The semantics of English *-ment* nominalizations

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List of abbreviations

Corpora

BNC	British National Corpus, Davies (2004-)
COCA	Corpus of Contemporary American English, Davies (2008-)
COHA	Corpus of Historical American English, Davies (2010-)
GB	*Google Books* (n.d.)
GloWbE	Corpus of Global Web-Based English, Davies (2013)
HC	Hansard Corpus (British Parliament), Davies (2015a)
iWeb	iWeb: The 14 Billion Word Web Corpus, Davies (2018-)
NOW	News on the Web Corpus, Davies (2016-)
OED	*Oxford English Dictionary Online* (2021)
SOAP	Corpus of American Soap Operas, Davies (2011-)
TIME	TIME Magazine Corpus, Davies (2007-)
WC	Webcorp, Renouf et al. (2006)
WIKI	The Wikipedia Corpus, Davies (2015b)

Genres

ACAD	academic literature
BLOG	private blog
COMM	comment in the comment section of a website
FIC	fiction
MAG	popular magazine
NEWS	newspaper or news blog
NONFIC	nonfiction literature
SPOK	transcript of spoken language
WEB	website of a company or institution

Symbols and notational conventions

*expression	impossible or ungrammatical expression
?expression	doubtful expression
$\doteq$	is defined as
$\wedge$	conjunction ('and')
$\veebar$	exclusive disjunction ('or')
<...>	orthographic string used in a corpus query
V; V-ment	a given group of (base) verbs
[...]	ellipsis in a quote or corpus attestation
SMALL CAPITAL LETTERS	a. frame attributes
	b. readings of words in context
italics	a. frame types
	b. examples within the text
	c. technical terms
boldface	important technical terms

Chapter 1

Introduction

Research in the field of derivational semantics investigates how the internal structure of derived words is related to their meaning. One central problem in this line of research is **affix polysemy**: one affix being able to generate several possible readings. An oft-cited example is the English nominalizing suffix *-er*. Attached to a base verb, it can exhibit the following readings (see Bauer et al. 2013; Lieber 2016):[1]

(1) a. INSTRUMENT: *opener*
b. AGENT: *writer*
c. [-animate] PATIENT: *loaner*
d. [+animate] PATIENT: *shooter*[2]
e. LOCATION: *diner*

In addition, it is often the case that several readings are possible even within one and the same derivative: According to the *Oxford English Dictionary Online* (OED), an *opener* can not only be an INSTRUMENT ('An implement or device for opening tins, bottles, etc.'), but also an AGENT ('A person who opens or begins something') or a [-animate] PATIENT ('A case or package that is opened by customs officials'). That is, *opener* can exhibit readings (1a) to (1c). Importantly, however, a given derivative will most likely not exhibit the full range of readings that its affix can potentially produce: The OED does not list *opener* as 'someone who has been opened' or as 'the place of opening' (readings (1d) and (1e)).

In recent years, affix polysemy has attracted considerable attention in linguistic research. Especially notable is the *Oxford reference guide of English morphology*

[1] Furthermore, *-er* can attach to location nouns to produce INHABITANT readings (*Londoner*), and to complex bases consisting of a number and a measure term to produce MEASURE readings (*20-pounder*).

[2] See Lieber (2016) for an example (p. 67) and a discussion (p. 74) of this unexpected reading.

(Bauer et al. 2013), which is the only work to date that includes a data-driven description of the whole range of semantic possibilities in English derivation. Recently, Lieber (2016) has added a theoretical vantage point to a subset of Bauer et al.'s insights, modeling English nominalizations in her Lexical Semantic Framework.

Major studies have investigated a variety of sub-topics, only a few of which I will mention here by way of example (see Lieber 2016 for a more comprehensive overview; see also the collection of articles in Bauer et al. 2015).[3] The semantic distinction between event and result nominalizations has figured prominently in research on morphology and syntax, especially in the generative tradition (e.g. Melloni 2007, 2011; Fradin 2011; Grimshaw 1990; Alexiadou 2001; Borer 2013), and has also been discussed extensively by James Pustejovsky in the field of computational lexical semantics (e.g. 1995; 1998). Morphologists have also given considerable attention both to suffixes which create person nouns (such as *-er* and *-ee*, see e.g. Lieber 2004; Booij 2004), and to those giving rise to abstract interpretations (such as *-ness* or *-ity*, see e.g. Trips 2009; Arndt-Lappe 2014). Especially *-er* has taken "center stage," as Rainer (2014) phrases it. Recently, quantitative approaches have gained momentum in the field, for example Analogical Modeling (e.g. Arndt-Lappe 2014) or Distributional Semantics (e.g. Lapesa et al. 2018; Wauquier 2020).

Apart from this extensive research literature, derivational semantics has figured internationally as a special topic of conferences, notably the International Morphology Meeting (Vienna 2012, see Rainer et al. 2014), the Mediterranean Morphology Meeting (Dubrovnik 2013), and the workshop Semantics of Derivational Morphology (Düsseldorf 2014, see Arndt-Lappe & Plag 2015).

Despite this intensive research, a workable model of derivational semantics is still under debate. I see two main issues with existing analyses of affix polysemy. First, what may be the chief desideratum in the endeavor of modeling affix polysemy: Most existing approaches put a focus on the semantic properties of the derivative, largely disregarding or leaving implicit what is contained in the base words' semantics. This oversight has been acknowledged, for example, by Bauer et al. (2013), who observe that there is often a non-arbitrary relationship between the semantics of the base word and that of the derivative (p. 213), and by Lieber

[3] By virtue of the scope of this study, I limit this overview to research dealing with the process of nominalization.

(2004), who leaves open "[e]xactly what the verbal body looks like" (p. 72) in her analysis of deverbal nouns.

That the base does play a major role for the availability of readings of its derivative can be illustrated with the example of *opener*: Its three possible readings are central elements of its base verb's semantics. Thus, the action denoted by the verb *open* involves someone who opens (AGENT), something that is opened (PATIENT), and something that can be used to open (INSTRUMENT). Other central elements in the semantics of *open* cannot be targeted by *-er*, but are available for other derivational processes. For example, according to the OED, the ACTION of making open can be targeted by *-ing* (*opening*), and the RESULT of opening can be targeted both by *-ing* and by conversion (*opening* and $open_{N}$; see also Andreou & Lieber 2020).

This example shows that the process of derivation can be considered compositional in the sense that both the base and the affix make a contribution: The base offers an array of semantic elements, and the affix may select from this array to construct the derivative's meaning. A comprehensive analysis of affix polysemy therefore requires a precise characterization of the interaction between input and output semantics. More precisely, a decompositional approach is needed to identify the elements in the base word's semantics that are potential targets for an affix.

The second issue with the current state of research is that existing analyses either remain on a descriptive level (e.g. Bauer et al. 2013), or opt for a semantically underspecified analysis (e.g. Pustejovsky's dot objects, Pustejovsky 1998, or Lieber's skeletal features, Lieber 2004 et seq.). However, the example of *opener* shows that there is a great deal to be gained from an explicit semantic decomposition of the derivative. Along with the decomposition of the base that I have advocated for above, such an analysis would allow the researcher to thoroughly describe and model the contributions both of the base and of the affix.

In order to address these issues, a semantic framework is needed in which meanings can be composed and decomposed. By giving access to the meaning components of the base, such a framework would allow the researcher to model the semantic contribution of the base in the process of derivation. Moreover, we need a framework that is both flexible enough to incorporate all possible nominalization readings, and at the same time restricted enough to preclude impossible ones.

A powerful framework that exhibits the desired characteristics is that of **frames** (Barsalou 1992a,b; Petersen 2007; Löbner 2013). Frames are recursive attribute-value structures which serve to model mental representations of concepts, similar to formalisms known from frameworks such as Head-driven Phrase Structure Grammar (HPSG, Pollard & Sag 1994) or Lexical Functional Grammar (LFG, Bresnan 1982). The core of frame theory consists in the assumption that frames are the fundamental representation of knowledge, which includes linguistic structures and processes (referred to as the *Frame Hypothesis*, Löbner 2014, 2017; see also Petersen 2007).

In this dissertation, I combine frame semantics with a qualitative analysis of corpus data. I focus on both the base and the affix, investigating how a derivational process acts on the semantics of a given base. Specifically, my thesis presents an in-depth study of the relationship between the English nominalizing suffix *-ment* and a semantically delimited set of verbal bases. Since I am interested to know how speakers of English productively and intuitively use *-ment* to create new words, my data sample consists of novel derivatives. The following overarching research questions guide my analysis:

1. Which readings are possible in newly formed *-ment* derivatives?
2. What are the semantic contributions of the base and of the affix?
3. How can this be modeled in a frame-semantic approach?

