestion network. The unthreaded version of the Feeding network is shown in Figure 4.11. The subevent labels of the participants in the Feeding network are the same as the subevent labels in the Ingestion network.

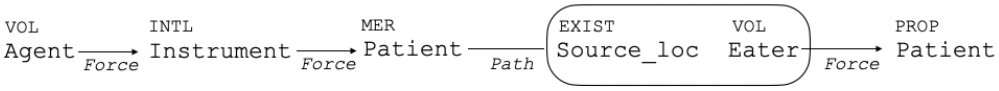


Figure 4.11: "Unthreaded" version of the Feeding network.

Feeding verbs are in the feeding-39.7 class in VerbNet. The feeding class does not include examples in which the Eater is an animal.

4.3.6.1 Syntactic realization of participants with Ingestion verbs

The Agent is syntactically realized as the subject and the Patient is a direct object. The Eater may be realized as a direct object in a simple transitive argument structure construction (98a) in a double object construction (98b). The Source_loc is not commonly expressed with Feeding verbs. When it is syntactically realized, it is a *from/out of/off of*-oblique (e.g., *She fed the baby from the bottle*) and the construal is metaphorical remove.

4.3.7 Absorb verbs

Absorb verbs describe events in which an entity is absorbed by another entity (99). An animate entity may absorb a substance by inhaling it (99a) or by ingesting food (99c), or an inanimate entity may absorb a substance by having certain physical properties (99b).

(99) a. Paul inhaled water.
b. The cotton absorbed water.
c. Cows take nutrients from their feed.

The verbal event structure associated with Absorb verbs is shown in Figure 4.12. The network describes an event in which a Physical_entity exerts FORCE on a Substance which causes the Substance to move from Source_loc to a spatial proximity with a Physical_entity which then causes the Substance to be absorbed. The first FORCE relation between the Physical_entity and the Substance may be a volitional action, such as breathing in (99a) or it may describe a physical property of an object that can lead to the Substance being absorbed, as shown in example (99b). The motion of Substance from the Source_loc to the Physical_entity is represented as a PATH relation in the network. Absorb verbs can occur in removal construals (99c), which describe a relation between the Physical_entity, the Substance and the Source_location.

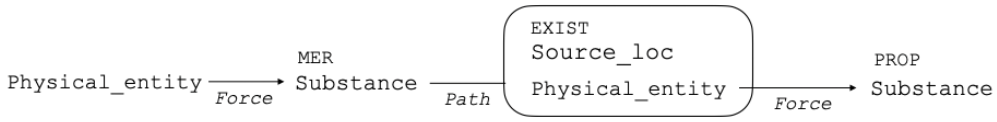


Figure 4.12: Absorb event structure.

The Substance is identified as a Mereological (MER) theme since the event of absorption can happen part by part. The Source_loc is identified as EXIST since it doesn't undergo a change of state and is conceptualized as a Ground in absorption events. We do not specify the subevent of the Physical_entity since it can be either a volitional or non-volitional entity. The Substance is identified as a Property theme at the end of the causal chain because it undergoes a change of state.

Absorb verbs are found in the absorb-39.8 and exhale-40.1.3-2 classes in VerbNet.

4.3.8 Hurt verbs

Hurt verbs describe events in which an agent hurts their or someone else's body part. The agent undergoes a change of state when they get hurt. For example, in (100a), the agent Tessa gets hurt by spraining her ankle. In (100b), the body part is not specified. The reflexive construction points to a construal in which

the agent is the initiator of the event and the Property theme at the same time (100b). In (100c), the agent hurts someone else's body part. It is also possible to construe the event as autonomous when the agent and their body part are expressed as a subject (100d).

(100) a. Tessa hurt/sprained her ankle.
b. Tessa hurt herself.
c. Tessa hurt her brother's hand.
d. My ankle twisted.

The event structure associated with Hurt verbs is shown in Figure 4.13. The initiator is a volitionally acting Agent who exerts physical FORCE to cause a Body_part to undergo a change of state. The Body_part belongs to an Experiencer who is mentally affected by the event and, as a result, also undergoes a change of state. Both the Body_part and the Experiencer are thus labeled PROP in the verbal network. In many examples, the Agent and the Experiencer denote the same entity.

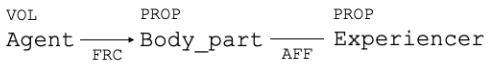


Figure 4.13: Hurt event structure.

Hurt verbs are found in the hurt-40.8.3 class in VerbNet.

4.3.9 Semantics of argument structure constructions with Change of State verbs

Change of state verbs most commonly occur in a causative transitive [SBJ V OBJ] argument structure construction (101a, 101b), in which the subject denotes the initiator and the direct object the Property theme, or a non-causative intransitive [SBJ V] argument structure construction (101c), in which the subject denotes the Property theme.

(101) a. Tony bent the rod.
b. The pliers bent the rod.
c. The clothes dried.

The constructional causal chains associated with the examples in (101a) and (101c) are depicted in Figure (4.14). In the causative construal (Figure 4.14a), the subject participant Tony is the initiator of a FORCE relation and the direct object rod is the endpoint. In the non-causative construal (Figure 4.14b), the subject clothes is the Property theme. The causal chain for the intransitive construal is non-relational. The constructional semantics doesn't describe a

a. A causative change of state causal chain

b. A non-causative change of state causal chain

Figure 4.14: Causal chains associated with the causative example in (101a) and non-causative example in (101c).

causal relation between two entities. Only the Property theme is engaged in the event.

The causal chain for the example in (101b) is very similar to the one depicted in Figure 4.14a. The pliers initiate the FORCE relation and the rod is the endpoint. However, the subevent of the pliers in the causal chain would be defined as INTL instead of VOL since pliers are not a volitionally acting entity.

The causal chain in (4.14a) is annotated Volitional (FD1) COS (FD2). The Volitional label designates the initiator as a volitional entity that is external to the core event. The causal chain in (4.14b) is annotated Autonomous (FD1) COS (FD2). The Autonomous label designates the initiator as non-volitional and internal to the core event. The causal chain associated with the example in (101b) is annotated Physical (FD1) COS (FD2). The FD1 label Physical designates the initiator as a non-volitional entity that is external to the core event.

4.3.9.1 Change of State argument structure constructions with instruments

A change of state event that is initiated by a volitional agent may constructionally specify the instrument that the agent uses to carry out the action. The instrument is usually syntactically realized as a *with*-phrase with change of state verbs (102), though a locative instrument is also possible when the instrument is stationary, it is not directly manipulated by the agent, and the patient is in motion (e.g., *I had scratched my arm on the cage door*).[2]

(102) a. Carol cut the bread with a knife.
b. Cony bent the rod with pliers.
c. Caesar killed Brutus with a knife.

The causal chain that describes the semantics of examples in (102a) is shown in Figure 4.15. The instrument participant is causally antecedent to the Patient in the event structure. The Agent uses physical FORCE to manipulate the instrument. The instrument directly causes the change of state in the Patient.

[2]Locative instruments are not in VerbNet with change of state verbs, and we do not discuss them further in this chapter.

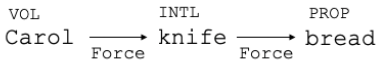


Figure 4.15: Causal chains associated with the example *Carol cut the bread with a knife*.

The instrument's subevent label in the constructional semantics is INTL since it undergoes internal motion when it is used by the agent. Carol is a volitionally acting entity and is therefore labeled VOL, and the bread is the Property theme in the event structure.

The mapping of this causal chain to the Causative COS network is shown in Figure 4.16. Carol maps to the initiator of the FORCE relation in the verbal network and the bread maps to the Patient since they are both identified as Property themes in the two representations. The instrument does not map to any participant in the network; it is constructionally added to the event structure.

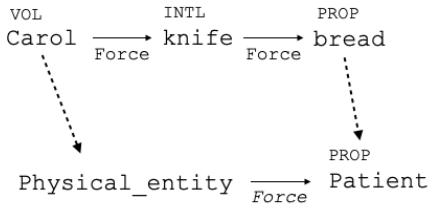


Figure 4.16: Mapping of the causal chain for *Carol cut the bread with a knife* to the Causative COS network

4.4 Motion events

Motion verbs describe events in which an entity (a Theme) moves with respect to a location or another entity (a Ground). We define the relation between the Theme and the Ground as PATH, and the motion of the Theme as holistically incremental. We have identified six distinct event structures associated with Motion verbs: A General Motion network (section 4.4.1), a Throw network (section 4.4.2), a Send network (section 4.4.3), a Carry network (section 4.4.4), and a Pursuit network (section 4.4.5). All networks share the same PATH segment between the Theme and Ground in which the Theme is identified as undergoing motion. However, different motion verbs evoke event structures of varying complexities.

4.4.1 General Motion verbs

General Motion verbs evoke the most basic event structure of all motion networks. They describe a PATH relation between the Motion theme and the Ground (103a-103c). The motion Theme may be a physical entity (103a) or a volitional entity (103b, 103c). If an external entity initiates the event (e.g., 103d), it is constructionally added to the event structure.

(103) a. The ball rolled down the hill.
b. He came to Colorado.
c. The horse jumped over the fence.
d. Bill rolled the ball down the hill.

The event structure associated with General Motion verbs is shown in Figure 4.17. The subevent of the Theme is identified as Motion (MOT). The Ground's subevent is EXIST because the Ground doesn't undergo any change in the event. The relation between the Theme and the Ground is defined as PATH, which is used to define a spatial relation between two physical entities.

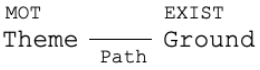


Figure 4.17: General Motion event structure.

General Motion verbs are in the following VerbNet classes: leave-51.2, reach-51.8, roll-51.3.1, run-51.3.2, slide-11.2, disappearance-48.2, escape-51.1, and waltz-51.5.

4.4.2 Throw verbs

Throw verbs describe events in which an agent sets an object in motion by throwing it or kicking it (104). Throw verbs obligatorily evoke an agent as an external initiator of the event. As shown in (104), the location from/to which the object is moved may or may not be specified.

(104) a. Steve tossed the ball.
b. Steve tossed the ball to the garden.
c. Steve tossed the ball from the corner to the garden.

Figure 4.18 shows the event structure associated with Throw verbs. The initiator is identified as a volitionally acting Agent who uses physical FORCE to cause the Theme to undergo motion. The second segment of the verbal network is identical to the General Motion network in which a motion Theme moves along a PATH with respect to a Ground.

Throw verbs are found in the throw-17.1 class in VerbNet.

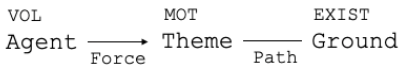


Figure 4.18: Throw event structure.

4.4.3 Send verbs

Send verbs describe events in which an agent causes an object to travel from an original location to a destination (105b, 105c) or to a recipient (105d). Argument structure constructions with Send verbs may express only the sender and the object (105a). Unlike throwing events, the agent has to use an instrument, i.e., a means of transportation, to send an object. The instrument does not have to be syntactically expressed but it is obligatorily evoked by the verbal semantics, as shown in Figure 4.19.

(105) a. Nora sent the book.
b. Nora sent the book to London.
c. Nora sent the book from Paris to London.
d. Nora sent me the book.

The event structure evoked by Send verbs is shown in Figure 4.19. The network describes an event in which an Agent uses Transport_means to make a Theme move. The Transport_means is analyzed as an instrument in the event structure: its subevent is analyzed as INTL and the relation between the Transport_means and the Theme is defined as physical FORCE. In addition to the FORCE relation which causes the Theme to move, we also define a CO-LOC ("Co-location") relation between the Transport_means and the Theme. This relation signals that the two participants are in a physical proximity during the event. This means that Transport_means moves with the Theme; however, only the Theme is identified as a Motion theme in the event. This is because the primary role of the Transport_means in the event structure is to facilitate the motion of the Theme.

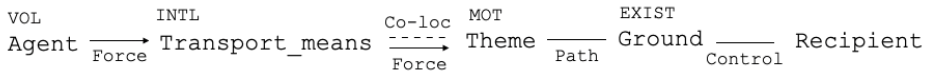


Figure 4.19: Send event structure.

Send verbs also evoke a Recipient in their event structure. The Recipient is a human entity who is intended to have CONTROL over the sent object when it reaches destination. The Recipient is analyzed as an endpoint of a CONTROL relation. The Recipient is causally subsequent to the Ground in the event structure.

Send verbs are found in the send-11.1 class in VerbNet.

4.4.4 Carry verbs

Carry verbs describe events in which an agent causes an object to move by constraining its physical location (either by holding it or by holding an object in which the theme is transported) and moving along with it (106). The original location and/or destination may or may not be expressed. In examples of vehicular motion (106e), the vehicle may be construed as the initiator of the event.

(106) a. Nora brought the book.
b. Amanda carried the package.
c. Nora brought the book to the meeting.
d. Amanda carried the package to New York from home.
e. The train brought us here.

Figure 4.20 shows the event structure evoked by Carry verbs. The Agent uses FORCE to cause the Theme to move. The CO-LOC relation between the initiator of the event structure and the Theme represents the spatial proximity of the two participants during the event which implies that the Agent moves along the same PATH with respect to the same Ground as the Theme. However, we do not specify the Physical_entity as a Motion theme in the event structure. Its primary role is to initiate the motion event. Since the initiator may be either a volitional or a physical entity (e.g., a train), we do not specify its subevent label in the network. The second segment of the network is identical to the General Motion network and describes the motion of the Theme with respect to a Ground.

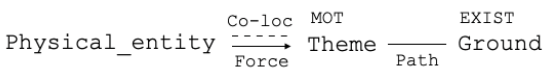


Figure 4.20: Carry event structure.

Carry verbs are found in the bring-11.3 and carry-11.4 classes in VerbNet.

4.4.5 Pursuit verbs

Pursuit verbs (e.g., *chase*, *accompany*, *follow*) describe events in which two (or more) entities move together with respect to the same Ground. The entities may be collaboratively involved in the event (e.g., with accompany verbs) or the relation between them may be adversarial (e.g., with chase verbs). We do not distinguish collaborative and adversarial relations as force-dynamically different and treat the relation between the two participants as Mutual, as shown in Figure 4.21.

(107) a. Jackie chased the thief.
b. Jackie chased after the thief.

c. Jackie accompanied Rose to the store.

d. Jackie accompanied Rose.

The verbal network associated with Pursuit verbs describes a MUTUAL relation between two entities, a Theme and a Co-Theme, and their motion on a PATH with respect to the same Ground. Both themes are identified as undergoing motion in the event structure. We also specify a CO-LOCATION relation between the two participants since they are spatially co-located as they move. The co-location relation with chase verbs may be more distanced than with accompany verbs but the motion of the two entities still follows the same path.

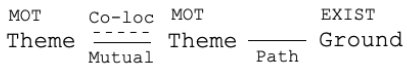


Figure 4.21: Pursuit event structure.

Pursuit verbs are found in the chase-51.6 and accompany-51.7 classes in VerbNet.

4.4.6 Vehicular Motion verbs

Vehicular Motion verbs such as *drive* or *ride* describe events in which an agent either directly manipulates a vehicle or is a passenger in a vehicle that moves with respect to a ground location (108). For example, in (108b), the agent he uses a boat to move across the lake. Similarly to other motion verbs, the original location and/or destination may or may not be expressed (108a). In some construals, the vehicle may not be overtly expressed either (108c).

(108) a. He rode on the train.

b. He rowed the boat across the lake.

c. Amanda drove Penny to New York.

d. Amanda trucked the package from Philadelphia to her mother's house.

The event structure that describes the semantics of Vehicular Motion verbs is quite complex. As shown in Figure 4.22, the Agent uses Transport_means as an instrument in order to move himself or another person/object (=Theme) with respect to a Ground. In some examples, the Agent and the Theme are the same entity (e.g., 108b). In other examples, the two participants are distinct entities (e.g., 108c). We define two CO-LOCATION relations in the network: one between the Agent and the Transport_means and one between the Transport_means and the Theme. The CO-LOCATION relations signal that all three entities are in close proximity with each other during the event. Consequently, all three entities undergo motion with respect to the same Ground. However, only the Theme is identified as a Motion (MOT) theme in the event structure. The Agent's

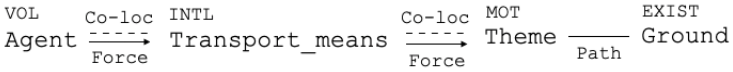


Figure 4.22: Vehicular Motion event structure.

primary role is to volitionally (VOL) initiate the event and the Transport_means serves as an instrument (INTL).

Vehicular Motion verbs can occur in a causative (e.g., *Amanda drove Penny to New York*) or a non-causative (e.g., *Amanda drove to New York*) Motion construals discussed in section 4.4.7. It is also common for Vehicular Motion verbs to occur in a Manipulate construal which describes the relation between the Agent and the Transport_means (e.g., *He drove the car* or *He rode on the train*). We discuss the Manipulate construal and the causal chain representation associated with it in section 4.9.

Vehicular Motion verbs are found in the following VerbNet classes: drive-11.5, nonvehicle-51.4.2, vehicle_path-51.4.3, and vehicle-51.4.1.

4.4.7 Semantics of argument structure constructions with Motion verbs

Motion verbs may occur in a non-causative [SBJ V LOCP] argument structure construction in which the subject denotes the Motion theme and the locative phrase denotes the Ground (109a). The Ground may also be expressed as a direct object, leading to a non-causative transitive [SBJ V OBJ] argument structure construction (109b). In a causative [SBJ V OBJ LOCP] construal, the motion theme is expressed as a direct object and the initiator of the event as the subject (109c). The Ground is expressed as a locative phrase. It is also possible to construe the event as Internal when the ground is not syntactically realized (109d) (discussed in section 4.4.7.1) or a Change of State event when a result phrase is specified (109e) (discussed in section 4.4.7.2).

(109) a. The horse jumped over the fence.
b. He entered the room.
c. Tom jumped the horse over the fence.
d. Steve tossed the ball.
e. Tom walked the dog to exhaustion.

The causal chain representation for motion events associated with the causative (109c) and non-causative (109a) examples is shown in Figure 4.23. In the causative construal shown in Figure (4.23a), the subject (Tom) is the initiator of the FORCE relation, which causes the motion theme (horse) to move over the fence. The spatial relation between the motion theme (horse) and the ground (fence) is represented by a PATH relation. In the non-causative construal shown in Figure (4.23b), the initiator of the event and the motion theme are the same

entity. We identify the horse as a volitional entity in this event since the horse has to employ some mental capacities to make the jump.

a. A causative change of state causal chain

b. A non-causative change of state causal chain

Figure 4.23: Causal chains associated with the causative example in (109c) and non-causative example in (109a).

The causal chain in (4.23a) is annotated Volitional (FD1) Motion (FD2). The Motion (FD2) label indicates that there is a PATH relation between a Motion theme and a Ground in the causal chain. The causal chain in (4.23b) is annotated Self-volitional (FD1) Motion (FD2). The label Self-volitional is used when the initiator acts volitionally but is internal to the core event.

An example of a mapping of a motion argument structure construction to a verbal network is shown in Figure 4.24. The Figure shows the constructional causal chain associated with the example in (109c) and its mapping to the General Motion network.

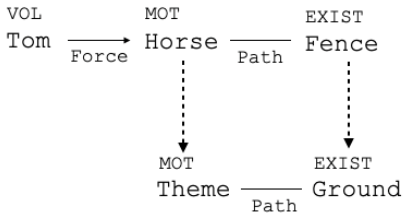


Figure 4.24: Mapping of a causal chain associated with the causative example in (109c) to the General Motion network.

The initiator of the constructional causal chain does not map to any participant in the network. This is because General Motion verbs, such as *jump* don't obligatorily evoke an external initiator in their event structure. The horse maps to the motion theme in the verbal network since they are both identified as MOT. The fence maps to the Ground participant in the network.

4.4.7.1 Internal construal

Motion verbs can also occur in argument structure constructions in which the Ground is not overtly expressed (e.g., *Steve tossed the ball*). Since we do not include participants that are not syntactically expressed in constructional causal chains, our analysis of examples such as *Steve tossed the ball* is different from

examples such as *Steve tossed the ball to the garden.* Argument structure constructions in which the Ground participant is not expressed are analyzed as describing events of internal change. The theme is not analyzed as a motion theme in these construals since there is no PATH relation with a Ground. The inference that the semantics of the example describes a motion event comes from the mapping of the constructional causal chain to the verbal network.

A causal chain associated with the Internal example *Steve tossed the ball* and its mapping to the Throw network is shown in Figure 4.25. The force-dynamic relation between Steve and the ball is FORCE and the ball is identified as an Internal (INTL) theme. The causal chain maps to the first segment of the verbal network. Since the Ground is not syntactically expressed, no participant in the causal chain maps to the Ground in the verbal network.

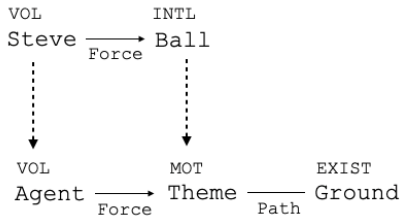


Figure 4.25: Mapping of the causal chain for *Steve tossed the ball* to the Throw network.

The annotation for a causative internal construal with a volitional initiator, such as the one in Figure 4.25, is Volitional (FD1) Internal (FD2). Examples of internal construals in which there is no external initiator (e.g., *The ball rolled*) are annotated Autonomous (FD1) Internal (FD2).

The mapping of the example

4.4.7.2 Change of state construal

Motion verbs can occur in a change of state construal when a result phrase is syntactically expressed (110). In this construal, the Path relation between the motion theme and the ground is not syntactically expressed. The examples in (110) describe events in which the motion theme is construed as undergoing a change of state. For example, in (110a), the dog's walking results in the dog being exhausted.

(110) a. Tom walked the dog to exhaustion.
b. The drawer rolled to an open position.
c. He waltzed her dizzy.

The constructional causal chain associated with the change of state construal in (110a) and its mapping to the General Motion network is shown in Figure

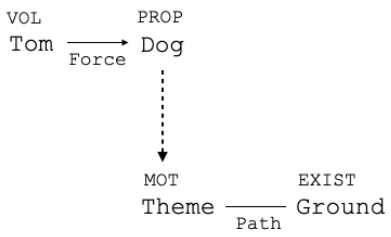


Figure 4.26: Mapping of the causal chain associated with the example in 110a to the General Motion network.

4.26. The dog maps to the Theme. Tom doesn't map to any participant in the network since the General Motion network doesn't evoke an external initiator.

The annotation for the change of state causal chain in Figure 4.26 is Volitional (FD1) COS (FD2).

4.5 Mereological events

Mereological verbs describe motion events in which an entity (a Theme) moves with respect to another entity (a Ground). Similarly to Motion verbs, there is a PATH relation between the Theme and the Ground; however, the motion of the Theme is mereologically incremental with mereological verbs. The motion of the Theme may be away from the Ground (in remove events) or towards the Ground (in place events). We have identified four distinct event structures associated with mereological verbs: a General Mereological network (section 4.5.1), a Causative Mereological network (section 4.5.2), a Conceal network (4.5.3), and a Pick-up network (4.5.4). In all of these networks, there is a PATH relation between the motion Theme and the Ground, which describes the "core" event shared by the different verbs.

4.5.1 General Mereological verbs

General Mereological verbs (e.g., *tape, cover, spray,* or *separate*) describe a relation between a motion theme and a ground (111). The event may be initiated by an external entity such as an agent (111a)) or the motion theme itself (111d). The motion event may describe an application (111a-111d) or a removal (111e) of an entity. With most General Mereological verbs, either the Theme or the Ground may be expressed as a direct object in an argument structure construction. For example, in (111a), the direct object describes the Theme and the oblique argument describes the Ground. In (116b), it is the Ground that is expressed as a direct object and the oblique argument denotes the Theme.

(111) a. I funneled the mixture into the bottle.
b. Linda taped the picture to the wall.

c. Leslie covered the bed with blankets.

d. Paint sprayed onto the wall.

e. Doug cleaned the dishes from the table.

The event structure associated with General Mereological verbs is shown in Figure 4.27. Both the Theme and the Ground are identified as MER in the network since they can both be construed as mereological themes when expressed as a direct object. The network is not specific to application or removal verbs and we therefore do not distinguish whether the participants are + or -MER in the verbal event structure; however, we do make this distinction in the constructional causal chain, as shown in Figure 4.28.

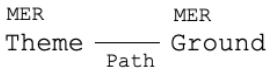


Figure 4.27: General Mereological event structure

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In the constructional representation (see the top part of Figure 4.28), the participant expressed as a direct object, i.e., mixture, is identified as +MER. The + sign indicates that the motion of the mixture is towards the bottle and the example describes an application event. In application examples where the Ground is expressed as a direct object (116b), the Ground is identified as +MER and the Theme is INTL. The subevent label INTL signifies that the Theme undergoes internal change (i.e., motion) in the event. In remove events (111e), the direct object participant is labeled -MER.

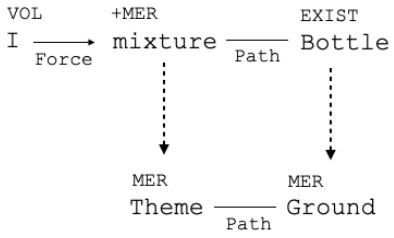

Figure 4.28: Mapping of the causal chain associated with the example in (111a) to the General Mereological network.

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In Figure 4.28, the initiator of the causal chain doesn't map to any participant in the network since an external initiator is not obligatorily evoked by verbal semantics. The mapping of the mixture and bottle to the verbal network is fairly straightforward. The initiator of the PATH relation maps to the Theme and the endpoint to the Ground.

Mereological verbs are found in the following VerbNet classes: being_dressed-41.3.3, clear-10.3, cling-22.5, coil-9.6, disassemble-23.3, dress-41.1.1, fill-9.8, funnel-9.3, herd-47.5.2, illustrate-25.3, mix-22.1, pocket-9.10, pour-9.5, put_spatial-9.2, separate-23.1, split-23.2, spray-9.7, and tape-22.4.

4.5.2 Causative Mereological verbs

Causative Mereological verbs (e.g., *wipe, remove,* or *put*) describe events in which an agent or some other physical entity causes the Theme to move to or from a Ground (112). The motion is mereologically incremental and may describe an event of application (112a-112b) or removal (112c-112d).

(112) a. He plowed the snow back into the ditch.
b. Lora buttered the toast with unsalted butter.
c. Brian wiped the fingerprints from the counter.
d. Doug removed the smudges from the table.

The event structure associated with Causative Mereological verbs elaborates on the General Mereological network. As shown in Figure 4.29, an external initiator, identified as a Physical_entity, causally precedes the core event in which the Theme and the Ground are in a PATH relation with each other. The initiator may be a volitional or a physical entity and we therefore do not identify the subevent of the Physical_entity in the network.

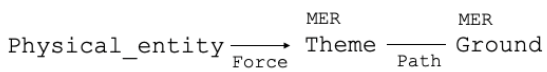

Figure 4.29: Causative Mereological event structure.

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Causative Mereological verbs are in the following VerbNet classes: butter-9.9, debone-10.8, mine-10.9, pit-10.7, put_direction-9.4, put-9.1, remove-10.1, wipe_instr-10.4.2, and wipe_manner-10.4.1.

4.5.3 Concealment verbs

Concealment verbs[3] (e.g., *hide, conceal*) express events in which an entity's movement with respect to another entity causes a human perceiver not to see it (113). The event may be initiated by an external entity (113a-113b) but doesn't have to be (113b-113d). The location where the hidden entity is put may be overtly specified (113c-113d) or not expressed (113a-113b). The human perceiver may also not be expressed (113c-113d). However, all participants are

[3]Note to Bill: The discussion of Concealment verbs reflects our latest analysis of this class of verbs. It doesn't include the locative-*with* alternation of the ground as possibly denoting an instrument since the instrumental *with*-phrase is not in VerbNet. We could include a more elaborate discussion in the final version of the report.

obligatorily evoked by the verbal semantics, as shown in the network in Figure 4.30.

(113) a. Frances hid the presents from Sally.
b. Frances hid the presents.
c. The children hid in the chimney.
d. The sun hid behind the clouds.

The event structure associated with Concealment verbs elaborates on the General Mereological network by including a Perceiver as an endpoint of an AFFECT relation. The Perceiver from which the object is hidden is analyzed as undergoing a change of mental state as a result of the Theme's spatial relation with the Ground. We identify the Perceiver as a Property theme in the concealment event. Both the Theme and the Ground are analyzed as MER in the verbal event structure though in English only the Theme tends to be construed as the mereological theme in the constructional semantics. That is, only the Theme (but not the Ground) is syntactically expressed as a direct object in argument structure construction.

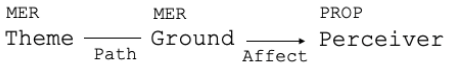

Figure 4.30: Concealment event structure.

Conceal verbs are in the concealment-16 class in VerbNet.

4.5.4 Pick up verbs

Pick up verbs, such as *pick up* or *drop*, describe events in which a volitional entity constrains the location of another entity by having physical control over it (114a). Alternatively, the volitional entity ends the constrain relation by intentionally or accidentally letting go of another entity (114b). The Pick up network is a 'dynamic' version of the Constrain network discussed in section 4.2.2. We identify Pick-up verbs as belonging to the Mereological event type because the event involves mereologically incremental motion of a Theme with respect to a Ground.

(114) a. He picked up the keys.
b. He dropped the books.

The event structure associated with Pick up verbs is shown in Figure 4.31. Both the Agent and the Theme are identified as MER. Similarly to other mereological networks, there is a PATH relation between the Theme and the Agent (=Ground). However, the Agent is also an initiator of a FORCE relation that causally precedes the PATH relation. The FORCE relation signifies the physical

control that the Agent has to exert on the Theme in order for the Theme to follow the PATH.

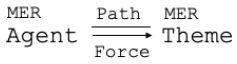

Figure 4.31: Pick up event structure.

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Pick up verbs may occur in a constrain (114) or place (*He dropped the books on the ground*) and remove (*He picked the keys from the table*) construals. The semantics of the Constrain argument structure construction was discussed in section 4.2.4 and the semantics of place and remove argument structure constructions is discussed in section 4.5.5.

There is not a class in VerbNet that contains Pick-up verbs.

4.5.5 Semantics of argument structure constructions with Mereological verbs

Mereological verbs occur in a number of different argument structure constructions depending on whether they describe application or removal events and whether it's the Theme or the Ground that is construed as the Mereological theme in the event. We identify four distinct causal chains associated with mereological verbs: "Place" and "Provide" causal chains with application verbs and "Remove" and "Deprive" causal chain with removal verbs. Our annotation reflects this analysis by having separate FD2 labels for all four of these construals.

An example of a Place causal chain and its mapping to the General Mereological network was provided in Figure 4.28. An example of a Provide causal chain for an example such as *Leslie covered the bed with blankets* is shown in Figure 4.32. The difference between the two construals is captured in the subevent labels assigned to participants in the causal chain. In Figure 4.28, it is the Theme that is identified as the +MER participant; whereas in Figure 4.32, the +MER participant is the Ground. The identification of the participant as +MER (or -MER in removal events) is determined by their syntactic realization as a direct object in the argument structure construction. The ordering of participants in the causal chain remains the same.

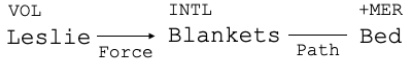

Figure 4.32: A Provide causal chain.

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The annotation for the causal chain in Figure 4.32 is Volitional (FD1) Pro-

vide (FD2).

The analysis and annotation of examples with removal verbs is analogous to application verbs. However, with removal verbs, the direct object participant is identified as -MER since the motion of the Theme is away from the Ground. The FD2 annotation is either Remove or Deprive depending on whether it is the Theme or the Ground that is expressed as a direct object. In Remove construals, the Theme is construed as a direct object. In Deprive construals, the Ground is construed as a direct object.

4.5.5.1 Internal construal

In some cases, the role of the Figure and the Ground may be construed as more symmetrical. In such construals, the two participants are expressed as a plural or a conjoined plural argument (115). Our constructional analysis treats the two entities as a single participant in the causal chain representation, as shown in Figure 4.33.

(115) a. The eggs and the cream mixed.
b. Herman connected the computers.
c. I separated the yolk and the white.

Figure 4.33 shows our analysis of the example in (115a). The eggs and the cream are a single participant in the causal chain and map to both the Theme and the Ground participants in the verbal network. We do not try to distinguish whether eggs or the cream are the Theme or the Ground. The participants are analyzed as undergoing internal change by being mixed together and are therefore labeled INTL.

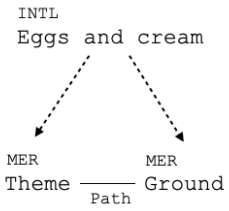

Figure 4.33: A mapping of an Internal causal chain associated with the example in 115a to the General Mereological network.

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The annotation of the causal chain for the example (115a) is Autonomous (FD1) Internal (FD2). The label Autonomous signals that the initiator is non-volitional and internal to the core event.

The causal chain representation for the examples in (115b and 115c) and their mapping to the General Mereological network is identical to the example in (115a) shown in Figure 4.33 with the addition of an external (VOL) initiator who causally precedes the Internal event.

4.5.5.2 Change of State construal

Mereological verbs can occur in a Change of State construal when the Ground is syntactically realized as a direct object and the Theme is unexpressed (116). For example, in (116a), the event describes an agent Lora who changes the property of the toast by buttering it. In (116b), the bed's property changes from uncovered to covered. Since we do not include null instantiated participants in our causal chain analysis, the semantics of the transitive [SBJ V OBJ.GROUND] argument structure construction is analyzed as describing a direct causal relation between the initiator of the causal chain and the Ground.

(116) a. Lora buttered the toast.
b. Leslie covered the bed.
c. Jessica sprayed the wall.

The causal chain associated with the example in (116a) and its mapping to the Causative Mereological network is shown in Figure 4.34. Lora maps to the initiator of the verbal network and the toast maps to the Ground participant. There is no mapping to the Theme from the causal chain.

Figure 4.34: A mapping of a Change of State causal chain associated with the example in 116a to the Causative Mereological network.

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The annotation of the causal chain for the example in (116a) is Volitional (FD1) COS (FD2).

The Theme participant may also be expressed as a direct object in a transitive [SBJ V OBJ.THEME] argument structure construction (e.g., *Jessica squirted water*). We analyze these construals analogous to transitive examples with motion verbs (e.g., *Steve tossed the ball*) discussed in section 4.4.7.1. The core event is analyzed as describing an internal change of the Theme and the causal chain is annotated Volitional (FD1) Internal (FD2).

4.6 Creation events

Creation verbs describe events in which an entity comes into existence. We have identified four verbal networks for creation verbs: a Causative Creation network (section 4.6.1), an Illustration network (section 4.6.2), an Emission network (4.6.3) and a Form network (section 4.6.4). The Causative Creation network is

the simplest one, as it describes an event structure in which an external initiator causes the creation of another entity.[4] The Illustration network (section 4.6.2) evokes a more complex event structure in which the creation of an entity involves its placement or imprint on another entity. The Emission network evokes a network in which the initiator of the creation event is also in a spatial relation with the created entity. Lastly, the Form network describes a relation between a created entity and the material from which the entity was created.

4.6.1 Causative Creation verbs

Causative Creation verbs (e.g., *build, construct* or *draw*) describe events in which an entity causes another entity to come into existence (117). We include verbs of performance (e.g., *sing*) and replication (e.g., *rehearse*) as creation verbs. In this analysis, the direct object participant such as the song in (117d) is analyzed as describing the created entity rather than the original song that is being replicated by the performance.

(117) a. Martha carved a toy.
b. David constructed a house.
c. Claire drew a picture.
d. Sandy sang a song.

The event structure associated with Causative Creation verbs is shown in Figure 4.35. The initiator of the causal chain is identified as a Physical_entity and the created entity, i.e., Creation, is analyzed as a Design theme and labeled DES. The Creation is created as a result of physical FORCE initiated by the Physical_entity.

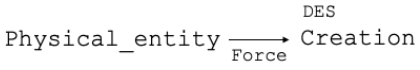

Figure 4.35: Causative Creation event structure.

Causative Creation verbs are found in the following VerbNet classes: birth-28.2, build-26.1, calve-28.1, create-26.4, performance-26.7, preparing-26.3, and rehearse-26.8.

4.6.2 Illustration verbs

Illustration verbs (e.g., *scribble, inscribe* or *transcribe*) describe events in which an entity's creation is dependent on its spatial co-location with another entity (118). Illustration verbs evoke an external initiator who makes the creation.

[4]We do not discuss a network for General Creation verbs here because VerbNet does not have a class for such verbs. General Creation verbs evoke just the created entity as a participant in the event structure.

For example in (118a), Smith creates the inscription of his name by using the ring. Without the ring, the creation of the name as an inscription would not be possible.

(118) a. Smith inscribed his name on the ring.
b. Saul jotted down readings on a notepad.
c. The secretary transcribed the speech into the record.

In the verbal event structure in Figure 4.36, we identify the relation between the Creation and the entity on which the Creation is made (= Medium) as PATH. The PATH relation signifies the spatial co-location of the two entities, which is necessary for the creation event to take place. The initiator of the event uses physical FORCE to bring about the event. The Creation has two subevent labels. It is identified as a Design theme in the Creation event but also as a Mereological theme in its relation with the Medium. The Creation comes to be spatially co-located with the Medium in a mereologically incremental fashion, i.e., part by part. The Medium is also identified as a Mereological theme as an endpoint of the PATH relation since it can be construed as an incremental theme in the constructional causal chain (e.g., *Smith inscribed the ring with his name*). The second segment of the verbal network thus closely resembles the General Mereological network.

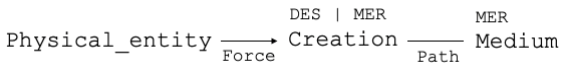

Figure 4.36: Illustration event structure.

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Illustration verbs are found in image_impression-25.1, scribble-25.2, and transcribe-25.4 classes in VerbNet.

4.6.3 Emission verbs

Emission verbs, such as verbs of light emission (e.g., *sparkle*), substance emission (e.g., *gush*) or sound emission (e.g., *squeak*) describe events in which an entity produces a creation by emitting it (119). For example, in (119c), a sound is emitted by the door hinges when the door moves. We analyze the door hinges as the emitting entity, or Source in the verbal network, and the sound as the created entity, or Creation. The created entity may not be syntactically expressed with Emission verbs (119c, 119d).

(119) a. The dragon breathed fire.
b. The well gushed oil.
c. The door hinges squeaked.
d. The jewel sparkled.

The event structure associated with Emission verbs is shown in Figure 4.37. The Creation is identified as a Design theme in the FORCE relation with the Source. Both the Creation and the Source are also identified as Mereological themes in the PATH relation since the emission event is mereologically incremental. For example, the well gushing oil in (119b) is a mereologically incremental event: the oil moves away from the well part by part.

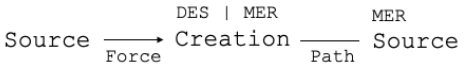

Figure 4.37: Emission event structure.

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Emission verbs occur in the following VerbNet classes: animal_sounds-38, breathe-40.1.2, exhale-40.1.3-1, light_emission-43.1, sound_emission-43.2, smell_emission-43.3, and substance_emission-43.4.

4.6.4 Form verbs

Form verbs describe events in which an entity's change of state results in a creation of a new identity of that entity. The new identity is usually associated with different physical characteristics. For example, in (120a), the acorn undergoes a change of state when it grows and, as a result of this change, a tree forms. The *old* and the *new* identity are syntactically realized as distinct arguments in argument structure constructions (120). We identify the *old* identity as a Material and the *new* identity as a Creation in the verbal network, as shown in Figure 4.38. An external initiator may bring about the form event (120c, 120b) but it is not obligatorily evoked by the verbal semantics.

(120) a. An oak tree will grow from that acorn.
b. The gardener grew an oak tree from that acorn.
c. My neighbor raised fruit trees.

We introduce a FORM force-dynamic relation to describe the relation between the Material and the Creation in the Form network. The FORM relation is non-causal and links two different identities of the same entity. The Material is identified as a Change of State theme and the Creation is a Design theme.

Figure 4.38: Form event structure.

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Form verbs occur in the following VerbNet classes: grow-26.2.1 and rear-26.2.2.