My research project thus tackles affix polysemy (research question 1) by investigating compositionality in derivation (research question 2). On the methodological side, I apply a framework that allows for the precise and detailed description and, ultimately, for the prediction of derivational semantics (research question 3). A secondary objective is to give attention to *-ment*, an affix which at this point remains understudied (see Lieber 2016, 4).

My data set consists of 40 *-ment* neologisms from the OED and the Corpus of Contemporary American English (Davies 2008-), with base verbs from two semantic classes, namely change-of-state verbs and verbs of psychological state as defined by Levin (1993) and Kipper et al. (2008). For the assertion of possible *-ment* readings, I take into consideration 502 attestations which were elicited from various corpora with a purposeful sampling approach. For each attestation, the *-ment* derivative is hand-coded using common semantic categories such as EVENT, STATE, RESULT and STIMULUS.

Applying the Frame Hypothesis to the subject of derivational semantics, I show that the process of deverbal nominalization can be modeled by assuming separate

semantic frames for the base verbs and for their derivatives. A nominalizing suffix can target a highly restricted set of elements in the frame of the base, inducing a shift of reference with regard to the resulting frame of the derivative. For example, the frame for the base verb *open* describes the ACTION of making open, and *-er* derivation shifts reference from the verbal meaning ACTION to one of the possible readings of *opener*. That is, the nominalization frame now describes either the INSTRUMENT, the AGENT, or the [-animate] PATIENT of opening. Polysemous derivatives are then disambiguated in context. In my approach, the relationship between input and output frames is made explicit by integrating them into lexical rules (see e.g. Sag & Wasow 1999) and inheritance hierarchies (see e.g. Riehemann 1998).

My study relies on a two-way relationship between language data and semantic frames. The frame representations of the base verbs are devised on the basis of existing literature, offering a first lead as to which readings may be expected in the nominalizations. For example, the frame for *open* would contain an attribute INSTRUMENT, among others. As a by-product of this analysis, the nominalizations' semantics provides evidence for (or against) the elements contained in the base verb frames: The existence of *opener* in an INSTRUMENT reading represents evidence for the existence of the INSTRUMENT attribute in the frame representation of the base.

The thesis is structured as follows. In chapter 2, I will give an overview of the variant of frame theory applied here, introducing key terminology and concepts as well as previous approaches to derivational semantics. In chapter 3, I will describe the methods which I used to elicit, choose and semantically classify the data set. Then, I will present the results of the two studies that I have conducted for this thesis: Chapter 4 deals with *-ment* on change-of-state verb bases, and chapter 5 addresses *-ment* on psych verb bases. In each of these two chapters, I will describe and model first the semantics of the base verbs, and then the semantics of the nominalizations. In chapter 6, I will take a quantitative perspective, addressing the issues of gaps and ambiguity in my data. In chapter 7, I will discuss the insights gained in chapters 4 to 6, answering my research questions and reflecting upon methodological issues. Finally, in chapter 8, I will present my conclusions and outline directions for further research.

Chapter 2

Frames

Since its emergence in the 1970s, frame theory has come to be widely used in a diverse range of disciplines from artificial intelligence, human cognition, and media science to philosophy, psychology and linguistics. In this chapter, I will give an overview of the relevant cognitive and linguistic literature. First, in order to be able to place the frame approach applied here historically, I will provide a brief sketch of the origin of frames (section 2.1).[4] Next, in section 2.2, I will introduce the general architecture of the type of frame theory applied here, namely Barsalou's (1992a; 1992b) approach as implemented in the *DFG Collaborative Research Center 991: The Structure of Representations in Language, Cognition, and Science* (CRC 991, Petersen 2007 et seq.; see Löbner 2021 for an overview of the different frame applications).

Finally, I will introduce the frame-related concepts and terminology that are needed to understand how derivation can be modeled in frames (section 2.3).[5]

2.1 Earlier frame approaches

In this section, I will delineate how the frame approach applied in this thesis integrates into the history of cognitive and linguistic research. I will first sketch the origins of frames in cognitive psychology (section 2.1.1), and then focus on Barsalou's approach (section 2.1.2).

[4]For a more detailed review of the development of the frame notion and related concepts see Ziem (2008), Busse (2012) and Busse (2017).

[5]Strictly speaking, the term *frame* refers to a cognitive structure, while the graphs and matrices would more appropriately be labeled *frame representations* or *frame visualizations*. For convenience, however, I will also refer to all frame representations as *frames*.

2.1.1 The origins of frames

It has been argued that frames ultimately go back to cognitive psychology and Bartlett's (1932) **schemata**, and that they are closely related to script theory, which addresses issues in artificial intelligence (among other things, see e.g. Busse 2012, 20). Cognitive scientist Marvin Minsky is usually regarded as the founder of cognitive frame theory (Kann & Inderelst 2018), while Charles Fillmore simultaneously developed the linguistic theory of frame-semantics (Busse 2012, 10).

In his seminal paper "A framework for representing knowledge" (Minsky 1975), Minsky posits a number of core assumptions about (or requirements for) frames which are also relevant in linguistic frame theory (see Kann & Inderelst 2018). Crucially, he regards frames as a detailed, structured, uniform format which can model and explain cognitive processes such as thinking, language, and perception.

Fillmorean frames (Fillmore 1968 et seq.) prominently figure in the FrameNet project (Fillmore et al. 2003; Fillmore & Baker 2010). They are case frames which are often evoked by lexical units, and they are constituted by core and non-core case roles (see *FrameNet: What is FrameNet?* n.d.). If the frame represents a verb, these roles correspond to its arguments and adjuncts. The frame "Sleep" (*FrameNet: Sleep* 2002), for instance, has one core role (SLEEPER) and five non-core roles (DEGREE, DURATION, MANNER, PLACE and TIME). FrameNet frames are flat role structures since all participants, both core and non-core, are given in the form of a list. Importantly, it has been argued that they are not sufficient as lexical frames because they lack other kinds of semantic or syntactic information (Löbner 2014, 18). I will come back to this issue in section 2.2.

The cognitive and linguistic research traditions are closely related. For instance, the work by Minsky has been recognized both by Fillmore (e.g. Fillmore & Baker 2010) and by Barsalou (1992a; 1992b), whose cognitive approach is in turn the basis for the linguistic frames developed in the CRC 991.

2.1.2 Barsalou

Barsalou's frame theory aspires to be a flexible and powerful representation of conscious and unconscious knowledge, regarding frames as "the fundamental representation of knowledge in human cognition" (Barsalou 1992b, 21). Frames represent **concepts**, that is, bundles of information that people have stored cognitively for a given concept such as *bird* or *color* (p. 31). The basic components of Barsalou

frames are sets of **attributes** and **values** (p. 30), as well as the relationships between them (p. 40).

Attributes are the central elements of a frame. They are a special kind of concept, namely one that can be used to describe some aspect of a category member (Barsalou 1992b, 30). For instance, the fact that all members of the category *car* have an engine can be represented by assuming an ENGINE attribute in the frame for the concept *car*.[6] Attributes are specified by values, which are defined as subordinate concepts of their respective attribute (p. 31). For instance, a possible value for ENGINE could be *four-cylinder*. The value inherits properties of its superordinate and is at the same time more specific: Among other things, ENGINE passes on the property that it consumes fuel and thereby produces force, and *four-cylinder* adds the information that it has four cylinders and pistons to accomplish this task. Since values represent concepts as well, they can in turn have attributes describing them, which makes frames **recursive** (p. 43).

Barsalou distinguishes between two kinds of relations, namely **structural invariants** and **constraints**. Structural invariants are spatial, temporal or causal relations between a frame's attributes. They are relatively consistent between different instantiations of the represented concept (Barsalou 1992b, 35). To stay with the *car* frame, if we assume a DRIVER attribute, it will be the understanding of most people that the driver has some sort of control over the engine. Barsalou therefore assumes an invariant *operates*-relation between the attributes DRIVER and ENGINE. Constraints, on the other hand, are relations between a frame's values. Unlike structural invariants, which Barsalou describes as "normative" (Barsalou 1992b, 37), constraints reflect "systematic variability" (ibid.). What this means will become clearer by looking at the four different kinds of constraints assumed by Barsalou, illustrated with the concept *vacation* (Barsalou 1992b, 37-40). The *vacation* frame (ibid., p. 38), which is not depicted here, contains detailed information on the transportation, location, and activities connected to a vacation scenario. Constraints are used to model how these elements interact.