4.6.5 Semantics of argument structure constructions with Creation verbs

Creation verbs can occur in different construals depending on which participants are syntactically expressed. The simple transitive [SBJ V OBJ] argument structure construction (e.g., *The dragon breathed fire*) is used to describe a FORCE relation between an external initiator and a created entity. The intransitive [SBJ V] argument structure construction can be used to describe an internal event in which the Source is construed as the only event participant (e.g., *The door hinges squeaked*) (see section 4.6.5.1). With verbs of substance emission, the intransitive construction can also be used to describe events of autonomous creation (e.g., *The oil gushed*). Creation verbs can also be used to describe a static spatial relation between two entities (e.g., *Over the fire bubbled a fragrant stew*), see in section 4.6.5.2.

An example of a causal chain associated with the transitive argument structure construction is shown in Figure 4.39. The causal chain corresponds to the example *David constructed a house*. The initiator is identified as a Volitional entity and the Creation as a Design theme. The force-dynamic relation between the two participants is FORCE.

Figure 4.39: A causal chain associated with the example *David constructed a house*.

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The causal chain in Figure 4.39 is annotated Volitional (FD1) Create (FD2). The Create FD2 label signals that the endpoint of the FORCE relation is a Design theme.

4.6.5.1 Internal construal

It is common for the Creation participant not to be overtly expressed with sound and light emission verbs. In such construals, only the Source is syntactically expressed (e.g., *The jewel sparkled*). We analyze such examples as describing an internal change of the Source participant. As shown in Figure 4.40, the constructional causal chain consists of a single participant: the Source. The Source is labeled INTL. Figure 4.40 shows the mapping of the example *The jewel sparkled* to the Emission network.

The annotation for the internal construal shown in Figure 4.40 is Autonomous (FD1) Internal (FD2). The label Autonomous signals that the causal chain is initiated by the Internal theme.

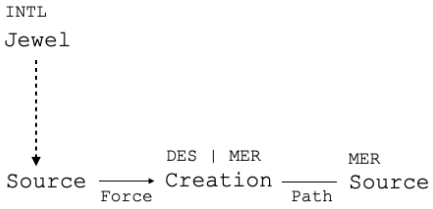

Figure 4.40: A mapping of the causal chain associated with the example *The jewel sparkled* to the Emission network.

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4.6.5.2 Location construal

Emission verbs can occur in argument structure constructions that describe a static spatial relation between the Source and another entity (e.g., *Jewels sparkled on the crown* or *In the hallway ticked a grandfather's clock*). The semantics of such examples is analyzed as describing the location of the Source with respect to a ground. The Source is analyzed as an Internal theme (INTL) because the verb describes an internal process. The relation between the jewels and the crown is analyzed as a spatial PATH relation. The crown is identified as EXIST since it doesn't undergo any change in the event.

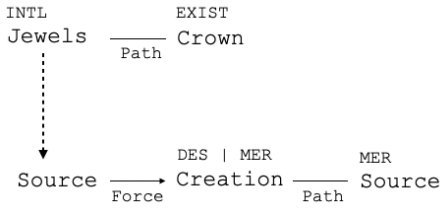

Figure 4.41: A mapping of the causal chain associated with the example *The jewel sparkled on the crown* to the Emission network.

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The annotation of the causal chain in Figure 4.41 is Autonomous (FD1) Location (FD2).

4.6.6 Semantics of argument structure constructions with Form verbs

The transitive argument structure construction with Form verbs is analyzed differently from other creation verbs. The relation between the two participants is analyzed as FORM, rather than Force. As shown in Figure 4.42, the causal chain that describes the semantics of the example *An oak tree will grow from that acorn* uses the non-causal FORM relation to define the force-dynamic relation

between the acorn and the oak tree. The causal chain is identical to the verbal network since the two participants that are overtly expressed are also obligatorily evoked by the verbal semantics.

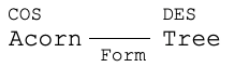


Figure 4.42: A causal chain for the example *An oak tree will grow from that acorn.*

The annotation for this example is Autonomous (FD1) Form (FD2). The Form FD2 label signals that there is a Form relation between two participants and that the initiator is a Change of State theme and the endpoint is a Design theme, grammatically expressed as a subject. The FD1 label Autonomous signals that there is no external initiator.

4.7 Location events

Location verbs describe events in which there is a static spatial relation between two entities, i.e, a figure and a ground (121). The location of the figure is described with respect to the ground. For example, in (121a), the spatial location of Italy is defined with respect to another country, i.e., France. In (121b), the spatial relation between the two entities is construed as symmetrical and both participants are syntactically expressed as a conjoined plural subject.

(121) a. Italy borders France.
b. Italy and France touch.
c. A ship appeared on the horizon.

The verbal network associated with Location verbs is shown in Figure 4.43. The relation between the Figure and the Ground participants is analyzed as PATH. The Ground is labeled EXIST since it doesn't undergo any change in the event. The subevent label of the Figure is not defined in the event structure so that different construals can map to it. In some examples, e.g., *A ship appeared on the horizon*, the Figure is construed as undergoing internal process (INTL). However, in examples such as *A pen is on the table*, there is no internal change happening to the theme and it is therefore identified as EXIST in the causal chain.

Figure 4.43: Location event structure.

Location verbs occur in the following VerbNet classes: contiguous_location-47.8, appear-48.1.1, and lodge-46.

4.7.1 Semantics of argument structure constructions with Location verbs

Location verbs can occur in a transitive [SBJ V OBJ] argument structure construction (121a), or intransitive argument structure constructions in which the Figure is syntactically realized as the subject and the Ground is either not expressed (e.g., *A ship appeared*) or it is expressed as a locative phrase (e.g., *A ship appeared there*). In symmetrical construals (121b), both Figure and Ground are expressed as a subject participant.

We analyze the semantics of argument structure constructions in which both the Figure and the Ground are overtly expressed as describing a spatial PATH relation between the two participants. As shown in Figure 4.44, the causal chain associated with the example in (121a) closely resembles the verbal network. However, in the constructional semantics, the subevent of the Figure Italy is specified as EXIST since the Figure doesn't undergo an internal process in the event.

Figure 4.44: A causal chain for the example *Italy borders France*.

The annotation for the causal chain in Figure 4.44 is Autonomous (FD1) Location (FD2). The FD2 label Location is used to describe a segment in the causal chain in which two participants are in a static spatial relation with each other.

4.8 Internal events

Internal verbs describe events in which an entity undergoes internal change (122). Events of internal processes are undirected (unlike events of incremental change that we have discussed above with Change of State, Mereological, or Motion verbs). For example, in (122a), the flag undergoes internal motion that is undirected. In (122b), the event describes Gloria undergoing an internal process while she sleeps. Similarly, the movement of Sharon's body while she shivers in (122c) is undirected and doesn't result in an incremental change.

(122) a. A flag fluttered.
b. Gloria snoozed.
c. Sharon shivered.

Figure 4.45 depicts the event structure associated with Internal verbs. The verbal network consists of a single participant: a Physical_entity who is identified as an Internal theme.

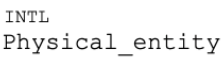


Figure 4.45: Internal event structure.

Internal verbs occur in the following VerbNet classes: assuming_position-50, meander-47.7, body_internal_motion-49.1, body_internal_states-40.6, bulge-47.5.3, crane-40.3.2, dressing_well-41.3.2, hiccup-40.1.1, entity_specific_modes_being-47.2, exist-47.1, snooze-40.4, modes_of_being_with_motion-47.3, nonverbal_expression-40.2, occur-48.3, tingle-40.8.2, sound_existence-47.4, spatial_configuration-47.6, swarm-47.5.1, and wink-40.3.1.

4.8.1 Semantics of argument structure constructions with Internal verbs

Internal verbs can occur in a causative [SBJ V OBJ] argument structure construction (123b) or a non-causative intransitive [SBJ V] argument structure construction (123a). Internal verbs can also occur in examples in which the internal process is used to express a static location (123c). We discuss these construals as instances of a Location schema (see section 4.8.1.1). Internal verbs can also occur in argument structure constructions in which the figure and ground are reversed (123d): the ground is expressed as the subject and the figure is expressed as an oblique argument. We discuss the semantics of these examples as instances of a Dynamic Texture image schema (see section 4.8.1.2).

(123) a. A flag fluttered.
b. The patriots waved the flag.
c. The flag fluttered over the fort.
d. The garden flowered with roses.

The causal chain representation for the causative example in (123b) is shown in Figure 4.46. The entity that is identified as undergoing internal change in the causal chain maps to the Physical_entity in the verbal network. The causal chain is annotated Volitional (FD1) Internal (FD2). Causal chains for non-causative examples such as (123a) contain only the Internal theme as a participant and are annotated either Autonomous (FD1) or Self-volitional (FD1) Internal (FD2). The FD1 label is dependent on whether the initiator is a physical or a volitional entity, respectively.

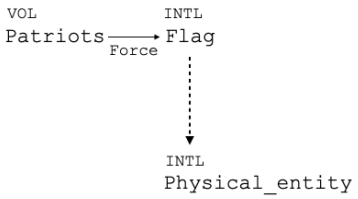


Figure 4.46: Mapping of the example *The patriots waved the flag* to the Internal network.

4.8.1.1 Location construal

The Location construal with Internal verbs describes an event in which an internal process of an entity is used to express a static spatial relation between a figure and a ground (124). For example, in (124a), the verb describes an internal process but the semantics of the example describes the location of the echo with respect to the ground hall. Similarly in (124b), the example describe the location of the fire.

(124) a. The voices echoed through the hall.
b. A fire raged in the mountains.
c. Bess are swarming in the garden.

The causal chain for the Location construal with Internal verbs is shown in Figure 4.47. The causal chain describes the semantics of the example *The voices echoed through the hall*. The ground hall does not map to any participant in the verbal network; it is constructionally added. The annotation for the causal chain in Figure 4.47 is Autonomous (FD1) Location (FD2).

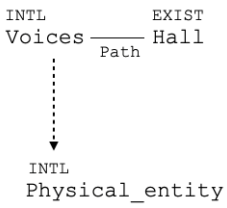


Figure 4.47: Mapping of the example *The voices echoed through the hall* to the Internal network.

4.8.1.2 Dynamic Texture construal

The expression of figure and ground is reversed in the Dynamic Texture construal when compared to the Location construal. The ground is expressed as a

subject and the figure as an oblique argument (125). In this argument structure construction, the internal process associated with the figure allows for the ground to be construed as having a "texture" in an otherwise static spatial construal.

(125) a. The bag is bulging with groceries.
b. The hall echoed with voices.
c. The garden abounds with flowers.

The causal chain associated with the semantics of the example in (125a) is shown in Figure 4.48. The relation between the figure and ground is still analyzed as PATH but the subevent of the ground is analyzed as INTL. The INTL label is what distinguishes the Location and the Dynamic Texture causal chains from each other. The ordering of participants is the same: the figure precedes the ground in both construals.

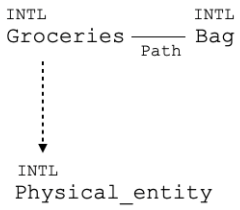


Figure 4.48: Mapping of the example *The bag is bulging with groceries* to the Internal network.

The Dynamic Texture causal chain is annotated Autonomous (FD1) Dynamic Texture (FD2). The Dynamic Texture label signals that both entities in the causal chain are analyzed as undergoing internal change (INTL) and the relation between them is PATH.

4.9 Manipulate events

Manipulate verbs describe a relation between an agent and an instrument. As shown in (126a), the verb *use* describes such a relation. Other verbs such as vehicular motion verbs can also be used in a Manipulate schema (126b) though they evoke a more complex verbal event structure. There is only one class in VerbNet that contains Manipulate verbs: use-105.1.

(126) a. I used the shovel.
b. He drove the car.

Figure 4.50 shows the event structure representation evoked by Manipulate verbs. The Agent uses physical FORCE to manipulate the instrument. The instrument is identified as INTL because it undergoes internal change when it

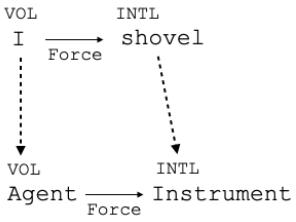


Figure 4.49: Mapping of the example *I used the shovel* to the Manipulate network.

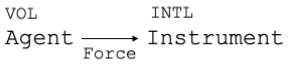


Figure 4.50: Manipulate event structure.

is handled by the Agent. The Agent always acts volitionally with Manipulate verbs.

An example of a mapping of a Manipulate causal chain to the Manipulate network is shown in Figure 4.49. The annotation for the causal chain is Manipulate (FD1). We do not specify an FD2 subevent label. The relation between an agent and an instrument is analyzed as describing the segment of the causal chain that precedes the core event. In examples in which the instrument is expressed as a direct object, we use the FD1 label Manipulate. In examples in which the instrument is syntactically expressed as a *with*-phrase (e.g., *He dug the hole with a shovel*), we use the FD1 label Instrument. The example *He dug the hole with a shove* would then be annotated Instrument (FD1) Create (FD2).

Chapter 5

Mental Events (William Croft, Pavlína Kalm, Michael Regan and Sook-kyung Lee)

5.1 The force dynamic structure of mental events

Mental verbs describe mental events, that is, mental states or processes of a person (or certain animals to whom internal mental states are attributed). These mental states or processes generally though not always occur oriented to some external situation: an entity, a static state of affairs, or the occurrence of a dynamic event. Mental events are usually divided into three domains: perception, cognition and emotion, with some linguists such as Levin (1993) and Verhoeven (2007) distinguishing desire/intention from emotion.

Mental events differ from physical events in two major ways. First, there is no physical transmission of force between the external situation and the person's mental state. Hence there is no force dynamic relation between participants. Nevertheless, mental events are construed as having "directionality". We will describe the varying construals of mental events as *mental force dynamics* or *mental dynamics* for short.

Second, what is happening in the mind is not outwardly apparent to the observer. Hence, the actual mental event—state or process, for example—is a construal by the observer who produces a sentence describing the mental event. Alternative construals of mental events are generally inferred from the grammatical constructions that mental predicates occur in, constructions that are often but not always used also for physical events. Tense-aspect constructions indicate whether the mental event is construed as a state or a process, and argument structure constructions indicate the "direction" of causation in mental

events. In many cases, there is a lexical split between alternative construals of mental events.

Mental events have two primary participants, the person whose mental state/process is being described, usually called the *experiencer*, and the external situation (entity, etc.), called the *stimulus*; the stimulus of emotion predicates is also called the target/subject matter of emotion (T/SM) following Pesetsky (1995).

The semantics literature has described three common construals of the mental force dynamic relation between the experiencer and the stimulus. Viberg (1983), a cross-linguistic survey of the semantics of perception verbs, distinguishes *activity* from *experience* predicates, as illustrated in 127.[1]

(127) a. Everyone was **looking** at you.
b. I **see** garbage on people's side yards that they haven't even picked up.

The activity construal corresponds to Levin's *Marvel* verb class 31.3 (Levin, 1993) (emotion verbs) and *Peer* verb class 30.3 (perception verbs; Levin does not include cognition verbs, which usually take sentential complements). The experience construal corresponds to Levin's *Admire* verb class 31.2 (emotion verbs) and *See* and *Sight* verb classes 30.1 and 30.2 (perception verbs).

In the third construal of the relationship that has been discussed in the literature, the external situation is construed as causing a mental state to occur in the experiencer (Zaenen, 1993; Pesetsky, 1995; Levin and Grafmiller, 2013; Doron, 2017).

(128) a. But as much as they **annoyed** him, he annoyed them right back.
b. But most of the exhibits will **surprise**, perhaps **startle**, and in some cases **delight** viewers.

In languages such as Hebrew (Doron, 2017) and Korean (example 129) there is explicit causative morphology in the causative construal.

(129) Senghankyung-i tto han-pen na-lul nolla-**ke**
Senhankyung-NOM again one-time I-ACC surprise-**CAU**
ha-ess-ta
CAU-PST-DECL
'Senghankyung surprised me once again.' (Sejong Corpus)

The causative construal corresponds to Levin's *Amuse* verb class 31.1 (emotion verbs); there are no basic perception verbs with this construal.

Activity and experience perception events can be distinguished aspectually in English by the Progressive construction, which is sensitive to the stative-dynamic event distinction. English sometimes distinguishes activity and experience lexically (*look* vs. *see*). However, other verbs may have either construal:

[1] All examples in sections 5.1 and 5.2 are from the news segment of COCA unless otherwise indicated.

(130) a. You can **taste** the mixture to see if you want a stronger coffee flavor. [activity]

b. I could almost **taste** a dish by watching it being prepared, especially if it was something simple. [experience]

This is an example of a single verb having alternative semantic interpretations that need to be distinguished, although in this case both construals use the same argument structure construction (the transitive).

Croft (1993) argues that there are consistent differences in argument structure across languages between the activity, causative and experience construals, and offers a "causal" analysis for the differences. The activity construal always expresses the experiencer as subject, and the stimulus as either object (as in Spanish *mirar*) or as an oblique, usually derived from a locative (as in English *look at*). The activity construal conceptualizes the mental event in terms of the experiencer directing her attention to the stimulus: the experiencer engages in a mental activity, usually volitionally, and hence is coded as subject.

The causative construal always expresses the stimulus as subject; the experiencer is expressed as object or as an oblique, typically dative. The causative construal conceptualizes the mental event in terms of the stimulus causing a mental state to occur in the experiencer, as described above; hence the stimulus as initiator of the event is subject.

In contrast, the experience construal is variable: the experiencer may be subject or nonsubject, as in 131 (a nonsubject experiencer is often in a dative case, hence the term "dative experiencer"). Most English verbs have subject experiencers (Talmy, 1985). However, there are some English verbs taking the stimulus subject construction for the experience construal, namely Levin's *Appeal* verb class 31.4 (emotion) and her Stimulus Subject Perception Verb class 30.4 (perception).

(131) a. We can now begin to **understand** the senseless act.

b. What **appeals** to you might not **appeal** to your neighbor.

The experience construal conceptualizes both directing of attention by the experiencer and the change of mental state by the stimulus. Hence it is stative (no direction of causation), and either experiencer or stimulus may be expressed as subject.

There may be a subtle semantic difference in the experience construal when both argument structures are possible. When the experiencer is subject, they have greater control over the mental event, and when the experiencer is object, they have less control. In Yoruba, one of the major languages of Nigeria, the subject experiencer construction indicates that the experiencer has control over their anger, but the object experiencer construction indicates that the anger has come to them involuntarily (Rowlands, 1969).

(132) **Mo** binú *vs.* Inú bi **mi**
I anger_inside inside anger **me**
'I am angry' *vs.* 'I feel/felt angry'

Pesetsky (1995) argues that some transitive constructions in English are ambiguous between what we are calling causative and experience construals. He argues that sentence 133 may mean that the article in the *Times* causes Bill to be angry at something else, for example corruption described in the article (the causative construal), or it may mean the same as sentence 134, namely that Bill has a mental state of anger with respect to the article, for example because it was written in a biased manner (the experience construal). Sentence 134 has only the experience construal.

(133) The article in the *Times* **angered** Bill. (Pesetsky, 1995)

(134) Bill **was angry** at the article in the *Times*. (Pesetsky, 1995)

Pesetsky observes that one cannot express both the causative of the mental state and the distinct situation towards which the caused mental state is directed in a simple clause in English, although a periphrastic causative construction can express both. However, Doron (2017) observes that it is possible to do so in Hebrew.

(135) *The article in the *Times* **angered** Bill at the government.

(136) The article in the *Times* **caused** Bill to **be angry** at the government. (Pesetsky, 1995)

(137) ha-martse **'inyen** ota be-balshanut
the lecturer **interested** her in-linguistics
'The lecturer got her interested in linguistics.' (Doron, 2017)

A final issue is the occurrence of some emotion predicates in the progressive, such as *But she **isn't rejoicing** over her place in history.*. This does not seem to be the activity construal, since the activity construal requires some control over the mental state, and emotions generally cannot be controlled by the experiencer. It is possible that the progressive occurs here because the verb describes not just an emotional mental state but also outward action reflecting the mental state.

5.2 Towards an annotation scheme for mental events

Based on the analysis of mental events in the semantics literature summarized in section 5.1, we developed an annotation scheme for mental force dynamic relations. We applied this annotation scheme to the mental event verb classes in VerbNet. Specifically, we annotated each example sentence for each case frame for each verb class and subclass in VerbNet that describes mental events. The number of example sentences, and hence the number of VerbNet (sub)class case frames for mental events, is 233. In this process, we were obliged to add four additional annotations. Two of the four new annotations, Engage and Refrain, pertain to subevents functioning as arguments of the main clause predicate

event, which is uncommon in physical events but frequent in mental events. The other two new annotations, Judge and Intend, represent mental dynamic construals beyond the three construals discussed in the semantics literature.

5.2.1 Attend and Affect

The core of the annotation consists of the three construals of mental force dynamics described in section 5.1. The activity construal represents an Attend relation between the experiencer and the stimulus (or T/SM). The experiencer directs her attention to the stimulus; this is generally a volitional activity on the part of the experiencer.

The causative construal represents an Affect relation between the experiencer and the stimulus. The stimulus, which as noted above may be an entity, a state of affairs, or an occurrence of a dynamic event, brings about a mental state in the experiencer. This is not physical causation, let alone volitional causation, but what Talmy (1976) calls affective causation. Affect is also the force dynamic relation between an event of any kind and a Beneficiary (or "Maleficiary") who is positively (or adversely) affected by the event, as in *A school bookkeeper baked a cake* ***for Gurley*** *with purple-and-gold icing, the school colors.* In this case, as in Croft et al. (2016), a single clause will be annotated for two segments of the causal chain, the "core" event and the participant in the Affect relation with respect to the core event.

5.2.2 Experience and Experience*

The experience construal represents both Attend and Affect at once (see section 5.1), that is, one "direction" of causation is not highlighted at the expense of the other; as a result, the relation is construed as stative. However, for annotation purposes, we represent the double construal simply as a distinct, third type of construal, an Experience relation between experiencer and stimulus. This construal is generally a stative relation holding between the two participants, as in examples 138 and 140. It can also have an inceptive aspectual construal, as in examples 139 and 141; an inceptive construal is not uncommon among normally stative predicates.

(138) I **see** garbage on people's side yards that they haven't even picked up.

(139) Stead walked out the back door and suddenly **saw** a bobcat holding in its jaws a dead rabbit

(140) But I don't really **remember** much about the clock.

(141) I started to cross-examine them but suddenly **remembered** I'd left the tire iron inside the house.

We also distinguish between the experiential construal in which the experiencer is subject (Experience) and the construal in which the stimulus is subject (Experience*). The purpose of distinguishing these alternative argument linkings is to allow for the mapping of the referents of the subject and object

phrases to the correct semantic participant roles. Also, in those languages that distinguish alternative construals semantically, as in the Yoruba sentences given in example 132, Experience and Experience* allows us to capture the distinct semantic interpretations of the alternative construals.

5.2.3 Engage and Refrain

The stimulus for a mental event need not be an entity but may be a state of affairs or the fact of an event occurring. In some cases, the state of affairs is expressed as an event nominal, as in example 142 below. In this case, the Experience relation holds between the experiencer and a stimulus that represents a state of affairs. In another case, the state of affairs is expressed as a sentential complement, particularly with cognitive verbs (propositional attitude verbs), as in example 143. These are analyzed in force dynamic terms in the same way as example 142. (For now, we are not distinguishing between propositions and events as complement types.)

(142) I could understand [**their action**].

(143) She then discovered [**that a purse was missing**].

In yet other cases, the state of affairs is divided syntactically between the "subject" and the "predicate" of the state of affairs, as in example 144. The noun phrase *a threat* is traditionally described as a predicative complement. In order to simplify the mapping between the syntactic structure and the semantic structure, we treat the state of affairs' "subject" and "predicate" as two separate "arguments", and posit an Engage relation between the two (that is, the referent of *it* Engages in the property of being a threat). In fact, there are only two event participants, the experiencer and the stimulus state of affairs, namely that it is a threat.

(144) But in a June 2005 survey, by a 48% to 44% margin, more respondents judged [**it**] [**a threat**].

We have also tentatively posited the negative counterpart to Engage, Refrain, since the syntactic construction for Refrain in English differs from the construction for Engage (*Rebuilding a life in Black Forest won't completely free **[her] [of the emotional turmoil that has marked the past year]**, she said.*); as noted above, one of the goals of this annotation scheme is to capture the semantics of the argument structure constructions that mental event verbs occur in.

5.2.4 Judge

In addition, we posited another distinct mental dynamic image scheme, Judge. Judge describes an active mental process mostly under the control of the experiencer, like Attend: it describes mental processes such as comparing, categorizing, inferring and measuring something. Unlike Attend, however, Judge

describes the result of the mental process: the conclusion, classification or measurement arrived at. The result is often expressed as a predicative complement, as in example 144.

5.2.5 Intend

The final mental dynamic image schema that we added to our annotation is Intend, for the relationship between a volitional agent and the agent's as yet unrealized, and possibly never realized, action with respect to the other participant. The Intend relation can be used for an intended subevent of a physical action. For example, in *This is the way to cook a chicken for any kind of cold chicken salad, Asian or Western*, the agent performs a physical action on the chicken, but there is an intended subsequent subevent of preparing a cold chicken salad which is not (yet) realized in this sentence. Hence the Intend relation can be used for purpose arguments for all types of events, not unlike Affect with respect to the beneficiary of an event..

There are other verbs in which there are only two participants, the agent and the entity towards which the agent's intention is directed. These include verbs of searching, caring and longing.

(145) Police were **searching** for a man suspected in the shooting.

(146) She **cared** for her grandchild until the end.

(147) She **looked** after him for years in the orphanage after their birth mother died.

(148) They seem to **long** for the "good old days" that are forever gone.

(149) What outdoor cook doesn't **lust** after one of those giant stainless steel grills, a mini-fridge and a sink with hot and cold running water?

Searching verbs and caring verbs do involve physical actions on the part of the agent, but the action is directed towards a potentially unrealized subevent pertaining to the endpoint of the causal chain: finding what is being searched for, and continued good condition of what is being cared for. Verbs of longing, on the other hand, are more purely mental events. However, all three verb classes use the construction [Subject Verb *for/after* Oblique], with the prepositions *for/after* that are characteristic of the intention/purpose construction. For this reason, we have included all of these categories in our annotation of mental events.

Intend cannot be reduced to Attend, although both describe the directing of some sort of mental state towards an external stimulus that is not (yet) affected. Example 150 is an Attend relation, using a locative preposition for the auditory stimulus that attention is being directed to; but example 151 describes a mental activity directed towards a specific sound which may or may not ever be heard by the experiencer.

(150) I **listened to** the record again (recently) for the first time in years.

(151) I **listened for** any sound of life and screamed for help.

As noted above, some semanticists distinguish verbs of desire from other emotion verbs. Levin (1993) distinguishes two subclasses of desire verbs, *Want* verbs and *Long* verbs. Unlike *Want* verbs, *Long* verbs express their "stimulus" with *for/after* in English, like other verbs of intention. For this reason, we have analyzed verbs of longing as instances of the Intend mental dynamic relation. Since *Want* verbs are semantically very similar, one might consider whether they are also instances of Intend. However, *Long* verbs may also construe the mental event as dynamic, similar to verbs of searching or caring, whereas *Want* verbs are stative.

(152) Dorothy **needs /*is needing** new shoes. (Levin, 1993)

(153) Dana **longs/is longing** for a sunny day. (Levin, 1993)

We therefore conclude based on both syntactic and semantic differences that *Want* verbs represent an Experience construal of the desire event, while *Long* verbs represent an Intend construal.

5.3 Applying the annotation scheme to mental events

The annotation scheme for mental events is summarized in Table 5.1. The scheme was tested by having two annotators involved in our project annotate the mental events in the news corpus used for the 2016 Events Workshop shared task. This news corpus contains a total of 3749 events annotated in Richer Event Description (RED) annotation, which does not annotate for force dynamics. We restricted our annotation to actual real-world events: we excluded nonfinite forms, including nominals, adjectives and prepositions, examining only primary predications. We also excluded coreferring events, some of which overlap with the previous categories. This filtering was done to avoid issues with annotating aspect and unrealized events, also part of this project although not the topic of this paper.

The filtering process left 779 events. We have no reason to believe that the distribution and type of events in the excluded categories are different from the distribution and type of events (physical, mental, social) included in our analysis. In other words, we believe that the force dynamic classification of events in the sample of 779 events is representative of the 3749 events in the total corpus. We used the VerbNet verb classification for an initial filter for mental events, and then hand-filtered the result. This left 156 mental events, of which a further 43 were deemed not to be mental events in the course of the annotation exercise. In other words, mental events make up around 15% of the 779 events in the news corpus. This is a relatively small number, but we expect that some of the mental dynamic analysis will carry over to the social events—which make up 51% of the 779 events—since social interaction involves persons using

Annotation	**Brief definition (Exp = experiencer, Stm = stimulus)**
Attend	Exp directs attention to Stm: dynamic, volitional, no change to Stm.
Affect	Stm causes change of mental state of Exp: dynamic, causative. Used also to describe a Beneficiary/Maleficiary subevent in other types of events.
Experience	A perceptual, cognitive or emotional relation holds between Exp and Stm: stative (or inceptive), Exp is grammatical subject.
Experience*	A perceptual, cognitive or emotional relation holds between Exp and Stm: stative (or inceptive), Stm is grammatical subject.
Judge	Exp discerns or confers a perceptual, conceptual or evaluative status on an entity or a relation between entities: dynamic, volitional, no change to Stm.
Intend	Agent intends to act on another participant in some way but action on the participant is not realized: no change (yet) to participant. Used also to describe a Purpose subevent in other types of events.
Engage	A relation between an argument denoting a participant and another argument denoting the event/subevent that the participant is involved with. The participant is a core participant in the event.
Refrain	A relation between an argument denoting a participant and another argument denoting an event/subevent that the participant ends up *not* being involved with. The participant is a core participant in the event.

Table 5.1: Annotation scheme for mental events

their mental faculties in the interaction. It is also possible that conversational data, where people frequently talk about other people including their beliefs and attitudes, will have a greater proportion of mental events compared to news stories.

A trial annotation of 25 sentences was performed by the two annotators and discussed by the annotators, the adjudicator and two other participants in the project. This led to clarification of the informal guidelines for the application of the annotation scheme, and the exclusion of 4 examples which were determined not to be mental events. The test annotation was then done on 92 remaining sentences; a further 39 sentences were excluded before the text annotation as not mental events (see section 5.4). The test annotation consisted of 92 tokens; there was 81% agreement in annotation (75 out of 92), with a Cohen's kappa of .85. As usual, it is difficult to compare the scoring of our semantic annotation to other semantic annotation tasks. Our force dynamic analysis annotates the combination of verb semantic class and the argument structure construction and the meaning it contributes, so that task itself is also not easily comparable to other verbal semantic annotation tasks.

5.4 Error analysis

The analysis of inter-annotator disagreements in the test annotation indicated a number of areas in which the annotation scheme can be improved.[2]

A content issue that arose in the test annotation is distinguishing cognition from communication events with an unexpressed addressee. Cognition and communication share much conceptual structure: both describe propositional attitudes, both can alternatively construe the propositional content as a topic (Boas, 2010), and both have a cognizer of the content/topic.

Communication events of course also have a second cognizer, the addressee. But it is sometimes rather subtle to decide whether the verb without an addressee entails that the propositional content must be expressed verbally and hence must describe a communication event. For example, support of a political position, as in *Skelton was a social conservative who* ***supported*** *gun rights*, is frequently verbalized, since politicians are expected to express their political views; but it was concluded that a person can support (believe in) a particular policy without necessarily expressing it to anyone, and hence *support* can describe a mental event.

On the other hand, the negative evaluation of *condemn* in *Michaloliakos* ***condemned*** *the murder last month of a 34-year-old hip-hop artist and anti-fascist, Pavlos Fyssas, by a self-professed supporter of Golden Dawn* is necessarily a speech act and hence is a communication event. 22 examples were reclassified as communication events, and the guidelines have been clarified to specify whether or not verbal expression of the mental state is inherently part of the verb meaning.

[2] All examples in this section are from the 2016 NAACL Events Workshop shared task news corpus.

Some emotional states can emerge without there being a clear external situation that brings it about, as in *But I **feel so good**....* We concluded that we had to posit a distinct annotation category, State, to represent an autonomous mental state that is not presented as part of a mental force dynamic relation to an external situation. The State mental event type is not found in VerbNet, possibly due to the fact that syntactically *good* is an adjective, not a verb.

A second issue is the fact that the same verb may have different mental force dynamic construals. This is of course the primary reason for positing such construals as part of constructional meaning. In some cases, the difference is indicated by a difference in the tense-aspect construction rather than the argument structure construction.

(154) [The British Foreign Office] **was considering** his request for a meeting with Hague.

(155) According to the Arizona Republic, Kyrsten Sinema **is thinking** of running.

(156) A saffron red thread called a tilak, worn around the wrist **is considered** to have deep religious significance among Hindus,

(157) I **thought** the point of an ecumenical council was to clarify essentialy (*sic*) there is a despute (*sic*) over the right faith and the council "decide" what is.

Examples 154 and 155 construe the mental event as dynamic and hence they describe the experiencer directing their cognitive attention towards the event, that is, the Attend relation. In contrast, examples 156 and 157 are stative and hence they describe the Experience relation holding between the experiencer and the stimulus situation. In addition, the latter two also express the situation as a finite complement clause, the typical expression of the propositional content of the cognitive experience. In contrast, 154 and 155 use event nominals to express the state of affairs being considered. Although the argument structure constructions are sometimes idiosyncratic in what mental dynamic relation they encode, the occurrence of the Progressive is a reliable cue that the mental dynamic relation is Attend as opposed to Experience.

A third issue that arose in the test annotation pertains to the difference between adjectival passives–an adjective with a passive participle form–and verbal passives (Wasow, 1977). A verb like *annoy* is usually construed as a causative, and the passive with *by* for the stimulus/causing participant is simply the passive voice version of the causative (Affect) construal. However, there also exists an adjectival form which is identical to the passive participle, but governs the stimulus with a lexically idiosyncratic preposition, one of the metaphorical locative prepositions typically found with the stimulus of mental events. The adjectival form is an instance of the Experience construal.

(158) He was **annoyed by** her hectoring. (COCA News corpus) [Affect]

(159) I was **annoyed at** him, for interfering in the elections, giving statements here and there. (COCA News corpus) [Experience]

Wasow (1977) observes that the adjectival and verbal passive forms are mostly easily distinguished in their syntactic behavior, with one exception: *known*; but *known* with a predicative complement, such as example 160, is the verbal passive (cf. the active counterpart *They know him as/to be an expert on national defense*). Example 160 and two other examples of *be known* in the test annotation were labeled Experience instead of (passive) Affect.

(160) Skelton, who was first elected to the House in 1976, **was known as** an expert on national defense

5.5 Conclusion

Mental events have not been studied in detail in approaches to a finer-grained annotation of events. The verbal semantics literature in theoretical linguistics has identified three common construals of events, which we have annotated as Attend, Affect and Experience (including Experience* for the alternative linking of the stimulus to the subject grammatical role). However, we needed to add two other mental dynamic construals, Intend and Judge, plus two construals, Engage and Refrain, for subevents.

The text annotation provided fairly reliable interannotator agreement. Error analysis indicated a number of subtle annotation judgements that can be honed with more explicit guidelines to distinguish cognition from communication events when the latter have an unexpressed addressee, adjectival passives from verbal passives, and to exploit aspectual as well as argument structure cues in the syntactic constructions. In sum, however, the task of annotating VerbNet mental event classes and annotating news corpora has led to a relatively stable annotation scheme for mental event structure.

Chapter 6

Semantics of possession verbs and argument structure constructions (Pavlína Kalm)

6.1 Introduction

In this chapter and the following two chapters, we describe social events. We define social events as events involving the interaction of two or more agents, and/or involving socially defined properties and relations. Semantic classes of verbs and associated argument structure constructions that denote social events fall into three broad categories of social behavior, with only a few exceptions. The first category involves possession. Possession events involve a socially defined relation between an agent and an entity, and two or more agents may be involved in a transfer of possession. Communication events involve two or more agents using a medium such a language or nonlinguistic signals which bear meaning (information content), a property of signals that is defined by the conventions of a speech community to which the agents belong. Function/role events involve a socially defined role (formal or informal) of an agent, including a role in a social institution that involves relations to other agents, and changes to that role including changes caused by another agent.

Our discussion of possession verbs is restricted to verbs that describe events of 'ownership' in which an agent has immediate physical control over the object (e.g., *She has a key* or *He gave her a key*). Our analysis of verbal and constructional semantics allows for a metaphorical extension of this prototypical ownership sense to argument structure constructions in which more abstract ownership situations are expressed, such as obtaining or transfer of socially defined non-physical entities (e.g., *She acquired a college degree* or *She owns*

shares in their company). We do not address other semantic functions observed with possession verbs that have been discussed in the literature, such as the highly polysemous verb *have* in various grammatical constructions in English (cf. Brugman 1988, Langacker 1995, Francis 2000).

Distinct semantic functions have been argued to be associated with the semantics of argument structure constructions with possession verbs in English depending on the semantics of the participants involved in the event (e.g., Aikhenvald 2013a). For example, constructions which describe a relation between an agent and their body part (e.g., *John's arm*) are semantically different from ownership constructions (e.g., *John's car*). In other cases, possession constructions may describe kinship relations (e.g., *John's father*). Crosslinguistically, the category of "possession" has been found not to be a unitary cognitive category (Wierzbicka and Goddard, 2019). The category of possession "represents an aggregation of diverse semantic schemas which center around three distinct conceptual anchor points: ownership, body-part, and kinship relations" (Wierzbicka and Goddard 2019, 224, cf. Aikhenvald 2013a, 3). The authors argue that cognitively, these different phenomena represent different "semantic primes": the ownership schema can be described by the semantic prime MINE, body-part by PARTS and kinship by the "semantic molecules 'mother' and 'father"' (Wierzbicka and Goddard, 2019, 225). In their view, "possession" as a category should be conceptualized as a set of interrelated cognitive schemas.

The semantic analysis of possession verbs presented here investigates the event structure associated with possession verbs in ownership contexts, in which there is a socially sanctioned CONTROL relation between an agent and an owned entity. Our semantic analysis of the force-dynamic event structure evoked by the semantics of possession verbs reveals that possession verbs can be grouped into three basic semantic categories: Possession verbs (section 6.2), which describe a stative relation between a Possessor and a Possession, Dynamic Possession verbs (section 6.3), which describe a dynamic relation between a Possessor and a Possession, and Transfer of Possession verbs (section 6.4), which describe a dynamic relation between an Agent, a Possession and a Possessor. The event structures associated with these verb types overlap to a great extent. All verbs evoke a Control relation between a Possessor and a Possession. With Possession and Dynamic Possession verbs, the Possessor is the initiator of the event. With Transfer of Possession verbs, the initiator of the event is an Agent, rather than the Possessor.

6.2 Possession verbs

Possession verbs such as *own, have,* or *belong to* have received much attention in the linguistics literature. Studies have focused on the grammatical encoding of possession verbs in different languages (e.g., Heine 1997; Stassen 2009; Aikhenvald and Dixon 2013), the historical origins of possessive morphemes and verbs (e.g., Heine 1997), or the semantics of a particular possessive construction in a language (e.g., Taylor 1996).

Possession verbs describe events of ownership between an agent and their possession (161). The agent has physical control over their possession in the most prototypical Possession sense. Neither participant undergoes change in the event. The stative nature of Possession examples contrasts with the event structure associated with Dynamic Possession verbs (discussed in section 6.3) which evoke dynamic events in which the agent either acquires or loses their possession.

(161) a. She owns a house.
b. He has a book.
c. The book belongs to him.

Our semantic analysis of Possession verbs is guided by cross-linguistic evidence that many Possession verbs in world's languages originated in physical Constrain verbs, such as *grasp* and *hold* (cf. Langacker 1995, 64, Stassen 2009, Aikhenvald 2013a, 28). The close correspondence between these two events is best illustrated by examples such as *She held the book*, in which the Agent's physical constraining of the object can also be interpreted as them having control over it. In the physical domain, the Constrain network (illustrated in Figure 4.2) evokes a physical FORCE relation between an Agent and a Theme. The Force relation describes the physical *holding* or *gripping* action in which the Agent constrains the Theme from falling or moving. The Constrain network also includes a CO-LOCATION relation between the Agent and the Theme. The Co-location relation specifies that the entities are in a close spatial configuration together, which is a necessary semantic component of the event.