The first distinction is made between **attribute constraints** and **value constraints** (note that both are relations between values). Attribute constraints are general rules, such as logical necessities, statistical patterns or personal preferences, which constrain values globally (Barsalou 1992b, 37, 39). For example, it is generally true that traveling far (DISTANCE: *far*) comes with a faster means

[6] Barsalou uses caps to indicate attributes and normal font for values. I will follow the CRC 991 convention to use small caps for attributes, while italics indicate values.

of transportation (SPEED: *fast*). However, this constraint could be overruled by someone's personal preference to travel slowly even over long distances to enjoy the landscape. Value constraints are also logical necessities, statistical patterns or personal preferences, but they are more specific and constrain values more locally (p. 39). For example, if the LOCATION attribute is fixed to the particular value *San Diego*, the ACTIVITY attribute is constrained to *surfing* (or other activities available in that location), while *snow skiing* is ruled out.

The second distinction is made between **contextual constraints** and **optimizations**. It is orthogonal to the first distinction. When a contextual constraint occurs, one aspect of a situation is constrained by another aspect due to physical or cultural mechanisms, and it is required that the value in question satisfy the constraint (p. 39). Contextual constraints can be either attribute constraints or value constraints. Optimizations, on the other hand, reflect an agent's goals; the given value must excel beyond all other options (ibid.). For example, if the goal is to travel as cheaply as possible, the cost for transportation needs to be fixed at the lowest possible value. Optimizations may contradict contextual constraints. For example, if the long-distance train is more expensive than the budget flight, the agent needs to decide whether to give more weight to their personal preference (scenic route) or the optimization 'as cheap as possible.'

2.2 Toolkit for frame formalization

In the previous section, we have seen that Barsalou frames are recursive structures which consist of attribute-value-sets and which are related in different ways. The assumption that this architecture is the fundamental representation of knowledge is the starting point for the frame theory applied here (*Frame Hypothesis*, Löbner 2014, 2017; see also Petersen 2007). However, in order to make Barsalou's informal frames fit as a tool for formal linguistic research, his theory has recently been enriched with a mathematically and logically sound foundation (see Löbner 2021). In the remainder of this thesis, I will use the term *frame* to refer to this cognitively plausible, formally precise frame format.

In this section, I will provide a toolkit of relevant concepts and terminology. First, I will introduce the basic elements of frame theory (section 2.2.1). Then, I will introduce the frame format I will apply in this thesis, namely generalized event frames (section 2.2.2).

2.2.1 The basics

Some basics are needed to understand frames. First, I will introduce the two formats used for representing frames, namely graphs and matrices (section 2.2.1.1). Then, I will discuss attributes (section 2.2.1.2), uniqueness conditions (section 2.2.1.3), constraints (section 2.2.1.4), and type signatures (2.2.1.5).

2.2.1.1 Graphs and attribute-value-matrices

Frames can be visualized as graphs or as attribute-value-matrices (AVMs). Consider the representations in Figure 2.1 for illustration.[7] In a frame graph, the attribute-value-structure is represented by edges (also sometimes *arcs*) which connect nodes. The node which is described by a given attribute is called its **possessor**. The referent node is indicated by double lines. Here, the frame depicts a *hit* event with two participant attributes, an AGENT and a PATIENT. The values of these participants are specified by their type labels as *John* and *ball*, respectively. Attribute and value labels are often, but not necessarily, natural language expressions. If a concept is not lexicalized in a language, a paraphrase can be applied. It can be useful to index nodes, as done here with simple numbering. In AVMs, they are necessary for co-indexation, which indicates that the values of two (or more) attributes share the same referent. In frame graphs, this is expressed by two (or more) attributes pointing to one and the same node. There, indices are sometimes used to facilitate referring to specific nodes in the frame description (see e.g. Kallmeyer & Richter 2014). If no indices are used, the type labels are often given inside the corresponding nodes (as in Figure 2.2 in the next section). Note that indices do not necessarily apply across, but rather within frames.

(a) Frame graph (b) AVM

FIGURE 2.1: Two ways of depicting a frame (Plag et al. 2018)

Frame graphs can be directly translated into AVMs similar to those used in other frameworks such as HPSG (Head-Driven Phrase Structure Grammar, see

[7] Note that all frames presented in this thesis should be interpreted as partial: I include only the level of semantic detail which is required to illustrate the issue at hand.

e.g. Pollard & Sag 1994). While many people consider graphs to be easier to read, AVMs have the advantage that they often take up less space. In an AVM, the attributes and values are arranged in columns, with an attribute listed underneath its possessor. The indices are given in boxes in front of the value they refer to.

2.2.1.2 Attributes

Attributes, the fundamental building blocks of frames, are assumed to be **functional**.[8] The term is meant in the sense of 'functional mapping': Each attribute assigns a unique value to its possessor (Löbner 2014, 26; Petersen 2007, 153). For instance, if the possessor of a COLOR attribute is a red table, the attribute can be specified by the value *red*. Note that the value of a given attribute may be a general term like *red*, or a more precise term like *scarlet*. If the color is unknown or irrelevant, the attribute may remain underspecified, in which case the node can be left without a label, or labeled with *color*, as exemplified in Figure 2.2.

FIGURE 2.2: Frame for *table* with an underspecified COLOR attribute

The term *color* can thus be used in two different ways: It can be an attribute label COLOR, or a value label *color*. This example illustrates a point which goes back to Guarino (1992, see also Petersen 2007; Petersen & Gamerschlag 2014), namely that we often have a one-to-one correspondence between attributes and certain types. Formally speaking, "there exists for each attribute a unique type corresponding to the value range of the attribute" (Petersen & Gamerschlag 2014, 205). This means that each possible value of COLOR is a subtype of *color* (as is fixed in the type hierarchy, see below). This dual interpretation of attributes is also found in natural language (see Löbner 2017, 100). In (2a), *color* is used relationally as an attribute term, alongside its possessor *an apple*. In (2b), *color* is used non-relationally, as a type term alongside its subtype *red*.

(2) a. the color of an apple
b. the color red

However, not all attributes can be used relationally or non-relationally. For example, labels for participants (like AGENT and PATIENT) are necessarily relational,

[8] Although Barsalou does not spell it out, this assumption is in line with his examples and also his intentions, see Löbner (2014, 25).

since they are defined in relation to an event. It follows that they only figure in the type signature as constraints on types, and not as types themselves.[9]

Löbner (2013 et seq.) defines four types of attributes, depending on the kinds of values they take: **part attributes, correlate attributes, property attributes,** and **event attributes**. I will illustrate them here with the example of the concept *table*. First, part attributes represent mereological relationships between the possessor and its parts. A typical table will be made up of the legs and the tabletop. Neither the whole nor its parts exist independently from one another; the whole is constituted by its parts and the parts exist only in relation to the whole (Löbner 2018, 3). Second, correlate attributes take as values objects which exist independently and which are uniquely related to the possessor. An example of this would be the MANUFACTURER of the table. In an event frame, the attributes representing semantic roles are correlate attributes (Löbner 2018, 3). Third, property attributes (or *dimensions*, Gamerschlag et al. 2014a) take abstract values such as colors or heights. These are abstract in the sense that they are not objects in themselves (Löbner 2018, 3). Rather, these values have a special ontological status, being manifested in relation to the entity they are allotted to. Finally, event attributes are attributes that uniquely connect their possessors to events and activities (Löbner 2013, 310). A table frame could thus have a PRODUCTION attribute. A special kind of event attribute is the **affordance attribute** (or *purpose attribute*, Gamerschlag et al. 2014a). It is usually labeled as FOR or PURPOSE and relates the possessor to an action it is typically associated with (Löbner 2013, 316; see also Terhalle 2017, 101-5). For example, a dining table has the affordance of being the locus of communal meals. The type of attribute is typically not indicated in a frame, but only related to when relevant.[10]

2.2.1.3 Uniqueness conditions

We have already seen that attributes are assumed to be functional, taking unique values. This requirement has been formulated as a uniqueness condition alongside two further conditions which have to be met by any formally correct frame (Löbner 2013, 307):

[9] It is conceivable to assume a type such as *potential agent*, with a potpourri of entities as subtypes which could instantiate the AGENT role in an event. This, however, is hardly useful.

[10] An example for an approach in which the attributes are grouped by type is Herweg (in prep), who arranges the attributes in a *locomotion* frame in three groups: FIGURE (containing the participants), EVENT_LAYERS, containing MANNER and PATH with their corresponding subframes, and EVENT_PROPERTIES, containing grammatical information such as ASPECT and TENSE.

Unique frame referent (UR)
There is a unique element that represents the potential referent of the frame. Every element in the frame is connected to the frame referent by a chain of attributes.

Unique attributes (UA)
For each element in the frame, an attribute is assigned no more than once.

Unique values (UV)
For each element in the frame, and each attribute applied to it, the attribute takes a unique value.

UR ensures that a frame is a coherent, interconnected whole (Löbner 2014, 27). According to Löbner (2013, 306), the potential referent of a frame can be generic (e.g. any member of the category *table*), or it can be a specific entity (e.g. the dining table in my living room). UA guarantees that the frame does not contain doubled and thus redundant attributes: Since attributes take unique values, it would not be possible to have arrows with the same attribute label originating from the same possessor node while taking different values. For example, the table legs need to be introduced by distinct attributes such as LEG_1, LEG_2, LEG_3 and LEG_4. Having four attributes labeled LEG originating from the same node would violate UA. Note, however, that the same attribute *can* occur several times in the same frame, as long as it has different possessors. Thus, if the frame should express that the table legs have different colors, the subframe of each leg would have an attribute labeled COLOR (e.g. LEG_1: *leg*, COLOR: *red*). Finally, UV spells out that attributes need to be functional, as introduced above.

2.2.1.4 Constraints

There is no uniform constraint format in frame theory. Rather, constraints have been proposed in different permutations, including various purposes, notations and categorizations.

Constraints have been used to model, for example, semantic and frame-structural restrictions, world-knowledge, and logic. To give some examples of applications: Löbner (2015) proposes that constraints can be used to depict the match between a lexeme's phonological form and its spelling, and that possible inflections of a word depend on its part of speech. Balogh & Osswald (in press) use constraints to clarify event structure and to ensure specific values in the scalar attribute of a telic verb. In Andreou (2017), constraints model that in stereotype negation, one attribute value is overridden by another one.

Regardless of any given constraint's purpose, it is important to note that constraints should always be data-driven. Like linguistic frames, they are a tool to model observations and to make predictions based on these observations. For example, Andreou (2017) proposes the above-mentioned override function to model the results of a corpus study of English *non-* and *un-* formations like *non-color* or *un-car*. In further studies, it can now be tested whether this function makes the right predictions about related phenomena such as comparable formations in German (e.g. *Nicht-Farbe* and *Nicht-Auto*, both attested in *Google*).

Constraints may be formulated in natural speech ("the theme of an event with a cyclic event structure is co-referential with the theme of the atoms of the event structure," Gamerschlag et al. 2014b, 130), or formalized in a constraint schema making use of logical operators ("$e \cdot \text{PROG} \triangleq T \wedge e'\ segm\ e \rightarrow e'\ inst\ T$," Balogh & Osswald in press). Such formal constraints are either introduced in connection with a type signature (as discussed in section 2.2.1.5), or given alongside a frame (e.g. Kallmeyer & Osswald 2012), or simply mentioned in the figure description. In Schurz & Votsis (2014), for example, the constraints are not spelled out at all, but merely indicated by double-edged arrows within their AVMs and then explained along the way.

Constraints can hold between the different frame elements (possessors, attributes, and values) in different configurations. Firstly, possessors are of course intricately related to their attributes. Schurz & Votsis (2014) give the example of a *mammal* frame: When it is specified as a *zebra* frame, the attribute CAMOUFLAGE-PATTERN is introduced. Secondly, attributes take values of a certain type (Löbner 2013). For example, HEIGHT may be specified by a measurement in centimeters. Thirdly, a possessor may constrain the range of possible values of its attributes. Löbner (2013) elaborates that, for example, not all measurements in centimeters are eligible for heights of persons; rather, there is a certain range of feasible heights. The fourth possibility is that there are dependencies between attributes. Referring again to their zebra frame, Schurz & Votsis (2014) give the example of the attribute SPECIFIC TYPE OF NUTRITION, which "goes hand in hand" with GENERAL TYPE OF NUTRITION (p. 96).[11] As a fifth and last option, constraints may hold between values of different attributes (*herbivorous nutrition* correlates with *molar teeth*). This constraint is observed both by Löbner (2013) and by Schurz & Votsis (2014).

[11] The authors do not clarify this, but I would assume that they mean that the presence of one attribute conditions the presence of the other, and vice versa.

In summary, we have seen that all configurations of possessors, attributes and values are represented when it comes to constraints.

2.2.1.5 Type signatures

In frame theory, **type signatures** are conceptualized similarly to the notion of typed feature structures as introduced in Carpenter (1992; see also Petersen 2007, 163-4). In a type signature it is possible to formally specify the ordering of types, which attributes are appropriate for a type, and which kind of value an attribute can take (see Gamerschlag et al. 2014a, 7). This is achieved by a combination of three essential features (see Petersen 2007, 163-4): A **plain type hierarchy**, enriched by a finite set of attributes and appropriateness conditions.

Figure 2.3 presents an example illustrating the interplay between frames, type signatures, and constraints. In the bottom of the figure, we see three simplified frames: for *bird*, for *water-bird* and for *land-bird*. These are well-typed because they correspond to the type signature, the relevant section of which is given in the top right.[12] This type signature fixes that the type *bird* comes with two attributes BEAK and FOOT, which have two admissible, underspecified values *beak* and *foot*. This is expressed by an appropriateness specification consisting of appropriateness

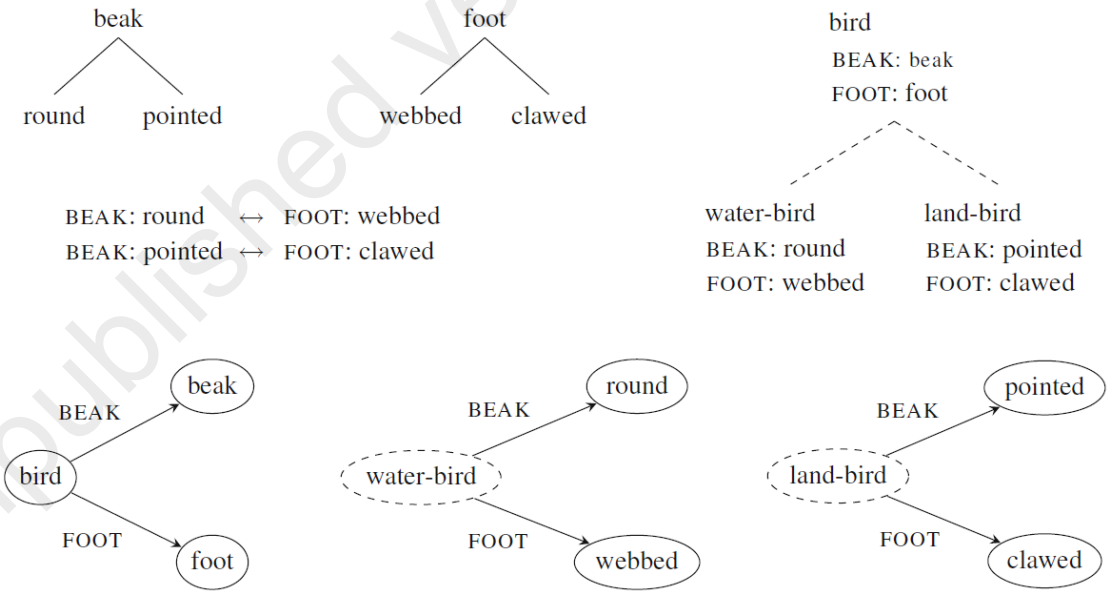


FIGURE 2.3: Type declarations, co-occurrence restrictions, type signature, and frames for *bird* and its subtypes (Gamerschlag et al. 2014a, 8)

[12] In this figure, the information contained in the frames and the type signature happens to be identical. This is, however, not necessarily the case, since the type signature states what is generally possible, while a frame can be subject to further constraints.

conditions of the format "BEAK: beak" (see also Petersen 2007, 163, 165). Appropriateness specifications have two purposes (see Petersen & Gamerschlag 2014). First, they declare a set of admissible attributes for a given possessor node and thus restrict the **attribute domain** of this node. Second, they specify that the values of an attribute need to be of a certain type, thereby restricting the **attribute range**. These appropriateness conditions express constraints of the kinds *possessor-attribute* and *attribute-value*. The type signature further introduces two subtypes of *bird*, namely *water-bird* and *land-bird*. These inherit their supertype's attributes and specify them according to the type declarations (top left) and the co-occurrence restrictions (center left). The type declarations, which are also portions of the underlying, complete type signature, indicate the subtypes of *beak* and *foot*, and thus, which values BEAK and FOOT can take.[13] Co-occurrence restrictions, in the center left of the figure, are bi-implicational constraints (Gamerschlag et al. 2014a, 8). They specify how the values of BEAK and FOOT co-occur: If the beak is round, the foot is webbed (and vice versa), and if the beak is pointed, the foot is clawed (and vice versa).[14]

A few issues which are not illustrated in Figure 2.3 can be demonstrated with Figure 2.4. To the left we have *object* with its subtypes, and to the right the required attributes are introduced in their type interpretation. This type signature