The Possession network shown in Figure 6.1 describes the non-causal relation between the Possession and the Possessor as CONTROL. The Control relation is a force-dynamic relation that prototypically describes a socially sanctioned relation between an agent and a physical entity. There is a metaphorical correspondence between the Control relation in the social domain and the Co-location relation in the physical domain. The causal relation between the Possessor and the Possession is defined as PERFORM. The Agent uses a performative action to establish their ownership of a Possession. The Perform relation in the Possession network metaphorically corresponds to the physical Force relation in the Constrain network. Unlike Constrain verbs, which always occur in Force argument structure constructions in English, Possession verbs may occur in argument structure constructions that metaphorically describe either the Perform relation or the Control relation (see section 6.2.2).

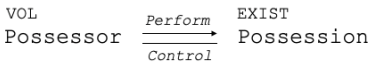


Figure 6.1: Possession event structure.

The Possessor is labeled as a Volitional entity VOL in the verbal network. The subevent of the Possession participant is identified as EXIST to indicate

that the Possession doesn't undergo any change in the event.

Possession verbs are in the own-100.1 class in VerbNet. FrameNet has Possession and Retaining frames for Possession verbs.

6.2.1 Syntactic realization of participants with Possession verbs

The Agent is syntactically expressed as a subject with *own* and *have* verbs in English, as shown in examples (161a) and (161b). In such argument structure constructions, the Possession is expressed as a direct object. Verbs such as *belong* syntactically express the Agent as a *to*-oblique and the Possession as a subject (161c). It has been argued that this syntactic alternation is "pragmatically-based" in English, depending on which of the two participants is in focus (Aikhenvald 2013b, 29, Heine 1997). Our analysis of the constructional semantics does not address this issue though we do propose a distinct analysis for each of the two variants in section 6.2.2, arguing that the semantics of these events differ given the distinct syntactic realization of participants.

6.2.2 Semantics and annotation of argument structure constructions with Possession verbs

There are two argument structure constructions that are used with Possession verbs in English: a transitive [SBJ V OBJ] construction and an intransitive [SBJ V *to*-OBL] construction. In our analysis, these argument structure constructions originate in two distinct metaphors extended from the physical domain: a Constrain metaphor and a Location metaphor. In the Constrain metaphor, the Possessor is causally antecedent to the Possession and the force-dynamic relation between the two participants is causal. In the Location metaphor, the Possession precedes the Possessor in the causal chain and the relation between the relation between the participants is non-causal.

6.2.2.1 Constrain metaphor

We analyze the semantics of the transitive argument structure construction (e.g., *He owns a car*) as a metaphorical Constrain event. The causal Perform relation between the Possessor and the Possession is metaphorically construed as a physical Force relation in the constructional semantics. The Possessor's owning of a Possession is metaphorically construed as a physical event of 'holding' in which the Possessor exerts physical Force to have control over the Possession. The causal chain associated with the semantics of the Constrain argument structure construction is shown in Figure 6.2.

The force-dynamic relation between the Possessor and the Possession is identified as metaphorical "Force". We do not have a "Constrain" force-dynamic relation in the physical domain. Force is used as a superordinate term for force and constrain events. Our motivation for not distinguishing Constrain from Force as a force-dynamic relation is motivated by the fact that both events

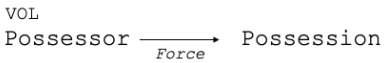


Figure 6.2: Constrain construal with Possession verbs.

use the same argument structure construction in English, namely the transitive construction. The subevent of the Possession participant is unspecified as an endpoint of Force. The source-domain constructional semantics does not specify whether the endpoint of Force undergoes change or not. The subevent of this participant is specified in the verbal network.

The Force relation in the causal chain maps directly into the social Perform relation in the Possession network. An example of a mapping of a metaphorical Constrain argument structure construction to the Possession network can be found in Figure 6.3).

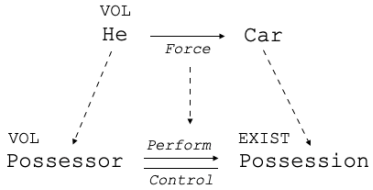


Figure 6.3: Location construal with Possession verbs.

The causal chain associated with the metaphorical Constrain argument structure construction is annotated the same as the source domain causal chain: Self-volitional (FD1) Force (FD2).

6.2.2.2 Location metaphor

Possession verbs can occur in argument structure constructions in which the relationship between the Possession and the Possessor is metaphorically construed as a physical Location. The English verb *belong* in the example *The book belongs to him* occurs in such a construal. The Possession is metaphorically construed as the Figure and the Possessor as the Ground. The Possession thus precedes the Possessor in the causal chain representation, as shown in Figure 6.4. *Belong* can also be used in a purely physical context in which it describes a "co-location" relation between two physical entities, e.g., *The barn belongs to the house*. The *barn* is the Figure and the *house* is the Ground.

Interestingly, the [Sbj V *to*-Obl] argument structure construction uses a 'dynamic' preposition to describe a stative possessive relation. It is not common to use the *to*-oblique to syntactically express the Ground in physical Location events.[1] A possible motivation for the encoding of the Possessor as a *to*-oblique

[1]However, it is possible to use dynamic prepositions to describe Location events in fictive

in Possession examples is that recipients in transfer events are also expressed as *to*-obliques (e.g., *She gave the book to him*). The event semantics of these two types of events have much in common, despite the stative vs. dynamic interpretation. In both types of examples, the Possession causally precedes the Possessor. The relation between the two participants is Control, and the Control relation is metaphorically construed as a physical Path relation.

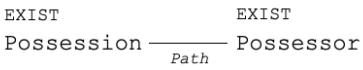


Figure 6.4: Location construal with Possession verbs.

The causal chain associated with the metaphorical Location construal shown in Figure 6.4 describes a physical Path relation between the Possession and Possessor. In this construal, the Possessor is not a volitional Agent. It is metaphorically construed as a physical Ground which specifies the location of the Figure, i.e. Possession, and is labeled EXIST. The EXIST subevent label of the Possession is inherited from the source domain causal chain. This causal chain maps to the second segment of the verbal network. The physical Path relation in the source domain maps to the social Control relation in the target domain.

The annotation of the causal chain in Figure 6.4 uses the source domain FD2 label Location. The non-volitional initiator is internal to the core event and is therefore labeled Autonomous (FD1).

6.3 Dynamic Possession verbs

Dynamic Possession verbs such as *get*, *obtain*, or *relinquish* describe events in which a Possessor either gains or relinquishes/loses control over Possession (162). The example in (162a) describes an event in which the Possessor gained control over her keys by locating them. In (162b), the Possessor comes to have ownership or control over a book. The verbal semantics of *getting* doesn't entail an original possessor or 'giver'. Lastly, in (162c), the event describes the Possessor losing control over their shoe. *Losing* doesn't evoke a recipient.

(162) a. She found her keys.
b. He got the book.
c. She lost her shoe.
d. She got the book from him.

The event structure representation evoked by Dynamic Possession verbs is very similar to that of Possession verbs described above. Dynamic Possession

motion examples (e.g., the preposition *through* in *The voices echoed through the hall* or *The river runs through the valley*).

verbs obligatorily evoke the same two participants: a Possessor and Possession. However, unlike Possession verbs, Dynamic Possession verbs describe a dynamic event in which the Possessor comes to have control over the Possession. The dynamic nature of the event is represented by the [MER] subevent label on the Possession participant which indicates a mereologically incremental change in possession; the change in possession may happen part by part analogous to the incremental change characteristic of application and removal events in the physical domain (Dowty 1991). For example, in *The child found all the Easter eggs* or *He gradually lost all his possessions*, the Possessor gains/loses control over the Possession one piece at a time. We do not distinguish whether the incremental theme is [+/-MER] as it is not relevant to the verbal event structure; it is only relevant to the syntactic realization of participants.

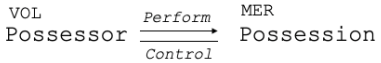


Figure 6.5: Dynamic Possession event structure.

The Agent uses performative force (PERFORM) to bring about change in the endpoint, i.e., to gain/lose control over the Possession. The Possessor, as an initiator of the Perform relation, is identified as a Volitional (VOL) entity. The Possessor is considered Volitional even in events that happen accidentally, such as when someone loses their possession. The outcome of the Possessor's action may not be intentional in such events but it is carried out volitionally.

VerbNet classes that contain Dynamic Possession verbs are obtain-13.5.2, get-13.5.1, earn-54.6, contribute-13.2, and consume-66. VerbNet does not have a class for verbs that describe a loss of possession. We categorized obtain-13.5.2 and get-13.5.1 verb classes as describing Dynamic Possession events despite there being some verbs in these classes that evoke more complex event structures. For example *borrow*, *receive* or *inherit* in the obtain-13.5.2 class evoke an original possessor or a giver in the event structure and would be better analyzed as Transfer of Possession verbs. However, other verbs in this class, such as *recover*, *grab*, or *acquire* do not necessarily evoke a giver. Given that our verbal networks map to VerbNet classes, rather than particular verbs in these classes, we decided to have a unified 'class' analysis and classified the obtain-13.5.2 and get-13.5.1 classes as Dynamic Possession verbs.

There are three frames in FrameNet frames that include Dynamic Possession verbs as Lexical Units: Amassing, Earnings_and_losses and Expend_resource.

6.3.1 Syntactic realization of participants with Dynamic Possession verbs

The Possessor with Dynamic Possession verbs is always expressed as a subject. The Possession is syntactically realized as a direct object. The semantics of argument structure constructions with Dynamic Possession verbs are discussed in the following section 6.4.3.

An additional participant, such as an original possessor or 'donor' may be constructionally added to the event structure and syntactically expressed as an oblique argument, as shown in (163). The event describes a transfer between the original possessor and the new possessor who comes to gain ownership or control over a Possession. The original possessor is syntactically expressed as a *from*-oblique. The semantics of the [SBJ V OBJ FROM-OBL] argument structure construction with Dynamic Possession verbs is discussed in section 6.4.3.

(163) a. She got the book from him.
b. Carmen obtained the spare part from Diana.

Dynamic possession verbs can also occur in argument structure constructions in which the event of obtaining requires an exchange with another item (e.g., *She obtained it for a small gift in exchange*) or the event describes commercial transaction (e.g., *She obtained it for five dollars*). The semantics and syntax of exchange events, including commercial transaction events, is discussed in section 6.5.2.

6.4 Transfer of Possession verbs

There is considerable coverage of the semantics and syntax of Transfer of Possession verbs in the linguistics literature. The focus has been on a very narrow range of verbs, however. For example, Newman (1996) looks specifically at the verb *give* and its lexical semantics and syntactic behavior from a typological perspective. Similarly, Viberg (2010) uses a combination of lexical typology and corpus-based analysis to study *get, give,* and *take* verbs in Swedish, English and a number of other European languages. Other studies focus on the "dative alternation", a syntactic alternation observed with English Transfer of Possession verbs, verbs of ballistic motion, and send verbs (e.g., Oehrle 1976; Beavers 2011; Rappaport Hovav and Levin 2008; Goldberg 1995). Levin (2008) discusses "dative verbs" from a crosslinguistic perspective. The semantics of the dative alternation is further discussed in section 6.4.3.3.

Transfer of Possession verbs, such as *give, take,* or *steal* evoke an en event in which a Possession is transferred from one agent to another (Newman, 1996; Viberg, 2010), as shown in examples in (164). The transfer event may be cooperative (164a, 164c) or adversarial (164b, 164d). Verbs such as *steal* or *cheat* describe events in which the original possessor does not willingly give up their possession.

(164) a. The lent me a bicycle.
b. The thief stole the painting from the museum.
c. Brown presented a plaque to Jones.
d. The swindler cheated Pat out of her fortune.

Our semantic representation does not aim to to represent the full complexity of verbal semantics or the nuances between different possession verbs in their

semantic frames. Our verbal event structure focuses on obligatorily evoked participants and the relations between them that are syntactically expressible. Consequently, we do not represent a direct cooperative or adversarial relation between the two agents in the verbal event structure.

The verbal network in Figure 6.6 describes the event structure associated with Transfer of Possession verbs. The network is similar to the Dynamic Possession and Possession networks in that the Possession participant is an endpoint of a Perform relation and an initiator of a Control relation. Transfer of Possession verbs describe dynamic events, like Dynamic Possession verbs; however, they evoke three distinct participants: a volitionally acting Agent who initiates the transfer event, the Possession being transferred, and the Possessor who either gains or relinquishes or loses control over the Possession. With Dynamic Possession verbs, the Agent and the Possessor are the same entity in the event structure: the Possessor initiates the Perform relation and is also the endpoint of the Control relation. With Transfer of Possession verbs, the Agent and the Possessor are distinct entities.

Figure 6.6: Transfer of Possession event structure.

The Possession and the Possessor are both assigned MER subevent labels in the network. The Possession undergoes a mereological change by being transferred, similarly to the Possession participant with Dynamic Possession verbs. The Possessor is also a mereological theme with Transfer of Possession verbs as they gain or lose control over the Possession. This is also true of the Possessor with Dynamic Possession verbs; however, we did not specify the MER subevent label in the Dynamic Possession network because the Possessor is syntactically never construed as a mereological theme (i.e., a direct object). Only one subevent label is generally specified for each participant in the network.

We do not specify a Control relation between the Agent and the Possession. We recognize that in many cases, a giving verb entails that the Agent loses Control over the Possession and a taking verb entails that the Agent gains Control over the Possession. However, this relation is not a precondition for the transfer event. Some transfer events do not entail a Control relation between the Agent and the Possession, as discussed in section 6.4.3.3 with respect to the example *The FBI provided the informant with a new identity.* Additionally, English argument structure constructions do not express this relation; the Agent is construed as an external initiator of a Control relation between the Possession and the Possessor.

VerbNet classes with Transfer of Possession verbs include: bill-54.5, cheat-10.6, contribute-13.2-2-1, deprive-10.6.2, equip-13.4.2, fulfilling-13.4.1, future_having-13.3, give-13.1, pay-68, rob-10.6.4, and steal-10.5. VerbNet doesn't have separate verb classes for commercial transaction verbs such as *sell, buy,* or *pay.* Our inventory of verbal networks that map to VerbNet classes thus doesn't include

separate networks for these verbs. However, commercial transaction verbs do evoke an Exchange relation between the purchased possession and money in their event structure. We discuss the semantics of these verbs separately in section 6.6.

FrameNet frames that include Transfer of Possession verbs as Lexical Units include: Robbery, Theft, Taking, Prevent_or_allow_possession, Billing, Commerce_collect, Commerce_pay, Commerce_sell, Delivery, Supply, Giving, and Offering.

6.4.1 Future having verbs

Future having verbs such as *promise* or *offer* are analyzed as evoking a Transfer of Possession event structure despite there not being an entailment that the Possessor (= intended recipient) actually receives the Possession (165). In (165a) and (165b), the agent has the intention of giving somebody their house in the future. In (165c), the event of transfer is not only dependent on the agent following through with their offer but also depends on the Possessor accepting the offer. And in (165d), the dispersement of the allocated money is set to happen at a later time provided that the agent follows through.

(165) a. I promised my house to somebody.
b. I promised him my house.
c. We offered our paycheck to her.
d. We allocated money to the organization for pensions.

Koenig and Davis (2001, 76) argue that the semantics of future having verbs "is fundamentally the same as that of *give*, but contains some additional modifying elements" specified in the SUBLEXICAL MODALITY of the verb (see also Croft 2003). For example, promise verbs entail a transfer of possession event in a world in which people honor their promises. That is, a promise event is a transfer of possession event when the set of circumstances in which the person performing the speech act carries out their promises is fulfilled (Koenig and Davis, 2001, 101).

In our analysis of verbal semantics, we do not aim to represent the sublexical modality of verbs. Sublexical modality does not change the force-dynamic relations between participants in the event structure. The relations between participants in *promise* and *give* event structures are the same; the entailment that the transfer in promise events happens in the future does not change the force-dynamic event structure. Therefore, there is no need to distinguish between the force-dynamic event structure associated with future having verbs and other Transfer of Possession verbs. Using the same event structure representation for future having verbs and other Transfer of Possession verbs shows the shared force-dynamic relations between participants in these events (or the "situational core" in Koenig and Davis 2001).

Additionally, future having verbs occur in the same syntactic alternations as other Transfer of Possession verbs which further supports our joined analysis

of these verbs. Specifically, they occur in the double object/*to*-oblique recipient alternation, as shown in example (165a) and (165b). The semantics of these argument structure constructions is discussed in section 6.4.3.

Importantly, our analysis of future having verbs as Transfer of Possession verbs is compatible with VerbNet's analysis of this class of verbs. VerbNet's analysis is the same for these verbs. VerbNet has an additional specification that the event of transfer with promise verbs is "IRREALIS." We do not specify sublexical modality in our verbal representations.

6.4.2 Syntactic realization of participants with Transfer of Possession verbs

The Agent is realized as a subject and the Possession as a direct object. The Possessor may be realized as a direct object or a *to*-oblique in events of giving or a *from*-oblique in events of taking. The semantics of argument structure constructions with Transfer of Possession verbs is discussed in the following section 6.4.3.

6.4.3 Semantics and annotation of argument structure constructions with Dynamic Possession and Transfer of Possession verbs

We discuss the semantics of argument structure constructions with Dynamic Possession and Transfer of Possession in one section since they occur in similar construals. The double object "Transfer" argument structure construction discussed in section 6.4.3.1 is restricted to Transfer of Possession verbs. Both types of verbs can occur in a metaphorical Constrain construal (section 6.4.3.2), in which only the initiator of the event and the Possession are overtly expressed, and a metaphorical COS construal (section 6.4.3.5), in which only the initiator of the event and the Possessor are overtly expressed. Metaphorical mereological argument structure constructions are used to describe transfer events in which all three participants are overtly expressed (sections 6.4.3.3 and 6.4.3.4).

6.4.3.1 Transfer construal

Transfer of Possession verbs, particularly give verbs, may use a double object [SBJ V OBJ OBJ] argument structure construction to express events in which an Agent causes that a Possession is transferred to a Possessor (166). The semantics of the ditransitive construction in English has been well studied. It has been widely accepted that the construction describes an event of transfer or "caused possession" (e.g., Rappaport Hovav and Levin 2008; Beavers 2011). Studies on the dative alternation (e.g., Levin 2008) support this analysis as they show that verbs of ballistic motion or send verbs entail a transfer event in the double object construction (e.g., *She threw him the ball* or *He sent her a letter*) though their semantics does not evoke transfer, only motion. Such examples support

the analysis that it is the constructional semantics that encodes transfer of possession rather than the verb alone.

(166) a. They lent me a bicycle.
b. He paid me 5000 pounds.
c. He gave me a book.

We use social domain force-dynamic relations to represent the semantics of this argument structure construction. The causal chain representation shown in Figure 6.7 is therefore very similar to the Transfer of Possession verbal network. The Agent uses a Perform relation to initiate the transfer event. Both the Possession and the Possessor are specified as mereological themes given their syntactic realization as direct objects in the "Transfer" argument structure construction. The subevents of the themes are specified with the "+" sign to signal that the Possession is *given* to the Possessor, rather than *taken* from the Possessor. The use of +/- signs with mereological themes in the social domain follows the same rules as their use in the physical domain.

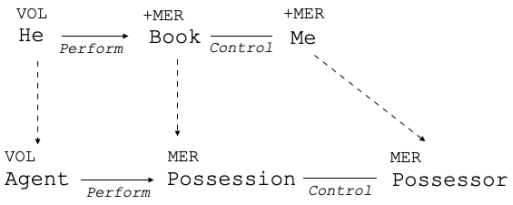


Figure 6.7: Transfer causal chain.

The Transfer argument structure construction is prototypically used with giving verbs. Their verbal event structure aligns with the constructional semantics since these verbs describe events in which an Agent causes a transfer of Possession to a Possessor.

(167) a. The thief stole Mary some paint.
b. Carmen bought Mary a dress.
c. We got the gas and I let her buy me a coffee from the cashier. (COCA)

However, taking verbs can also occur in the Transfer construction in English (167). In this construal, the first direct object is the final recipient who is intended to possess the Possession, it is not the original possessor (or the victim) from whom the Possession is taken. The semantics of the Transfer construction with taking verbs has not been addressed in the literature because taking verbs, unlike giving verbs, do not occur in the dative alternation. The use of taking verbs in the Transfer construction is somewhat unexpected. The Agent removes the Possession from a Possessor who is therefore a -MER theme in the constructional causal chain representation when it is syntactically expressed. This is

different from the Possessor in the Transfer construction with giving verbs who comes to have control over the Possession and is therefore labeled +MER.

The constructional semantics for the double object [SBJ V OBJ OBJ] argument structure construction with taking verbs is the same as shown for giving verbs in Figure 6.7; however, the mapping to the verbal network is different. The mapping to the verbal network shows that the recipient with taking verbs denotes a participant that is constructionally added, i.e., the recipient is not evoked by the verbal semantics. As shown in Figure 6.8, the endpoint of the CONTROL relation, Mary, doesn't map to the Possessor in the verbal network because she is not the original possessor of the stolen item. Mary is constructionally added as an intended recipient of the item that the thief stole.

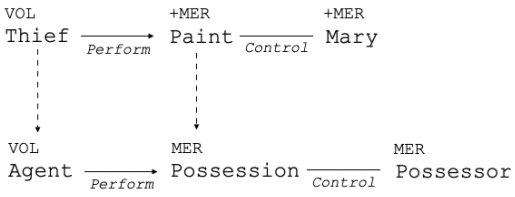


Figure 6.8: Mapping of *The thief stole Mary some paint* to the Transfer of Possession network.

A more complex causal chain representation is required for examples in which both the intended recipient and the original possessor are syntactically expressed in the same argument structure construction, such as in (167c). In such examples, two distinct core events have to be represented: a removal event in which the agent takes a coffee from the cashier and a transfer event in which the agent intends to give the coffee to me. The semantic representation requires two distinct causal chains since the agent is engaged in two separate core events. The constructional representation for (167c) is shown in Figure 6.9.

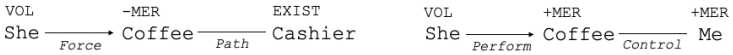


Figure 6.9: Causal chain representation for *She bought me a coffee from the cashier.*

The two causal chains are temporally ordered: The buying event temporally precedes the (intended) giving event. The first causal chain describes the event structure associated with the argument structure construction *She bought coffee from the cashier*. The example is analyzed as a metaphorical use of the physical remove construction discussed in section 6.4.3.4. The second causal chain represents the semantics of the argument structure construction *She bought me coffee*, which corresponds to the Transfer causal chain discussed in the current section above.

Unlike giving verbs, taking verbs do not occur in the dative variant. Rather, they express the intended recipient as a benefactive *for*-oblique (e.g., *The thief stole some paint for Mary*). The Transfer-*for* alternation is also common with other verbs, such as verbs of creation or performance in the physical domain (168). The indirect object in these argument structure constructions describes the intended recipient of the creation or the performance. This can be also illustrated on examples in which a possessive construction is used to describe the result of the event with verbs such as *dig* and *grill*: once the hole is dug, "the hole is *mine*," and once Donna grills the steaks, "the steaks are *mine*".

(168) a. David dug me a hole.
b. David dug a hole for me.
c. Donna grilled me steaks.
d. Donna grilled steaks for me.
e. Sandy sang me a song.
f. Sandy sang a song for me.

Based on this evidence, we argue that the Transfer argument structure construction can alternate with either the giving [SBJ V OBJ *to*-OBL] or the benefactive [SBJ V OBJ *for*-OBL] argument structure construction in English. The alternation is determined by the semantics of the verb. The causal chain associated with the *for*-oblique variant with taking verbs (e.g., *He bought a coffee from the cashier for me*) is shown in Figure 6.10. The constructional semantics describes an event in which the participant expressed as a *for*-oblique is intended to benefit from the taking event by receiving the Possession from the Agent at a later time. This is what motivates the construal of the recipient as a beneficiary. The beneficiary is causally subsequent to the core taking event.

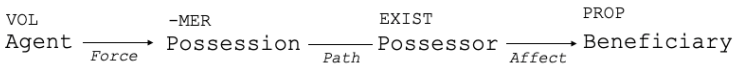


Figure 6.10: Double object argument structure causal chain with an original possessor.

The Transfer argument structure construction can also be used with Communication verbs (e.g., *He told him the secret*). The constructional semantics for these examples are analyzed as instances of metaphorical Transfer. For more discussion of our analysis of Communication verbs, please see Chapter 7.

6.4.3.2 Metaphorical Constrain construal

Dynamic Possession verbs can occur in a metaphorical Constrain argument structure construction (169a-169c) in which the event describes an obtaining or relinquishing relation between an Agent and a Possession. Similarly to Possession verbs, the Constrain metaphor with Dynamic Possession verbs originates

in the Perform relation between the Agent and the Possession in the verbal network. The Perform relation directly links to the Force relation in the physical source domain. The Agent's obtaining of a Possession is metaphorically construed as a physical event of 'picking up' in which an Agent gains physical control (and is spatially co-located) with an object by grasping it. The metaphorical construal of relinquishing of a Possession is parallel. The event of relinquishing is metaphorically construed as an event of 'dropping' or 'letting go' of an object in which an Agent willingly loses physical control (and is spatially no longer co-located) with an object.

(169) a. Carmen obtained the spare part.
b. He lost the book.
c. She got a new car.
d. The thief stole the paint.

The transitive Constrain argument structure construction can also be used with Transfer of Possession verbs, in particular verbs of taking (169d). It is generally uncommon to use the Constrain metaphor with giving verbs (e.g., **He gave the book*) since they tend to occur in argument structure constructions in which the Possessor is syntactically expressed.

Figure 6.11 depicts the constructional semantics associated with the examples in (169). The causal chain representation is identical to the representation used for static Constrain examples with Possession verbs in section 6.2.2.1. As noted above, Constrain events are subsumed under a more general Force schema, and we do not specify the subevent of the Theme in Force events. Consequently, we do not distinguish static and dynamic events of Constrain. The verbal network supplies this information about the event structure.

Figure 6.11: Metaphorical Constrain causal chain with possession verbs.

The causal chain in Figure 6.11 is annotated Self-volitional (FD1) Force (FD2). This annotation matches the causal chain in the source domain. Metaphorical causal chains are additionally annotated for Event Domain, which is "Possession" with Dynamic Possession and Transfer of Possession verbs.

6.4.3.3 Metaphorical Place and Provide construals

Dynamic Possession and Transfer of Possession verbs can occur in a [SBJ V OBJ *to*-OBL] argument structure construction (170) in which the *to*-oblique denotes the Possessor (= recipient) of the transferred Possession.[2]

[2]The *to*-variant is not commonly used with Dynamic Possession verbs which describe events in which the Agent *relinquishes* or *loses* their Possession. There are no examples in VerbNet, though examples of *relinquish* in this construal can be found in the COCA corpus: *September relinquished the key to his brother.*

(170) a. We contributed our paychecks to her.
b. Brown presented a plaque to Jones.
c. We offered our paycheck to her.

The semantics of the [SBJ V OBJ *to*-OBL] construction has received much attention in the literature. This argument structure construction has been scrutinized as a syntactic alternation of the double object construction, referred to as the "dative alternation", with various types of verbs, including physical verbs of ballistic motion (171a, 171b), sending verbs (171c, 171d), and transfer verbs (171e, 171f) (e.g., Fillmore 1965; Pinker 1989; Pesetsky 1995; Beavers 2011; Rappaport Hovav and Levin 2008). We take the approach that the semantics of the intransitive dative variant is distinct from the transitive double object argument structure constructions following Goldberg (1995), Rappaport Hovav and Levin (2008), and many others. That is, we assume that the distinct realization of participants in these argument structure constructions is semantically motivated.

(171) a. He threw her the ball.
b. He threw the ball to her.
c. She sent him a letter.
d. She sent a letter to him.
e. I gave John a book.
f. I gave a book to John.

Most semantic analyses agree that the *to*-variant encodes caused motion (Beavers, 2011) or "X causes Y to go to Z" event (Goldberg, 1995; Pinker, 1989) and the verb supplies the transfer interpretation. For example, in (171b) or (171d), the intended recipient may or may not receive the theme being thrown or sent. In addition, the *to*-oblique is not semantically restricted to a human entity. A location may be expressed instead, as in *He threw the ball to the garden* or *She sent the letter to London*. A caused possession reading is available only with verbs that denote events of transfer of possession, e.g., *give* in (171f). In this example, it is entailed that John did receive the book. Since transfer of possession is entailed with these verbs, it is not possible to express the location as a *to*-oblique: **I gave a book to London*.

We argue that the entailment of caused possession in the *to*-variant is lexically determined. The constructional semantics describes an event of caused motion in which transfer of possession is metaphorically construed as a motion event. However, unlike the examples with throw and send verbs in which the theme moves holistically, the semantics of events with possession verbs entails mereological motion. Consequently, we analyze the *to*-variant with possession verbs as a metaphorical Place construal.

The metaphorical extension of the physical Place [SBJ V OBJ *to*-OBL] construction to the possession domain is motivated by the Possession being conceptualized as a mereologically incremental theme when it is transferred to a

recipient. Analogous to physical Place events in which the Figure comes to be spatially co-located with the Ground, the Possession in prototypical transfer events ends up being spatially co-located with the Possessor.

The causal chain for the metaphorical Place argument structure construction with possession verbs and its mapping to the Transfer of Possession network is shown in Figure 6.12. The target domain causal chain is identical to the source domain casual chain. In the source domain, the initiator applies physical Force which causes the Theme to move along a Path towards the Ground. The Theme is labeled +MER since the motion is *towards* the Ground. The initiator of the causal chain maps to the Agent in the verbal network. The endpoint of Force maps to the Possession and the endpoint of Path maps to the Possessor. With Dynamic Possession verbs, the Possessor maps to the initiator of the causal chain and the recipient of the Possession maps to the endpoint of the Path relation. A more detailed discussion of the semantics of the source domain causal chain can be found in Chapter 4.

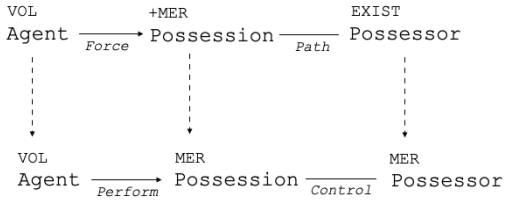


Figure 6.12: Mapping of a Metaphorical Provide causal chain to the Transfer of Possession network.

The causal chain in Figure 6.12 is annotated Volitional (FD1) Place (FD2), which is the same as the physical domain annotation. Metaphorical causal chains are additionally annotated for Event Domain, which is Possession with Dynamic Possession and Transfer of Possession verbs.

Transfer of Possession verbs also occur in a metaphorical Provide [SBJ V OBJ *with*-OBL] argument structure construction used with mereological verbs in the physical domain (e.g., *He sprayed the paint on the wall*). Examples of this construal with possession verbs are shown in (172). The direct object denotes the Possessor and the oblique argument denotes the Possession.

(172) a. Brown equipped Jones with a camera.
b. Brown presented Jones with a plaque.

The causal chain associated with the metaphorical Provide argument structure construction is shown in Figure 6.13. The representation is similar to the Place causal chain in that the ordering of the participants and the relations between them are the same. However, the Possession, which is expressed as a *with*-oblique has an INTL subevent label in the Provide construal. The Possessor is identified as the [+MER] theme since it is syntactically expressed as a

direct object. The Provide causal chain in Figure 172 is annotated Volitional (FD1) Provide (FD2) and the Event Domain is annotated Possession.

Figure 6.13: Metaphorical Provide causal chain with possession verbs.

Transfer, in its prototypical possession sense, is defined as a change in which a Possession is transferred from an Agent to a Possessor. The Agent has to lose control over the Possession in order for the Possessor to gain control over it. However, in many instances of transfer in which the Possession is a non-physical entity, the transfer event does not require that the Agent loses control over the Possession. For example, in *The FBI provided the informant with a new identity*, the identity is not a Possession that belonged to the FBI. The FBI has the authority to give such a document but no one 'loses' their identity in the process of the informant receiving it.

Examples in which the Possession is a non-physical entity suggest that it is not the verbal or constructional semantics that denotes transfer, i.e., the relinquishing of a Possession by the Agent and its obtaining by the Possessor. The verb simply denotes the acquisition (or loss) of the Possession by the Possessor. The semantics of events with possession verbs thus closely resembles events with physical mereological verbs (173) in which the original (or goal) location of the theme is not verbally or constructionally specified. For example, in (173a), the paint comes to be spatially co-located with the wall. However, neither the verbal nor the constructional semantics specifies where the paint was located before it was handled by the agent. It wasn't spatially co-located with the agent until the agent started painting. Similarly, in (173b), the example describes an event of removal in which the bark is no longer on the tree. The verbal or constructional semantics doesn't specify the goal location of the bark. The bark may be on the ground but it is not necessarily spatially co-located with the agent at the end. The inference about the theme's old or new location comes from commonsense physics, rather than the semantics of the construction. We argue that this analysis holds for the *to*-variant with possession verbs. The inference that the Agent is the 'original possessor' of the Possession in transfer events is not constructionally entailed and is therefore not represented anywhere in our semantic representation.[3]

(173) a. She sprayed paint on the wall./She sprayed the wall with paint.
b. He stripped bark from the trees./He stripped the trees of bark.

[3]With obtain and get verbs, the pairing of constructional and verbal semantics does entail that the Agent comes to have Control over the Possession in argument structure constructions in which a *from-oblique* is overtly expressed (e.g., *She got the book from him*). The verbal semantics evokes a Control relation between the subject participant and the Possession and the constructional semantics evokes a Control relation between the Possession and the old Possessor. It is the combination of the two representations that yields this interpretation, rather than the verbal or constructional semantics independently.

6.4.3.4 Metaphorical Remove and Deprive construals

Dynamic Possession and Transfer of Possession verbs can occur in a metaphorical Remove [SBJ V OBJ *from*-OBL] argument structure construction (174a, 174b) and a Deprive [SBJ V OBJ *out of/of*-OBL] argument structure construction (174c, 174d). In the Remove construal, the direct object is the Possession while in the Deprive construal, the direct object is the Possessor from whom the Possession is taken. Transfer of Possession verbs occur in both construals; however, the use of Dynamic Possession verbs in these construals is more limited. Dynamic Possession verbs, such as *obtain*, can occur in the Remove argument structure construction (e.g., *He obtained it from the owner*); however, they don't allow the Deprive construal. Obtain verbs describe an event of acquiring a Possession by the subject participant and are therefore incompatible with the semantics of the Deprive construal which focuses on the event of depriving someone of a Possession. The Remove construal is possible because the Possession is expressed as a direct object, similarly to the Constrain construal common with obtain verbs, and the subject participant is thus construed as the Agent in the constructional semantics. The Possessor is expressed as an oblique argument.

(174) a. The thief stole the painting from the museum.
b. The swindler swindled 20 dollars from his boss.
c. The swindler cheated Pat out of her fortune.
d. They deprived Pat of sleep.

The causal chain for the metaphorical Remove argument structure construction with possession verbs is shown in Figure 6.14. The force dynamic relations and participants' subevent labels are metaphorically extended from the physical source domain. In the physical domain, the Agent applies Force which causes the Theme not to be spatially co-located with the Ground (e.g., *Doug cleared the dishes from the table*). The Theme moves mereologically along a Path with respect to the Ground. In the target domain, the Agent metaphorically exerts Force on the Possession which results in the Possessor not being spatially co-located with the Possession. The subevent label of the Possession is identified as "[-MER]" since the Possession is taken away from the Possessor.

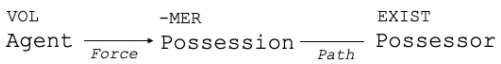


Figure 6.14: Metaphorical Remove causal chain with possession verbs.

Figure 6.15 shows the causal chain representation for the Deprive argument structure construction. The ordering of participants in the Deprive and Remove causal chains is the same. However, in the Deprive construal, the Possessor is construed as the mereological theme since it is syntactically expressed as a direct object. Their subevent label is [-MER] given that the event describes removal.

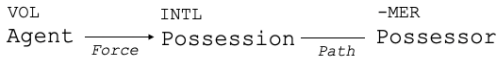


Figure 6.15: Metaphorical Deprive causal chain with possession verbs.

The annotations for the causal chains in Figures 6.14 and 6.15 are identical to the source domain annotations: Volitional (FD1) Remove (FD2) for the causal chain in Figure 6.14 and Volitional (FD1) Deprive (FD2) for the causal chain in Figure 6.15. The Event Domain is specified as Possession for both metaphorical causal chains.

6.4.3.5 Metaphorical Change of State construal

Transfer of Possession verbs may occur in a transitive argument structure construction in which the direct object describes the Possessor (175). The Possession is not syntactically expressed in these examples. The constructional causal chain describes a direct relation between the Agent and the Possessor.

(175) a. Brown equipped his soldiers.
b. Hess supplied its customers.
c. The swindler cheater Pat.

The transitive construal is analyzed as a metaphorical Change of State ("COS") event in which the Possessor is affected by the transfer of possession event and is analyzed as a Property theme, as shown in Figure 6.16.[4] A metaphorical COS construal with possession verbs is likely motivated by the syntactic behavior of physical mereological verbs, which also occur in argument structure constructions in which the Ground is expressed as a direct object (e.g., *He painted the wall*). In the transitive construal, the Ground is analyzed as a Property theme: the *wall*'s property changes when it is *painted*. Analogous to the Ground in this physical domain, the Possessor metaphorically undergoes a change of state when it is given or relinquished of a Possession. The causal chain associated with the metaphorical Change of State construal is shown in Figure 6.16. The relation between the Agent and the Possessor is analyzed as metaphorical Force, following our analysis of the source domain causal chain.

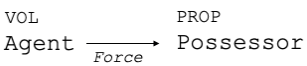


Figure 6.16: Change of State construal with possession verbs.

[4]This construal is not commonly seen with Dynamic Possession verbs as they do not evoke a Possessor in their verbal event structure. Dynamic Possession verbs occur in construals in which the Possession is overtly expressed.

Transfer of Possession verbs can also express the Addressee as a *to*-oblique when the Possession is not overtly specified (176). The constructional semantics of these examples is also analyzed as metaphorically extended from the physical mereological domain. The oblique argument denotes a metaphorical Ground with possession verbs, just like the oblique arguments in the physical Place (177b) and Remove (177d) construals.

(176) a. He donated directly to JSP members.
b. The thief stole from the museum.

The physical source domain argument structure constructions are analyzed as COS events. As shown in (177b, 177d), it is possible to express the Ground as an oblique argument with mereological verbs when the Figure is not syntactically expressed. This syntactic pattern alternates with the transitive variant and seems to be semantically motivated, particularly with Place verbs such as *paint* in (177a) and (177b). The transitive variant entails a fully affected Patient while the intransitive variant correlates with a partially affected Patient. The semantic motivation for the syntactic alternation between the transitive and the oblique variants also appears to determine the syntactic realization of the Patient with COS verbs (177e, 177f). We argue that the same semantic motivation leads to this syntactic alternation being used with physical Remove verbs (177c, 177d).

(177) a. He painted the wall.
b. He painted on(to) the wall.
c. The men mined the mine.
d. The men mined from the mine.
e. She cut the bread.
f. She cut into the bread.

Our analysis does not aim to capture the semantic difference between the two syntactic variants since it is not related to the force-dynamics of the event. In both construals, the Patient undergoes a change of state and is therefore analyzed as a Property theme. The causal chain representation for the metaphorical COS [SBJ V *to*-OBL] argument structure construction with possession verbs is the same as the causal chain for the transitive variant in Figure 6.16.

The syntactic realization of the Possessor in the COS construals is mostly determined lexically (e.g., *He donated *me/to me* but *He equipped his solders/*to his soldiers)*. The semantic motivation for the two syntactic variants in the source domain does not carry over to the target domain. The inference of partial vs. full affectedness is not relevant to the syntactic realization of the Possessor with possession verbs.

The annotation of the causal chain in Figure 6.16 uses the source domain FD2 label: COS. The FD1 label is Volitional since the agent is external to the core event and acts volitionally. A mapping of a COS causal chain to the Transfer of Possession network can be found in Figure 6.17.

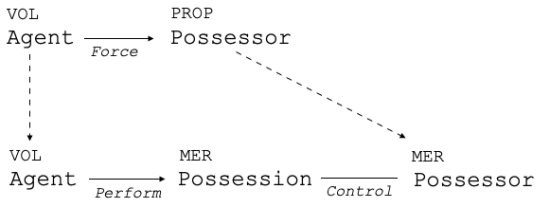


Figure 6.17: Mapping of a Change of State causal chain to the Transfer of Possession network.