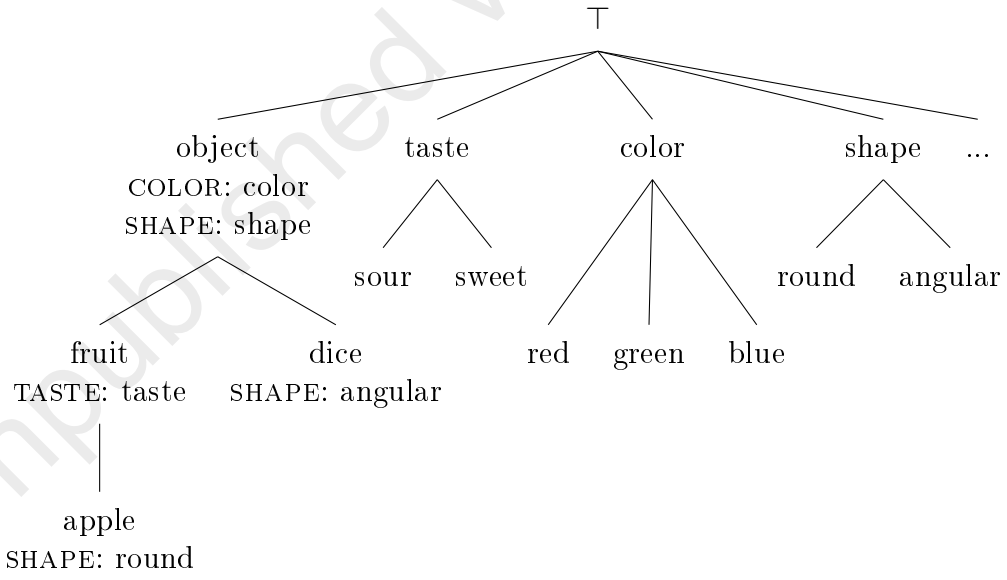


FIGURE 2.4: Example type signature (taken from Petersen et al. 2008, 11)

[13] As the authors also observe (p. 8), it would be a more adequate representation if the subtypes *round, pointed, webbed* and *clawed* were introduced not as subtypes of *beak* and *foot*, but rather of something like *shape*, for instance: "*water-bird*, BEAK: *beak*, SHAPE: *round*."

[14] This, of course, is an illustratory simplification which does not reflect ornithological reality.

shows that subtypes can have further subtypes. ⊤ is the most general type, the **top type** (McGlashan 1992, 153). We can also look at the inheritance mechanism in a bit more detail. By definition, subtypes are more restricted than their supertypes. Therefore, subtypes inherit and possibly restrict their supertypes' appropriateness conditions, as we have already seen above. In addition, notice that inherited appropriateness conditions do not need to be spelled out. For instance, *fruit* inherits the appropriateness conditions COLOR: *color* and SHAPE: *shape*, but since these are still not specified at this level, they need not be repeated. Only on the level of *apple* is SHAPE represented again, since it is now specified as *round*. Secondly, further appropriateness conditions can be introduced at lower levels. Thus, not all objects in the world have a taste, but fruit do. Therefore, TASTE: *taste* is introduced for the type *fruit* and its subtypes.

Finally, Figure 2.5 presents a partial type signature of event types. Several more issues are illustrated here. First, *activity* ∧ *motion* ('activity and motion') is an example of a label for an unlexicalized concept. Second, the appropriateness conditions we have seen so far merely replicate information from the type signature and relate it to the type they describe. However, appropriateness conditions can be more complex, as in ACTOR ≐ MOVER ('the actor is defined as a mover'), that is, the ACTOR attribute is replaced by its subtype MOVER. Finally, the types in the left strand of the hierarchy show that types can have multiple parents, which involves that they inherit both parents' appropriateness conditions. For instance, a *bounded-locomotion* is both a *locomotion* and a *bounded-translocation*.

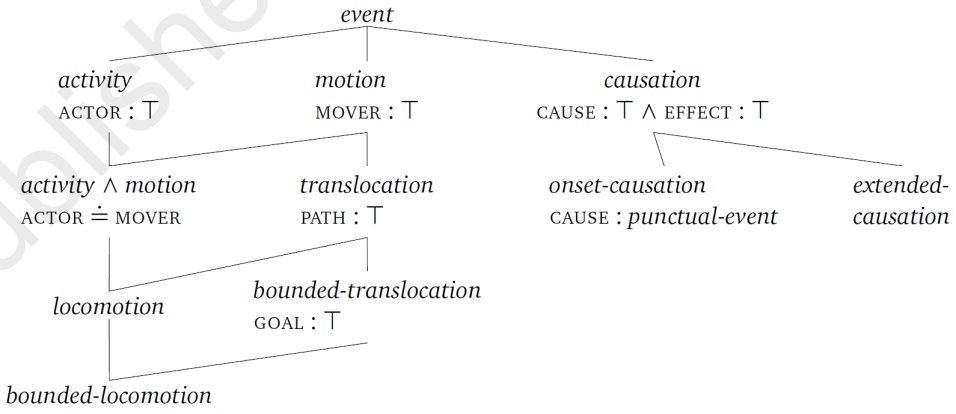


FIGURE 2.5: Partial sketch of constraints on event types and attributes (Kallmeyer & Osswald 2013, 36)

Type signatures are an essential part of frame theory because they introduce formal restrictions, as illustrated in the three example type signatures. Were these not assumed, this could lead to non-well-typed frames such as the one in Figure

2.6. There, a TASTE attribute is assigned to a *sound* possessor node, although TASTE does not belong to the attribute domain of nodes of the type *sound*.

FIGURE 2.6: Non-well-typed frame of a bitter-tasting sound (Petersen & Gamerschlag 2014, 210)

2.2.2 Generalized event frames

In my analysis, I make use of lexical event frames which represent groups of words. In this section, I will describe the general properties of this kind of frame representation. Any details pertaining specifically to change-of-state verbs or verbs of psychological state will be left for their respective chapters.

There are two crucial aspects with regard to lexical frames: First, they are evoked by lexical units of a language, representing concepts which exist in a speaker's mental lexicon (Petersen & Gamerschlag 2014, 208), and second, they model the stable, constant meaning of these lexical items (Löbner 2013, 297). Correspondingly, frames are considered non-lexical if either they are not directly evoked by a lexical item (see e.g. Osswald & Van Valin 2014, 131), or if they contain more than semantic meaning. I will illustrate both contrasts with an example.

In FrameNet, a lexical frame such as "Sleep" (*FrameNet: Sleep* 2002) is directly related to a set of lexical units, including verbs (*drowse, hibernate, sleep*), nouns (*doze, shut-eye, sleep*), adjectives (*asleep, out, unconscious*), and multi-word expressions (*forty winks, out like a light*). A non-lexical frame like "Sleep_wake_cycle" (*FrameNet: Sleep_wake_cycle* 2002), on the other hand, does not contain any lexical units. The represented concept ("A Sleeper enters a state of consciousness of reduced external awareness, remains in this state for some amount of time, and (normally) returns to full wakeful consciousness," ibid.) is not lexicalized in English. The frame is, however, indirectly related to lexical items via its subframes (e.g. Being_awake or Fall_asleep), which are lexical frames.[15]

Löbner (2013) argues that lexical meaning must be general enough to cover all potential referents of a word, and that it can thus not contain world knowledge (that is, cultural and personal knowledge, p. 293). For example, *apple juice* means 'juice made of apples' (p. 295). There are two reasons why a specification such as

[15]Löbner (2014) argues that case frames such as the ones used in FrameNet are not, in fact, lexical frames, but rather "an interface between lexical verb meanings and grammar" (p. 44).

'COLOR: *yellow*' is not part of its lexical meaning: It is not necessary to know this feature in order to understand what *apple juice* means, and we could still call a liquid *apple juice* if it was dyed a different color (ibid.). In opposition to Löbner's view, many cognitive linguists argue for abandoning the distinction between semantic knowledge and world knowledge, arguing that category descriptions should also include "associative and experiential attributes" (Ungerer & Schmid 2006, 95).

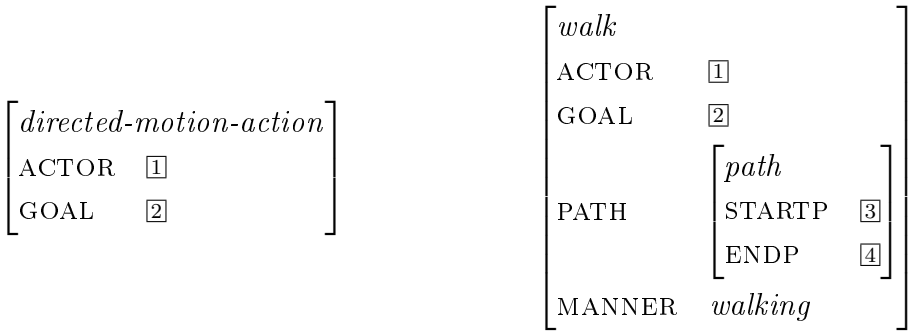
In frames, all types of knowledge can be modeled. Apart from lexical knowledge, world knowledge and encyclopedic knowledge, this also includes information provided by a specific context (Ziem 2015, 95). For example, a frame for *apple juice* can straightforwardly contain the information 'juice made from apples' as well as its taste and color, the fact that Germans like to mix it with sparkling water, the detail that apple juice has a pH of 3.4, and the information that my colleague Katja thinks it's delicious. Which information is included depends on the purpose of the frame. In the present study, I will use the term *lexical frame* merely to refer to frames representing lexical units of a language, without joining the debate about the inclusion of world knowledge.