6.4.3.6 Internal construal

Transfer of Possession verbs can occur in an Internal construal, in which only the Agent is overtly expressed as an event participant, e.g., *Some of the members may donate privately* or *Some people just take and take and never give.* The causal chain associated with examples such as these and its mapping to the Transfer of Possession network is shown in Figure 6.18. The causal chain is non-relational in that the event doesn't evoke a force-dynamic relation between two participants. The Agent is construed as a sole participant who acts volitionally and undergoes Internal change by being engaged in the event.

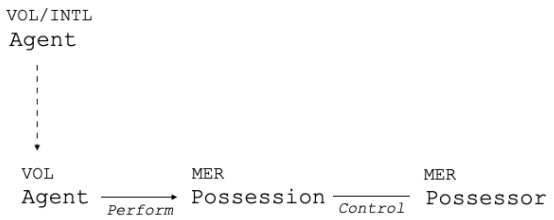


Figure 6.18: Internal construal with possession verbs.

This construal is not common with Dynamic Possession verbs and there are no examples of the Internal construal with Dynamic Possession verbs in VerbNet. The annotation of the causal chain in Figure 6.18 is Self-volitional (FD1) Internal (FD2). The initiator is annotated as Self-volitional since they are internal to the core event.

6.5 Replace and Exchange events

The semantics of verbs that denote an exchange of two entities (or their roles) has received little attention in the linguistics literature (Croft, 1991, 225-226). The main focus has been on the event structure of reciprocal events that describe a symmetrical engagement of two (or more) participants in social interactions (e.g., *Mary and John kissed* or *I met with my friend*). However, studies on recip-

rocals generally don't include exchange verbs since they cover a much broader category of verbs and construals that do not fit the semantics of prototypical reciprocal events. For example, in replace events, one entity may take on the role of another entity but reciprocality is not entailed, e.g., *Milk and lemon juice may substitute for buttermilk. Milk and lemon juice* take on the role of *buttermilk* in a recipe but *buttermilk* doesn't take on the role of *milk and lemon juice* as a result of the replace event.

In some cases, exchange events evoke a change of possession in which two agents collaboratively exchange each other's belongings. However, Exchange verbs do not necessarily evoke change of possession events. We discuss them in this chapter because of their relevance to the event structure evoked by commercial transaction verbs, discussed in section 6.6.

We distinguish two types of verbs based on the event structure that is obligatorily evoked by their verbal semantics: Replace verbs and Exchange verbs. With both types of verbs, a 'reciprocal' EXCHANGE relation is evoked between two participants and their roles in the event structure. In the Exchange network, the EXCHANGE relation is externally initiated by two agents who act cooperatively. In the Replace network, not external initiator is obligatorily evoked.

6.5.1 Replace verbs

Replace verbs evoke an event structure with two participants: Item 1 and Item 2. Item 2 replaces Item 1 in its Role. Item 1 may take the Role of Item 2 if it is constructionally specified. A number of construals are possible with Replace verbs. In symmetrical construals, both participants take each other's Roles (178a, 178b). In asymmetrical construals, one participant takes the Role of the other (178c, 178d), and it is not entailed that the exchange of Roles was reciprocal. In some examples, the participants, rather than the Roles, may be expressed (178c). In other examples, the Role(s) may be specified along with the participants (178d-178b).

(178) a. The bell ringers switched places.
b. One bell ringer swapped places with another.
c. Milk and lemon juice may substitute for buttermilk.
d. They replaced the Queen as the head of state.

The event structure associated with Replace verbs is shown in Figure 6.19. The EXCHANGE relation between Item 1 and Item 2 is an 'equivalence' relation, rather than a force-dynamic relation. It represents that the two items are similar in value or function and may be replaced by one another in a replace event. The replace event may be construed as reciprocal though reciprocality is not always entailed. The participant labels are unspecified in the verbal network. The participants may act volitionally, as is the case in (178a and 178b), or may be inanimate entities (178c) in which case their engagement in the event is non-volitional. The constructional representation supplies information about the participants' subevents.

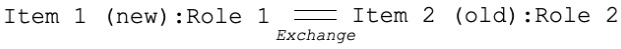


Figure 6.19: Replace event structure.

The class that consists of Replace verbs in VerbNet is substitute-13.6.2. Replace verbs can be found in the following FrameNet frames: Taking_place and Replacing.

6.5.1.1 Syntactic realization of participants with Replace verbs

In symmetrical construals, one or both of the exchanged Items are grammatically expressed as the subject. If only one of the Items is expressed as a subject, the other Item is syntactically realized as a *with*-phrase (178b). In asymmetrical construals, the replacing entity (or 'new' entity) is expressed as a subject (178c) and the replaced entity (or 'old' entity) is expressed as a *for*-phrase (178c) or a direct object (e.g., *Video replaced radio*). When the 'old' entity is syntactically realized as a subject, the 'new' entity is expressed as a *with*-phrase (e.g., *They replaced their old dishes with new ones*). The Role(s) may be expressed as a direct object (182c, 178b) or an *as*-oblique (178d).

An external initiator may be constructionally specified with Replace verbs. In (178d), the subject participant causes an Exchange relation between the *Queen* and her successor. In this example, the 'old' entity (i.e., the *Queen*) is expressed as a direct object. The 'new' entity would be expressed as an antecedent *with*-oblique if it were overtly expressed. The causal ordering of participants thus always remains the same. Item 1, which denotes the 'new' entity, is always causally antecedent to the 'old' entity, i.e., Item 2, in the constructional causal chain.

An interesting observation regarding the syntactic realization of participants with the verb *substitute* is that in a non-causal construal, Item 1 may be syntactically realized either as a direct object (e.g., *Video substituted radio* (just like Item 1 with *replace*) or a subsequent *for*-oblique (e.g., *Milk and lemon juice may substitute for buttermilk*). In both cases, Item 2 is causally subsequent to Item 1 but the argument structure construction is different.

6.5.2 Exchange verbs

Exchange verbs describe an event structure in which external initiators of the EXCHANGE relation are obligatorily evoked (179). The event structure of Exchange verbs elaborates on the semantics of Replace verbs. The EXCHANGE segment between Item 1 and Item 2 is preceded by an Agent and a Co-agent who collaboratively initiate the exchange event. Since reciprocal exchange of two items is always evoked, the relation between the Agent and the Co-Agent is always construed as symmetrical. Additionally, the ordering of the new and old entity in the causal chain is reversed in exchange events: the old entity is

causally antecedent to the new entity (Croft, 1991, 225-226). Consequently, the identity of Item 1 and Item 2 in the verbal network is reversed from the Replace network: Item 1 denotes the old entity and Item 2 denotes the new entity, as shown in Figure 6.20.

(179) a. Gwen exchanged the dress for a shirt.
b. Cathy is swapping equity stakes with the U.S. carrier.
c. They exchanged rings.

The verbal network in Figure 6.20 describes an event structure in which an Agent and a Co-Agent engage in a PERFORM relation to bring about the exchange of Items. Their mutual engagement in the same force-dynamic relation is represented by a plus sign. The Agent and the Co-Agent act volitionally and their subevent is therefore identified as VOL. The subevents of the Items are unspecified in the verbal representation. In the constructional semantics, the exchanged Items are frequently labeled EXIST since they don't undergo any internal change in the event and are inanimate non-volitional entities.

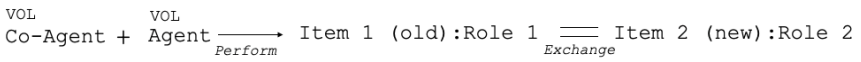


Figure 6.20: Substitute event structure.

The exchange event with Exchange verbs results in the Agent and the Co-Agent having control over the exchanged Item that wasn't previously theirs, i.e., the Agent receives Item 2 (and gives up Item 1) and the Co-Agent receives Item 1 (and gives up Item 2). This part of the verbal semantics is not represented in the Exchange network because the CONTROL relation between the agents and the exchanged items is not syntactically expressible in English.

Verbs that describe Exchange are in the exchange-13.6 class in VerbNet. FrameNet has an Exchange frame for Replace verbs.

6.5.2.1 Syntactic realization of participants with Exchange verbs

The Agent is always syntactically realized as the subject. The Co-Agent may be co-expressed as a subject in a (conjoined) plural construal (179c) or is syntactically realized as a *with*-phrase. Neither Role 1 nor Role 2 are expressed with Exchange verbs.

The syntactic realization of exchanged Items with Exchange verbs reveals that Item 1 denotes the 'old' entity, rather than the 'new' entity like we noted for Replace verbs. For example, in (179a), the *shirt*, which denotes the newly acquired item is syntactically expressed as a subsequent *for*-oblique. The old item is expressed as a direct object. In a symmetrical construal, Item 1 and Item 2 may be syntactically realized as a direct object (179b, 179c).

When the Agent and the Co-Agent are syntactically expressed as a plural subject, the FD1 label is annotated Volitional Collective to signal that the

initiator of the constructional causal chain maps to the Agent and Co-Agent in the verbal network. When the Co-Agent is expressed as a *with*-phrase, the FD1 label is annotated Volitional Mutual. When the Co-Agent is not expressed in the syntax, we do not annotate it and the initiator (Agent) is either annotated as Self-volitional or Volitional FD1 depending on the construal, as discussed in section 6.5.3.

(180) a. Some parishes replace the water with sand.
b. The mother or father [come] during the night and replace the tooth for cash.
c. Sand replaced water.

It should be noted that some Replace verbs (e.g., *replace* or *switch*) can occur in an exchange construal in which the old item is expressed as antecedent to the new item that replaces it (180b). This construal alternates with the more prototypical replace construal in which the new entity is causally antecedent to the old entity in the causal chain (180a). In the non-causative construal, both verbs occur in a transitive argument structure construction in which the new item is causally antecedent to the old item (180c).

6.5.3 Semantics and annotation of argument structure constructions with Replace and Exchange verbs

The syntactic realization of participants with Replace and Exchange verbs overlaps to a great extent. We discuss the common construals observed with these verbs in this section.

6.5.3.1 Exchange Construal

Replace and Exchange verbs frequently occur in an Exchange construal in which both exchanged items are overtly expressed as separate arguments in the argument structure construction (181). The argument structure construction associated with this construal may be a a [SBJ V OBJ *for*-OBL] construction when the event is externally initiated (181a) or a simple transitive [SBJ V OBJ] construction when an external initiator is not present (182b). We do not distinguish which participant in the constructional causal chain refers to the old item (or role) and which to the new item (or role). This information is supplied by linking the causal chain to the relevant verbal network.

(181) a. Gwen exchanged the dress for a shirt.
b. Video replaced radio.

Causal chains associated with the Exchange construal closely resemble the event structure of Replace and Exchange verbs since the EXCHANGE relation is part of the constructional semantics. Figure 6.21 shows a representation for the example in (181a). The Agent uses performative force (PERFORM) to initiate an EXCHANGE relation between Item 1 and Item 2. The Agent is identified as a

Volitional (VOL) initiator and the exchanged Items' subevents are specified as EXIST since they don't undergo internal change in the event. A causal chain representation for the example in (181b) (not depicted here) includes only the second segment of the causal chain in Figure 6.21.

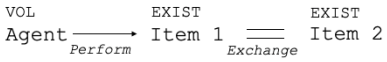


Figure 6.21: Exchange causal chain with exchange verbs.

In the example *The bell ringers switched places*, both participants switch Roles. However, many exchange examples describe an event in which only one of the Items assumes a new role, e.g., *Twelve years later, oil replaced coal as the energy of choice*. Although the Role is now associated with the new filler and one could argue that the assertion is focused primarily on the new filler taking the Role, the syntactic realization of participants points to a constructional analysis in which the Role is associated with the old filler (i.e., the *coal*). The Role is realized as a subsequent *as*-oblique and thus follows the direct object in the causal chain, as shown in Figure 6.22. The constructional semantics thus describes an event in which the oil replaces coal in its Role as the energy of choice. The mapping of this example to the Replace network is shown in Figure 6.22.

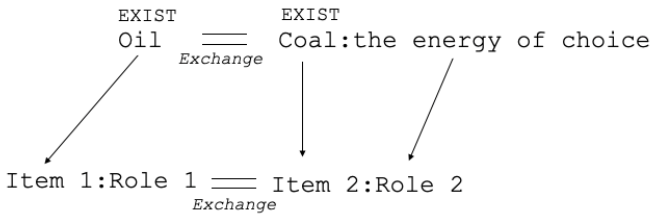


Figure 6.22: A mapping of an Exchange causal chain to the Replace network.

The annotation of causal chains with an EXCHANGE relation uses the FD2 annotation label Exchange. The FD1 label is either Self-volitional in examples in which an external initiator is not present (181b) or Volitional in examples in which the EXCHANGE relation is preceded by an external initiator and a PERFORM relation (181a).

6.5.3.2 Internal Construal

Replace and Exchange verbs can also occur in an Internal construal in which the exchanged Items (or their Roles) are syntactically realized as a plural argument (182). This construal is possible with Replace verbs only when the participants in the event are volitional entities (182c) or when the exchange event is externally initiated by an Agent (182d).

(182) a. They exchanged rings.
b. The bells ringers switched places.
c. They switched.
d. He switched the keys.

The analysis of the exchanged Items as undergoing Internal change in the event when they are expressed as a plural argument is motivated by our analysis of combining, mixing, and separating events in the physical domain, in which the Figure and the Ground may be expressed as a plural (or a conjoined plural) argument (e.g., *He mixed the eggs* or *The yolk and the white separated*). In the Internal construal, the participants are construed as undergoing the same change in the event; the distinction that one is the Figure and the other one the Ground in the event structure is not relevant. Their 'roles' in the event are construed as symmetrical. They undergo an Internal change by being combined or separated. Similarly, in the social domain, the exchange event may be construed as symmetrical when both Items replace each other in their Roles. In such a scenario, the event may be construed as Internal and the participants are expressed as a plural (or a conjoined plural) argument.

The causal chain associated with the Internal construal always represents the exchanged Items as a single participant that undergoes an Internal (INTL) change, as shown in Figure 6.23. The Items (or Roles) in the causal chain map to Item 1 and Item 2 (or Role 1 and Role 2) in the verbal network. The causal chain associated with the example in (182d) is shown in Figure 6.23. A causal chain for an example without an external initiator, such as (182c), would include only "Items" as a single participant in the constructional representation.

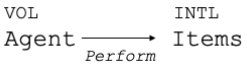


Figure 6.23: Internal causal chain with exchange verbs.

The annotation of Internal causal chains uses the FD2 label Internal. The FD1 annotation is determined by the type of initiator in the example. In (182a) and (182b), the FD1 label is Volitional Collective since the plural subject refers to the Agent and the Co-Agent and they are external to the core event. In (182c), the FD1 label is Self-volitional Collective because the participants are internal to the core event and are expressed as a plural subject. In (182d), the FD1 label is Volitional because the subject refers to an Agent who is external to the core event.

6.5.3.3 Metaphorical Constrain Construal

Exchange verbs may occur in a metaphorical Constrain [SBJ V OBJ] argument structure construction in which the direct object denotes the 'old' entity (183a, 183b). Replace verbs may also occur in this construal but only when the exchange event is initiated by an external agent (183c). The event describes the

relinquishing of an old Item by the Agent. Similarly to the Constrain metaphor with possession verbs, the use of this argument structure construction is motivated by the event describing a metaphorical 'dropping' or 'letting go' event in which the Agent willingly loses control over the Item. The PERFORM relation between the Agent and Item 1 in the verbal network directly links to the FORCE relation in the source domain.

(183) a. I spent all the money.
b. She exchanged the purchase.
c. He switched the key.

The metaphorical Constrain causal chain with exchange verbs is shown in Figure 6.24. The causal chain describes a metaphorical Force relation between the Agent and Item 1. The representation is identical to that of dynamic Constrain examples with possession verbs discussed in section 6.4.3.2. The Item's subevent label is unspecified and the Agent is identified as a Volitional agent.

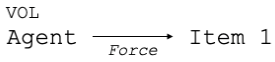


Figure 6.24: Constrain causal chain with exchange verbs.

The causal chain is annotated Self-volitional (FD1) Force (FD2). This annotation matches the source domain annotation. The causal chain is also annotated for Event Domain, which is Exchange with Replace and Exchange verbs.

6.6 Commercial Transaction verbs

Commercial Transaction verbs, such as *buy, sell,* or *pay*, evoke a more complex event structure compared to Transfer of Possession verbs or Exchange verbs. The semantics of these verbs obligatorily evokes four participants: a seller, a buyer, goods, and money. The buyer buys goods from the seller and, at the same time, the seller sells goods to the buyer for money (184). The event of buying and selling is cooperative in that both the seller and the buyer have to willingly engage in the transaction together.

(184) a. I just bought the cutest little pumpkin yesterday. (COCA)
b. I bought an angle grinder for 25 bucks. (COCA)
c. I know this because I bought one from Sears. (COCA)
d. But this year, our paper was sold to a land developer. (COCA)
e. I sold all my belongings, home, auto and invested a lot of money.(COCA)

The event structure representation of Commercial Transaction verbs is consistent with our analysis of other verbs in the possession domain. The analysis

focuses on the semantics of buy and sell verbs as each evoking only a subpart of an otherwise very complex semantic frame that is associated with events of commercial transaction. In addition, we include only relations between participants in the verbal representation that are syntactically expressible.

Commercial Transaction verbs describe the event from the perspective of either the buyer or the seller. With buy verbs only the buyer *buys*, and with sell verbs only the seller *sells*. The event is never construed as reciprocal or symmetrical despite commercial transaction being understood to entail a joint cooperative interaction between the two agents. This contrasts with the semantics of reciprocal Exchange verbs such as *trade* or *swap* which entail a reciprocal engagement and both agents can be said to *trade* or *swap*. This semantic difference between Commercial Transaction and Exchange verbs has syntactic consequences: with Commercial Transaction verbs, the agents cannot be expressed as a comitative *with*-phrase or a plural subject, unlike agents with Exchange verbs when both agents are overtly expressed (e.g., *He swapped bikes with his friends*).

The event structure representation for Commercial Transaction verbs does not define a reciprocal mutual relation between the agents. In our analysis, their cooperative engagement in the event is not evoked by the verb itself, and it is therefore not syntactically relevant. In fact, syntactic construals observed with Commercial Transaction verbs and the semantics associated with them quite closely resemble construals with Transfer of Possession verbs such as *receive* or *borrow* in which only one participant is construed as the agent and overtly expressed as the grammatical subject in the argument structure construction. Though the semantics of *receive* and *borrow* entails a cooperative event in which a donor willingly relinquishes their possession, the verbs don't occur in symmetrical construals, similarly to Commercial Transaction verbs. We do not establish a separate network for the handful of taking verbs that evoke a cooperative giver and analyze them as describing the same event structure as other Transfer of Possession verbs. As discussed in section 6.4, the Transfer of Possession event structure does not represent a mutual relation between the two human participants. The event structure describes an event in which an agent causes that a possession is either transferred to or taken from a possessor.

Figure 6.25: Commercial Transaction event structure.

Analogously, the Agent with Commercial Transaction verbs causes that Goods are either transferred to or taken from the Possessor. We define a single network for buying and selling verbs, following our analysis of taking and giving verbs in which the participants are defined on a very schematic level. With taking and giving verbs discussed in section 6.4, the initiator of the transfer event is analyzed as an Agent, whether it is a 'taker' or a 'giver' and the other

human participant is analyzed as a Possessor. The initiator of the event structure causes that the Possessor either loses or obtains a Possession. Whether the event describes taking or giving is determined by the verb used in the argument structure construction. Given our schematic force-dynamic analysis of the relations between participants in verbal networks, this analysis can be extended to Commercial Transaction verbs.

As depicted in Figure 6.25, the initiator of the event structure with Commercial Transaction verbs causes that the Possessor either gains or loses control over the Goods. With buy verbs, the Agent is the buyer and the Possessor is the seller. The buyer causes that the Possessor loses control over the Goods. With sell verbs, the Agent is the seller and the Possessor is the buyer. The seller causes that the buyer gains control over the Goods.

Similarly to the Transfer of Possession network, the Goods and the Possessor are construed as mereological (MER) themes. We do not specify in the verbal representation whether the Goods are transferred to the Possessor or taken from the Possessor. This information is specified in the constructional causal chain. We implemented the same analysis with Transfer of Possession verbs.

The relation between the Agent and the Goods is defined as PERFORM and the relation between the Goods and the Possessor as CONTROL. This part of the event structure is identical to the Transfer of Possession network. The PERFORM relation establishes that the Agent is an external causer of the CONTROL relation between the Goods and the Possessor with Commercial Transaction verbs. The CONTROL relation and the MER subevent labels assigned to the Goods and the Possessor participants provide a schematic description of the event in which either the Possessor is the seller who relinquishing the goods or the Possessor is the buyer who comes to have control over the goods.

We do not represent a CONTROL relation between the Money and the Agent, though the event does entail that the Agent either relinquishes the Money when it is a buyer or receives the Money when it is a seller. However, this relation is never overtly expressed in argument structure constructions. Money is always construed as an endpoint of an EXCHANGE relation rather than an endpoint of a CONTROL relation with the Agent. Given that the CONTROL relation between the Agent and Money is not syntactically relevant, we do not include it in the verbal semantic representation. We also don't include a direct relation between the Goods and Money, though Money always expresses the value of Goods. That is, the amount of money paid equals the price of the Goods. This relation is expressed by other verbs, such as *cost* in *The book costs $25.* Examples such as these describe an ENGAGE relation between the Goods and its value.

Commercial Transaction verbs do not occur in construals in which an ENGAGE relation between Goods and Money is overtly expressed. The role of Money in commercial transaction events is different. The Money describes the object that is exchanged for the Goods in the event. The transaction takes place because Money is exchanged in the event. We analyze Money as an endpoint of an EXCHANGE relation in the network.

With Replace verbs discussed in section 6.5.1, the EXCHANGE relation describes an equivalence relation between two entities. However, with Commercial

Transaction verbs, the EXCHANGE relation describes an equivalence relation between an entity (i.e., Money) and an event (i.e., buying or selling).

This analysis is motivated by the use of the EXCHANGE relation in other types of events, such as change of state or placing events in the physical domain, as shown in (185). As shown in (185a), the constructional semantics describes an exchange of money for a service. It does not describe an equivalence relation between $20 and the windows. Put differently, $20 does not refer to the value of the windows but rather to the value of washing the windows. Similarly, in (185b), the amount of money given to the agent is not for the hay but for loading the hay. The EXCHANGE relation in these examples specifies an equivalence relation between the event and its value.

(185) a. He washed the windows for $20.
b. He loaded hay on the truck for $50.

The syntactic realization of the endpoint of the EXCHANGE relation as a *for*-oblique is very common in English. Verbs from various verb classes can occur in argument structure constructions in which the *for*-phrase denotes an exchanged item. Besides physical Change of State and Mereological verbs, verbs of Exchange (186a), Commercial Transaction verbs (186b-186d), and Transfer of Possession verbs (186e, 186f) occur in this construal, as well.

(186) a. He exchanged his car for $2,000.
b. He sold his car for $2,000.
c. He bought his car for $2,000.
d. He paid $2,000 for his car.
e. He gave him his car for $2,000.
f. He got his car for $2,000.

The *for*-phrase can also be used to describe a purpose relation in English (e.g., *He killed him for $1000* or *She married him for money*). In these examples, the participant expressed as a *for*-phrase describes an intended outcome. In the kill example, the purpose of the event is to steal $1000 and in the marry example, the purpose is to obtain money through marriage. The use of the *for*-phrase in the examples in (186) has different semantic motivations. It describes an item that is exchanged in the event. A distinct analysis of the *for*-phrase in the examples in (185) and (186) is also supported by cross-linguistic evidence from Czech.

Czech uses the same syntactic alternation for the examples in (185) and (186); however, a different prepositional phrase is used for a purpose relation. Specifically, the endpoint of an EXCHANGE relation is expressed as a *za*-phrase but the endpoint of a purpose relation is expressed as a *pro*-phrase. The oblique arguments in (185) and (186) are syntactically encoded as *za*-phrases (187) but the kill and marry examples discussed in the preceding paragraph are encoded as *pro*-phrases in Czech (188).

(187) a. Umyl okna za $20.
Washed windows for $20
'He washed the windows for $20.'

b. Naložil seno do nákladáku za $50.
Loaded hay into truck for $50
'He loaded the hay on the truck for $50.'

c. Vyměnil si svoje auto za $2,000.
Exchanged REF his car for $2,000
'He exchanged his car for $2,000.'

d. Prodal svoje auto za $2,000.
Sold his car for $2,000
'He sold his car for $2,000.'

e. Koupil si auto za $2,000.
Bought REF car for $2,000
'He bought his car for $2,000.'

f. Zaplatil $2.000 za svoje auto.
Paid $2,000 for his car
'He paid $2,000 for his car.'

(188) a. Zabil ho pro $1000.
Killed him for $1000
'He killed him for $1000.'

b. Vzala si ho pro peníze.
Married REF him for money
'She married him for money.'

Evidence from English and Czech strongly points to a unified analysis of the *for*-phrase in (185) and (186). The EXCHANGE relation in the Commercial Transaction network can be analyzed as describing a relation between Money and the event as a whole, rather than the Goods as a single participant. This analysis is also motivated by metaphorical argument structure constructions in which the EXCHANGE relation is construed as subsequent to the core event (see section 6.6.2).

Essentially, the analogy between the physical and social examples in which the EXCHANGE relation is overtly expressed is that in the physical domain, performing a task equals a sum of money (=the value of the task). Similarly, with Commercial Transaction money, losing or gaining control over Goods equals a sum of money (=the value of the Goods).

6.6.1 Pay verbs

Pay verbs describe events from the perspective of the buyer. That is, the initiator of the event is the buyer rather than the seller. However, unlike buy verbs

in which the Possessor loses control over the Goods, the Possessor gains control over Goods with pay verbs (189). Unlike sell verbs, which also describe events in which the theme is transferred to a Possessor, the theme with pay verbs refers to the Money and the exchanged item to the Goods. For example, in (189b), the theme that is transferred to the Possessor is the 500 pounds and the exchanged item is the car.

(189) a. He paid 500 pounds.
b. He paid 500 pounds for the car.
c. He paid me 500 pounds for the car.
d. He paid 500 pounds to the seller.

We define a separate verbal network for Pay verbs to distinguish the different roles that Goods and Money play in the event structure. As shown in Figure 6.26, the network is basically identical to the Commercial Transaction network except that ordering of Money and Goods is reversed.

Figure 6.26: Commercial Transaction event structure.

We discuss the semantics of argument structure constructions with pay verbs together with sell and buy verbs in the following section 6.6.2 since Pay verbs occur in the same syntactic construals as sell verbs.

6.6.2 Semantics of argument structure constructions with Commercial Transaction verbs

Commercial Transaction verbs occur in similar construals that we have identified for Transfer of Possession verbs in section 6.4.3. Specifically, Commercial Transaction verbs frequently occur in metaphorical physical construals such as physical Constrain (section 6.6.2.1) or Place and Remove construals (sections 6.6.2.2 and 6.6.2.3). Commercial Transaction verbs can also occur in the double object Transfer construction (section 6.6.2.4).

6.6.2.1 Metaphorical Constrain construal

Commercial Transaction verbs can occur in construals in which only the Agent and the Possession are overtly expressed (190). The Agent is expressed as the subject and the Possession as a direct object. The Possessor is not expressed as a syntactic argument. We analyze the semantics of examples in (190) as metaphorical Constrain, following our analysis of Transfer of Possession verbs in the transitive argument structure construction in which the direct object is the Possession (section 6.4.3.2). The relation between the Agent and the

Possession is metaphorically construed as physical FORCE, which directly links to the causal PERFORM relation between the Agent and the Possession in the social domain. The Agent's paying or selling results in their relinquishing of the Possession and buying results in the Agent's obtaining the Possession. The event is metaphorically construed as a physical event of 'letting go' and 'picking up', respectively. In the physical source domain, events of letting go, dropping, or picking up are analyzed as describing Constrain causal chains in which an agent either loses or gains physical control over a physical object. The force-dynamics between the agent and the object are represented by a causal FORCE relation in the metaphorical construal.

(190) a. He paid 500 pounds.
b. She bought a pumpkin for Halloween.
c. He sold all his merchandise.

In the absence of the Possessor in the constructional causal chain, the PERFORM relation is metaphorically construed as a physical FORCE relation, as shown in Figure 6.27. The causal chain depicts the semantics of the examples in (190). The Possessor is analyzed as a volitional (VOL) participant in the event. The constructional semantics for the source domain Constrain construal does not distinguish whether the event describes letting go or picking up. This is because constrain events are subsumed under a more general Force schema in which the change of the endpoint of FORCE is unspecified. Therefore, the target domain representation for the metaphorical constrain causal chain does not assign a subevent label to the Possession participant either. The constructional causal chain does not distinguish whether the event describes relinquishing or obtaining.

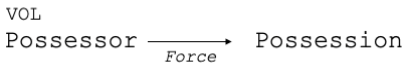


Figure 6.27: Metaphorical Constrain causal chain with Commercial Transaction verbs.

The causal chain associated with the examples in (190) is annotated Self-volitional (FD1) Force (FD2), which is identical to the source domain. The annotation of Event Domain, which is Possession, signals that the causal chain is metaphorically extended to the Possession domain.

Money may be overtly expressed in the Constrain construal, as shown in (191). In both examples, the participant expressed as a *for*-oblique refers to the amount of money that was exchanged in the event. In the example in (191a), a few hundred dollars describes the amount of money that one had to give to the seller in exchange for the seller to relinquish his merchandise. In (191b), the $15 describes the amount of money that was needed for the agent to buy a pumpkin.

(191) a. He sold all his merchandise for a few thousand dollars.
b. He bought a pumpkin for $15.

The causal chain associated with the examples in (191) is shown in Figure 6.28. It describes an event in which a volitionally acting agent, Possessor, metaphorically constrains a Possession. The Exchanged_item is subsequent to the main constrain event, i.e., the Constrain causal chain. The first segment of the causal chain describes a metaphorical constrain event. As explained above, the subevent of Goods is not specified in this construal. Money is analyzed as EXIST in the constructional causal chain since it does not undergo internal change in the event.

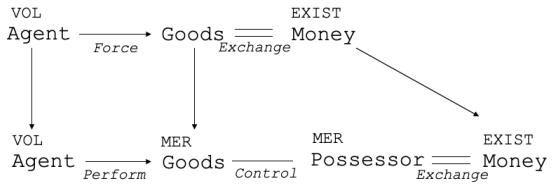


Figure 6.28: Metaphorical Constrain causal chain with Money.

This analysis is compatible with our analysis of argument structure constructions with mereological verbs in which only the theme but not the ground is overtly expressed, such as *He loaded the hay for $20*. With mereological verbs, the theme is analyzed as undergoing Internal change; however, what the two representations have in common is that the EXCHANGE relation is understood to describe an equivalence relation between the event and the Money; rather than the theme and the Money. The EXCHANGE relation is analyzed as subsequent to the loading event and the relinquishing/obtaining events with Commercial Transaction verbs in the Constrain construal.

6.6.2.2 Metaphorical Place construal

Sell and pay verbs can occur in argument structure constructions in which the Possessor is expressed as a *to*-oblique (192). With sell verbs, the Possessor denotes the buyer who gains control over the sold item. With pay verbs, the Possessor denotes the seller who receives the Money. Similarly to our metaphorical analysis of giving verbs discussed in detail in section 6.4.3.3, the Agent with sell and pay verbs is construed as an external initiator of a physical co-location relation between the Goods and the Possessor. The Possessor is metaphorically construed as a ground in a PATH relation with the theme. The semantics of sell and pay verbs lend themselves to a Place construal because the event in the target domain identifies the Goods as a mereological theme and the relation between the Goods and the Possessor is non-causal, just like the PATH relation between the theme and the ground in the source domain.

(192) a. If you have to pay a fee to a travel agent, [...]. (COCA)

b. The city again attempts to sell the land to a private group. (COCA)

c. Julie had sold the car to him for $1,500. (COCA)

Additionally, purchased items may be physical objects. In the most prototypical commercial transactions scenario, the event of buying and selling involves that the purchased item undergoes physical motion from the seller to the buyer. This physical aspect of the commercial transaction event can be considered to also motivate the use of the physical place and remove argument structure constructions with buy, sell, and pay verbs. We do not attempt to represent the physical aspect that accompanies many social events. In the case of commercial transaction verbs, the social aspect of the event in which the buyer gains social control and the seller loses control over the purchased item is more relevant to the semantics of these verbs. The physical aspect is secondary to the transfer event and is not always present in commercial transaction.

The causal chain that describes the semantics of the metaphorical Place argument structure construction for the examples in (192b) is the same as shown for Transfer of Possession verbs discussed in section 6.4.3.3. The Possession is construed as a mereological (+MER) theme and the Possessor is construed as an endpoint of a physical PATH relation.

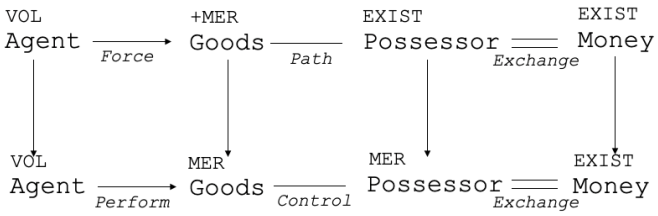


Figure 6.29: Metaphorical Place causal chain with Money.

Sell and pay verbs do not occur in a Provide construal in which the Possessor is syntactically realized as a direct object and the Goods as an oblique argument. This construal is common with giving verbs but does not extend to Commercial Transaction verbs in English.

As shown in (192c), an EXCHANGE relation can be part of the causal chain when Money is overtly expressed. Money is expressed as a subsequent *for*-oblique. The causal chain for this example and its mapping to the Commercial Transaction network is shown in Figure 6.29. The causal chain includes an additional EXCHANGE relation at the end of the causal chain. Similarly to the EXCHANGE analysis in the Constrain construal, the EXCHANGE relation is subsequent to the core event which describes an event of metaphorical placing in (192c). Money is labeled EXIST since it doesn't undergo change in the event.

Similarly to the metaphorical analysis of argument structure constructions with Transfer of Possession verbs, the social PERFORM relation maps to the physical FORCE relation and the CONTROL relation maps to the PATH relation in

the source domain. The EXCHANGE relation remains the same in both construals since it is not specific to any domain when it is construed as subsequent to the event. The source domain causal chain for examples such as *He loaded the hay on the truck for $20* would be the same as the causal chain shown in Figure 6.29. The *for*-oblique would be identified as an endpoint of an EXCHANGE relation with physical domain verbs, as well.

6.6.2.3 Metaphorical Remove construal

Buy verbs can occur in a metaphorical Remove construal in which the Possessor is syntactically realized as a *from*-oblique (**??**). The motivations for the use of the remove argument structure construction with Commercial Transaction verbs is the same as we noted for the Place construal discussed in the previous section. The Agent causes that the Possession is metaphorically removed from the Possessor. In (193a), the knife is metaphorically removed from Diver Tech Supply.

(193) a. Witness says you purchased a knife from Diver Tech Supply. (COCA)

b. That said, I could buy a car from a private party with no ID at all. (COCA)

Buy verbs do not occur in a Deprive construal in which the Possessor is syntactically realized as a direct object and the Possession is an oblique argument. Though this construal is common with taking verbs, it does not extend to Commercial Transaction verbs in English.

The semantic representation of metaphorical Remove construals with buy verbs is very similar to Place construals, as shown in Figure 6.30. The ordering of participants and the force-dynamic relations between them are the same. The only difference is that the Goods in the Remove causal chain are labeled as -MER since they are metaphorically removed from the Possessor.

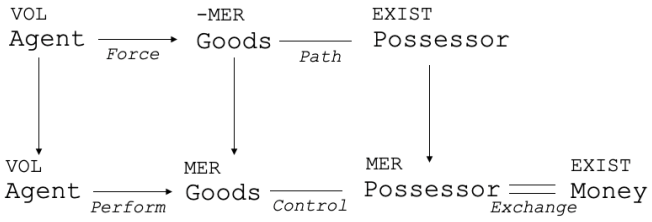


Figure 6.30: A Remove causal chain and its mapping to the Commercial Transaction network.

Remove verbs can also occur in argument structure constructions in which an EXCHANGE relation with Money is overtly expressed (e.g, *You purchased a knife from Diver Tech Supply for $20*). The constructional analysis for such

examples is analogous to the analysis for sell and pay verbs in a metaphorical Place construal.

6.6.2.4 Transfer construal

Sell and pay verbs can occur in a double object Transfer argument structure construction in which both the Goods and the Possessor are syntactically realized as direct objects (194). The semantic analysis of sell and pay verbs is the same as our analysis of giving verbs in this argument structure construction (see section 6.4.3.1). Both the Possessor and the Goods are construed as mereological themes and the Agent as an initiator of the event.

(194) a. I sold him a car. (COCA)
b. He paid me 500 pounds.

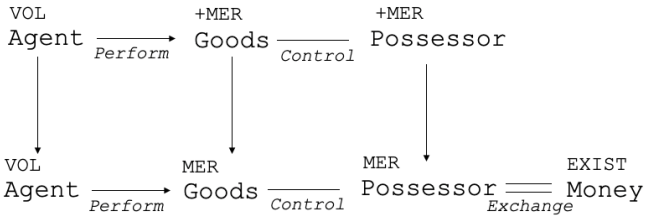


Figure 6.31: A Transfer causal chain with Commercial Transaction verbs.

The causal chain associated with the Transfer construal and its mapping to the Commercial Transaction network is shown in Figure 6.31. The participants in the causal chain map to the respective participants in the verbal network. Since the semantics of the Transfer argument structure construction originates in the social domain, the relations between participants in the constructional causal chain and the verbal event structure match.

Money may also be overtly specified in Transfer construals (e.g., *He paid 500 pounds for the table*). In such causal chains, the EXCHANGE relation is analyzed as subsequent to the Transfer event.

Similarly to taking verbs, buy verbs can also occur in the Transfer construal. However, as noted for taking verbs, the direct object refers to a recipient rather than the Possessor with buy verbs. The recipient is intended to own the Goods after the buyer purchases it. Though the causal chain for buy verbs in the double object argument structure construction is the same as for pay and sell verbs, the mapping to the verbal network is different. As shown in Figure 6.32, the endpoint of the CONTROL relation does not map to the Possessor in the verbal network.

(195) a. And [I] went to the mall, where I bought her some blouses. (COCA)

As shown in Figure 6.32, which represents the semantics of the example in (195a), the recipient her is a distinct participant from the Possessor in the verbal representation. The Possessor with buying verbs refers to the seller from whom the goods are bought. The recipient is the intended possessor of the purchased goods. Therefore, there is no link between the recipient her and the Possessor in the network. However, it is possible for the Possessor to also be expressed in the Transfer construal and thus included in the constructional causal chain.

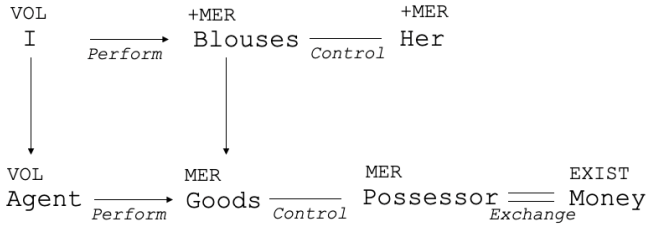


Figure 6.32: A Transfer causal chain with a beneficiary direct object.

A more complex causal chain representation is needed for examples in which the Possessor is syntactically expressed as an argument (e.g., *I bought her some blouses from the store*). As explained in section (6.4.3.1) with taking verbs, the constructional analysis must represent two distinct core events: a removal event in which the agent takes the merchandise from the seller and a transfer event in which the agent gives the merchandise to the intended recipient. As shown in Figure (6.33), the semantic representation for the example *I bought her some blouses from the store* requires two distinct causal chains. The two events are temporally ordered: the metaphorical remove event temporally precedes the giving event. That is, the blouses can only be given to someone after they have been purchased from the store.

Figure 6.33: Transfer causal chain with an overtly expressed Possessor and a beneficiary.

In an even more complicated scenario, Money can also be overtly expressed in the argument structure construction (e.g., *I bought her blouses from the store for $20*). In such examples, the EXCHANGE relation is added to the metaphorical Remove causal chain, i.e., the EXCHANGE relation is subsequent to the removal event, as shown in Figure 6.34. The buyer giving the seller money allows the buyer to buy the blouses. The buying event temporally precedes the giving event which is depicted by the second (Transfer) causal chain.

Figure 6.34: Transfer construal with an overtly expressed Possessor, Money, and a beneficiary.

6.7 Conclusion

Chapter 7

Semantics of communication verbs and argument structure constructions (Pavlína Kalm)

7.1 Introduction

Verbs that describe speech events make up a large part of the verbal lexicon. About 25% of social domain classes describe communication events. Human interactions facilitated by language have been extensively addressed in philosophy as well as linguistics with a particular emphasis on the meaning and structure of speech acts and their pragmatics (Austin, 1962; Tsohatzidis, 1994). Communication verbs have been primarily discussed in the context of speech act theory (Searle, 1969) which views communicative interactions as 'performative' acts. The act of speaking, such as making statements, promises, or asking questions has been analyzed as a rule-governed form of behavior (Searle, 1969, 16).

The semantics and syntax of communication verbs has been sparsely discussed in the theoretical linguistics literature. Levin's 1993 verb classification, which is based on syntactic alternations observed with semantically coherent classes of verbs, provides one of the more comprehensive discussions of communication verbs. Levin divides communication verbs into distinct classes based on their semantic and syntactic properties; however, her account of verb classes is incomplete. She fails to include various types of communication verbs, such as *inquire* and *interrogate* verbs, *beg* verbs, *lecture* verbs, *spell* and *pronounce* verbs and others. Additionally, her description of communication verbs provides "an

abbreviated treatment of some of the classes of verbs" (Levin, 1993, 202). One of the reasons for her abbreviated account of communication verbs is that they commonly occur with sentential complements. Including argument structure constructions with sentential complements was outside of the scope of Levin's book. Our discussion of the syntactic behavior associated with communication verbs includes argument structure constructions with sentential complements; however, the semantics of sentential complements is not decomposed into semantic primitives, unlike the semantics of main clauses.

Other linguistic studies on communication verbs take a narrow approach and only look at the semantics of a few verbs, such as *tell* or *say* (e.g., Cuyckens and Parret 1982) or a small class of verbs that are semantically very similar, such as manner and noise verbs (e.g., Urban and Ruppenhofer 2001). Occasionally, an argument structure construction that is used with a category of physical and social verbs, including communication verbs, such as the English dative alternation, may receive isolated attention (e.g., Rappaport Hovav and Levin 2008).

Online resources such as FrameNet (Fillmore et al., 2003) and VerbNet (Kipper et al., 2007) provide a considerably broader coverage of communication verbs. FrameNet's emphasis is on the event structure associated with verbs, while VerbNet focuses on syntactic alternations. The semantic analysis developed in this study primarily uses these online resources to ensure a comprehensive account of communication verbs.

Communication verbs describe events in which an agent produces a signal which represents a meaningful conceptual unit. The production of the signal may be spoken, signed, or gestured. Many communication verbs highlight a social communicative function of speech while other verbs focus on the creation of the utterance itself. There are four main types of communication verbs that we distinguish based on their distinct event structures: Statement (7.4), Communicate (7.5), Joint Statement (7.6), and Request (7.7). These verb types focus on different aspects of communication events. The distinct verbal networks associated with these verbs reflect their semantic differences.

All communication verbs share a common sequence of causal relations in their event structure representations. This shared sequence consists of three event participants: SPEAKER, SIGNAL, and MESSAGE, as shown in Figure 7.1. The Speaker, a volitionally acting agent, produces a Signal which is decoded as a contentful utterance, i.e. "Message". The relation between the Speaker and Signal is defined as physical FORCE since the creation of the Signal takes place in the physical domain. The Signal is a Design theme in the event structure. The Signal is decoded as a contentful unit by way of there being a symbolic relation between it and the Message. This is represented as a RELATE relation which is used to define an asymmetrical conceptual relation between two entities in the social domain. The Speaker's production of the Signal is tied to the intentional creation of the Message. Hence, the Message is also identified as a Design theme in the verbal event structure.

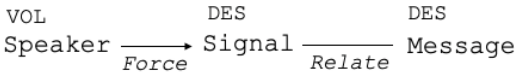


Figure 7.1: A shared causal sequence in communication networks

7.2 Message vs. Topic

We analyze Message as semantically distinct from Topic, following FrameNet's analysis. Message decodes the Signal as a meaningful utterance to be conveyed to the Addressee. Topic, on the other hand, describes the subject matter of the communication event. It provides a short conceptual summary that places the Message within a broader context. Message and Topic differ in how they are syntactically realized in argument structure constructions in English.

Message is syntactically realized as a direct object (196a-196c)[1], complement clause (196d, 196e), or a direct speech clause (196f). With some verbs, e.g., *suggest*, the direct object may refer to a subevent of the Addressee. For example in (196b), *eye glasses* stands for the suggested subevent that the Addressee '*use/buy eye glasses*'. Less frequently, Message may also be syntactically realized as a *for*-Obl: *[...] he argued for the cut-off in American aid to Pakistan* (FrameNet). The use of the preposition *for* in this example reveals the Speaker's positive attitude towards the proposition. English uses the preposition *against* to signal a negative attitude toward the proposition (e.g., *Ellen argued against the cut-off in American aid*).

(196) a. Heather cabled **the news**.
b. John suggested **eye glasses** to her.
c. They confessed **their stealing**.
d. John declared **how to do it**.
e. Susan complained **that the party would be tonight**.
f. Ellen warned, **'Avoid that hole in the sidewalk'**.

In contrast, Topic is usually syntactically expressed as an *about*-phrase (197a), though other prepositions (e.g., *of, regarding* or *over*) may also be used (197b-197d):

(197) a. Someone called **about this the other day**. (FrameNet)
b. Several readers have already contacted me **regarding foul play and the role of the touch-judge**. (FrameNet)
c. Morland [...] openly boasted **of his skill as a forger**. (FrameNet)
d. John Stewart laments **over the quality of programs[...]**. (FrameNet)

[1]The direct object in (196c) is an event nominal.

Topic and Message do not commonly co-occur in the same argument structure construction, though they are not mutually exclusive. When expressed together, Topic may be used to specify what the Message pertains to (e.g., *She told him the news about the president*). Topic tends to be expressed when Message is contextually underspecified.

It has been argued that communication verbs are pragmatically different in terms of what aspect of the speech event they perspectivize (Dirven, 1982). Some verbs, such as *tell* and *say*, perspectivize the Message (in which case Topic is not in focus and is not likely to be expressed), while other verbs, such as *speak* and *talk*, perspectivize the Topic. *Talk* verbs denote the linguistic action in its entirety and usually refer to a larger amount of verbal output (Dirven, 1982, 39). As such, *talk* verbs tend to occur with Topic rather than Message. *Speak* is semantically and syntactically very similar to *talk*.[2]

Topic and Message also differ in their syntactic 'obligatoriness'. Topic is not obligatorily expressed in the syntax with communication verbs, whether they pragmatically perspectivize it or not (e.g., *She talked/She talked about it*). Message, on the other hand, is syntactically obligatory with many communication verbs that perspectivize it, such as *say* (**She said*).

We analyze Topic as a circumstantial phrase that situates the communication event in a conceptual domain. As such, Topic is not included as a participant in causal chain representations. The use of Topic as a circumstantial phrase is not limited to the communication domain. It can be used to situate other social actions, such as interpersonal interactions, in a conceptual domain. For example, Topic can be used to set the background for an action of fighting or battling (e.g., *They battled about it* or *They fought about/over it*).

Additionally, the semantics of intransitive argument structure constructions with verbs that perspectivize Topic (e.g., *talk, speak*) strongly point to an event in which the Speaker is engaged in a non-causal one-participant ("Internal") event, rather than an event of creation. *Talk* verbs are frequently used to describe an extensive linguistic action (198a). They can also be used to describe various aspects of a linguistic action, such as the physical aspect of speech production (198b), psychological action (198c), or cognitive action (198d) (Dirven, 1982, 43-47).

(198) a. She is out there talking in the dark.
b. Don't talk with your mouth full.
c. I breathe, I walk, I talk, I smile, I think.
d. Babies walk and begin to talk about one year old.

In (198b), the event focuses on the movement of one's mouth while talking, rather than the creation of a Message. In (198c), the ability to speak, expressed with *talk*, occurs alongside with verbs such as *breathe*, a verb of substance emission, *walk*, an internal motion verb, *smile*, a gesture verb, and *think*, a cognition

[2]FrameNet does not distinguish between the semantics of *tell, say, speak, and talk.* These verbs all belong to the Statement frame. VerbNet's analysis distinguishes between these verbs by classifying them into different verb classes given their distinct syntactic behavior.

verb, all construed as describing internal events. Lastly, in (198d), *talk* describes a cognitive ability which is construed as an Internal action.

The semantics of intransitive argument structure constructions with verbs such as *talk* strongly point to an analysis in which the production of speech is construed as an Internal action, rather than an event in which a Message is created. Whether Topic is overtly expressed or not with verbs such as *talk* does not affect this construal.

7.3 Instruments with Communication events

An Instrument participant ("Medium") may be used to describe an object, such as a telephone, TV, or a computer, that the Speaker uses to transmit a Signal. We do not include a Medium as a participant in our verbal networks with communication verbs because it is not obligatorily evoked by verbal semantics. Communication verbs obligatorily evoke the use of a body part, i.e. vocal cords or hand movements; however, a Medium has a different role in the event structure when compared to a body part instrument.[3] Body part instruments are generally antecedent to the theme in the event structure. For example, vocal cords in communication events causally precede the Signal. A Medium, on the other hand, is causally subsequent to the Signal (and Message) in the event structure. The Signal is produced first before it is transferred to an Addressee via a Medium.

When an Addressee is not overtly expressed, the Medium tends to be syntactically realized as a subsequent oblique (199a), rather than an antecedent oblique (199b). This syntactic realization of a Medium is different from a body part instrument, which is expressed as an antecedent *with*-oblique with communication verbs (199c). When an Addressee is part of the causal chain, a Medium may be expressed as either an antecedent or subsequent oblique (199d). The syntactic realization of the Medium as an antecedent oblique when the Addressee is overtly expressed is largely determined lexically. For example, *warn* can occur with either an antecedent or subsequent oblique, while *complain* only occurs with a subsequent oblique (199e). The syntactic realization of a Medium does not affect its antecedent position to the Addressee in the casual chain.

(199) a. Susan said a few words on the phone.
b. *Susan said a few words by phone.
c. Susan gestured with her right hand.
d. Ellen warned me about it by phone/on the phone.
e. Susan complained to her ?by phone/on the phone.

[3]Body part instruments are not included in our event structure representations unless they introduce cyclicity to the verbal network, such as the Instrument in the Perception network.

7.4 Statement verbs

Statement verbs describe an aspect of communication that highlights the production of a Signal and the Message associated with it. Statement verbs are similar to sound emission verbs in the physical domain in that the Signal can be equated to an emitted sound which is created by an emitting entity. However, unlike physical sound emission events, the emitted sound in communication events is intended to represent a meaningful utterance. Statement verbs do not evoke an Addressee in the event structure (200a and 200b), though an Addressee may be constructionally added (200c and 200d).

(200) a. They confessed it.
b. Susan talked.
c. He suggested it to her.
d. Susan whispered to Rachel.

Statement verbs describe the simplest event structure of all communication verbs. The network representation in Figure 7.2 is identical to the sequence of causal relations identified as shared by all communication verbs, discussed in Section 8.1.

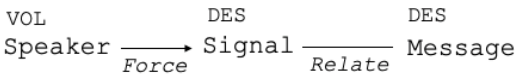


Figure 7.2: Statement event structure

VerbNet classes that contain Statement verbs include: characterize-29.2, complain-37.8, confess-37.10, declare-29.4, lecture-37.11, talk-37.2, overstate-37.12, pronounce-29.3.1, curtsey-40.3, reflexive_appearance-48.1.2, say-37.7, manner_speaking-37.3, and transfer_mesg-37.1.1. Curtsey-40.3 and pronounce-29.3.1 verbs are semantically somewhat different from other Statement verbs and are discussed separately in section 7.4.1 and 7.4.2.

FrameNet frames that include Statement verbs as Lexical Units include: Statement, Communication, Spelling_and_pronouncing, Complaining, Reveal_secret, Communication_noise, and Communication_manner.

7.4.1 Curtsey verbs

Curtsey verbs (e.g., *salute, genuflect, bow*) describe non-verbal communication events in which an Agent uses a conventionalized gesture that is interpreted as a meaningful social act. For example, the action of saluting conveys a greeting. Genuflecting is a gesture that conveys respect for another person. Commonly, these verbs occur in intransitive argument structure constructions (201a). In such cases, the gesture is interpreted as conveying the meaningful act that it serves to represent. Curtsey verbs can also be used to signal communicative

events in which a more contentful Message, rather than just a conventionalized gesture, is intended to be conveyed (201b). The Addressee may or may not be overtly expressed.

(201) a. The princess curtseyed.
b. The princess curtseyed her assent (to the queen).

Curtsey verbs occur in the same syntactic construals as other Statement verbs (discussed in section 7.4.3). Consequently, our analysis of the event structure of curtsey verbs doesn't distinguish them from other Statement verbs. This analysis is also compatible with VerbNet which analyzes the intransitive frame in (201a) as a transfer of information event. VerbNet's semantic description of the example in (201a) is identical to their analysis of intransitive syntactic frames with other Statement verbs, such as *say* or *speak*.

7.4.2 Pronounce verbs

Pronounce verbs (e.g., *pronounce, spell*) describe an event of pronouncing a word or creating a gesture. These verbs always occur with a direct object (202). This syntactic behavior distinguishes them from other Statement verbs which don't require a direct object and commonly occur in intransitive construals (e.g., *She spoke/talked,* etc.). However, pronounce verbs are semantically similar to other Statement verbs in that they describe an event structure in which a Speaker produces a Signal that represents a meaningful utterance.[4]

(202) a. You spelled 'Kalamazoo' incorrectly.
b. She pronounced it 'con-TROV-er-sy'.
c. She spelled it to us.

Pronounce verbs commonly occur with an overtly specified 'Attribute,' which refers to the pronunciation of a word. The Attribute is not part of the verbal event structure; it is constructionally added. Other Statement verbs (e.g., *say*) can be used to describe pronounce events if an Attribute is overtly expressed, e.g., *He said it incorrectly* or *He said it as 'con-TROV-er-sy.* Like other Statement verbs, pronounce verbs can occur in argument structure constructions with an Addressee (202c). In such an example, the spelled word is construed as a Message intended to be communicated to an Addressee.

Our analysis of argument structure constructions with pronounce verbs is compatible with VerbNet's analysis, which describes the semantics of examples in (202a) and (202b) using the predicate 'Characterize'. In their analysis, the Agent's event (described by the predicate 'Do') 'Causes' a 'Characterize' relation between a Theme and an Attribute. Our causal analysis of the example in (202b) treats '*con-TROV-er-sy'* as an 'Attribute' of the direct object. Our

[4]Alternatively, we could have a distinct Pronounce network. The event structure would include an Engage relation between "Message" and "Attribute" (=the pronunciation). But it would mean that we have a distinct verbal network for just a handful of verbs, which we have been trying to avoid.

analysis of the example in (202a) doesn't include '*incorrectly*' in the causal chain representation as we do not analyze adverbs as event participants.

7.4.3 Syntactic realization of participants with Statement verbs

The Speaker is usually realized as the subject. The Signal can be expressed as a direct object (e.g., *She said a few words*) or may be construed as an instrument-like participant and realized as an antecedent oblique in argument structure constructions with an overtly expressed Message (e.g., *She said it all with a smile*). However, the Signal is not commonly expressed in the syntax. Communication verbs more frequently occur with an overtly specified Message.

Some Statement verbs (e.g., *lecture, talk*) do not occur in transitive argument structure constructions. The semantics of these verbs focuses on the Speaker's activity of talking rather than the creation of a Signal or Message. Our analysis of these verbs does not distinguish their verbal event structure from other Statement verbs because this syntactic behavior is primarily motivated by English having a number of distinct lexical items for various semantically distinct communication events, such as *speak, talk, say,* and *tell*. It is not our aim for verbs in the same semantic verb type to share the same syntactic patterns. Verbal networks are constructed based on shared semantics.[5]

An Addressee may be constructionally added to the causal chain as a subsequent *to*-oblique (203). Argument structure constructions with an Addressee most commonly signal joint actions in which both Speaker and Addressee engage in discourse. However, unlike examples in which the Addressee is expressed as a comitative *with*-phrase (e.g., *talk with someone*), the asymmetrical *to*-construal does not necessarily imply joint cooperative action. The following examples show the use of the *to*-phrase when an Addressee is not the intended receiver of the communicative action (203a), is a doubtful receiver (203b), or a mere 'receptor' (203c, 203d) (Dirven, 1982, 50-53).

(203) a. I am not talking to you, Flynn.
b. Are you talking to me?
c. I tried talking to him but he never said a word.
d. You're the only person I can talk to, and even you never answer me.
(examples are from Dirven 1982)

Importantly, certain Statement verbs, such as *speak*, never imply an active engagement of the Addressee in the communication event. For example, in *He spoke to the crowd*, it is understood that the Addressee is not involved in the discourse as a Speaker, only as a listener. The communicative action is

[5]Whether it is common for languages to have Statement verbs that do not perspectivize Message would have to be investigated further. If it is cross-linguistically common, it might be better to have a separate verbal network for these verbs that does not include Message as an obligatory participant.

clearly asymmetrical in that only the Speaker is communicating a Message to the Addressee, not vice versa.

Consequently, we do not analyze the relation between the Speaker and Addressee as 'Mutual' when the Addressee is overtly expressed as a *to*-oblique, despite the possibility of a joint action interpretation. Instead, we analyze the semantics of the argument structure construction as metaphorically extended from the physical mereological domain (see section 7.5.5.4). A symmetrical relation between two interlocutors is signaled by the *with*-phrase (e.g., *She talked with him*). The relation between the two Agents in these argument structure constructions is analyzed as Mutual. A 'Collective' construal is also possible with Statement verbs when the Speaker and Co-Speaker are syntactically realized as a plural subject (e.g., *They/Susan and Mary talked*). For a more detailed discussion of symmetrical communication events, see section 7.6.

Different Statement verbs allow different types of Messages to be syntactically realized as direct objects, as shown in examples in (204). For example, the verb *state* in (204a) can occur with the direct object *problem* but this is not the case for the verb *say* in (204c). Interestingly, both verbs can occur with the direct object *truth*. This semantic incompatibility doesn't appear to play a role when the Message is expressed as a complement clause (204b, 204d).

(204) a. She stated the problem/the truth.
b. She stated what the problem/the truth was.
c. She said *the problem/the truth.
d. She said what the problem/the truth was.

We are not aware of any corpus studies investigating the effect of lexical semantics on the type of Message expressed as a direct object. Such a study is outside of the scope of this project and we do not further address this phenomenon in our report.

7.5 Communicate verbs

The event structure of Communicate verbs describes an event in which a Speaker creates a Signal with the intention of conveying a Message to an Addressee. As shown in Figure 7.3, the Message is assigned two subevent labels in the Communicate network. It is not only a Design theme that is created along with the Signal, it is also a mereological ('MER') theme in the intended communicative event in which the Speaker communicates a Message to an Addressee. The Message is identified as a Mereological theme with Communicate verbs because its conveyance to an Addressee happens one sound/word at a time. The relation between a Message and an Addressee is analyzed as mental Affect. Hearing a Message affects the mental state of an Addressee who undergoes a change of state in the event. The Addressee is therefore identified as a Property ('PROP') theme.[6]

[6]The communicative event may have an intended Addressee who does not hear the Message. This can be inferred from context. Our causal analysis of verbal and constructional semantics

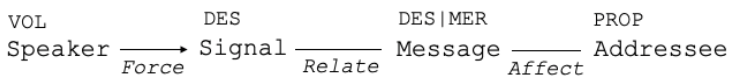


Figure 7.3: Communicate event structure

Communicate verbs occur in the following VerbNet classes: advise-37.9, promise-37.13, tell-37.2, initiate_communication-37.4, instr_communication-37.4.1, interrogate-37.1.3, and inquire-37.1.2. We discuss inquire and interrogate verbs in more detail in section (7.5.1). Advise and promise verbs are discussed in sections 7.5.2 and 7.5.3, respectively.

FrameNet frames that include Communicate verbs as Lexical Units include: Telling, Speak_On_Topic, Prevarication, Communication_means, and Commitment.

7.5.1 Inquire and interrogate verbs

Inquire and interrogate verbs obligatorily evoke an Addressee in their verbal event structure. Unlike an Addressee with other Communicate verbs (e.g., *tell* or *warn*), the Addressee with verbs of questioning is expected to reply to the Message they hear. As such, inquire verbs are semantically similar to Request verbs (e.g., *urge, beg*) in that they describe an action in which the Speaker asks the Addressee to do something, i.e. to answer. However, they are different from Request verbs syntactically. Neither interrogate nor inquire verbs occur in argument structure constructions in which the subevent of the Addressee (i.e. the requested action) is overtly expressed (e.g., **She interrogated him to answer*). This is different from Request verbs which can express the Addressee's subevent in the syntax (e.g., *She urged him to come*). We analyze the Addressee with interrogate and inquire verbs as an endpoint of a Communicate event rather than an endpoint of inducive causation in a Request event.

Inquire and interrogate verbs are not 'request for action' verbs in our analysis. The inference that the Addressee is expected to reply is supplied by lexical semantics. We analyze the content of the Signal with inquire verbs as a Message that is conveyed to an Addressee. The Message with inquire verbs may be realized as a direct object (205a) or a complement clause (205b). Inquire verbs also occur in argument structure constructions in which the Addressee is not expressed as a direct object but can be inferred contextually or from the Message. For example, in (205c) the subject of the complement clause may be understood to be the intended Addressee.[7]

does not attempt to represent whether the communicative event was successful or not given that this does not impact the syntactic realization of participants in English.

[7]As mentioned above, we do not decompose the semantics of complement clauses. Complement clauses are treated as describing the Message. One reason for not decomposing complement clauses is that our semantic analysis of argument structure constructions is not supplemented with contextual information and making a judgment about the identity of the subject of the complement clause in (205c) is not possible without context.

(205) a. They asked him a question.
b. They asked him what to do.
c. They inquired if he went to the store.

Interrogate verbs are not semantically compatible with a Message. The action of interrogating pespectivizes larger amount of output, similarly to some Statement verbs such as *talk*. They can occur either with a Topic, which is analyzed as a circumstantial phrase, (e.g., *They questioned him about the accident*) or in an argument structure construction in which only the Speaker and Addressee are expressed (e.g., *They questioned him*)[8].

In some languages such as Czech the Addressee in the transitive argument structure construction with interrogate and inquire verbs is marked ACCUSATIVE (e.g., *Vyslýchali ho*(ACC) 'They interrogated him') as opposed to the prototypical transitive construction with Communicate verbs in which the Addressee is marked DATIVE (e.g. *Řekl mu*(DAT)) 'He told him'. It is likely that the accusative construal in Czech is motivated by the Addressee being an endpoint of an Affect relation in communication networks. This evidence poses a question as to whether the English transitive argument structure construction with inquire and interrogate verbs should be treated as semantically different from the transitive construction with Communicate verbs. We have concluded that there is no syntactic evidence for having two separate analyses for the transitive construction with communication verbs in English.

7.5.2 Advise verbs

Advise verbs share the same verbal event structure as Communicate verbs though the Speaker's intention for speaking is to advise the Addressee to do something rather than to just transfer a Message. Consequently, advise verbs frequently occur in inducive construals in which the advised action is expressed as a subevent of the Addressee (206a). Other Communicate verbs can also occur in inducive construals, as discussed in section 7.5.5.6. Like other Communicate verbs, advise verbs can be construed as describing an event in which a Message is conveyed to an Addressee. In such construals, the Addressee's subevent is expressed as a complement clause (206b).

(206) a. He advised him (not) to skate on thin ice.
b. Earl warned Helen that the party would be tonight.
c. Earl warned Helen against skating on thin ice.

Advise verbs can also occur in constructions in which the subevent of the Addressee is expressed as an *against*-phrase (206c). The constructional semantics describes an inducive event and the preposition *against* signals that the Addressee is advised not to engage in an action. This syntactic behavior is specific

[8]FrameNet does not distinguish inquire and interrogate verbs. They have a single Questioning frame for both verbs. This is largely because their semantics are so similar and FrameNet's verb classification is not strictly based on syntactic patterns.

to advise verbs; other Communicate verbs do not occur in this construal and generally only allow the use of an infinitival clause to express the Addressee's subevent in inducive argument structure constructions.

7.5.3 Promise verbs

Promise verbs describe a speech act in which the Speaker expresses either their own commitment to a future event (207a) or a desired future event that the Speaker wants the Addressee to engage in (207b) (cf. Farkas 1988). The Speaker may also commit a third party to a future event (207c). In all of these cases, the future event may be syntactically realized as a complement clause. We do not distinguish the semantics of these argument structure constructions considering that we do not decompose causal relations in complement clauses.

(207) a. I promised him that I would come.
b. I promised him that he would arrive in time.
c. I promised him that Helen would arrive in time.
d. I promised him the house.
e. I promised him to arrive on time.

The promised future event may be syntactically expressed as a complement clause (207a-207c). We analyze the complement clause as a Message, which is consistent with our analysis of complement clauses with other communication verbs. Many Communicate verbs can be used to describe promise events in argument structure constructions with complement clauses (e.g., *I told him that I would come*). The inference that the event describes a promise comes from the semantics of the complement clause rather than the argument structure construction. The [SBJ V OBJ COMP] argument structure construction is also used to describe communication events in which a Speaker transfers information to an Addressee (e.g., *I told him that she arrived*). We do not distinguish semantics of argument structure constructions with complement clauses in the communication domain. Complement clauses are analyzed as describing a Message with different types of verbs.

It is also possible to express the future event as a direct object (207d). The direct object always refers to the Addressee's subevent. For example, the *house* in (207d) describes the future event of the Addressee, i.e. him getting the house. The example could be paraphrased as *I promised him that he would get the house*. The semantic analysis of the double object argument structure construction in (207d) follows our analysis of other Communicate verbs in this construction (see section 7.5.5.5).

The future event can also be syntactically realized as an infinitival clause (207e)[9] which always describes the Speaker's commitment to a future event, not the Addressee's. We analyze the infinitival clause as a Message, similarly to

[9]This syntactic frame is not in VerbNet.

the complement clause. It describes the content of the Signal.[10] However, the analysis of the infinitival clause as denoting a Message does not carry over to argument structure constructions with other Communicate verbs (e.g., *She told him to arrive on time*). With Communicate verbs such as *tell*, the infinitival clause always refers to the Addressee's subevent. The constructional semantics of the infinitival clause with tell verbs describes an event of inducive causation.

The Addressee can be syntactically omitted with promise verbs (e.g., *I promised to arrive on time*). In such examples, the constructional causal chain does not include an Addressee. Although the infinitival clause always refers to the Speaker's subevent; the causal chain for this example describes a relation between a Speaker and Message. This is consistent with our analysis of examples with infinitival clauses in which an Addressee is overtly expressed.[11] The semantics of this causal chain is discussed in section 7.5.5.2.

7.5.4 Syntactic realization of participants with Communicate verbs

The syntactic realization of participants in Communicate events is the same as described for Statement verbs with the exception of an Addressee. The Addressee is part of the event structure of Communicate verbs and is therefore not constructionally added when it is overtly expressed. The Addressee can be expressed as a *to*-oblique or a direct object (e.g., *She told him*). The semantics of argument structure constructions with Communicate verbs are discussed in the following section 7.5.5.

7.5.5 Semantics and annotation of argument structure constructions with Statement and Communicate verbs

Statement and Communicate verbs occur in similar construals, including metaphorical argument structure constructions that are extended from the physical and social domains. However, there are some differences in their syntactic behavior. Statement verbs more commonly occur in intransitive argument structure constructions which construe the communication event as an INTERNAL activity that the Speaker engages in (see section 7.5.5.1). This construal is much less common with Communicate verbs which include an Addressee in their verbal event structure and tend to occur in argument structure constructions in which the Addressee is syntactically expressed.

When Signal or Message are overtly expressed, the communication event may be metaphorically construed as a physical creation event (section 7.5.5.2).

[10] We could also analyze it as the Speaker's subevent just like we analyze the infinitival clause when it refers to the Addressee. But this analysis would be quite challenging to work out in terms of annotation and the mapping from constructional to verbal semantics. So I opted to analyze the semantics of *He promised her to go* the same as *He promised her that he would go*.

[11] I realize this is not the best solution. A better analysis would be to treat the infinitival clause as a subevent of the Speaker. But, as I pointed out in the previous paragraph, there are some issues with that analysis, too.

Statement and Communicate verbs use a metaphorical Place [SBJ V OBJ *to*-OBL] argument structure construction to describe the conveyance of a Message to an Addressee (section 7.5.5.3). Communicate verbs can also construe the communicative action as a metaphorical Change of State event when Message is not overtly expressed (section 7.5.5.4) or a Transfer of Possession event when both the Addressee and the Message are expressed as direct objects (section 7.5.5.5).

7.5.5.1 Internal construal

Intransitive [SBJ V] argument structure constructions with communication verbs (208) are analyzed as Internal events. The causal chain associated with Internal argument structure constructions is non-relational; it consists of the Speaker as a sole participant engaged in the event evoked by the verb. Internal construals are primarily characteristic of Statement verbs. The semantics of Statement verbs does not focus on the conveyance of a Message to an Addressee since an Addressee is not obligatorily evoked in the event structure. Thus, they are more likely to occur in intransitive argument structure constructions without overtly expressing the Message or constructionally adding an Addressee.

(208) a. She lectured.
b. Susan whispered.
c. Susan complained.

The annotation of Internal argument structure constructions uses an "Internal" FD2 label. The FD1 label is always "Self-volitional" with communication verbs since the initiator of the causal chain (i.e. Speaker) acts volitionally.

7.5.5.2 Metaphorical Create construal

Statement and Communicate verbs can occur in transitive argument structure constructions in which the direct object describes either a Signal or a Message. In (209a), the direct object denotes a Message.

(209) a. Heather cabled the news.
b. John declared how to do it.
c. John suggested that he should go.

The semantics of the transitive construction in (209a) describes a metaphorical physical Create event. The Speaker metaphorically uses physical Force to create a Message. When the direct object is the Signal, the creation event is not metaphorical; the Force relation between the Speaker and Signal takes place in the physical domain. The causal chain associated with the example in (209a) is shown in Figure 7.4. The participant labels in the causal chain are specific to the communication domain but the force-dynamic relation is metaphorically extended from the physical domain. The participants' subevent labels in the

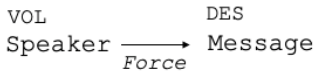


Figure 7.4: Metaphorical Create causal chain with Communication verbs

constructional causal chain match the subevent labels identified for participants in the Statement and Communicate networks.

The Creation theme in the social target domain has varied syntactic realizations when compared to the theme in the physical source domain. A Message may be expressed as a complement clause (209b, 209c) or a direct speech complement. No matter the syntactic realization of the Message, the argument structure construction is analyzed as a metaphorical Create event. It is expected that the realization of the Message deviates from the source domain when the subevent is realized in the syntax instead of the participant.

The annotation of metaphorical Create examples uses the physical domain "Create" label for the FD2 category. The FD1 label is "Volitional" with communication verbs since the initiator's use of physical Force is volitional. We use an "Event Domain" annotation category that specifies the domain and the subdomain of the example when dealing with constructional metaphors (see Kalm et al. 2020). Specifying the Event Domain helps distinguish metaphorical uses of argument structure constructions from non-metaphorical ones. The Event Domain is frequently implicit in the verb (or verb class).

7.5.5.3 Metaphorical Place construal

Statement and Communicate verbs can occur in a metaphorical causative Place [SBJ V OBJ *to*-OBL] construal when the Addressee is overtly expressed (210). In the physical domain, the causative Place construction describes an event in which an external initiator causes an object (Figure) to undergo a mereologically incremental motion towards another object (Ground) (see chapter 4). The metaphorical extension of this argument structure construction to the communication domain is motivated by the Message being conceptualized as a mereologically incremental theme when it is transferred to an Addressee.[12] The Message is metaphorically understood to 'reach' the Addressee which is analogous to the physical Place event in which the Figure comes to be spatially co-located with the Ground.

(210) a. I presented a solution to him.
b. Susan whispered to Rachel how to avoid the crowd.

[12]I came across Beavers (2011, 7) short discussion of communication events. He states that "direct objects [with communication verbs] are like paths of traversal of the subject (i.e. *John read the story to Mary* involves John traversing the story end to end in a manner similar to *John walked the plank*)". His analogy is different from ours and doesn't really make sense to me because traversing a story end to end presupposes a mereologically incremental event while John walking the plank is a holistically incremental event.

c. I explained the matter to them.

The causal chain associated with the metaphorical Place argument structure construction with communication verbs is shown in Figure 7.5. The target domain causal chain is identical to the source domain causal chain. In the source domain, the initiator applies physical Force which causes the Theme to move along a Path towards the Ground. The initiator of the causal chain maps to the Speaker and the endpoint of Force maps to the Message (or Signal) in the verbal network. With Communicate verbs, the endpoint of Path maps to the Addressee in the network. However, with Statement verbs, the Addressee is constructionally added and does not map to any participant in the verbal network.

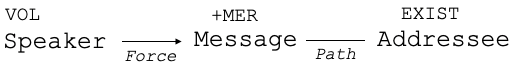


Figure 7.5: Metaphorical Place causal chain with Statement and Communicate verbs

The annotation of metaphorical Place argument structure constructions is the same as the physical domain annotation. The FD2 label is "Place" and the FD1 label is determined by the initiator. With communication verbs, the initiator always acts volitionally and is external to the core event in the Place causal chain. As such, the FD1 label in the metaphorical Place construal is always "Volitional".

7.5.5.4 Metaphorical Change of State construals

Communicate verbs can occur in transitive argument structure constructions in which the direct object denotes the Addressee (211). In these examples, the Message is not overtly expressed. The semantics of the argument structure construction describes a direct causal relation between the Speaker and Addressee.

(211) a. John informed me.
b. Earl alerted Helen.
c. Wanda taught the students.

The casual chain associated with these examples is shown in Figure 7.6. The causal chain is analyzed as a metaphorical Change of State ("COS") event in which the Addressee is affected by the communicative event.[13] A metaphorical COS construal with communication verbs is likely motivated by the syntactic

[13]I considered analyzing the semantics of these examples as mental Affect but I think a metaphorical physical COS analysis is better because it allows us to have a unified analysis for the the transitive ASC (*John informed me*) and the [SBJ V *to*-OBL] ASC (*John talked to me*). We discussed that these two syntactic variants with communication verbs are related to the same mereological ASCs (*He painted the wall/He painted onto the wall*). I discuss the intransitive variant after the transitive one in this section.

behavior of physical mereological verbs. Physical place (and remove) verbs can occur in transitive argument structure constructions in which the Ground is expressed as a direct object (e.g., *He painted the wall*). The Ground is construed as a Property theme in these examples. In the example *He painted the wall*, the *wall* undergoes a change of state by being *painted*. The semantics of the transitive argument structure construction with Place verbs is metaphorically extended to communication verbs.

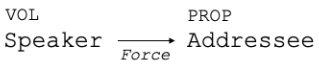


Figure 7.6: Metaphorical COS causal chain with Communicate verbs

Both Statement and Communicate verbs can also express the Addressee as a *to*-oblique when Message is not overtly expressed as a direct object (212). The semantics of this argument structure construction is also analyzed as metaphorically extended from the physical mereological domain. The *to*-oblique describes a metaphorical Ground with communication verbs, just like the *to*-oblique in the metaphorical Place construal (213b).

(212) a. Susan complained to Rachel.
b. Susan talked to Rachel.
c. They confessed to us.

The physical source domain [SBJ V *to*-OBL] argument structure construction is analyzed as a COS event. Some mereological verbs may express the Ground as an oblique argument when the Figure is not syntactically expressed. This syntactic pattern alternates with the transitive variant and seems to be semantically motivated (213a-213b). Specifically, it appears that the transitive variant correlates with a Patient that is fully affected by the event while the intransitive variant correlates with partial affectedness of the Patient. The same semantic inference also appears to motivate this alternation with COS verbs (213c,213d).[14]

(213) a. He painted the wall.
b. He painted on(to) the wall.
c. She cut the bread.
d. She cut into the bread.

We do not capture this semantic difference between the two syntactic variants in our force dynamic analysis. The constructional causal chains are the same for both argument structure constructions. In both cases, the Ground undergoes a change of state and is identified as a Property theme. The causal

[14]This alternation is also possible with physical Remove verbs (*The men mined the mine/from the mine*); however, there are no corresponding communication verbs that occur in the *from*-oblique variant.

chain analysis for the metaphorical COS [SBJ V *to*-OBL] argument structure construction with communication verbs is the same as the analysis for the transitive [SBJ V OBJ] variant depicted in Figure 7.6.

Communication verbs generally occur in either the transitive or the intransitive variant. The syntactic realization of the Addressee with communication verbs is mostly determined lexically (e.g., *He confessed *me/to me* but *He informed me/*to me*). In addition, there doesn't appear to be an underlying semantic inference of partial vs. full affectedness that would motivate the realization of the Addressee as either a direct object or an oblique argument in the communication domain.

The annotation of the causal chain associated with Figure 7.6 uses the source domain FD2 label: "COS." The FD1 is annotated "Volitional" since the initiator is external to the core event and acts volitionally.

7.5.5.5 Metaphorical Transfer construal

Only Communicate verbs occur in the double object argument structure construction (214) characteristic of Transfer of Possession verbs. The communicative action is metaphorically construed as a transfer event; a Speaker transfers a Message to an Addressee (cf., Levin 1993, 202, Goldberg 1995). The event structures of Communicate and Transfer verbs share certain semantic correspondences that motivate this metaphorical construal (see Chapter 6 for a more detailed discussion of Transfer of Possession verbs). In particular, the themes in both verbal networks (i.e. the Message in the Communicate network and the Possession in the Transfer of Possession network) are conceptualized as mereological and the Addressee is conceptualized as an intended Recipient of the Message in communication events.

(214) a. Heather cabled Sara the news.
b. She told him what to do.
c. John informed me that this situation had changed.

The semantics of the double object argument structure construction with Communication verbs is identical to the semantics of the source domain causal chain with transfer of possession verbs, as shown in Figure 7.7. The participant labels in Figure 7.7 are specific to the communication domain; however, the force-dynamic relations are metaphorically extended from the possession domain. In the source domain, an Agent causes a Possession to be transferred to a new Possessor. The Agent uses a performative illocutionary force ("Perform") to bring about the metaphorical transfer of possession event. The relation between the Possession and new Possessor is defined as Control. Control prototypically describes a socially sanctioned relation between an entity and an Agent. In transfer of possession events, the Control relation indicates that the Agent (or Possessor) either loses or gains control of the Possession. In the target domain, the Speaker metaphorically maps to the Agent, the Message maps to the Possession, and the Addressee maps to the Recipient in the source domain.

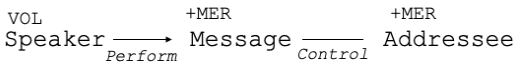


Figure 7.7: Metaphorical Transfer causal chain with Communicate verbs

The annotation of the causal chain in Figure 7.7 uses the source domain FD2 label: "Control." This label describes the second segment of the causal chain. The volitionally-acting initiator of the causal chain is external to the core event and is therefore annotated "Volitional". [15]

7.5.5.6 Other construals

Statement and Communicate verbs can occur in argument structure constructions with a Co-Speaker. The Co-Speaker may be expressed as a *with*-phrase (e.g., *Susan talked with Rachel*) or the Speaker and Co-Speaker are expressed as a plural subject (e.g., *Susan and Rachel talked*). These argument structure constructions are common with Joint Statement verbs and are discussed as a "Mutual" and "Collective" construals respectively in section 7.6.2.

Statement verbs can also occur in construals in which they designate a relation between an Entity and an Attribute (e.g., *The president declared Smith professor* or *He characterized him as smart*) or the Entity's subevent (e.g., *The president declared the matter closed*). The semantics of these examples describes an event in which the Speaker uses verbal means to assign an Attribute or Subevent to an entity. The causal chain associated with these examples is shown in Figure 7.8. The force-dynamic relation between the Speaker and the Entity is defined as Perform.[16] The relation between the Entity and the Subevent is Engage. The Speaker engages in the event as a volitional ("VOL") initiator. The Entity does not undergo any change in the event and is therefore labeled "EXIST".