Lexical frames for events have some additional requirements which are not relevant for entity lexical frames such as *apple juice*. Thus, it has been stated that they need to specify dependencies between semantic roles as well as temporal and causal characteristics (Löbner 2014, 45). For example, a verb of locomotion (expressing movement of x from A to B) has, among others, three roles: AGENT, SOURCE and GOAL. These are linked to one another as in (3), including a change in time from t_1 to t_2 (ibid.).

(3) SOURCE(e) = LOCATION(AGENT(e), t_1)
GOAL(e) = LOCATION(AGENT(e), t_2)

This calls for a recursive formalization, as offered by frames. In this study, causality will be of central importance, but temporality will be left implicit.

Having clarified what I mean by the term *lexical frame*, I will now introduce the notion of the *generalized lexical frame*. In order to be able to generalize over several lexemes, my frames do not represent single lexical units, but rather sets of semantically similar ones. This is not the first time that frames are used in this way. For example, Kallmeyer & Osswald (2012) model directed motion verbs (see Figure 2.7). In the generalized frame to the left, they use the attributes ACTOR and GOAL. When applying this frame to a specific verb, it is altered to accommodate the semantics of this verb, as seen to the right. Here, *walk* adds two further attributes, a PATH and a specific MANNER of motion.



(a) *directed motion* (b) *walk*

FIGURE 2.7: Frames for (a) general directed motion and (b) *walk* as a directed motion (both adapted from Kallmeyer & Osswald 2012, 43-4)

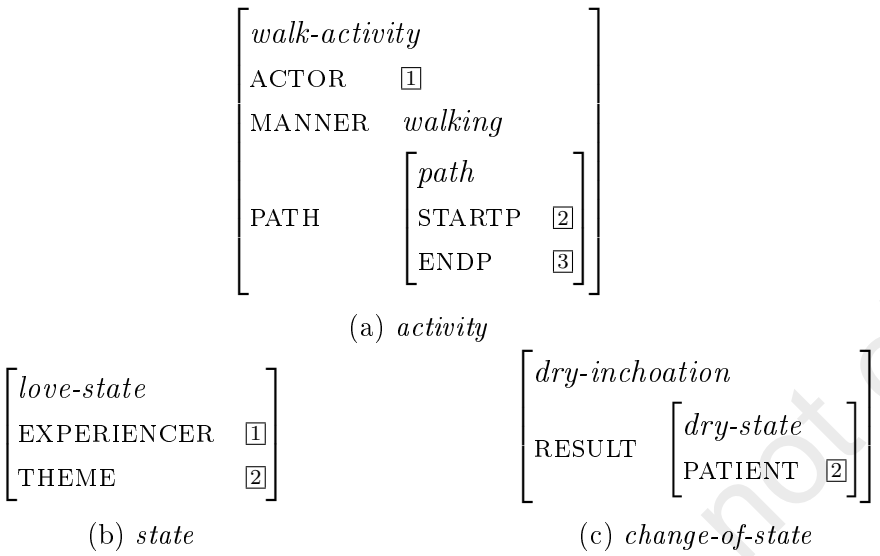
Apart from generalized frames, I will at times also include frames for single tokens of my corpus data, that is, nominalizations in specific contexts. I will refer to these as **instantiated frames.**

Finally, let us have a look at event structure. The main distinction I will draw between kinds of events is between simple and complex ones (Pustejovsky 1991, 1995; Van Valin & LaPolla 1997; Rappaport Hovav & Levin 1998; Levin & Rappaport Hovav 1999). In this research tradition, simple events are those consisting of only one subevent, while complex events are those composed of two subevents. We have already seen examples for simple event frames in Figures 2.1 and 2.7.

The simple event structure template is used for activities, states, and changes-of-state. This has been proposed also in the non-frame formal literature, as exemplified in (4). The examples have been taken from Rappaport Hovav & Levin (1998), but similar structures have also been suggested in other approaches.

(4) a. *activity*: [x ACT]
b. *state*: [x <*STATE*>]
c. *change-of-state*: [BECOME [x <*STATE*>]]

A frame for each of these structures is given in Figure 2.8. In these examples from the literature, we can see participants embedded in simple frames consisting of just one event (*walk-activity, love-state* and *dry-inchoation*). Observe how the participants change with each type of event (e.g. ACTOR for *walk-activity* vs. EXPERIENCER for *love-state*).



(a) *activity*

(b) *state*

(c) *change-of-state*

FIGURE 2.8: Frames for the verbs (a) *walk* (adapted from Kallmeyer & Osswald 2012, 38), (b) *love* (adapted from Zinova & Kallmeyer 2012, 28) and (c) intransitive *dry* (adapted from Osswald & Van Valin 2014, 140)

The decomposition of complex events works analogously to that of simple events. Example (5) gives a notation based on Rappaport Hovav & Levin (1998), and Figure 2.9 is an example for a corresponding frame. There, the two subevents of the complex causation event *break* are expressed by CAUSE and EFFECT. The first subevent is an unspecified activity with one participant, an ACTOR. This activity causes a change-of-state, the result of which is that a patient is in a broken-state.[16]

(5) [[x ACT] CAUSE [BECOME [y *BROKEN*]]]

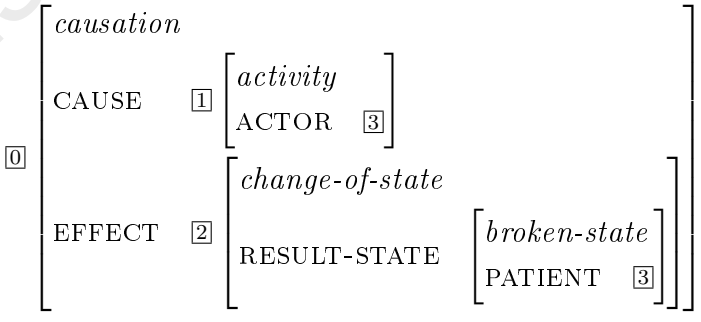


FIGURE 2.9: Frame for transitive *break* (adapted from Kallmeyer & Osswald 2013, 13)

[16]In the frames presented here, time is modeled implicitly by employing attributes such as RESULT, CAUSE or EFFECT, which are defined as preceding or succeeding other frame elements, respectively. In studies which aspire to be semantically more explicit than is required for my purposes, it can be expedient to incorporate time specifically (see e.g. Gamerschlag et al. 2014b; Löbner 2017, 109).

2.3 Modeling derivation in frames

In order to tackle derivation in frames, two distinct but related approaches have been put forward. In the first approach, derivation is modeled as a process of frame unification (section 2.3.1); in the second, as a process of a referential shift in the base word frame (section 2.3.2). In this thesis, I follow the second approach.

The biggest difference between the two approaches is that unification approach assumes that an affix comes with a separate frame-semantic representation, while the shift approach looks at the affix's contribution by comparing the derived word with its base. In terms of morphological theory, it could be said that the unification approach takes the perspective of the morpheme-based tradition, while the shift approach goes more in the direction of word-based morphology (see Plag 2003, 179-190 for an overview of both positions). For many purposes, however, unification and shifts seem to be notational variants of one another. This is in line with Plag (2003), who finds that morpheme- and word-based approaches are rather in a complementary (as opposed to a conflicting) relationship (p. 189), and that both would serve equally well to model affixation (p. 185). The following two sections should thus not be regarded as a juxtaposition of conflicting views, but rather as two related perspectives on modeling derivation in frames.

2.3.1 Unification

Frame unification is an "information combining procedure" (Petersen 2007, 158) whereby two (or more) nodes of two (or more) frames are conjoined in order to form a single frame.[17] In this section, I will first use the rather straightforward example of compounding in a frame graph to explain the mechanism (section 2.3.1.1), and then describe Zinova's (2016) more complex AVM approach to prefixation (2.3.1.2).