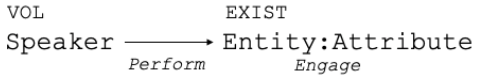


Figure 7.8: An externally initiated Engage relation with Statement verbs

The causal chain in Figure 7.8 is annotated "Volitional" FD1 "Engage" FD2. The domain of the verb determines that the relation between the Speaker and the Entity is social Perform.

Communicate verbs can also be used to describe inducive events in which an Agent asks or orders an Addressee to engage (or not to engage) in an event

[15] The domain of the verb determines that the force-dynamic relation between the initiator and the theme is Perform (rather than physical Force, which is associated with the FD1 label "Volitional" in the physical domain).

[16] The definition of Perform should be stated in the Introductory chapter when we talk about the different types of force-dynamic relation in the social domain.

(e.g., *Heather told Sara (not) to come*). An inducive construal is common with Request verbs (discussed in section 7.7) and the causal chain associated with inducive examples is shown in Figure 7.12 (section 7.7.2). The subevent in inducive construals may also be expressed as an *against*-phrase (e.g., *Ellen warned Helen against skating on thin ice*). The preposition *against* signals a Refrain relation between the Entity and the Subevent. The relation between the Entity and the Subevent is defined as "Refrain' in the causal chain representation.

7.6 Joint Statement verbs

The event structure associated with Joint Statement verbs, such as *discuss, chat*, or *agree* is similar to that of Statement verbs in that they don't evoke an Addressee. However, unlike Statement verbs, Joint Statement verbs describe events in which two (or more) Agents are engaged in the same communicative event as Speakers (215). "No person is construed as only a speaker or only an addressee. Rather, it is understood that both (or all) participants do some speaking and some listening - the process is understood to be symmetrical or reciprocal" (FrameNet's description of the Discussion frame which consists of Joint Statement verbs).

(215) a. They agreed.
b. Susan chitchatted about it with Rachel.
c. Susan and Rachel chitchatted.
d. We debated the matter.
e. They agreed (about) what to do.

The verbal network in Figure 7.9 represents the semantics of Joint Statement verbs. The network representation depicts the communication event as a joint action in which both the Speaker and Co-Speaker create the Signal and Message together. The symmetrical relation between the two interlocutors is depicted as a plus sign. The network only represents the role of the interlocutors as Speakers (i.e. initiators of the causal chain), not as Addressees. Their role as Addressees in the event structure is never syntactically expressed. The network in Figure 7.9 does not represent the 'reciprocal' nature of the interaction. It only represents that the Speaker and Co-Speaker have a symmetrical role in the event.

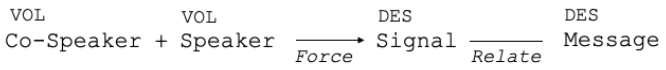


Figure 7.9: Joint Statement Network

Joint Statement verbs do not evoke an Addressee as a participant in their event structure. Unlike Statement verbs, Joint Statement verbs cannot occur

in argument structure constructions in which an Addressee is overtly expressed (e.g., **She agreed/debated/chitchatted to him*).

Joint Statement verbs occur in the following VerbNet classes: settle-36.1.2, chit_chat-37.6, and correspond-36.1.1. FrameNet frames that include Joint Statement verbs as Lexical Units include: Discussion, Be_in_agreement_on_assessment, and Chatting.

7.6.1 Syntactic realization of participants with Joint Statement verbs

In symmetrical construals, the Speaker and Co-Speaker are realized as a plural subject (215a, 215d) or a conjoined subject (215c). In less symmetrical construals, one of the interlocutors is expressed as a subject and the other interlocutor is expressed as a *with*-oblique (215b).

Joint Statement verbs can occur in argument structure constructions with a Topic (215b, 215d, 215e) or without it (215a, 215c). Neither Signal nor Message tend to be overtly expressed with Joint Statement verbs. Direct objects (215d) and complement clauses (215e) with Joint Statement verbs are analyzed as referring to a Topic rather than a Message. Some verbs in the correspond-36.1.1 class can occur in a syntactic alternation in which the Topic can be expressed either as a direct object (or complement clause) or it is preceded by the preposition *about* (215e). Other verbs may only occur in transitive argument structure constructions, such as *debate* in (215d), or intransitive argument structure constructions in which Topic is expressed as a prepositional phrase, e.g., *chitchat* in (215b). We follow VerbNet's analysis and do not distinguish the semantics of these examples.

7.6.2 Semantics and annotation of argument structure constructions with Joint Statement verbs

Joint Statement verbs commonly occur in an Internal (215a-215c) construal in which only the Speaker and Co-Speaker are syntactically realized. Depending on the syntactic realization of participants, the causal chain includes either one participant (=Speakers) or two participants (=Speaker and Co-Speaker), as shown in Figure 7.10.

The one-participant causal chain in Figure 7.10a corresponds to argument structure constructions in which the interlocutors are realized as a plural (or conjoined) subject (e.g., *They debated* or *Susan and Rachel chitchatted*). The two-participant causal chain in Figure 7.10b corresponds to argument structure constructions in which the Speaker is realized as a subject and the Co-Speaker is realized as a *with*-phrase (e.g., *Susan chitchatted with Rachel*). The relation between the Speaker and Co-Speaker is identified as Mutual in this causal chain. Both participants have the same role in the event and hence the same subevent labels.

Our annotation scheme distinguishes these two constructional causal chains by specifying that the "Self-volitional" FD1 label is either "Collective" (for

a. Collective Internal construal b. Mutual Internal construal

Figure 7.10: Internal construals with Joint Statement verbs

7.10a) or "Mutual" (for 7.10b). In both cases, the FD2 is annotated as "Internal".

7.7 Request verbs

Request verbs (e.g., *beg, order*) describe an event structure in which a Speaker communicates a request to an Addressee (216). The goal of the communication event is for the Addressee to fulfill this request. The request is semantically and syntactically different from a Message with other communication verbs and is represented as the Addressee's "Subevent" in the Request network in Figure 7.11.

(216) a. I begged her.
b. I begged him to be civilized.
c. Pat begged them to forgive him. (FrameNet)
d. I begged her for release.
e. He asked forgiveness from Jews who [...] (FrameNet)

The Request network includes the same participants as the Communicate network but the force-dynamic relation between Message and Addressee in the last segment is defined as "Perform." The Perform relation represents a social performative force initiated by the Speaker; however, the Speaker is 'displaced' from the relation in the causal chain by being the initiator of the event structure. The Addressee is identified as a Volitional participant in the causal chain because their role in the event structure is to volitionally engage in the requested action. The Addressee is considered a volitional participant even if they are forced into doing something that they don't want to do.

The Subevent of the Addressee is in a future-oriented mental space (Fauconnier, 1994) which is different from the speech event. Unlike the communicative action which takes place in the reality space, the subevent refers to a request that may or may not be fulfilled by the Addressee in the future. This is not reflected in the network representation for Request verbs. Our force-dynamic event representations do not aim to capture different mental spaces if there is no indication that a different mental space affects the syntactic realization of participants.

The following VerbNet classes contain Request verbs: urge-58.1, beg-58.2, and order-58.3. The only FrameNet frame that includes Request verbs as Lexical

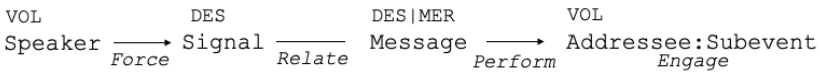


Figure 7.11: Request Network

Units is Request. This frame includes more verbs than the two VerbNet classes; however, many of the Lexical Units cannot occur in the syntactic frames that are listed in VerbNet.

7.7.1 Syntactic realization of participants with Request verbs

As an initiator of the causal chain, the Speaker is always syntactically realized as the subject. Neither the Signal nor the Message are overtly expressed in argument structure constructions with Request verbs. The Addressee is always syntactically realized as a direct object and never as a *to*-oblique. This syntactic behavior reflects the Addressee's distinct role as an endpoint of inducive causation in the verbal event structure when compared to an Addressee with other communication verbs.

The Subevent may be expressed as an infinitival clause (216b, 216c), a *for*-phrase (216d), or a direct object (216e). The direct object denotes the subevent of the Addressee, whether it refers to an event, such as *release* (216d), a physical item, such as *keys* (*She begged him for his keys*), or information, such as *advice* (*She asked him for advice*). In the example in (216d), the Speaker asks the Addressee to release them. The example could be paraphrased *I begged her to release me.*

7.7.2 Semantics and annotation of argument structure constructions with Request verbs

Request verbs most commonly occur in inducive argument structure constructions in which there is a direct Perform relation between the Speaker and Addressee (e.g., *I begged him*). This construal is not restricted to the communication domain. The inducive [SBJ V OBJ argument structure construction is also used with other verbs in the social domain. In particular, it is used with Social Interaction verbs, such as compel verbs (e.g., *pressure, bully*, or *trick*), or letting causation verbs (e.g., *let* or *allow*).

Figure 7.12 illustrates the causal chain associated with the inducive argument structure construction when the Subevent is overtly expressed. The Subevent is not part of the causal chain when it is not syntactically realized (e.g., 216a). The Addressee is always included in the causal chain as a null instantiated participant whether it is syntactically expressed or not.

The annotation of inducive examples is "Self-volitional" FD1 "Inducive" FD2 when the Subevent is not part of the constructional semantics (e.g., 216a).

Figure 7.12: Inducive causal chain

When the Subevent is overtly expressed, the annotation includes an "Engage" FD3 label to specify that the Subevent is part of the causal chain.

7.8 Communication events with non-communication verbs

Communication events may be expressed with various semantically different types of verbs that do not inherently evoke a communication event structure. For example, Transfer of possession verbs (217) or mental Experience verbs (218) can be used to describe events of communication. Other verbs that can be used to describe communication events include animal sounds or other sound emission verbs (219).

7.8.1 Transfer of possession verbs

Transfer of possession verbs can be used to metaphorically describe the conveyance of information as a transfer event (217) (cf. Goldberg 1995, 148). For example, verbs such as *provide* or *supply* can be used to describe communication events (e.g., *She provided him the information*). Other examples in which the Addressee is metaphorically construed as a Recipient include *Jo received the information from Sam* or *He got the ideas across to Jo* (Goldberg, 1995, 148). This extension pattern is cross-linguistically not uncommon and is documented with a few examples of *give* in Newman (1996, 136-137). Newman (1996, 137) notes that the conceptual mapping between transfer and communication is "an easy one to make: the transmission of a message to someone is understood as the giving of a thing to someone." However, he adds that despite these semantic structural similarities, communication events are different from transfer events in that a Speaker does not lose control over the Message when it is shared with an Addressee (Newman, 1996, 138). This semantic difference does not appear to have an impact on the metaphorical use of transfer verbs in communication events.

Transfer verbs can be used to perspectivize either the Speaker or the Addressee. The perspectivized participant is syntactically expressed as a subject in the argument structure construction (217). Successful communication requires that the Addressee actively participate in the event. The Addressee has to attend to the Speaker in order for the Message to be effectively communicated. However, this part of the event structure is not profiled by communication verbs. English doesn't have communication verbs that describe a causal chain initiated

by the Addressee. Transfer verbs and mental Experience verbs may be used to describe this part of the event.

(217) a. He gave him advice.
b. The Russians supplied the Syrians with information.
c. He received the news.

The syntax of communication events with transfer verbs is inherited from the possession source domain. The communication event may be construed as a metaphorical Transfer event (217a), a metaphorical physical Mereological event (217b) or a metaphorical physical Constrain event (217c). Transfer of possession verbs do not occur with complement clauses or direct speech complements.

7.8.2 Mental Experience verbs

English uses mental Experience verbs such as *discover* or *learn* to describe the Addressee's cognitive engagement in the communication event (218).

(218) a. He discovered the truth from him.
b. He learned that she didn't leave.

Discover and *learn* are mental domain verbs; they evoke an event structure in which an Experiencer experiences a Stimulus (e.g., *I discovered the fleece*). In the mental domain, these verbs may occur with a constructionally added "Source" participant which describes the source of the information, e.g. *facts* in *He learned the truth from the facts.* The Source in mental Experience events is analogous to the Speaker in communication events (218a). The extension of *discover* and *learn* to communication events stems from a parallel made between the Experiencer (=Addressee) who comes to experience new content (=Message) provided by a Source (=Speaker).

Many Experience verbs used to describe communication events occur in metaphorical Remove argument structure constructions in which the Addressee is expressed as the subject, the Message as a direct object or a complement clause, and the Speaker as a *from*-oblique (218a). This constructional metaphor is not unexpected given the use of the mereological Place argument structure construction with communication verbs. In both cases, the event is construed as mereologically incremental.

7.8.3 Sound Emission verbs

Communication events can be described by verbs that refer to noises which are not inherently produced by humans (cf. Urban and Ruppenhofer 2001). The inference that the verb is used to describe a communication event stems from the argument structure construction in which the sound emission verb is used as well as the participants expressed as arguments (219). However, there are various syntactic and semantic constrains associated with the use of sound

emission verbs in communication events (Levin, 1991; Urban and Ruppenhofer, 2001).

(219) a. 'Shut up, Doreen,' Silas barked [...]. (Urban and Ruppenhofer, 2001)

b. He honked a goodbye.

c. Grandson Richard rumbled a reply.

d. The dog barked a warning to his owner.

As shown in (219a-219c), an animal sound or a sound emission verb may be used to describe a manner of communication initiated by a Speaker. However, it is also possible to conceptualize of animals as initiators of communication events (219d). In some cases, animals may be conceptualized as emitters of meaningful sounds whether the communicative event is intentional or not. For example, in (219d) the dog's barking is most likely an instinctual reaction to a stimulus, not an intentional action to communicate a Message to the owner. But the noice is interpreted as a *warning* by the owner. This results in an acceptable description of a situation as a communication event in which the noice that the dog makes is grammatically encoded as a Message. Whether the dog's intention was to produce a meaningful sound or not is not a leading factor in allowing animals to be expressed as subjects in communication events. The event can be described as a communication event if it's conceptualized as such by the observer. It is generally not common to conceptualize inanimate objects as initiators of communication events (**The door squeaked a warning*) because one would not attribute a meaning to a noice produced by an object.

Sound emission verbs behave syntactically like Statement verbs, though there are additional restrictions on the syntactic expression of participants with sound emission verbs (see Urban and Ruppenhofer 2001). They may occur in simple transitive argument structure constructions in which the direct object refers to the Message (219a-219c) or constructions in which an Addressee is constructionally added as a *to*-oblique (219d).

Chapter 8

Social Role Verbs (Pavlína Kalm)

8.1 Introduction

The domain of social events describes various types of situations beyond interpersonal interactions. In this chapter, we focus on Social Role verbs that describe events in which humans and their involvement in society is characterized by their roles in social institutions, such as schools, places of employment, or other socially defined groups. In some cases, the role that an entity assumes may be socially defined but not tied to any particular institution There are many verbs in English that evoke one's membership in larger social units but fewer verbs that do not evoke a membership. Our social identities are closely tied to social institutions and groups and there are many verbs in English that describe different scenarios in which humans enter or leave an institution or assume or leave a role. In the following sections, we discuss the semantics of these types of verbs separately from verbs that evoke roles or attributes but not a membership in an institution.

There has been very little said about the semantics of Social Role verbs in the linguistics literature. The most comprehensive coverage of Social Role verbs can be found in VerbNet and FrameNet. VerbNet verb classes cover a wide range of Social Role verbs and the syntactic frames associated with them. FrameNet's coverage of these verbs is also quite broad though the depth of their analysis depends on the verb. For example, FrameNet has a detailed analysis of frames for *hire* and *fire* verbs but they don't have frames for verbs such as *supervise* or *knight*.

We define three verb types in the Social Role subdomain: Membership verbs, which evoke a force-dynamic relation between an individual and a social group (section 8.2), Cause Membership verbs, which evoke a causative Membership event structure (section 8.3), and Role verbs, which evoke an event in which an individual is engaged in a Role (section 8.4).

8.1.1 Roles as participants' subevents in event structure

Social Role verbs describe events in which participants are assigned roles, fulfill roles, or resign from roles. Prototypically, a role describes a formal post, a position, an occupation of an individual (e.g., a secretary, engineer, etc.) or a task that one is given within an organization (e.g., a front desk volunteer). We also analyze a participant's attribute in certain verb classes as a role. For example, attributes with verbs in the masquerade-29.6 class (e.g., *Dina masqueraded as a lawyer*) or denominal verbs in the captain-29.8 class (e.g., *She mothered his child*) are analyzed as denoting roles.

Roles do not represent participants in the event structure. They are not distinct entities from the agents whom they are associated with. In a force-dynamic event structure representation, an entity and their role is treated as a single participant. That is, we do not define a force-dynamic relation between an entity and their role in constructional causal chains or verbal event structure representations.

Roles describe participant's 'subevents'. The term subevent is used to refer to events and propositions that are associated with event participants but are realized as separate arguments in argument structure constructions, as we discuss in Chapter 3 (Croft and Vigus, 2020). As Croft and Vigus (2020)argue, either the participant or their subevent may be used to describe that participant in a sentence. The participant and their subevent may be expressed as separate arguments in the same clause (220a) or either the participant (220b) or the subevent (220c) is overtly expressed. Whether it is the participant, the participant's subevent, or both that are expressed as arguments does not change the meaning of the argument structure construction (Croft and Vigus, 2020, 169). In all three examples, the president and his tweets refer to a single participant in the event structure. The tweets specify the president's action, and the president is the participant in that event.

(220) a. The president's tweets shocked the Democrats.
b. The president shocked the Democrats.
c. The tweets shocked the Democrats.

Croft and Vigus (2020) focus their discussion on examples in which subevents denote events or actions; however, their analysis is applicable to other types of subevents such as roles and attributes. In all of these instances, the argument describes an event, a role, or an attribute that the participant is engaged in. As shown in (221), agents and their roles can be found in similar alternations as participants and their subevents. As shown in (221), the role specifies the position of the hired person. The hired person and the secretary are the same participant in the event structure. In (221a), the participant and her role are expressed as separate arguments. In (221b), only the participant is expressed, and in (221c), only the role is syntactically realized. Importantly, in all three examples (221a-221c), only two participants are causally involved: the hiree and the hired. The force-dynamic event structure analysis for these three examples is therefore the same.

(221) a. He hired her as a new secretary.
b. He hired her.
c. He hired a new secretary.

Roles can describe various socially sanctioned attributes such as a person's role in a company, a job title or occupation (222a-222d), or some other private role that two (or more) people agree on, such as (222e). The syntactic realization of roles is variable. The role may be expressed as an *as*-oblique (222a), a direct object (222b), an *on*-oblique (222c) or an infinitival clause (222d). The verbal semantics determines whether the participant is in a role, entering a role, or leaving a role.

(222) a. She works as a secretary.
b. I resigned my position.
c. His wife works on secret government projects at IBM.
d. I trained them to be blacksmiths.
e. Miriam tutored her brother.

Some Social Role verbs can occur in examples in which the subevent expresses an attribute of a participant (223a, 223b). Verbs from other social subdomains, such as function verbs, also frequently express an attribute as a separate argument from the participant that it is associated with. For example, in (223c), the attribute of the nail is defined by its function. In (223d), the book's attribute is defined by its weight.

(223) a. Dina masqueraded as a lawyer.
b. He acts like a boss.
c. The nail functions as a coat hook.
d. The book weighs a pound.

The syntactic realization of attributes is less variable than that of roles. Attributes are usually expressed as prepositional phrases with Social Role verbs, such as *as* or *like*-phrases (223a-223c). With some verbs, it is also possible to express the attribute as a direct object (223d).

Events or actions that the participant is engaged in can also be expressed as separate arguments in clauses (Croft and Vigus, 2020). Examples of Social Role verbs, such as *collaborate* or *volunteer*, are given in (224). The event or action is analyzed as the participant's subevent.

(224) a. They collaborated on the task.
b. I volunteered for the task.
c. They excluded me from the meeting.
d. Amanda worked at finishing the task.
e. I volunteered to run the workshop.

Subevents that describe participant's events or actions are syntactically most variable. They can be expressed as event nominals and occur as arguments in various prepositional phrases, e.g., *on*-oblique (224a), *for*-oblique (224b) or *from*-oblique (224c). Events can also be expressed by gerunds in prepositional phrases (224d) or infinitival clauses (224e).

8.2 Membership verbs

Membership verbs (e.g., *work, attend,* or *resign*) describe events in which an individual is affiliated with a social group or organization. There are two types of Membership verbs: verbs that describe joining or participating in a group (e.g., *join, work* or *attend*) and verbs that describe leaving a group (e.g., *resign* or *quit*) (225). We analyze the force-dynamic event structures associated with these verbs as identical even though resigning is a reverse event of joining. The schematic force-dynamic relation between the person (a Member) and the group (a Group) is the same: AFFILIATE. This analysis is consistent with our analysis of mereological verbs in the physical domain. The relation between Figure and Ground with application and removal verbs is defined as PATH (Croft et al. 2016).

(225) a. His wife works.
b. His wife worked as an engineer for IBM.
c. His wife works on secret government projects.
d. I attend the University of Colorado.
e. He resigned from the military.
f. Eventually he was able to quit his job at the market and pursue his passion full time. (COCA)

In the Membership event structure, a Member is understood to have a particular Role in a Group which may be defined as their work position, such as an engineer or a secretary (225b), or may be specified by referring to their job assignment, such as working on a specific task (225c). The Group may be an institution, such as a place of employment or a school, or any other socially defined group to which a Member belongs. For example, in (225b) the Group describes the company in which the Member is employed. In (225d), the Group is a school that the Member attends. The Role that the Member holds within a Group may also be specified in the argument structure construction (225b, 225c). In some construals, both the Group and the Role may be syntactically omitted (225a).

The Membership event structure shown in Figure 8.1 obligatorily evokes two participants: a Member and a Group. The Member's position or task in the company is specified as a Role in the network. The Member and their Role are analyzed as a single participant in the event structure and the 'relation' between them is defined as either ENGAGE (Eng) or REFRAIN (Ref). With participate verbs, which describe a Member's affiliation with a Group, the relation between

the Member and the Role is ENGAGE. With resign verbs, the Member's leaving an organization involves stepping down from their Role and the relation between the Member and the Role is therefore defined as REFRAIN. REFRAIN is the reverse of ENGAGE.

The Member is in an AFFILIATE relation with the Group. The AFFILIATE relation is non-causal but directional, similarly to the PATH relation in the physical domain: the Member is the initiator of the AFFILIATE relation and the Group is the endpoint. Whether the event denotes a participate or a resign scenario is specified by the verb but is not represented in the verbal network.

The Member is identified as a volitional (VOL) entity in the event structure. The Member's engagement in the Group is volitional in that they have to employ mental capacities that allow them to consent to, leave, or be in a Group. Belonging to a Group may entail working, attending school, or participating in various group-mandated activities. In our analysis, even a very passive type of membership involves some type of engagement and thus entails a volitionally acting Member. The Group is labeled as EXIST because it doesn't undergo change in the event.

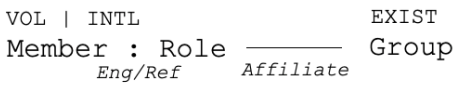


Figure 8.1: Membership event structure.

Membership verbs occur in the following VerbNet classes: attend-107.4, supervision-95.2.2, and employment-95.3. FrameNet frames that contain participate verbs include: Membership, Being_employed, Becoming_a_member, and Working_a_post. The Working_a_post frame doesn't include an Employer (which is equivalent to the Group in our representation) as a Frame Element since these verbs (e.g., *staff* or *man*) typically don't occur in argument structure constructions in which an Employer is overtly expressed. However, the examples in this frame (e.g., *Volunteers were staffing the telephones* or *Man your stations!*) suggest that the event structure requires that the job is assigned by an employer or a supervisor.

There are fewer verbs that describe resign events in the English lexicon when compared to participate verbs. Resign verbs occur in the resign-10.11 class in VerbNet. There is only one FrameNet frames that contains Resign verbs: Quitting.

8.2.1 Supervise verbs

Supervise verbs (e.g., *supervise, command, lead*, and others) encode the Member's Role in their definition. For example, the verb *lead* in (226a) entails that Martha's Role is to be a leader of a research group and the verb *supervise* in (226b) entails that Miriam is a supervisor of Kevin. Unlike other Membership verbs, supervise verbs don't frequently occur in construals in which the Group

is overtly expressed. It is more common for these verbs to occur in argument structure constructions in which a beneficiary of the event is expressed (226b).

(226) a. Martha led a big research project at CU Boulder.
b. Miriam supervises Kevin.

We do not analyze the semantics of these verbs as obligatorily evoking a beneficiary in the event structure. That is, we do not propose a separate verbal network for these verbs that is distinct from Membership verbs though they frequently occur with an additional participant, a beneficiary. Being a leader or a supervisor is a role that one holds within an institution, not unlike being a secretary or a president of a company. The difference seems to be that with verbs such as *lead* and *supervise*, it is in the job description to closely work with another person, whereas with other Membership verbs such as *work* it is not.

(227) a. Kevin works for Martha.
b. She clerkes for a federal judge.

Additionally, there appears to be a semantically motivated alternation observed with beneficiaries in argument structure constructions with Social Role verbs. Beneficiaries with supervise verbs, i.e., supervisees, are frequently expressed as direct objects while beneficiaries with verbs that describe working for someone, i.e., supervisors, tend to be expressed as *for*-obliques, as shown in the examples in (227). The syntactic realization of the beneficiary appears to be semantically motivated, namely by an authority dynamic in the event: a beneficiary that has higher authority than the Member is expressed as a *for*-oblique and a beneficiary with lower authority is expressed as a direct object. We do not distinguish between these two types of beneficiaries in our event structure representation. In both cases, the beneficiary is a participant that is constructionally added.

8.2.2 Semantics of argument structure constructions with Membership verbs

Membership verbs occur in various argument structure constructions that are metaphorically extended from the physical domain. The AFFILIATE relation between the Member and the Group is metaphorically construed as a physical PATH relation. This metaphorical correspondence leads to Membership verbs occurring in argument structure constructions that are characteristic of physical location and motion events. With verbs such as *work*, the event is construed as static and the argument structure construction describes metaphorical location (section 8.2.2.1). With verbs such as *attend, go to* or *resign*, the event is construed as dynamic and a metaphorical motion argument structure construction is used (section 8.2.2.2).

Location and Motion metaphors are also motivated by the metonymy between institutions and places in cases in which institutions have a physical presence, such as schools having campus locations or companies having headquarter buildings.

In argument structure constructions with participate verbs, the Group may be construed as a beneficiary of the event. For example, when the Group denotes an employer, the employer may be construed as benefiting from the Member's work. We discuss this type of construal in section 8.2.2.3. The semantics of argument structure constructions in which only the Member is overtly expressed is discussed in section 8.2.2.4. Causal chains in which a Role is syntactically realized are discussed in section 8.2.2.5.

8.2.2.1 Location construal

Membership verbs can occur in argument structure constructions that describe metaphorical physical Location. In Location construals, the Member is syntactically realized as a subject and the Group as an *at* or *in*-oblique (228a-228b). It is also possible to use the possession verb *belong* to describe membership events (228c). The [SBJ V *to*-OBL] argument structure construction with *belong* is analyzed as metaphorical Location. In possession examples such as *The book belongs to him*, the Possession, the book, is metaphorically construed as the Figure and the Possessor, him, as the Ground (see section 6). The relation between the Possession and the Possessor is static, just like the relation between figure and ground in the physical domain. The Possession is also causally antecedent to the Possessor, analogous to the physical figure and ground. As noted in Chapter 6 on possession verbs, the verb *belong* can also be used to describe a spatial relation between two physical entities, as in the example *The barn belongs to the house*. The example describes a 'co-location' relation between the barn and the house. With Participate verbs, *belong* denotes a metaphorical spatial relation between a Member (=figure) and a Group (=ground).[1]

(228) a. His wife works at IBM.
b. The 450,000 employees, 300,000 of whom work in the postal service, are unhappy. (COCA)
c. Only one of the three victims belonged to the Free Aceh Movement. (COCA)

The causal chain associated with the physical Location construal for the examples in (228a-228c) is shown in Figure 8.2. The relation between the Member and the Group is defined as physical PATH, which is also used in the physical source domain. In the physical Location construal, the ground doesn't undergo any change in the event and is identified as EXIST. The Group in the target domain inherits the same subevent label. In the source domain, the figure may be volitional (e.g., *He was in a building*) or non-volitional (e.g., *The statue stood on a pedestal*). In the target domain, the Member is always a volitional entity and is therefore identified as Volitional (VOL) in the causal chain. The member also undergoes an internal change in the event structure; however, this is not inferrable from the constructional semantics, only the verbal event structure, as shown in Figure 8.2.

[1] More discussion on the locative [SBJ *belong to*-OBL] argument structure construction can be found in Chapter 6, section 6.2.2.

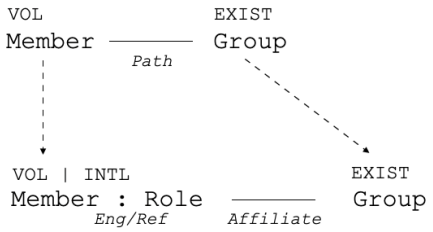


Figure 8.2: Location construal with Participate verbs.

Figure 8.2 shows the mapping of the metaphorical Location construal to the Membership network. The AFFILIATE relation is metaphorically construed as a physical PATH relation. Both force-dynamic relations are non-causal. The mapping of the causal chain participants to the network reveals that the Member undergoes internal change in the event structure evoked by the verb. The annotation of the causal chain in Figure 8.2 is Self-volitional (FD1) Location (FD2), following the annotation of the source domain causal chain. An Event Domain annotation label "Social Role" distinguishes the target domain causal chain from the source domain.

8.2.2.2 Motion construal

Membership verbs can occur in dynamic construals in which the Member's participation in a Group or institution is not construed as a static event. For example, the participate verb *attend* describes a dynamic construal of a static membership event in (229a). The motion verb *go to* also construes the event as dynamic (229b) though the event of attendance itself is understood as static. More commonly, the motion metaphor is used with verbs that describe the act of joining or leaving a Group, such as *join* (229c) or *resign* (229d). Motion verbs such as *enter* (229e) or *leave* (229f) are also commonly used to describe Membership events in motion construals.

(229) a. I attend the University of Colorado.
b. I go to the University of Colorado.
c. Carmack eventually joined the company as chief technology officer. (COCA)
d. I recently I resigned from a company operating world wide, I held the position of National Service Manager. (COCA)
e. The 23-year-old applied to an aviation school so he could enter the military as a pilot. (COCA)
f. Associates believe Perlozzo will leave the organization before facing another interview. (COCA)

The causal chain associated with the motion construal with Membership verbs is shown in Figure 8.3. The causal chain depicts the semantics of argument

structure constructions in which a Role is not overtly expressed. Following the analysis of motion events in the physical source domain, the Member is identified as a metaphorical theme and labeled MOT. The Member is also identified as a volitional (VOL) participant since their engagement in the event is volitional. The Group is identified as a metaphorical ground. The ground doesn't undergo internal change in the physical motion event. The Group is therefore labeled EXIST in the metaphorical causal chain.

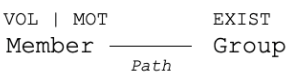


Figure 8.3: Motion construal with Membership verbs.

A transitive (e.g., *He entered/quit a new job*) and a *from*-oblique argument structure construction (e.g., *He resigned from his job*) can be used to describe a relation between a Member and a Role. In these examples, the syntactic realization of the Role is the same as the Group in motion construals. However, unlike Member and Group, Member and Role are not two distinct participants in the event structure and the relation between them lacks an equivalent in the physical domain. As such, it would not be accurate to establish a metaphorical mapping from the ENGAGE or REFRAIN relations to the non-causal PATH relation in the physical domain.

Importantly, the syntactic realization of a participant's subevent as a direct object or a *from*-oblique is not unique to Social Role verbs. These argument structure constructions can be used to express a relation between a participant and subevent with other verbs, such as *avoid* (*He avoided his nagging*) or *refrain* (*He refrained from eating*). The relation between the participant and the subevent in these examples describes social REFRAIN.

Argument structure constructions with dynamic Membership verbs can also express all three participants, as shown in (230b-230c). The analysis of the Group in these examples is different from the prototypical metaphorical motion construal (230a) discussed above. The syntactic alternation observed with the verb *resign* in (230) points to two distinct analyses depending on the syntactic realization of the Group. In (230a), the Group is syntactically realized as a *from*-oblique and construed as an endpoint of PATH in a metaphorical motion construal, as discussed above. However, in (230b-230c), the Group is syntactically realized as an *at*-oblique, which is a static preposition commonly used in locative construals. As shown in (230d), it is not possible to use a *from*-oblique for the Group when the Role is overtly expressed. That is, the event cannot be construed as metaphorical motion when the Role is included in the causal chain. This evidence points to an analysis in which the Group describes the location of the job when it is expressed as an *at*-phrase. That is, the Group modifies the Role in these construals and is not a separate participant in the constructional semantics: *He resigned from [his job at IBM]*.

(230) a. He resigned from IBM.

b. He resigned his job at IBM.

c. He resigned from his job at IBM.

d. He resigned his job *from IBM.

The causal chain associated with examples such as (230b) and (230c) and its mapping to the Membership network is shown in Figure 8.4. The causal chain for these examples is identical to the causal chain for examples in which the Group is not overtly expressed (e.g., *He resigned from his job*). The causal chain describes an event in which a Member refrains from having a Role. A more detailed analysis analysis of argument structure constructions in which a Role is overtly expressed can be found in section 8.2.2.5.

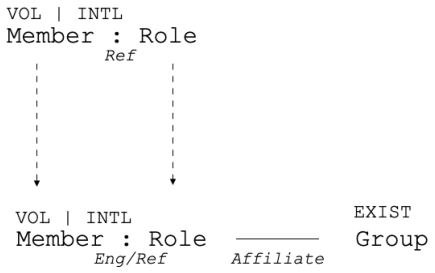


Figure 8.4: Motion construal with Membership verbs.

The annotation of the causal chain shown in Figure 8.4 is Self-volitional (FD1) Refrain (FD2). The FD2 label Refrain signals that the participant's subevent, i.e., Role, is overtly expressed in the argument structure construction.

8.2.2.3 Beneficiary construal

Participate verbs can occur in argument structure constructions in which the Group is construed as a beneficiary of the event. This construal is not possible with refrain verbs. The Group can be expressed as a *for*-phrase (231). The Group is analyzed as subsequent to the core event denoted by the main verb. The Role may or may not be expressed, as shown in (231).

(231) a. His wife worked for IBM.

b. His wife worked as an engineer for IBM.

The constructional semantics of the example in (231b) is shown in Figure 8.5. The Member's role is overtly expressed in the argument structure construction, which is depicted as an ENGAGE relation in the causal chain. The Group is analyzed as a subsequent oblique argument that is constructionally added to the event structure. That is, the syntactic realization of the Group as a benefactive *for*-phrase leads to an analysis of this participant as external to the core event in the constructional semantics. This analysis can be better explained on an example in which both a beneficiary and an employer are overtly expressed,

such as *His wife worked for Linda at the president's office*. In this example, the beneficiary is the supervisor and the Group is the employer. When both a beneficiary and a Group are overtly expressed, it is clear that only the Group is evoked by the verbal semantics. The beneficiary is a constructionally-added participant. The Group is syntactically expressed as an *at*-oblique and therefore semantically functions as the ground in a location construal (as we discussed above). When the Group is expressed as a *for*-oblique, as is the case in the examples in (231), the construal is that the Group is a beneficiary rather than a ground in a metaphorical physical construal. In this analysis, the beneficiary doesn't map to the Group in the network, even when it does denote the employer (= Group).

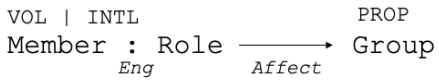


Figure 8.5: A causal chain associated with the example *His wife worked as an engineer for IBM*.

We analyze beneficiaries as endpoints of an AFFECT relation. The AFFECT relation is defined as a mental domain relation in which the endpoint undergoes a change of state in their mental property. The AFFECT relation describes an event in which a stimulus affects the mental state of an experiencer. The experiencer is analyzed as a property theme. We do not distinguish different types of property changes (i.e., mental, physical, or social). Mental verbs that prototypically describe an AFFECT relation between a stimulus and an experiencer include verbs such as *amuse* or *scare* (e.g., *The big thunder scared him*). When a beneficiary is constructionally added to an event structure, they are affected by the event by benefiting from it. Though the benefit may be physical or social, the beneficiary is always a human entity and as such, the event always affects their mental state. Therefore, we use the same AFFECT force-dynamic relation when a beneficiary is added to the event structure with physical or social verbs.

The annotation of the causal chain in Figure 8.5 is Self-volitional (FD1) Engage (FD2) Affect (FD3). The FD3 label signals that there is a subsequent oblique argument that is constructionally added to the event structure.

8.2.2.4 Internal construal

Membership verbs can occur in argument structure constructions in which only the Member is syntactically realized (232). In such examples, the verb describes an internal event since the Member is not engaged in a force-dynamic relation with another participant. For example, in (232a), the event describes a Member undergoing internal change by resigning. In (232b), the wife is engaged in an internal activity by working

(232) a. He resigned.

b. His wife works.

The causal chain associated with the semantics of the examples in (232) includes only the Member as an event participant. As shown in Figure 8.6, the Member is identified as a volitional (VOL) entity. The label INTL indicates that the Member undergoes internal change. The type of change is not further specified since the Member is not engaged in a force-dynamic relation with another participant. That is, the constructional semantics does not tell us more about the type of change that the Member undergoes.

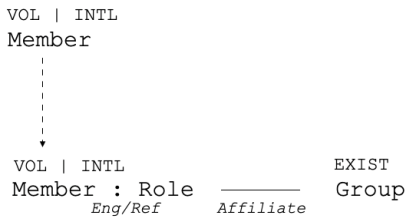


Figure 8.6: A mapping of a causal chain associated with the examples in (232) to the Membership network.

8.2.2.5 Analysis of causal chains with Engage and Refrain relations

When a Role is syntactically expressed, the constructional causal chain represents the relation between the Member and the Role as ENGAGE or REFRAIN, depending on the verb. Though the Role is frequently syntactically realized as a separate argument from the Member, we do not analyze it as a distinct participant in the event structure. It describes a 'subevent' of the Member, as explained in section 8.1.1. The argument structure construction may overtly express either just the Member and the Role (233a-233b) or may also include the Group (234d). As noted above in sections 8.2.2.2 and 8.2.2.3, different construals are available when the Group is overtly expressed; however, in this section, we only focus on examples that express the relation between a Member and their Role.

The Role may be described by referring to a Member's job assignment (233a), their position in general without specifying anything about it (233b), or the tasks that a Member is responsible for when they are affiliated with a Group (233c).

(233) a. His wife worked as an engineer.
b. I resigned my position.
c. His wife works on secret government projects at IBM.

The causal chain for the example in (233b) shown in Figure 8.7 identifies the Member as a volitional (VOL) initiator. The Role does not have its own

subevent label; it 'inherits' the subevent of the participant to which it belongs. The relation between the Member and Role is identified as REFRAIN. The Member is no longer engaged in fulfilling the Role they were assigned to do by the Group. The colon between the Member and the Role signals that they are syntactically realized as separate arguments but do not refer to two distinct participants.

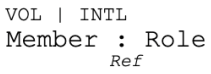


Figure 8.7: A causal chain associated with the example *I resigned my position.*

We use an annotation label Engage and Refrain to signal that the causal chain includes a Role. The example in (233b) is thus annotated Self-volitional (FD1) Internal (FD2) Refrain (FD3). The FD2 is annotated as Internal since the Member's engagement in a Role evokes an Internal change. The initiator of the Engage/Refrain relation is always considered Self-volitional since they are internal to the Engage/Refrain event.

8.3 Cause Membership verbs

Cause Membership verbs describe events in which the AFFILIATE relation between a Member and Group is externally initiated. Verbs that describe this event structure include *hire* or *fire* verbs though the event structure is not necessarily restricted to employment scenarios. Examples in (234) show various argument structure constructions used with Cause Membership verbs. The external initiator (= Agent) causes a Member to be affiliated with a Group by having a position of authority that allows them to make such a decision. As shown in (234a-234c), the Member may be referred to by their Role. For example in (234a), the Members hired into a Group are referred to by their official position, i.e., secretaries. Similarly, the person dismissed from the army in example (234c) is referred to by their role, i.e., a general. In some cases, the Role of the Member may be elaborating, as shown in (234b). The argument structure construction in this example includes an *as*-phrase, which specifies that the secretaries are employed as helpers. The Member and Role may also be expressed as separate arguments (234d), as is commonly seen with Membership verbs discussed in the preceding section.

(234) a. I hired two secretaries.
b. I hired two secretaries as helpers.
c. The king banished the general from the army.
d. I fired him as my chief of staff.

The event structure that depicts the semantics of Cause Membership verbs is shown in Figure 8.8. The first segment describes an externally initiated event

in which an Agent uses a social performative force (PERFORM) in order for the Member to become affiliated with a Group. The second segment of the Cause Membership network is identical to the Membership network (section 8.2) with the exception that the Member's subevent is defined as motion (MOT) rather than internal. The Member's subevent is specified as Motion with Caused Membership verbs because the verbs describe dynamic events in which the Member either joins or leaves a Group. Since subevent types are not specific to any one domain, the label motion here refers to a motion subevent in the social domain. The Member's entering or departing a Group is construed as a social 'motion' event. The Member is volitionally involved in the event; however, we do not specify its subevent as VOL in the verbal event structure; only MOT is specified since the Member does not generally occur in argument structure constructions in which it is a volitional initiator of the event.

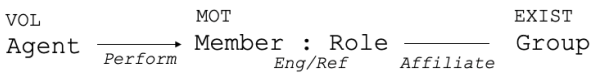


Figure 8.8: A Cause Membership event structure.

VerbNet classes that include Cause Membership verbs include fire-10.10, banish-10.2, hire-13.5.3, and confine-92. We discuss confine-92 verbs and why we analyze them as Cause Membership verbs in more detail in section 8.3.1.

8.3.1 Confine verbs

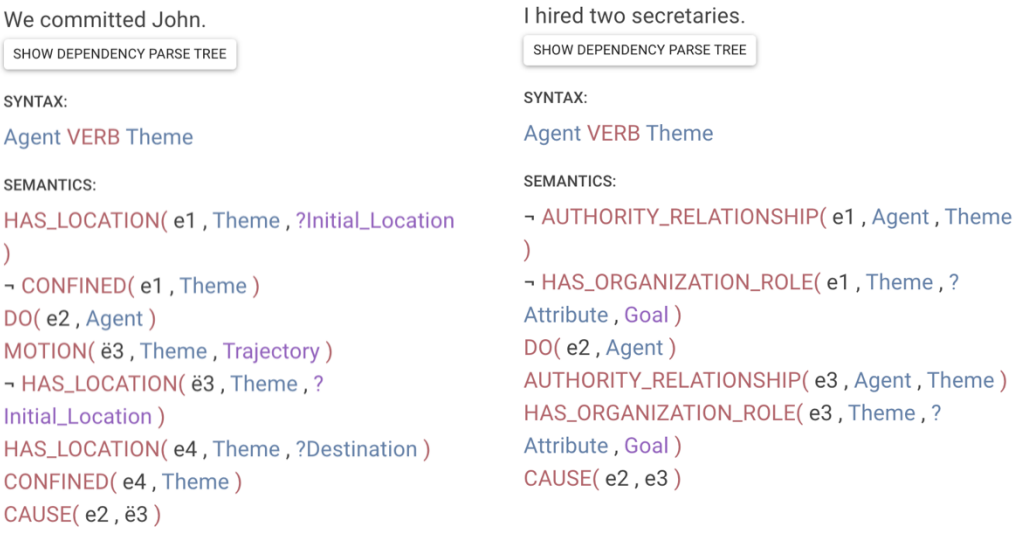
We include confine verbs such as *institutionalize, incarcerate, jail, imprison*, etc. as Cause Membership verbs. These verbs describe events in which a person of authority commits a person to a social institution, such as a prison (235). The verbs obligatorily evoke an external initiator. The person who becomes affiliated with the institution denotes the Member and the institution denotes the Group.

(235) a. We committed John.
b. We committed John to prison.

In our analysis, the event structure evoked by confine verbs is on a schematic level the same as the event structure of Cause Membership verbs. However, VerbNet's analysis of these verbs is different from other Cause Membership verbs, such as *hire* or *fire*. In VerbNet, the theme changes their physical location by which their status changes from 'not confined' to 'confined'. This is different from hire verbs in which the agent causes the theme to have a role in an organization.

Figure 8.9 shows VerbNet's analysis for the simple transitive argument structure construction with confine and hire verbs. With confine verbs, the analysis does not include authority_relationship or has_organization_role. This distinction is valid; however, it is not relevant to the event structure representation

that depicts force-dynamic relations between participants. In our analysis, the Agent and the Member needn't be in an authority relationship with each other. What is relevant force-dynamically is that the Agent is an external causer of the AFFILIATE relation between the Member and Group. The semantics of confine verbs thus fits the Cause Membership event structure. Unlike VerbNet's analysis, we consider the Member to assume a Role when he becomes affiliated with a Group. For example, when one is committed to prison, their social role is defined as a prisoner.



a. Semantic analysis of *commit*

b. Semantic analysis of *hire*

Figure 8.9: VerbNet's semantic analysis of examples with *commit* and *hire*.

We acknowledge that with confine verbs, the change of location is more permanent than the change of location that is associated with going to work when one is hired; however, the social aspect of the event is the same: a Member becomes affiliated with a Group. Our analysis of social verbs focuses solely on social relations that are evoked by verbal semantics. We do not aim to represent physical motion or other physical relations that may take place in social events. With confine verbs, physical confinement comes only after the social affiliate relation has been established.

8.3.2 Semantics of argument structure constructions with Cause Membership verbs

Cause Membership verbs occur in argument structure constructions that are metaphorically extended from the physical domain. They can occur in Motion construals when the Group is overtly expressed (section 8.3.2.1). When the

Group is not syntactically realized and only Member is expressed in the argument structure construction, we analyze the constructional semantics as analogous to physical motion events in which the theme undergoes an internal change (section 8.3.2.2). When the Role is overtly expressed, the relation between the Member and the Role is analyzed as either ENGAGE or REFRAIN depending on whether the event describes assuming or leaving a position, respectively.

8.3.2.1 Motion construal

Cause Membership verbs use metaphorical motion argument structure constructions when all three participants (i.e., Agent, Member, and Group) are overtly expressed (236). Cause Membership verbs describe dynamic events in which the Member either enters or leaves a Group. The Member's motion subevent in the verbal event structure and the direct correspondence between the social AFFILIATE and physical PATH relation contribute to the extension of the motion argument structure construction to the social domain. In (236a) and (236b), the Agent causes the Member to no longer be affiliated with a Group, which is metaphorically construed as a caused motion event in which the Member moves away from the Group. In (236c), the physical motion argument structure construction describes an event in which the Member's metaphorical motion results in his spatial co-location with the Group.

(236) a. I fired two secretaries from the company.
b. The king banished the general from the army.
c. We committed John to prison.

The causal chain associated with examples in (236) is shown in Figure 8.10. Following the analysis of caused motion examples in the physical source domain, the relation between the Agent and the Member is analyzed as physical FORCE. The relation between the Member and the Group is analyzed as physical PATH. This analysis is consistent with our analysis of Membership verbs in which the AFFILIATE relation also maps to the PATH relation in the physical source domain in metaphorical motion construals. The Agent is analyzed as a volitional (VOL) initiator, similarly to external initiators that act volitionally in the physical domain. The Member acts volitionally as well but the metaphorical motion construal treats the Member as a motion (MOT) theme in the event structure. We therefore assign only a MOT subevent label to the Member. The Group does not undergo a change in the event and is therefore analyzed as EXIST.

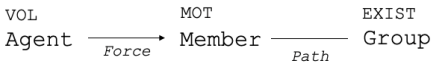


Figure 8.10: A causal chain associated with examples in (236).

A mapping of the causal chain in Figure 8.10 to the Cause Membership network is shown in Figure 8.11. The subevent labels in the causal chain and

the verbal network match between the corresponding participants: the volitional initiator in the constructional causal chain maps to the Agent, the motion theme maps to the Member in the verbal network, and the endpoint of PATH, which is EXIST, maps to the Group, also labeled EXIST in the network. The causal social PERFORM relation maps to the causal physical FORCE relation in the physical source domain. The non-causal social AFFILIATE relation maps to the non-causal physical PATH relation. As the mapping shows, there is a clear analogy between physical motion events and social cause membership events which motivates the metaphorical motion construal with Cause Membership verbs.

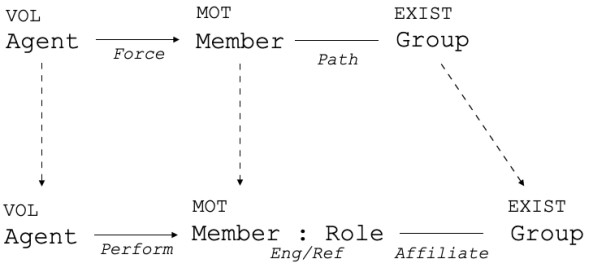


Figure 8.11: A mapping of a metaphorical caused motion construal to the Cause Membership network.

The annotation for the causal chain in Figure 8.11 uses physical-domain annotation labels: Volitional (FD1) Motion (FD2). The annotation also includes the Event Type, which is used when an argument structure construction is used metaphorically. The Event Type is annotated as 'Social Role'.

8.3.2.2 Internal construal

Cause Membership verbs can occur in a construal in which the Group is not syntactically realized in the argument structure construction (237). The causal chain associated with such examples describes a relation between the Agent and the Member. We analyze the semantics of these examples as describing an internal event in which the Agent's action causes the Member to undergo internal change. The theme's change is specified as internal in the constructional causal chain since the constructional semantics does not tell us more about the type of event. However, as shown in the mapping of the causal chain to the Cause Membership network in Figure 8.12, the verbal event structure supplies this additional information about the event. The internal theme maps to a motion theme in the verbal network.

(237) a. I fired two secretaries.
b. The king banished the general.
c. I hired two secretaries.

The analysis of the Member in the transitive argument structure construction with Cause Membership verbs is consistent with our analysis of the motion theme in the physical domain when the ground is syntactically omitted. Specifying that the theme undergoes motion in the constructional semantics is only possible when the argument structure construction syntactically expresses the path of motion, i.e., when the ground is overtly expressed. When the ground is not syntactically realized in the constructional semantics, the causative construal depicts only a causal relation between the initiator and the endpoint of the FORCE relation. The endpoint of the FORCE relation undergoes change but the type of change is not readily available from the constructional semantics. The same is true for the endpoint of the social PERFORM relation. The type of change is therefore only inferable from the verbal event structure, as shown in Figure 8.12.

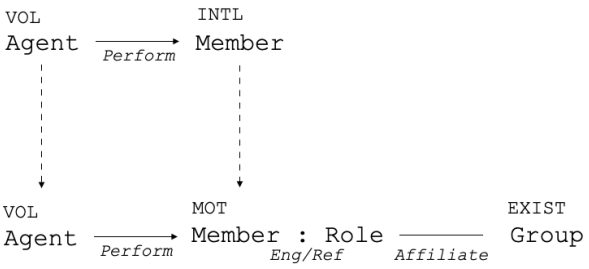


Figure 8.12: A mapping of an internal construal to the Cause Membership network.

The simple transitive [SBJ.AGENT VERB OBJ.MEMBER] argument structure construction is not analyzed as metaphorically extended from the physical domain despite being used analogously with physical verbs. Drawing a metaphorical link between the physical FORCE relation and the social PERFORM relation is not necessary because the causal PERFORM relation in the social domain also causes change in the endpoint. This analysis contrasts with our analysis of argument structure constructions in which the relation between the Member and the Group is analyzed as metaphorical PATH, which necessitates the metaphorical analysis of social PERFORM as a physical FORCE relation, in order for the causal chain to be defined within a single semantic domain.

In the internal constructional causal chain (upper part of Figure 8.12), the Agent is analyzed as a volitional (VOL) entity. The Member is analyzed as an internal (INTL) theme and the relation between the two participants is social PERFORM, which is used for causal relations between two human entities. The causal chain is annotated Volitional (FD1) Internal (FD2). This annotation is identical to the annotation of transitive argument structure constructions with Motion verbs in the physical domain. The annotation of the Verb Domain distinguishes the two causal chains from each other. In particular, the Verb Domain annotation signals that the relation between the Agent and the Member

in the causal chain is specific to the social domain, i.e., social PERFORM for the 'Social' Domain and physical FORCE for the 'Physical' Domain.

8.3.2.3 Analysis of causal chains with Engage and Refrain relations

Cause Membership verbs can occur in argument structure constructions in which both the Member and their Role are overtly expressed (238). The Role may denote the Member's official job title, such as chief of staff in (238a), their responsibility within a Role, such as a helper in (238b), or their occupation such as blacksmiths in (238c). In (238c), the profession that the Member is trained to do results in their affiliation with a particular Group in which members share the same training. The Role has variable syntactic realizations with Cause Membership verbs, as shown in (238).

(238) a. I fired him as my chief of staff.
b. I hired two secretaries as helpers.
c. I trained them to be blacksmiths.

Similarly to causal chains with Membership verbs, the relation between the Member and the Role is analyzed as ENGAGE or REFRAIN depending on the semantics of the verb. With hire verbs in which the Member comes to take on a Role, the relation is ENGAGE. With fire verbs, the Member leaves a Role and the relation is defined as REFRAIN.

The causal chain in Figure 8.13 represents the constructional semantics associated with the example *I trained them to be blacksmiths* in (238c). The causal chain describes an internal event in which the Member is an endpoint of a social PERFORM relation, similarly to the examples in (237) depicted in Figure 8.12. The causal chain also includes the Role since it is overtly expressed in the syntax.

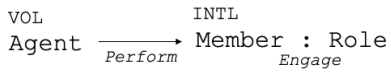


Figure 8.13: A causal chain associated with the causative engage example in (238c).

Similarly to Membership verbs, the syntactic realization of the Group when a Role is overtly expressed is a stative locative phrase such as an *in* or *at*-phrase (e.g., *I fired my chief of staff at IBM*). As discussed in section 8.2, this syntactic realization of the Group points to an analysis in which the Group semantically functions as a modifier of the Role. The verb and the argument structure construction describe a dynamic event but the prepositional phrase that denotes the Group is stative. A dynamic construal in which the Group is expressed as a *from*-oblique is not possible when the Role is overtly expressed: *I fired my chief of staff *from IBM*. The stative preposition used with the Group

in *I fired my chief of staff at IBM* is not compatible with an analysis in which the Group is metaphorically construed as a ground in a motion construal, unlike the Group in an example *I fired him from IBM*.

The causal chain in Figure 8.13 is annotated Volitional (FD1) Internal (FD2) Engage (FD3). The Engage (FD3) annotation label signals that the Role is overtly expressed in the argument structure construction.

8.4 Role verbs

Role verbs, such as *behave, masquerade, tutor*, or *function*, describe events in which an entity is engaged in an activity that either changes or specifies their role or attribute. These verbs evoke an event structure with a single participant: an entity that is engaged in a role. Unlike with Membership verbs discussed in section 8.2, no organizational membership is implied with Role verbs. As shown in example (239), the role may denote an attribute of an entity (239a, 239b) or a more formal role, such as being a tutor (239c). The role can be expressed as a separate argument in the clause (239a, 239b) or may be encoded in the verb. In (239c), the verb *tutor* denotes the role of the entity.

(239) a. Dina masqueraded as a lawyer.
b. Dina acted like a cretin.
c. Miriam tutored her brother.

The event structure evoked by Role verbs consists of an Entity and their Role, as shown in Figure 8.14. The Entity's engagement or disengagement in a Role is analyzed as an internal (INTL) activity. The Entity undergoes internal change when they take on a Role or cease to have a Role. The Entity is also specified as a volitional (VOL) participant. The verbal network allows for either an ENGAGE or REFRAIN relation between the Entity and their Role. However, English does not have any verbs that describe a REFRAIN relation between an Entity and a Role without also obligatorily evoking a Group in the event structure.

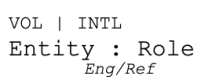


Figure 8.14: A Role event structure.

VerbNet classes that include Role verbs are: captain-29.8 and masquerade-29.6. Some examples in these classes describe formal roles that are defined within an institution, such as a place of employment (e.g., *He had served in financial planning positions*). Such construals suggest that *serve* can also be analyzed as a Membership verb. However, in the masquerade-29.6 class to which it belongs, the verb does not obligatorily evoke a Group.

8.4.1 Captain verbs

We analyze captain-29.8 verbs, such as *volunteer, babysit, coach, or captain*, as Role verbs. This class in VerbNet also consists of various verbs that describe one's profession, such as *judge, lawyer, valet, doctor*, etc. Though it is the case that one's profession is frequently associated with their place of employment, i.e., a Group, the event structure associated with these verbs does not obligatorily evoke a membership scenario in which the Entity is affiliated with a Group.

An employer may be constructionally added to the event structure as a beneficiary, as shown in the example in (240b). This example implies a formal employment setting and the verb is construed as a Membership verb. However, this construal is constructionally evoked when a particular kind of beneficiary is overtly expressed in the syntax; it is not evoked by the verbal semantics.

(240) a. Miriam tutored her brother.
b. Her cousin clerked for Judge David.

In our analysis, verbs in the captain-29.8 describe events in which the Entity's Role is encoded in the verb. This analysis is compatible with VerbNet which analyzes the semantics of the verb as describing an attribute of the agent. For example, the semantics of the example in (240a) is analyzed as *act* (e1, Agent, V_Attribute). The direct object is analyzed as a beneficiary: BENEFIT (e1, Beneficiary). VerbNet's analysis is in line with our analysis of the *for*-oblique as a beneficiary.

8.4.2 Semantics of argument structure constructions with Role verbs

Role verbs usually occur in internal construals. Unlike other Social Role verbs, it is not common for the Entity to be expressed without the Role unless the verb is denominal and describes the Role of the Entity (e.g., *clerk* or *tutor*). In such examples, a beneficiary tends to be included in the event structure (section 8.4.2.2).

8.4.2.1 Internal construal

The analysis of argument structure constructions in which a Member and a Role are overtly expressed with Role verbs is the same as our analysis of these examples with Membership verbs discussed in section 8.2. The main difference is that in English the relation between a Member and a Role with Role verbs is always ENGAGE since English doesn't have any Role verbs that describe events in which a Member is not engaged in a Role. The examples in (241) describe causal chains in which a Member is in an ENGAGE relation with their Role. In (241a), the Role refers to a quality of a person, i.e., a brave man or a coward. In (241b) and (241c), the Roles electricians and herbalists describe professions.

(241) a. Would you behave like a brave man or like a coward? (COCA)

b. The NYPD is looking for two men who posed as electricians and broke into the home of an elderly man in Queens. (COCA)

c. There were also lots of women who acted as unofficial herbalists as well. (COCA)

The causal chains associated with the semantics of the examples in (241) are the same: the argument structure construction describes an event in which a Member is engaged in a Role. The causal chain for these examples is shown in Figure 8.15. The Entity is a volitional (VOL) participant and undergoes internal change (INTL) in the event. The Entity's engagement in a Role entails internal activity.

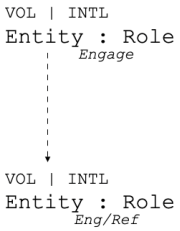


Figure 8.15: A causal chain associated with the examples in (241).

The causal chain depicted in Figure 8.15 is annotated Self-volitional (FD1) Internal (FD2) Engage (FD3). The Engage label signals that the Role is overtly expressed in the argument structure construction.

8.4.2.2 Internal construal with a beneficiary

Denominal role verbs, such as verbs in the captain-29.8 class (*judge, butcher, referee*, etc.) usually occur in argument structure constructions with a beneficiary (242). As discussed in section 8.2.1, the syntactic realization of beneficiaries with Social Role verbs appears to be semantically motivated. In events in which the beneficiary is not in a position of higher authority over the Entity and the Entity does not report to them, the beneficiary is expressed as a direct object (242a). When the beneficiary has higher authority than the Entity and the Entity reports to them, the beneficiary is expressed as a *for*-oblique (242c). In the example in (242b), the President is expressed as a direct object despite holding higher authority over the person who escorts him and the escort having to report to them. This construal of the event is likely motivated by the job dynamics in which the escorted person has to follow the escort's directions to safely move around. In an alternative construal in which the president is expressed as a *for*-phrase (e.g., *We escort for the President*), the President is construed as the employer.

(242) a. She had mothered her siblings because it was right, and impossible not to. (COCA)

b. "We have to escort the President to safety!" shouted a soldier early in the demo. (COCA)

c. I refuse to be bullied into policing for a goddamn phantom. (COCA)

The causal chain associated with the examples in (242) is shown in Figure 8.16. The Entity is analyzed as undergoing an internal (INTL) change when it is engaged in a Role, even if the Role is not syntactically expressed. The beneficiary is analyzed as subsequent to the core internal event. Similarly to our analysis of beneficiaries with other Social Role verbs, the beneficiary is an endpoint of an AFFECT relation and undergoes a property (PROP) change.

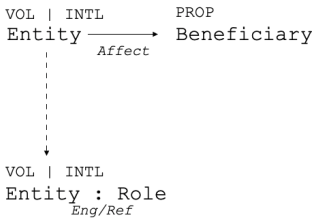


Figure 8.16: A causal chain associated with the semantics of examples in (242).

The annotation of the causal chain in 242 is Self-volitional (FD1) Internal (FD2) Affect (FD3).

8.5 Conclusion

In this section, we discussed the semantics of verbs that describe events in which humans have, enter into, or leave social roles which are associated with their membership in social institutions or other socially-defined groups. We also discussed the semantics of verbs that evoke socially-sanctioned roles (such as being a tutor) that an entity can be associated with regardless of their institutional membership.

However, there are other types of social role verbs that we did not cover in this section. Specifically, we did not discuss the semantics of verbs such as *befriend* or *marry* which describe events in which a participant can be said to have a social role, such as being a friend or a spouse (husband or wife). The primary reason for not including these verbs in this section is that they belong to VerbNet classes that consist of social interaction verbs, such as *hug, kiss,* or *date*. These verbs do not fall under the category of social role verbs. An analysis of verbs that describe social interactions is a subject for future research.

Chapter 9

Formalization of the Event Structure Representation (William Croft)

9.1 A Formalization of event structure

Here we formalize the idea that stories are made up of participant histories that interact over time. This view of story structure informs the formalization of the individual events in a story that express the participant interactions. Since event structure is complex, almost all of our attention here will be focused on the event structure formalization. The formalization expands the annotation to formulas that allow for inference about events and their participants, and allow for visualizations of the structure of events and the structure of stories.

9.1.1 Aspect and the interval calculus

Our formalization uses the interval calculus for both the temporal and qualitative dimensions (Allen, 1984; Mani and Pustejovsky, 2012), and the commonsense knowledge axioms of Gordon and Hobbs (2017).[1] Since event decomposition involves many composite entities, we use the notational simplification of $x{=}a{+}b$ to describe a composite entity x with exactly a and b component entities, that is, CompositeEntity(x) & Component-of(a, x) & Component-of(b, x) & $a \neq b$ & $((y \neq a \;\&\; y \neq b) \supset \neg$ Component-of(y, x)); likewise for composite entities with more than two component entities. The notation $x{=}a$ indicates equality, that is, there is exactly one component to the composite entity. However, we will use Equal(i, j) for interval equality following Allen (1984).

We begin with the formal analysis of subevents and their participants. Each

[1] We use the axioms that are presented at `http://www.isi.edu/~hobbs/csk.html`, which are basically identical to the axioms that will appear in Gordon and Hobbs (2017).

participant is identified with its own subevent. A participant is modeled as a history, namely, the states and changes that a participant has, performs or undergoes over time. The identity of a participant as an individual is expressed by the unity of the participant history.

A subevent is a component of a participant history. The subevent consists of qualitative states and changes of the participant during a time interval of the participant history. We model the qualitative structure of a subevent by the qualitative dimension q orthogonal to the time dimension t.

Different verbs or predicates define different relevant qualitative states for each participant subevent. Hence each subevent has a distinct set of qualitative states. One can consider each predicate's set of qualitative states as an interval on the q dimension. Alternatively, each predicate can be thought of as representing a distinct qualitative dimension. Where necessary, we will distinguish qualitative state dimensions for different predicates, for example for different subevents of a multiparticipant event, as $q_1, q_2 \ldots$

Following Allen (1984), we represent "points" in time as very small intervals. Specifically, we define a "point" interval as an interval that does not contain a smaller interval, that is, $\text{Pnt}(i) \equiv (\neg\exists j)\text{During}(j, i)$. Extended (Ext) intervals are not punctual. One reason for treating points as the smallest intervals is that an event that is construed as occurring in an "instant" (*The bridge collapsed*) may also be construed as occurring over an interval (*The bridge is collapsing*). We would represent these two construals as both occurring over intervals with different granularities (Hobbs, 1985) such that for the coarser-grained temporal metric, there are no smaller intervals than the event interval, but for a finer-grained temporal metric, there are. (We have not yet modeled granularity shifts.)

9.1.2 The structure of the qualitative dimension

We analyze the structure of the qualitative dimension q for each subevent also using the interval calculus, which can be generalized beyond time (Mani and Pustejovsky, 2012; Hobbs and Pan, 2004). Verbs and other predicates impose more specific structure on q.

We distinguish four types of qualitative dimensions that capture the potential variation of qualitative states defined by predicates over time. Inherent predicates cannot vary over time for a participant; for example one cannot start or stop being French. Hence only one point is defined on q, which we label r. Complementary predicates can vary between applying or not applying to a participant; for example a window can be either whole or broken. Only two points are defined on q, a "base state" b called a "rest state" in Croft (2012), and the "result state", also labeled r. Graded predicates vary dynamically in their states beyond the base state b; for example, one can either dance or not dance, but dancing involves various changes on a dimension of bodily movements. Graded predicates involve the base state b and a continuous interval c for the process. Finally, telic predicates such as entering a room have a base state b (not being in the room), the central interval of dynamically varying states c (the entering

movement), and a result state r (being in the room).

The types of predicates are defined in Table 9.2 in the Supplementary Material. The structure of a telic predicate is illustrated in Figure 9.1.

9.1.3 Phases and subevents

A phase is defined as a function from an interval i on t to an interval j on the q dimension (see Table 9.2). Phases can be distinguished by properties of the domain and/or range. A state is a phase whose range is a point (that is, the smallest interval) on q. A process is a phase whose domain and range are extended on t and q respectively. Processes may be monotonic (Mon(p)) or nonmonotonic.

A transition (Trans) is a phase derived from two phases that meet: it is made up of the finish "point" of the first phase and the start "point" of the second phase. This is our solution to the "divided instant" problem described by Mani and Pustejovsky (2012, pg. 60); our solution is similar to that of Hobbs and Pan (2004) (however they distinguish instants from intervals). We divide the "instant" of transition of two phases that meet into the finish point of the first phase and the start point of the second phase. The transition phase is a composite phase made up of those two point phases.

In order to define transitions, we first define start and finish "points" of a temporal interval. We then define start and finish phases of a larger phase, namely the phases whose domains are the start and finish points of the larger phase. A transition phase is then defined as a composite phase made up of the finish of the first phase and start of the second phase. A transition phase is not a point interval, but it is the smallest extended interval: that is, there is no interval between the finish point of the first phase and the start point of the second phase, since the two phases meet.

Finally, for convenience we define specific phases in terms of the interval on q that serves as their range; these are b', c' and r' in Table 9.2 in the Supplementary Material. Because of the nature of b, c, r, it follows that State(b', i, b, q), Process(c', i, c, q) and State(r', i, r, q).

A subevent has an aspectual type. Aspectual types are composite entities composed of one or more phases. The four types of states differ with respect to their domains (time intervals) on t, defined on the interval calculus. Unbounded

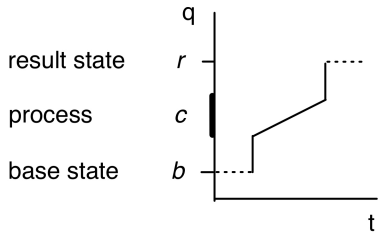


Figure 9.1: The structure of a telic predicate on the q dimension

Aspectual Types/Image Schemas *all below* $\supset$ AspTyp(x, i, j, q)	
Inherent state	Inhst$(x, i, r, q) \equiv$ Inherent(r, q) & Equal(i, t)
Inherent state phase	InhStPh$(b, i, j, q) \equiv$ Phase(b, i, j, q) & $(\exists p, l, m)$[Inhst(p, l, m, q) & During(i, l) & Maps(p, i, j)]
Incremental accomplishment	IncrAcc$(x, i, j, q) \equiv$ Telic(b, c, r, q) & x=p_1+c'+p_2 & Mon(c') & $(\exists b', r')$[Trans(p_1, b', c') & Trans(p_2, c', r')]
Undirected endeavor	UndEnd$(x, i, j, q) \equiv$ Graded(b, c, q) & x=p_1+c'+p_2 & $\neg$ Mon(c') & $(\exists b')$[Trans(p_1, b', c') & Trans(p_2, c', b')]
Force Dynamic Image Schemas	
Volitional	Volitional$(e, x, y, i) \equiv$ Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Force(f, g) & Vol(q_1)
Apply	Apply$(e, x, y, i) \equiv$ Theme-of(e, x) & Component-of(g, y) & Component-of(h, z) & Subevent(g, i, j, q_1) & InhStPh(h, i, k, q_2) & Path(g, h) & +Mer(q_1) & Exist(q_2)
Aspectual Type of Theme Participant	
Incremental Accomplishment	IncrementalAccomplishment$(e, i) \equiv$ Theme-of(x, e) & Component-of(g, x) & IncrAcc(g, i, j, q)
Predicate Calculus Representation of Example Sentence	
He dumped them into some baskets.	Dump$(Farmer, Pears, Baskets) \equiv$ Component-of$(f, Farmer)$ & Component-of$(g, Pears)$ Component-of$(h, Baskets)$ & UndEnd(f, i, j, q_1) & IncrAcc(g, i, k, q_2) & InhStPh(h, i, l, q_3) & Vol(q_1) & +Mer(q_2) & Exist(q_3) & Force(f, g) & Path(g, h)

Table 9.1: Formalization of aspectual and force dynamic image schemas for example sentence.

events, that is noninherent states and activities, presuppose that there was a transition from the base state to the asserted phase; the presupposed phase is represented by an existentially quantified predicate. Formalizations of all aspectual types can be found in Table 9.3 in the Supplementary Material.

9.1.4 Events as force dynamic chains of subevents

Events expressed by single clauses are informally analyzed as interactions between participants for multiparticipant events. For example, in *The rock broke the window*, the rock acted on the window. We analyze these force-dynamic relations as relations between subevents that are components of the participant's history. In our example, the rock's contact subevent caused the window's change of state subevent (the specific qualitative state being contributed by the semantics of the verb *break*). The rock's contact subevent is a component of the rock's history, and likewise the window's change of state event is a component of the window's history.

The unity of an event expressed by a single clause (verb and argument struc-

ture construction) is defined by the fact that all subevents of an event are simultaneous, what Croft (2012) calls the temporal unity of events; and by the presence of force dynamic relations between the subevents.

We model the type of incremental change that a participant undergoes as a property of that participant's subevent, or more precisely the qualitative dimension of that subevent. The types of change described in are Property change (Prop), Motion (Mot), Mereological change (Mer), Design change (Des), and Internal change (Int). Mereological change falls into four subtypes. Apply represents incremental change of the spatial figure with respect to the ground object, for example paint being gradually applied to a wall. Apply and Remove are inverses, represented by +Mer and -Mer. Cover represents a construal by which the incremental change happens to the spatial ground, for example the wall being gradually covered by the paint. Cover and Uncover are also inverses.

We also provide an analysis of the qualities of subevents of the agent and instrument, not discussed by Croft et al. (2016). Agents interact in physical processes using their body. Most of the time what the agent does is volitional, that is, a process involving mental as well as physical aspects of a person. For now, we model volitionality as the type of action that an agent engages in, that is, the agent's subevent has the property Vol. Instruments interact solely physically, of course, ultimately through some sort of contact. We model the interaction of instruments by attributing the property Contact to the instrument's subevent.

The aspectual annotation of the overall event describes the aspectual type of the theme participant. For this reason, the formalization of the aspectual annotation of the overall event is distinct from the representation of the aspectual type of each subevent. The formalization of the force dynamic annotation that includes the theme participant specifies which participant is the theme. The combination of the aspectual annotation predicate and the force dynamic annotation predicate(s) specifies the aspectual type of the theme participant subevent. The physical force and mental "force" applied by an instrument is dynamic but nonmonotonic. The aspectual type of an agent or instrument subevent varies depending on the aspectual type of the theme: an undirected activity if the overall event is unbounded, an undirected endeavor if the event is bounded and durative, or a semelfactive if the event is punctual.

Formalization of all of the force dynamic types analyzed so far, including external/internal cause, is found in Table 9.6 in the Supplementary Material.

9.1.5 Deriving the graphic representation of the event structure of a sentence

To illustrate the formalization of the aspectual and force-dynamic decomposition of events, we briefly go through the derivation of the semantic representation of *he dumps them into some baskets*. The first step is extracting the argument structure construction and tense-aspect construction forms from the sentence (not modeled here). The associated meaning is represented by the aspectual and force dynamic annotations, with the arguments of the semantic annotations bound to the participants in the construction; see Figure 9.2.

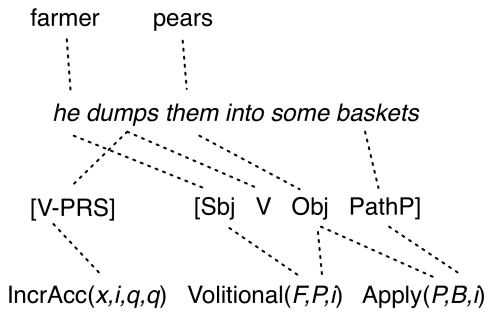


Figure 9.2: Linking constructions to the semantic representation

The force dynamic annotation, in two parts, can be expanded with the representations in Table 9.1. A Volitional external cause involves the farmer's volitional subevent in a force relation with the pears' subevent. The pears' subevent involves mereologically moving the pears with respect to the baskets' subevent. The baskets' subevent is simply the phase of the inherent state of existing as an entity with which the pears enter a spatial relationship; this is represented by the inherent state phase formalization in Table 9.1.

The incremental accomplishment aspectual type is associated with the theme argument, as noted above. The formalization of incremental accomplishments in Table 9.1 indicates that the q dimension of an incremental accomplishment defines base, center and result intervals. The subevent spans the transition from the base state to the central process and from the central process to the result state, that is, the subevent is bounded; it is also monotonic.

The agent subevent is specified as an undirected endeavor, since the overall event is temporally bounded. As such, the q dimension defines base and center intervals only. The subevent spans the transition from the base state to the central process and back to the base state.

The predicate calculus representation allows the decompositional event structures and the relations between clausal events to be used for inference using commonsense reasoning axiomatizations such as those in Allen (1984), Hobbs (2005) and Gordon and Hobbs (2017). The predicate calculus representations also specify the structures of the events and their participants to the degree that visualizations can be constructed. These are described in the next section.

9.2 Supplementary material: Annotation and formalization of aspect and force dynamic structure of events

Structure of q:	*Phases:*
Inherent$(r, q) \equiv$ Pnt(r) & Equal(r, q)	Phase$(p, i, j, q) \equiv$ Function(p, i, j) & Interval-on(i, t) & Interval-on(j, q)
Complementary$(b, r, q) \equiv q{=}b{+}r$ & Pnt(b) & Pnt(r) & Meets(b, r)	b': Phase(b', i, b, q) & (Complementary$(b, r, q) \vee$ Graded$(b, c, q) \vee$ Telic(b, c, r, q))
Graded$(b, c, q) \equiv q{=}b{+}c$ & Pnt(b) & Ext(c) & Meets(b, c)	c': Phase(c', i, c, q) & (Graded$(b, c, q) \vee$ Telic(b, c, r, q))
Telic$(b, c, r, q) \equiv q{=}b{+}c{+}r$ & Pnt(b) & Ext(c) & Pnt(r) & Meets(b, c) & Meets(b, r)	r': Phase(r', i, r, q) & (Inherent$(r, q) \vee$ Complementary$(b, r, q) \vee$ Telic(b, c, r, q))
Transitions:	
Start point: Spt$(x, i) \equiv$ Starts(x, i) & Pnt(x)	*Finish point*: Fpt$(x, i) \equiv$ Finishes(x, i) & Pnt(x)
Start phase: Sph$(s, p) \equiv$ Phase(s, i, j, q) & Phase(p, k, l, q) & Spt(i, k) & Maps(p, i, j)	*Finish phase*: Fph$(f, p) \equiv$ Phase(f, i, j, q) & Phase(p, k, l, q) & Fpt(i, k) & Maps(p, i, j)
Transition phase: Trans$(p, p_1, p_2) \equiv$ Phase(p, i, j, q) & Phase(p_1, k, l, q) & Phase(p_2, m, n, q) & Meets(k, m) & Fph(f, p_1) & Sph(s, p_2) & $p{=}f{+}s$	

Table 9.2: Structure of q dimensions and types of phases. These axioms and definitions underlie the phasal geometrical model of aspect.

Aspectual types/image schemas	
Inherent States	
Full state	$\text{Inhst}(x, i, r, q) \equiv \text{Inherent}(r, q)$ & $\text{Equal}(i, t)$
Phase of state	$\text{InhStPhase}(b, i, k, q) \equiv \text{Phase}(b, i, k, q)$ & $(\exists p, l, m)(\text{Inhst}(p, l, m, q)$ & $\text{During}(i, l)$ & $\text{Maps}(p, i, k))$
Noninherent States	
Reversible	$\text{RevSt}(x, i, r, q) \equiv \text{Complementary}(b, r, q)$ & $\text{Ext}(i)$ & $(\exists p, b')\text{Trans}(p, b', x)$
Irreversible	$\text{IrrSt}(x, i, r, q) \equiv \text{Complementary}(b, r, q)$ & $\text{Finishes}(i, t)$ & $(\exists p, b')\text{Trans}(p, b', x)$
Point	$\text{PntSt}(x, i, r, q) \equiv \text{Complementary}(b, r, q)$ & $\text{Pnt}(i)$ & $(\exists p, b')\text{Trans}(p, b', x)$
Achievements	
Directed	$\text{DirAch}(x, i, j, q) \equiv \text{Complementary}(b, r, q)$ & $(\exists b', r')\text{Trans}(x, b', r')$
Cyclic	$\text{CycAch}(x, i, j, q) \equiv \text{Complementary}(b, r, q)$ & $x = p_1 + p_2$ & $(\exists b', r')(\text{Trans}(p_1, b', r')$ & $\text{Trans}(p_2, r', b'))$ & $\text{OverlapPnt}(p_1, p_2)$
Activities	
Undirected	$\text{UndAct}(x, i, c, q) \equiv \text{Graded}(b, c, q)$ & $\neg\ \text{Mon}(x)$ & $(\exists p, b')\text{Trans}(p, b', x)$
Directed	$\text{DirAct}(x, i, c, q) \equiv \text{Graded}(b, c, q)$ & $\text{Mon}(x)$ & $(\exists p, b')\text{Trans}(p, b', x)$
Accomplishments	
Incremental	$\text{IncrAcc}(x, i, j, q) \equiv \text{Telic}(b, c, r, q)$ & $x = p_1 + c' + p_2$ & $\text{Mon}(c')$ & $(\exists b', r')(\text{Trans}(p_1, b', c')$ & $\text{Trans}(p_2, c', r'))$
Nonincremental	$\text{NonincrAcc}(x, i, j, q) \equiv \text{Telic}(b, c, r, q)$ & $x = p_1 + c' + p_2$ & $\neg\ \text{Mon}(c')$ & $(\exists b', r')(\text{Trans}(p_1, b', c')$ & $\text{Trans}(p_2, n, c', r'))$
Endeavors	
Undirected	$\text{UndEnd}(x, i, j, q) \equiv \text{Graded}(b, c, q)$ & $x = p_1 + c' + p_2$ & $\neg\ \text{Mon}(c')$ & $(\exists b')(\text{Trans}(p_1, b', c')$ & $\text{Trans}(p_2, c', b'))$
Directed	$\text{DirEnd}(x, i, j, q) \equiv \text{Graded}(b, c, q)$ & $x = p_1 + c' + p_2$ & $\text{Mon}(c')$ & $(\exists b')(\text{Trans}(p_1, b', c')$ & $\text{Trans}(p_2, c', b'))$

Table 9.3: Definitions of aspectual contours as composites of phases. The terms in the left hand column make up the annotation of the aspectual type of the overall event. The aspectual type of the overall event is identical to the aspectual type of the subevent of the theme participant; see Table 9.6. This mapping is done by rules of the type illustrated in the formalization of the example sentence in Table 9.1.