2.3.1.1 The unification mechanism

Löbner (2013, 317-9) describes how unification can account for different kinds of nominal compounds. Figure 2.10 shows how the two frames *coffee* and *cup* unify to form *coffee cup*: Both concepts have an affordance attribute with a *drink* value. When the two *drink* nodes unify, in order to fulfill UR, *coffee* loses its referent status and *cup* becomes the sole central node in Figure 2.11. This reflects that *coffee* is the modifier and *cup* is the head of the compound.

[17] Apart from derivation, unification has also been used to model the semantics of compounds and sentences (Löbner 2013), and of adverbial modification (Goldschmidt et al. 2017).

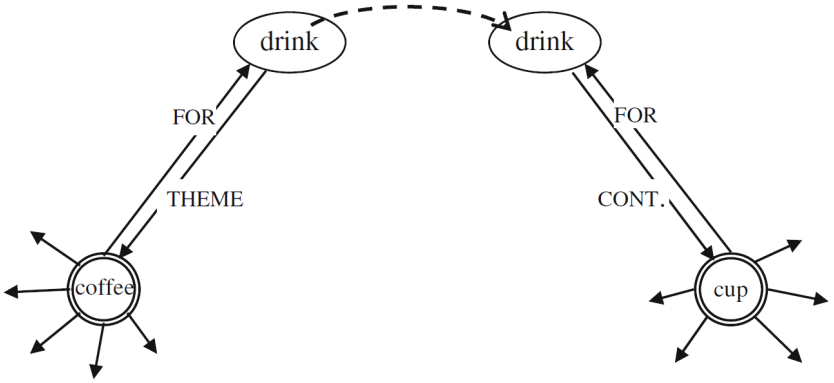


FIGURE 2.10: Frame unification for *coffee* and *cup* (Löbner 2013, 317)

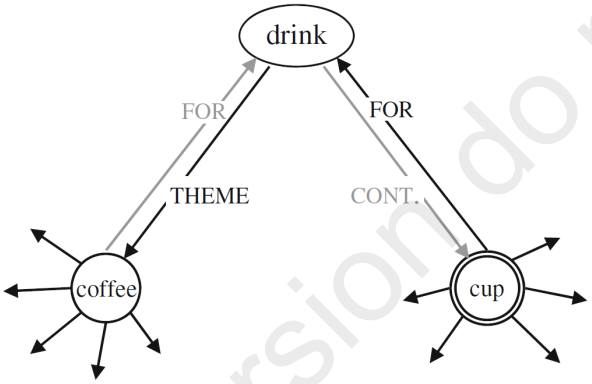


FIGURE 2.11: Frame for *coffee cup* (Löbner 2013, 317)

Thus, a modifier can specify an attribute by unifying two value nodes. Moreover, the modifier's central node can unify with an attribute's value node (e.g. *plastic bag*), and, when the head is an inherently relational noun, its frame provides an empty possessor node that can be unified with (e.g. *air pressure*, p. 318). Effects other than value specification have been proposed as well: In some cases, unification may cause a new attribute to be added (Goldschmidt et al. 2017), or an existing attribute to be overwritten (Zinova & Kallmeyer 2012). In all of these cases, constraints are needed in order to preclude undesirable specifications or additions.

2.3.1.2 Unifying an affix with a base

The principle of frame unification can be applied to derivation. Zinova (2016) analyzes verbal prefixation in Russian and proposes a frame for each prefix sense, which then unifies with that of the respective base verb. I will demonstrate the mechanism with the prefix *na-* in its cumulative usage, that is, in derivations like

varit' 'to cook' > *navarit'* 'to cook a lot of' (p. 121). The prefix is modeled in Figure 2.12, while a frame for the base can be found in Figure 2.13.

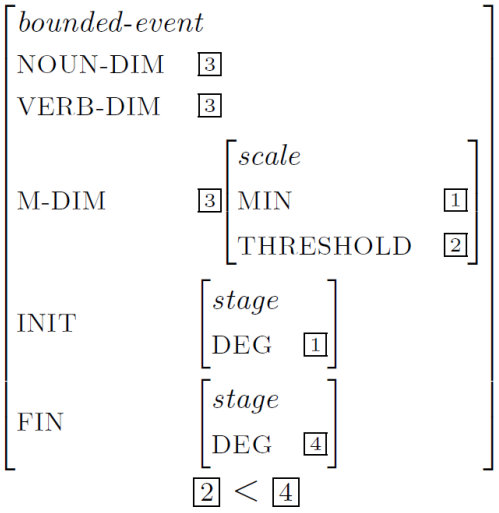


FIGURE 2.12: Frame for the prefix *na-* (Zinova 2016, 232)

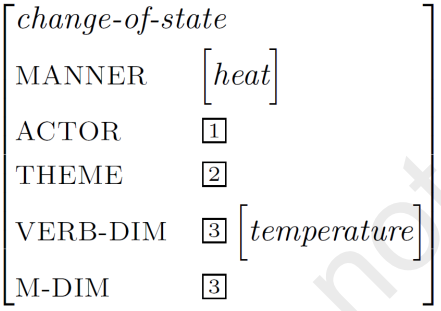


FIGURE 2.13: Frame for the verb *gret'* 'to heat' (Zinova 2016, 233)

The prefix *na-* contributes the following semantic specifications in its cumulative usage: The event denoted by the derived verb is a bounded event which has a scale as its measure dimension (M-DIM). The measure dimension corresponds to the dimensions of the verbal base (VERB-DIM) and its syntactic object (NOUN-DIM). The initial stage of the event (INIT: *stage*) has a degree (DEG) which is at the same time the minimum (MIN) of the measure dimension scale, and the scale's threshold value is smaller than or equal to the final stage's degree ($\boxed{2} \leq \boxed{4}$). Finally, the prefix requires its verbal base to provide a scale which is also a parameter of the verb's object. In the case of *gret'* 'to heat' this scale is of type *temperature*, as depicted in Figure 2.13. A possible object with a *temperature* would be *soup*.

Figure 2.14 depicts the derived verb *nagret'* 'to warm up.' Two things are relevant here. First, we can see that the two frames from Figures 2.12 and 2.13 have unified in a complex manner. To illustrate the respective contributions, I have color-coded them here. The central nodes have been merged and now constitute a complex type *bounded-event* $\wedge$ *change-of-state*. Some specifications have been contributed by the prefix (NOUN-DIM, INIT, FIN), and some by the base (MANNER, ACTOR, THEME). The attribute M-DIM, which is shared by the prefix and the base, has been specified by the value *temperature*. The second point to observe is that, given only the final frame, the derivational process is invisible. That is,

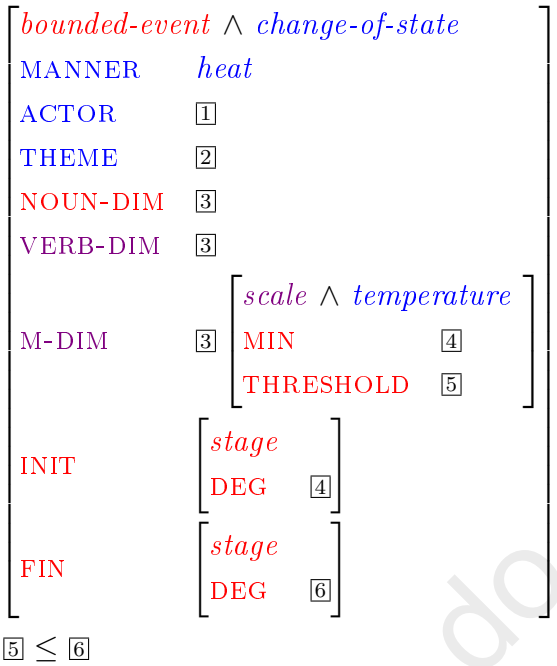


FIGURE 2.14: Frame for *nagret'* 'to warm up' (Zinova 2016, 234; color coding added). Contributions are indicated in blue (base), red (prefix) and violet (both)

the representation of a simplex word with the same meaning as *nagret'* would not differ from the one given in Figure 2.14.

2.3.2 Referential shifts

Löbner (2013) first observed that some derivational processes can be modeled by referential shifts in frames. In his terminology, such referential shifts are called *metonymy*. I will first explain how metonymy in the traditional sense can be modeled in frames (section 2.3.2.1), and then turn to the application of this mechanism in modeling the semantics of derivation (section 2.3.2.2). Next, I will address the morphological side of this approach, which has recently been fleshed out by means of lexical rules (section 2.3.2.3) and inheritance hierarchies (section 2.3.2.4).