	Direct	**Inverse**
	Force (*contact, force exertion)*	Resist (*maintain)*
Theme	**Direct**	**Reverse**
Property	Change of State	
Path	Motion (*directed motion, manner of motion)*	
Mereological	Apply (*application, combining)*	Remove (*removal, separation)*
	Cover (*covering, filling)*	Uncover (*uncovering, emptying)*
Design	Create	
	Form	
Existence	Internal	
	Location	Dynamic Texture

Table 9.4: Force-dynamic image schemas for annotation: theme change type. The terms in the second and third columns make up the annotation.

External Cause		**Example**
Autonomous	no external cause	*Paint spilled onto the floor.*
Self-Volitional	no external cause; theme argument brings about action volitionality	*Wanda ran out of the room.*
Physical	external physical cause	*The baseball shattered the window.*
Volitional	external volitional cause; no distinct instrument	*I painted the wall.*
Instrumental	external volitional cause with distinct instrument	*I painted the wall with a roller.*

Table 9.5: External/Internal cause. The terms in the first column make up the annotation.

Initial part of causal chain	
Volitional	Volitional$(x, y, i) \equiv$ Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Force(f, g) & Vol(q_1)
Physical	Physical$(x, y, i) \equiv$ Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Force(f, g) & Cont(q_1)
Instrument	Instrument$(x, y, z, i) \equiv$ Component-of(f, x) & Component-of(g, y) & Component-of(h, z) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Subevent(h, i, l, q_3) & Force(f, h) & Vol(q_1) & Force(h, g) & Cont(q_3)
Self-volitional	Self-Volitional$(x, i) \equiv$ Component-of(f, x) & Subevent(f, i, j, q) & Vol(q)
Central part of causal chain	
COS	COS$(x, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Subevent(f, i, j, q) & Prop(q)
Motion	Motion$(x, y, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & InhStPh(g, i, k, q_2) & Path(f, g) & Mot(q_1)
Apply	Apply$(x, y, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & InhStPh(g, i, k, q_2) & Path(f, g) & +Mer(q_1) & Exist(q_2)
Remove	Remove$(x, y, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & InhStPh(g, i, k, q_2) & Path(f, g) & -Mer(q_1) & Exist(q_2)
Cover	Cover$(x, y, i) \equiv$ Theme-of(e, y) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Path(f, g) & +Mer(q_2) & Int(q_1)
Uncover	Uncover$(x, y, i) \equiv$ Theme-of(e, y) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Path(f, g) & -Mer(q_2) & Int(q_1)
Create	Create$(x, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Subevent(g, i, j, q) & Des(q)
Form	Form$(x, y, i) \equiv$ Theme-of(e, y) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Transform(f, g) & Des(q_2) & Int(q_1)
Internal	Internal$(x, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Subevent(f, i, j, q) & Int(q)
Location	Location$(x, y, i) \equiv$ Theme-of(e, x) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & InhStPh(g, i, k, q_2) & Path(f, g) & Int(q_1) & Exist(q_2)
Dynamic Texture	DynamicTexture$(x, y, i) \equiv$ Theme-of(e, y) & Component-of(f, x) & Component-of(g, y) & Subevent(f, i, j, q_1) & Subevent(g, i, k, q_2) & Path(f, g) & Int(q_2) & Int(q_1)

Table 9.6: Formal definitions of event types. The terms in the first column correspond to the force dynamic annotations in Tables 9.4 and 9.5. The aspectual type of the Theme-of argument is the aspectual type of the entire event. The the aspectual types of subevents are determined by the overall aspectual type of the event, based on rules not included here for reasons of space.

Chapter 10

Implementation as an Online Resource (Michael Regan)

An online resource with the geometric and formal representations was developed, and implemented for physical and mental events in VerbNet. The resource is currently accessible through individual verb entries via the Unified Verb Index in VerbNet (`https://uvi.colorado.edu`), through the examples of each case frame (argument structure construction) in each verb entry.

For example, Figure 10.1 is the VerbNet page for the *roll* class of verbs (class 51.3.1), highlighting the case frame NP V NP.theme, with the example *Bill rolled the ball*. At the bottom right of the page, after the VerbNet semantic representation, there is the annotation of the force dynamic structure of the event, Volitional Motion, and a link to the UNM page with the force dynamic (FD) representation of the structure of this event.

Figure 10.2 is the UNM page with the force dynamic representation of the same event expressed by the *roll-51.3.*1 verb class in the Volitional Motion argument structure construction. On the left is the elaborated geometric representation of the event structure, comparable to the representations in *Verbs* illustrated above. On the right is information from VerbNet, including the example sentence, its VerbNet class, and the VerbNet case frame. There is also information for the force dynamic representation: the argument structure construction corresponding to the VerbNet verb class, the annotation of the force dynamic and aspectual structure, and the predicate calculus representation of the event structure.

The other major activity is to implement our analyses of verb force dynamic networks in the online resource linked to VerbNet. We have completed the first step of this process, namely the design of the webpages that will present our verb force dynamic networks. Since we have separated the construction force dynamics from the verb force dynamics, there will be three new types of

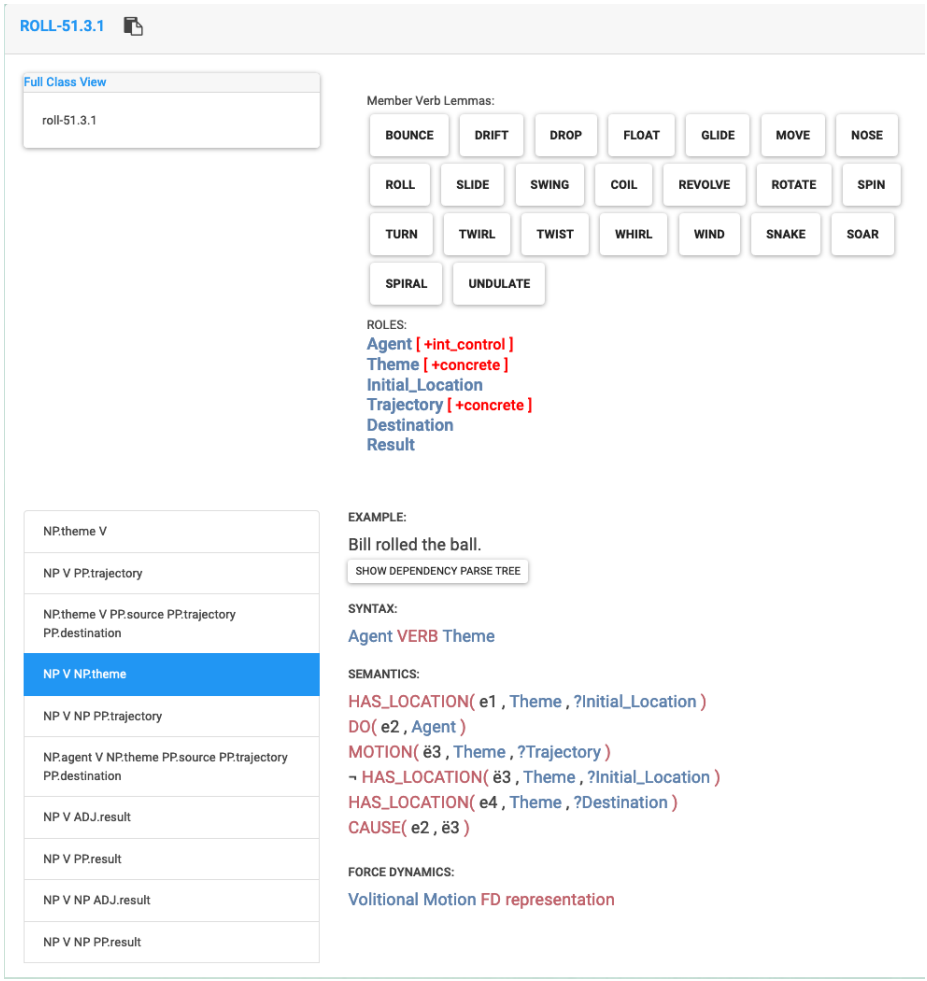


Figure 10.1: VerbNet page for the roll-51.3.1 class of verbs, with the NP V NP theme case frame and the corresponding example sentence *Bill rolled the ball.*

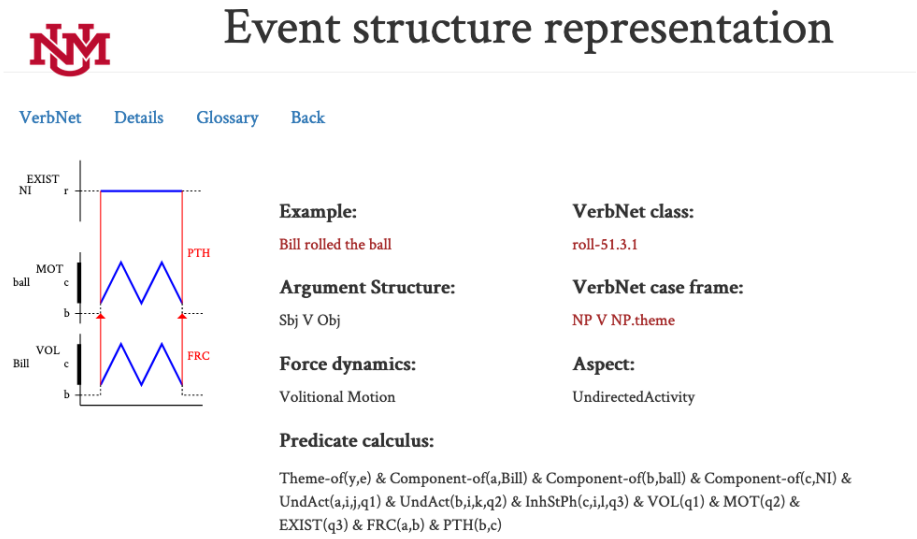


Figure 10.2: UNM event structure representation page for roll-51.3.1 class verbs in the Subject-Verb-Object (basic transitive) construction, and the corresponding example sentence *Bill rolled the ball*.

webpages: a page for the construction force dynamics, a page for the verb force dynamics, and a page for the mapping between the two. These pages will be linked from the example page that serves as the interface between VerbNet and the UNM force dynamic event structure representations.

These pages are illustrated below for the *roll-51.3.1* class of verbs. Figure 10.3 illustrates the revised example sentence page for *Bill rolled the ball*. The page includes the full event structure representation, including both aspect (temporal) structure of the event and the force dynamic structure of the event that is found on the event structure pages currently linked to VerbNet. In addition, it includes an event structure representation that includes only the force dynamic event structure, that is, the force dynamic event structure expressed by the verb and argument structure construction in the example sentence. The aspectual structure of how the event unfolds over time is suppressed in the force dynamic representation. Suppressing the aspectual structure makes it easier to visually present the mapping from the construction force dynamics to the verb force dynamics in the other webpages. The construction force dynamics is in red, just as it is in the full aspectual-cum-force dynamic representation.

The force dynamic annotation, Volitional Motion, is a link to the Volitional Motion page for that constructional causal chain for the [Subject VERB Object] argument structure construction. Below that is a link to the General Motion Network which represents the force dynamic structure of the verb *roll* in the example sentence. Finally, there is a link to the page showing the mapping from

the construction causal chain to the verb force dynamic network.

Figure 10.4 shows the construction force dynamics page for the Volitional Motion construction. This page gives the construction force dynamics for Volitional Motion, and all of the verb force dynamic networks that the Volitional Motion construction is used for in English. Thus, all of the mappings from this particular constructional force dynamic structure to verb force dynamic networks are given on this page. To the right are links to the pages that list all the mappings of the Volitional Motion force dynamic chain onto the particular verb force dynamic network (General Motion, Send Motion, etc.).

Figure 10.4 shows only the Motion verb force dynamic networks that the Volitional Motion construction semantics maps onto. There are other verb force dynamic networks that the Volitional Motion construction maps onto, which will be included as their analyses are implemented.

Figure 10.5 shows the verb force dynamic network page for Motion networks. As we noted above, Motion verb classes actually belong to a family of overlapping Motion verb force dynamic networks. All of the Motion verb force dynamic networks share a core subevent in which a Theme participant moves on a path relative to another entity, the Ground participant. On the right of the page is a list of all the constructional force dynamic meanings that map to that particular Motion network. The links take the user to the page describing the mapping of that particular constructional meaning to that particular Motion verb force dynamic network. There are other Motion verb networks, which will be included as their analyses are implemented.

Figure 10.6 illustrates the page showing the mapping between a particular construction force dynamic meaning (causal chain) and a particular verb force dynamic meaning (causal network)–in this case, the mapping from the Volitional Motion construction force dynamics to the General Motion verb force dynamics. The subtitle allows the user to link to the construction force dynamics page (Volitional Motion) or the verb force dynamics page (General Motion Network).

The upper part of the page shows how the force dynamic chain of the construction is mapped to the corresponding participant roles and force dynamic interactions of the verb force dynamic network. The constructional force dynamic chain is in red, as in the example sentence event structure and construction force dynamics pages, and the verb force dynamic network is in green, as in the verb force dynamics page.

The lower part of the page includes a table with all of the argument structure constructions that express the constructional meaning, their corresponding VerbNet classes, and the example sentence illustrating each argument structure construction (also from VerbNet). The rows are live links that take the user to the UNM force-dynamic event structure page with that particular example.

The development of the verb force dynamic analyses for mental and social events, and the implementation of the analyses of the mappings from construction force dynamics to verb force dynamics for all events, will constitute the completion of the research originally envisioned in the grant proposal, in the rest of Option Year 5.

The web links for force-dynamic event structures (the main pages through

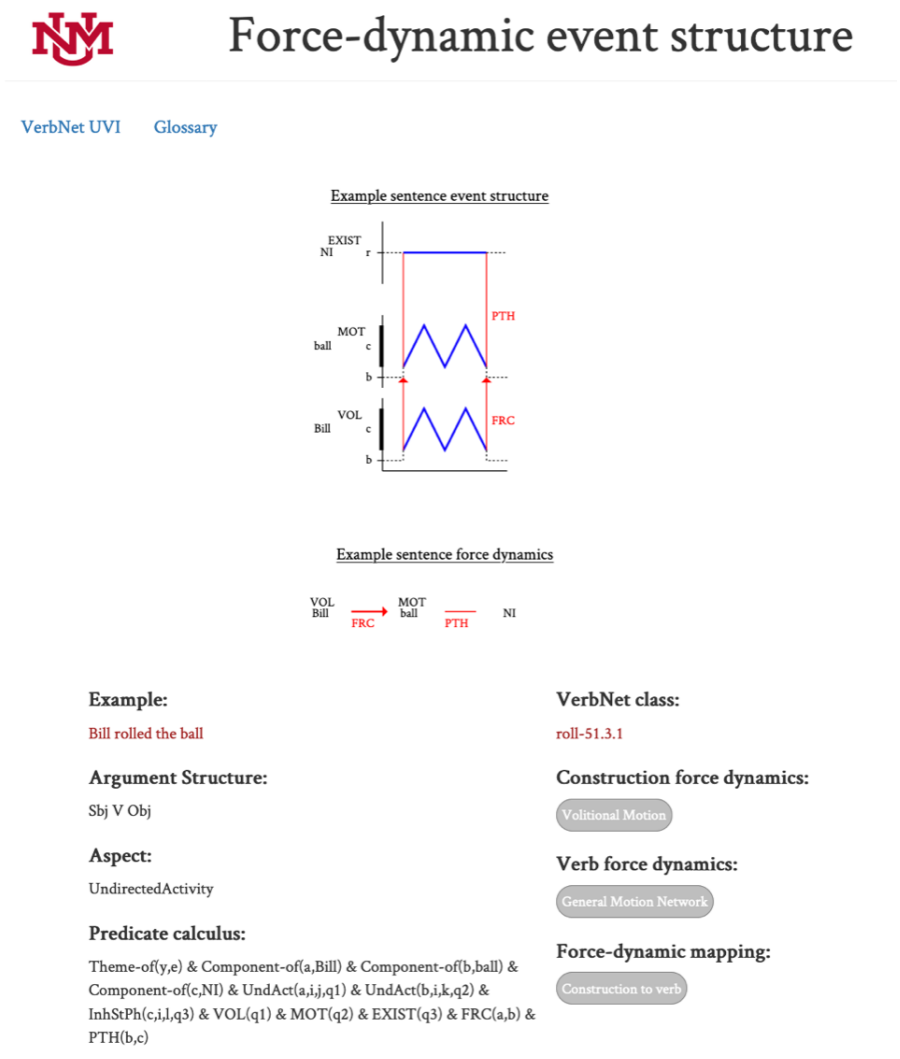


Figure 10.3: Revised event structure representation page for roll-51.3.1 class verbs in the Subject-Verb-Object (basic transitive) construction, and the corresponding example sentence *Bill rolled the ball*.

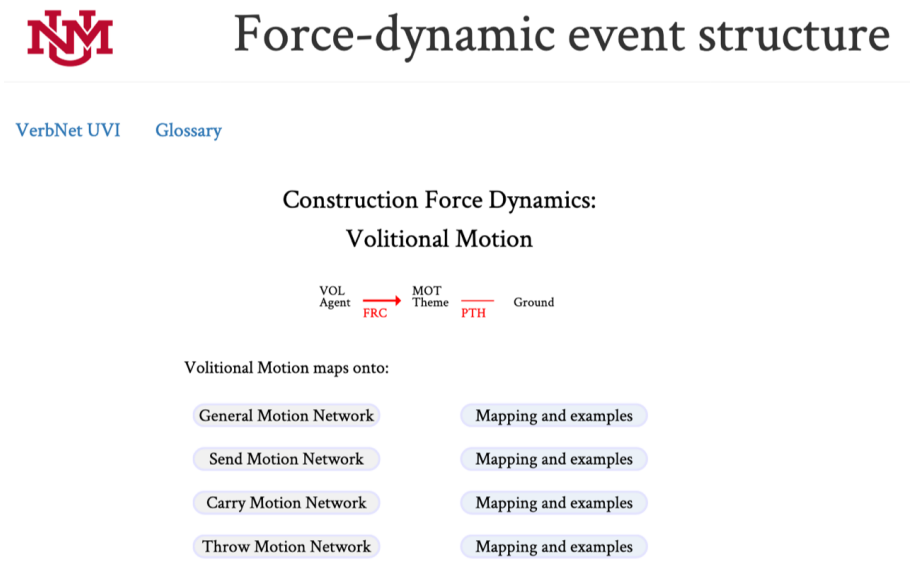


Figure 10.4: Constructional force dynamics page for the Volitional Motion construction.

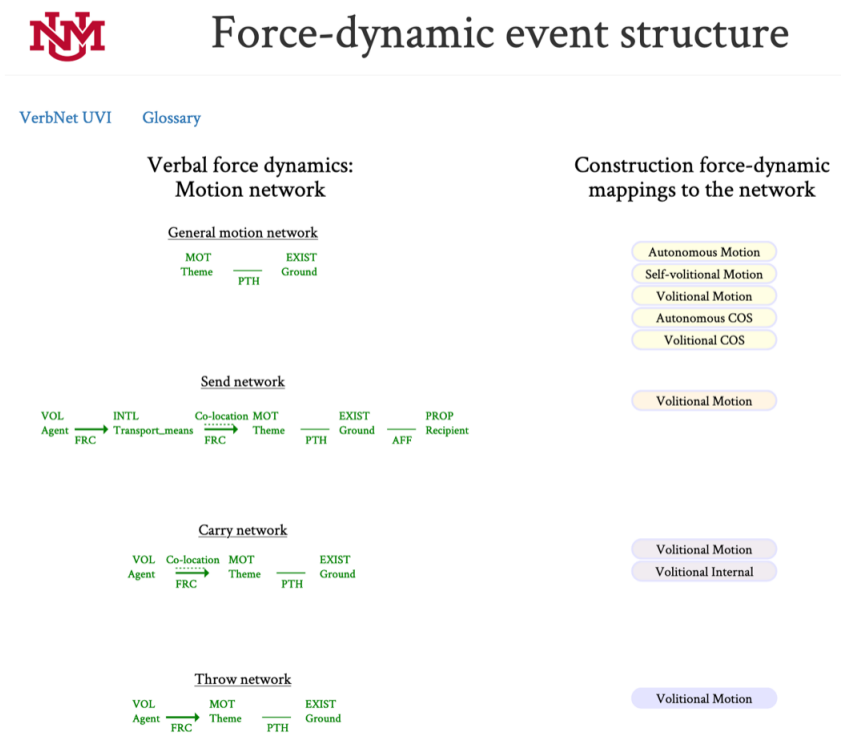


Figure 10.5: Verb force dynamic network page for Motion events.

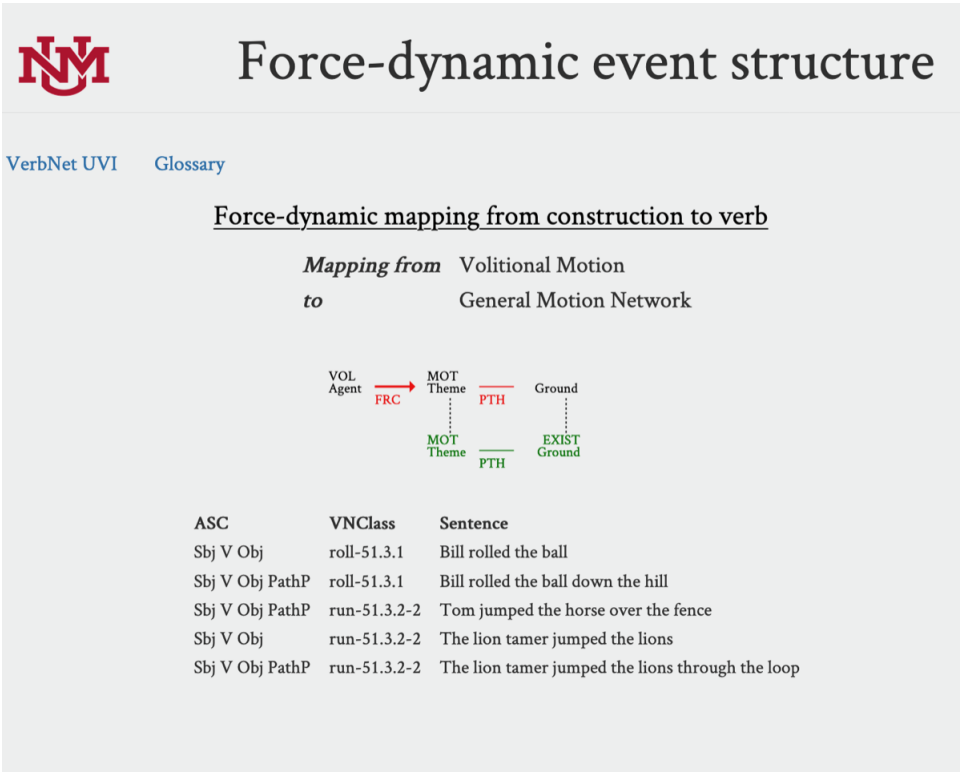


Figure 10.6: Page illustrating mapping from the Volitional Motion construction force dynamics to the General Motion Network verb force dynamics.

which all other annotations can be found) are not currently accessible through the VerbNet webpage. Until these pages can be properly linked to that webpage, the resources will be instead available in a GitHub repository. Example pages include:

Motion network:

`https://michael-regan.github.io/fd-website/index.html?id=10003`

Illustration network:

`https://michael-regan.github.io/fd-website/index.html?id=10007`

Force+Constrain network:

`https://michael-regan.github.io/fd-website/index.html?id=10012`

Change-of-state (COS) network:

`https://michael-regan.github.io/fd-website/index.html?id=10015`

Mereological+Causative+Concealment Mereological network:

`https://michael-regan.github.io/fd-website/index.html?id=10026`

Vehicular Motion network:

`https://michael-regan.github.io/fd-website/index.html?id=10033`

Appendix A

Annotation spreadsheets for physical, mental and social events

The spreadsheets are provided as separate documents.

Appendix B

Code for the online resource of verbal semantic representations linked to VerbNet

The code is provided as separate documents.

Bibliography

Aikhenvald, A. Y. (2013a). Possession and ownership: A cross-linguistics perspective. In Aikhenvald, A. Y. and Dixon, R. M. W., editors, *Possession and ownership: a cross-linguistic typology*, pages 1–64. Oxford: Oxford University Press.

Aikhenvald, A. Y. (2013b). Possession and ownership: A cross-linguistics perspective. In Aikhenvald, A. Y. and Dixon, R. M. W., editors, *Possessuin and ownership: a cross-linguistic typology*, pages 1–64. Oxford: Oxford University Press.

Aikhenvald, A. Y. and Dixon, R. M. W. (2013). *Possession and ownership: a cross-linguistic typology*. Oxford: Oxford University Press.

Allen, J. F. (1984). Towards a general theory of action and time. *Artificial Intelligence*, 23:123–54.

Austin, J. (1962). *How to do things with words*. Oxford: Clarendon.

Baker, C. F. and Ruppenhofer, J. (2002). FrameNet's frames vs. Levin's verb classes. In Larson, J. and Paster, M., editors, *Proceedings of the Twenty-eighth Annual Meeting of the Berkeley Linguistics Society*, pages 27–38. Berkeley: Berkeley Linguistics Society.

Beavers, J. (2011). An aspectual analysis of ditransitive verbs of caused possession in english. *Journal of Semantics*, 28:1–54.

Boas, H. (2010). The syntax-lexicon continuum in Construction Grammar: a case study of English communication verbs. *Belgian Journal of Linguistics*, 24:54–82.

Bowerman, M. (1996). The origins of children's spatial semantic categories: cognitive versus linguistic determinants. In Gumperz, J. J. and Levinson, S. C., editors, *Rethinking linguistic relativity*, pages 145–76. Cambridge University Press, Cambridge.

Brugman, C. M. (1988). *The Syntax and Semantics of HAVE and its Complements*. PhD thesis, University of California at Berkeley.

Clausner, T. C. and Croft, W. (1999). Domains and image-schemas. *Cognitive Linguistics*, 10:1–31.

Comrie, B. (1976). The syntax of action nominals: a cross-language study. *Lingua*, 40:177–201.

Croft, W. (1991). *Syntactic categories and grammatical relations: the cognitive organization of information*. Chicago: University of Chicago Press.

Croft, W. (1993). Case marking and the semantics of mental verbs. In Pustejovsky, J., editor, *Semantics and the Lexicon*, pages 55–72. Dordrecht: Kluwer Academic.

Croft, W. (2003). Lexical rules vs. constructions: a false dichotomy. In Cuyckens, H., nad René Dirven, T. B., and Panther, K.-U., editors, *Motivation in Language*, pages 49–68. John Benjamins Publishing Company: Amsterdam/Philadelphia.

Croft, W. (2009). Connecting frames and constructions: a case study of 'eat' and 'feed'. *Constructions and Frames*, 1:7–28.

Croft, W. (2010). Relativity, linguistic variation and language universals. *CogniTextes*, 4.303.

Croft, W. (2012). *Verbs: aspect and causal structure*. Oxford University Press.

Croft, W. and Cruse, D. A. (2004). *Cognitive linguistics*. Cambridge: Cambridge University Press.

Croft, W., Pešková, P., and Regan, M. (2016). Annotation of causal and aspectual structure of events in RED: a preliminary report. In *4th Events Workshop, 15th Annual Conference of the North American Chapter of the Association of Computational Linguistics: Human Language Technologies (NAACL-HLT 2016)*, pages 8–17. Stroudsburg, Penn: Association for Computational Linguistics.

Croft, W. and Vigus, M. (2017). Constructions, frames, and event structure. In *The AAAI 2017 Spring Symposium on Computational Construction Grammar and Natural Language Understanding*, AAAI Technical Report SS-17-02, pages 147–153, http://www.aaai.org/Library/Symposia/Spring/ss17-02.php. AAAI Press.

Croft, W. and Vigus, M. (2020). Event causation and force dynamics in argument structure constructions. In *Perspectives on Causation*, pages 151–183. Springer.

Cruse, D. A. (1986). Some thoughts on agentivity. *Journal of Linguistics*, 9:11–23.

Cuyckens, H. and Parret, H., editors (1982). *The scene of linguistic action and its perspectivization by speak, talk, say, and tell*. Pragmatics and Beyond: An Interdisciplinary Series of Language Studies. John Benjamins Publishing Company: Amsterdam/Philadelphia.

De Swart, H. (1998). Aspect shift and coercion. *Natural Language and Linguistic Theory*, 16:347–85.

Dirven, R. (1982). Talk: Linguistic action perspectivized as discourse. In Dittmar, N., Holdcroft, D., Mey, J., Sadock, J. M., Schegloff, E. A., Vanderveken, D., and van Dijk, T. A., editors, *The scene of linguistic action and its perspectivization by speak, talk, say, and tell*, Pragmatics and Beyond: An Interdisciplinary Series of Language Studies, pages 37–84. John Benjamins Publishing Company: Amsterdam/Philadelphia.

Doron, E. (2017). The causative component of locative and psychological verbs. Paper presented at the Workshop on Linguistic Perspectives on Causation, The Hebrew University of Jerusalem.

Dowty, D. (1991). Thematic proto-roles and argument selection. *Language*, 67:547–619.

Dowty, D. (2000). 'the garden swarms with bees' and the fallacy of 'argument alternation'. In Ravin, Y. and Leacock, C., editors, *Polysemy: Theoretical and computational approaches*, pages 111–128. Oxford University Press, Oxford.

Dowty, D. (2001). The semantic asymmetry of 'argument alternations' (and why it matters). In van der Meer, G. and ter Meulen, A. G., editors, *Making sense: from lexeme to discourse, in honor of Werner Abraham at the occasion of his retirement*, volume 44 of *Groninger Arbeiten zur germanistischen Linguistik*, pages 171–86. Center for Language and Cognition, University of Groningen, Groningen.

Farkas, D. F. (1988). On obligatory control. *Linguistics and Philosophy*, 11(1):27–58.

Fauconnier, G. (1994). *Mental Spaces: Aspects of Meaning Construction in Natural Language*. New York: Cambridge University Press.

Fillmore, C. J. (1965). *Indirect Object Construction in English and the Ordering of Transformations*. Monographs on Linguistics Analysis. Mouton: The Hague.

Fillmore, C. J. (1986). Pragmatically-controlled zero anaphora. In Fillmore, C. J., Nikiforidou, V., Clay, M. V., Niepokuj, M., and Feder, D., editors, *Proceedings of the Twelfth Annual Meeting of the Berkeley Linguistics Society*, pages 95–107. Berkeley Linguistics Society, Berkeley.

Fillmore, C. J. and Atkins, B. T. S. (1992). Towards a frame-based lexicon: the semantics of RISK and is neighbors. In Lehrer, A. and Kittay, E. F., editors, *Frames, fields and contrasts: new essays in semantics and lexical organization*, pages 75–102. Lawrence Erlbaum Associates, Hillsdale, NJ.

Fillmore, C. J., Johnson, C. R., and Petruck, M. R. (2003). Background to FrameNet. *International Journal of Lexicography*, 16:235–50.

Francis, E. J. (2000). Two perspectives on the grammar of possession. *Language Sciences*, 22:870–107.

Goldberg, A. E. (1995). *Constructions: A Construction Grammar Approach to Argument Structure*. Chicago: University of Chicago Press.

Gordon, A. S. and Hobbs, J. R. (2017). *A Formal Theory of Commonsense Psychology: How People Think People Think*. Cambridge University Press, to appear.

Grimshaw, J. B. (1990). *Argument Structure*. MIT Press, Cambridge, MA.

Hay, J., Kennedy, C., and Levin, B. (1999). Scalar structure underlies telicity in "degree achievements". In Matthews, T. and Strolovitch, D., editors, *Proceedings of SALT*, volume 9, pages 127–144. Ithaca: Cornell University Press.

Heine, B. (1997). *Possession: Cognitive Sources, Forces, and Grammaticalization*. Cambridge University Press, Cambridge.

Hobbs, J. R. (1985). Granularity. In *Proceedings of the Ninth International Joint Conference on Artificial Intelligence, Volume 1*, pages 432–435. San Francisco, Calif.: Morgan Kaugmann.

Hobbs, J. R. (2005). Toward a useful concept of causality for lexical semantics. *Journal of Semantics*, 22:181–209.

Hobbs, J. R. and Pan, F. (2004). An ontology of time for the semantic web. *ACM Transactions on Asian Language Information Processing*, 3(1):66–85.

Iwata, S. (2005). Locative alternation and two levels of verb meaning. *Cognitive Linguistics*, 16(2):355–407.

Jackendoff, R. (2002). *Foundations of language*. Oxford: Oxford University Press.

Kalm, P., Regan, M., kyung Lee, S., Peverada, C., and Croft, W. (2020). Representing constructional metaphors. In *Proceedings of the Second International Workshop on Designing Meaning Representations*. Association for Computational Linguistics.

Kipper, K., Korhonen, A., Ryant, N., and Palmer, M. (2007). A large-scale classification of English verbs. *English Resources and Evaluations*, 42:21–40.

Kipper-Schuler, K. (2005). *VerbNet: A broad-coverage, comprehensive verb lexicon*. PhD thesis, University of Pennsylvania.

Koenig, J.-P. and Davis, A. R. (2001). Sublexical modality and the structure of lexical semantic representations. *Linguistics and Philosophy*, 24:71–124.

Koptjevskaja-Tamm, M. (1993). *Nominalizations*. Routledge, London.

Lakoff, G. (1987). *Women, fire and dangerous things: what categories reveal about the mind*. Chicago: University of Chicago Press.

Lambrecht, K. and Lemoine, K. (2005). Definite null subjects in (spoken) French: A Construction-Grammar account. In Fried, M. and Boas, H. C., editors, *Grammatical Constructions: Back to the roots*, pages 13–55. John Benjamins Publishing, Amsterdam.

Langacker, R. W. (1987). *Foundations of Cognitive Grammar, vol. I: theoretical prerequisites*. Stanford: Stanford University Press.

Langacker, R. W. (1991). *Foundations of Cognitive Grammar, vol. II: descriptive application*. Stanford: Stanford University Press.

Langacker, R. W. (1995). Possession and possessive constructions. In Taylor, J. R. and MacLaury, R. E., editors, *Language and the Cognitive Construal of the World*, number 82 in Trends in Linguistics: Studies and Monographs, pages 51–80. Mouton De Gruyter.

Levin, B. (1991). Building a lexicon: The contribution of linguistics. *International Journal of Lexicography*, 4(3):205–226.

Levin, B. (1993). *English verb classes and alternations: a preliminary investigation*. Chicago: University of Chicago Press.

Levin, B. (2008). Dative verbs: A crosslinguistic perspective. In *Lingvisticae Investigationes*, volume 21, pages 285–312. John Benjamins Publishing.

Levin, B. and Grafmiller, J. (2013). Do you always fear what frightens you? In King, T. H. and de Paiva, V., editors, *From Quirky Case to Representing Space*, pages 21–32. CSLI Publications.

Levin, B. and Rappaport Hovav, M. (2005). *Argument realization*. Cambridge University Press, Cambridge.

Levinson, S. C., Meira, S., the Language, and Group, C. (2003). 'natural concepts' in the spatial topological domain—adpositional meanings in crosslinguistic perspective: an exercise in semantic typology. *Language*, 79:485–516.

Lyngfelt, B. (2012). Re-thinking FNI: on null instantiation and control in Construction Grammar. *Constructions and Frames*, 4:1–23.

Mani, I. and Pustejovsky, J. (2012). *Interpreting motion: grounded representations for spatial language*. Oxford: Oxford University Press.

Michaelis, L. (2004). Type shifting in construction grammar: an integrated approach to aspectual coercion. *Cognitive Linguistics*, 15:1–67.

Nemoto, N. (2005). Verbal polysemy and Frame Semantics in Construction Grammar: some observations on the locative alternation. In Fried, M. and Boas, H. C., editors, *Grammatical constructions: back to the roots*, pages 119–36. Amsterdam: John Benjamins.

Newman, J. (1996). *Give: A Cognitive Linguistic Study*, volume 7 of *Cognitive Linguistics research*. Mouton de Gryuter: Berlin.

Oehrle, R. T. (1976). *The Grammatical Status of the English Dative Alternation*. Unpublished Ph.D. thesis, Department of Linguistics and Philosophy, MIT, Cambridge MA.

Palmer, M., Bonial, C., and Hwang, J. D. (2017). VerbNet: Capturing English verb behavior, meaning and usage. In Chipman, S., editor, *The Oxford Handbook of Cognitive Science*, pages 315–336. Oxford: Oxford University Press.

Pesetsky, D. (1995). *Zero Syntax: Experiencers and Cascades*. Cambridge, Mass: MIT Press.

Petruck, M. R. L. (2019). Meaning representation of null-instantiated semantic roles in framenet. In *Proceedings of the First International Workshop on Designing Meaning Representations*, pages 121–127. Association for Computational Linguistics.

Pinker, S. (1989). *Learnability and Cognition*. MIT Press. Cambridge, MA.

Rappaport Hovav, M. and Levin, B. (1998). Building verb meanings. In Butt, M. and Geuder, W., editors, *The projection of arguments: lexical and compositional factors*, pages 97–134. Stanford: Center for the Study of Language and Information.

Rappaport Hovav, M. and Levin, B. (2008). The English Dative alternation: the case for verb sensitivity. *Journal of linguistics*, pages 129–167.

Rowlands, E. C. (1969). *Yoruba*. Sevenoaks, Kent: Hodder and Stoughton.

Searle, J. (1969). *Speech Acts*. Cambridge: Cambridge University Press.

Stassen, L. (2009). *Predicative Possession*. Oxford University Press, Oxford, UK.

Talmy, L. (1976). Semantic causative types. In Shibatani, M., editor, *The grammar of causative constructions*, volume 6, pages 43–116. New York: Academic Press.

Talmy, L. (1985). Lexicalization patterns: semantic structure in lexical forms. In Shopen, T., editor, *Language typology and syntactic description: grammatical categories and the lexicon*, volume 3, pages 57–149. Cambridge: Cambridge University Press.

Talmy, L. (1988). Force dynamics in language and cognition. *Cognitive Science*, 2:49–100.

Taylor, J. R. (1996). *Possessives in English: An Exploration in Cognitive Grammar*. Clarendon Press, Oxford.

Trang Hoa Dang, Karen Kipper, M. P. and Rosenzweig, J. (1998). Investigating regular sense extensions based on intersective levin classes. *Proceedings of the 17th International Conference on Computational Linguistics (COLING$_A$CL)*, 1:293–99.

Tsohatzidis, S. L., editor (1994). *Foundations of Speech Act Theory. Philosophical and Linguistics Perspectives*. London: Routledge.

Urban, M. and Ruppenhofer, J. (2001). Shouting and screaming: Manner and noise verbs in communication. *Literary and linguistic computing*, 16(1):77–97.

Valin, R. D. V. and LaPolla, R. J. (1997). *Syntax: structure, meaning and function*. Cambridge: Cambridge University Press.

Vendler, Z. (1967). Verbs and times. In Vendler, Z., editor, *Linguistics in philosophy*, pages 97–121. Ithaca: Cornell University Press.

Verhoeven, E. (2007). *Experiential Constructions in Yucatec Maya: a typologically based analysis of a function domain in a Mayan language*. John Benjamins Publishing Company.

Viberg, A. (1983). The verbs of perception: a typological study. *Linguistics*, 21(1):123–162.

Viberg, Å. (2010). Basic verbs of possession. a contrastive and typological study. *CogniTextes. Revue de l?Association française de linguistique cognitive*, 4.

Wasow, T. (1977). Transformations and the lexicon. In et al., P. W. C., editor, *Formal Syntax*, pages 327–360. New York: Academic Press.

Wierzbicka, A. and Goddard, C. (2019). Cognitive semantics, linguistic typology and grammatical polysemy: "possession" and the English Genitive. *Cognitive Semantics*, 5:224–247.

Zaenen, A. (1993). Unaccusativity in Dutch: Integrating syntax and lexical semantics. In Pustejovsky, J., editor, *Semantics and the lexicon*, pages 129–61. Dordrecht: Kluwer Academic.