2.3.2.1 Metonymy

Löbner (2013) defines metonymy as the process of using "an expression [...] to refer to things that belong to the kind of objects to which the expression refers in its literal meaning" (p. 52). That is, the new referent is a fundamental component of the original concept. The author gives the example of a metonymical shift from

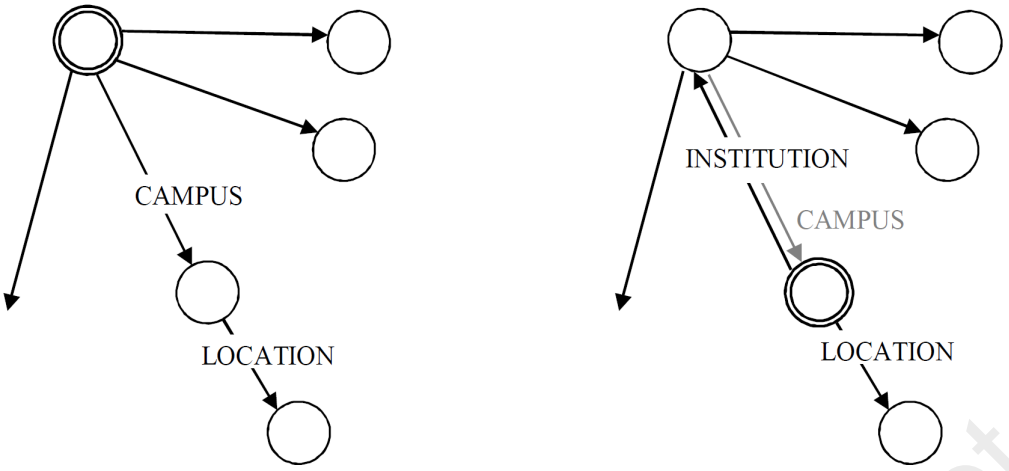


FIGURE 2.15: Shift from *university* to *university campus* (Löbner 2013, 314)

the concept *university* (as an institution) to *university campus*. The corresponding frames are given in Figure 2.15.

In frames, metonymy is modeled by shifting a frame's reference to the value of one of its attributes. In Figure 2.15, reference is shifted along the CAMPUS attribute. Löbner (2013, 314) argues that such a shift is only possible if there is a one-to-one correspondence between the two referents. As can be seen on the right-hand side of the figure, this is represented by attributes going both ways between the two involved nodes, which has been dubbed **bidirectionality/bidirectional functionality** (Schulzek 2014; also *bi-uniqueness*, Löbner 1985). According to Löbner (2013, 315), bidirectionality reflects the fact that the literal referent can stand for the metonymical referent (and vice versa). Furthermore, bidirectionality need not be inherent in the concept but can also be established by a specific context (Schulzek 2014, 233). For example, there is standardly a one-to-many relationship between *university* and *professor*, but a sentence like the one in (6) is possible if the referent can be uniquely identified in context (ibid., my example).

(6) "It's a big honour for me, I'm humbled to get this, but on the other hand it's a big deal for the university," notes Chen. "This is the first time **the university has won this award** ever. [...]" (iWeb ucalgary.ca 2017)

This assumption is shared by Terhalle (2017), who models how the source and the target are potentially related when the metonymy is first created. His so-called **integrated frames** "can contain a certain amount of contextually motivated information, which is not part of the lexical meanings [of the source and the target] but can be responsable [sic] for the contiguity between source and target" (p. 74).

To what extent bidirectionality is a necessary condition for metonymy is still a matter of dispute. While it is fulfilled in most cases (Terhalle 2017, 163-5; Schulzek 2019, 215), there are also counterexamples, and the generalizations which are made in the literature are inconsistent. Löbner (2013) and Schulzek (2014) claim that bidirectionality is obligatory for metonymy. More recently, Schulzek (2019) has found evidence that it is necessary only for certain kinds of concepts, namely for what Löbner (1985, 2011) calls **sortal concepts**, and not for **functional concepts**. Thus, metonymy involving sortal concepts like *stone* or *book*, which are neither inherently unique (-U) nor inherently relational (-R) requires bidirectionality, while metonymy involving **functional concepts** like *father* and *head* (+U and +R), does not (p. 100). Schulzek (2019) states that, overall, only an attribute link from the source to the target is necessary (p. 215). Contrary to these findings, Terhalle (2017) argues that only +U metonymic targets require bidirectionality, while for -U targets a unidirectional link from the target to the source suffices (p. 162).

Apart from the open question of whether bidirectionality is a necessary condition for metonymy, it should also be mentioned that it is definitely not a sufficient condition. Consider the following examples:

(7) a. In the 1970s, the students/*the university had long hair (Schulzek 2014, 240)
b. Eat your whole tray/*book, dear (Terhalle 2017, 102)

Although a one-to-one-correspondence between source and target-to-be can be asserted in all cases, a shift to *the university* or *book* is impossible. Something else must come into play here (see Terhalle 2017 for further discussion).

2.3.2.2 Derivation

The mechanism of referential shifts[18] has been applied to model deverbal nominalization, both in frames (Löbner 2013; Schulzek 2014; Kawaletz & Plag 2015; Plag et al. 2018; Schulzek 2019) and in other approaches (e.g. Panther & Thornburg 2002).[19] Figure 2.16 depicts three frames: the argument frame of the verb *walk*, and the argument frames of its nominalizations *walk* and *walker*. The fact that the

[18] In order to avoid unwanted implications, I will use the less theoretically laden term *referential shift* for Löbner's and Schulzek's conception of *metonymical shift*.

[19] Kawaletz & Plag (2015) and Plag et al. (2018) are closely connected to this dissertation project: Kawaletz & Plag (2015) is a pilot study out of which the present analysis of psych nominalizations (chapter 5) has developed, and Plag et al. (2018) is based on findings from both analyses presented here (chapters 4 and 5).

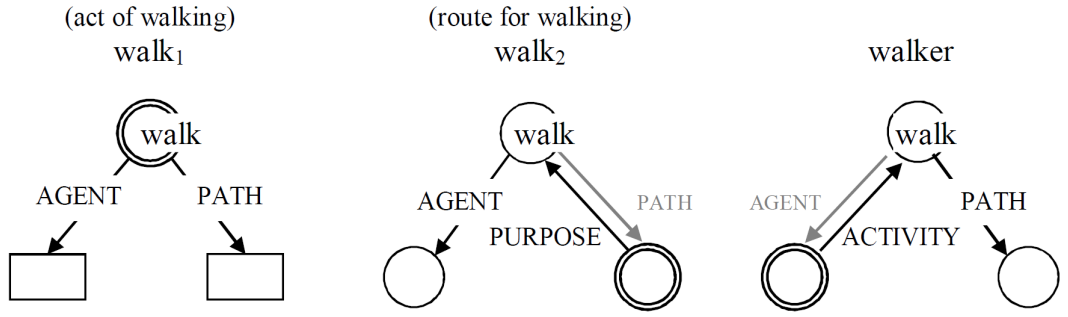


FIGURE 2.16: Frame graphs for three nominalizations of the verb *walk* (Löbner 2013, 312)

two attributes of the original reference node (PATH and AGENT) are not deleted reflects that these still appertain to the derived concepts (Löbner 2013, 313). This is often, but not necessarily the case. For example, an opaque derivative like *health* will not have as much in common with its base *heal*.

Figure 2.17 presents a translation of the frames in Figure 2.16 into the AVM notation. Since there is no central node in an AVM, reference is indicated underneath by "REF = {}" (see Plag et al. 2018). Without this specification, [0] would standardly be assumed to be the referent of the frame.

$$\boxed{0}\begin{bmatrix} walk & \\ \text{AGENT} & \boxed{1} \\ \text{PATH} & \boxed{2} \end{bmatrix} \qquad \text{REF} = \{\boxed{0}\}$$

(a) *walk*$_1$ 'act of walking'

$$\boxed{0}\begin{bmatrix} walk & \\ \text{AGENT} & \boxed{1} \\ \text{PATH} & \boxed{2} \end{bmatrix} \qquad \text{REF} = \{\boxed{2}\}$$

(b) *walk*$_2$ 'route for walking'

$$\boxed{0}\begin{bmatrix} walk & \\ \text{AGENT} & \boxed{1} \\ \text{PATH} & \boxed{2} \end{bmatrix} \qquad \text{REF} = \{\boxed{1}\}$$

(c) *walker*

FIGURE 2.17: Frame AVMs for three nominalizations of the verb *walk* (based on Löbner 2013, 312)

It may be contested whether there really is bidirectional functionality between *walk* and the values of PATH and AGENT, respectively, since the person walking is potentially performing a number of activities at the same time (like talking on the phone or watching some ducklings), and the path may be used not just for the walking activity of this one person. Again, context offers a way out: Löbner (1985, 316) argues that, if the context is restricted enough (including temporal restrictions), then there is indeed a one-to-one relationship between *walk* and its two arguments.

This restriction of context could be conceptualized as a kind of *zooming* (see e.g. Gamerschlag et al. 2013) or *refinement* (Naumann 2013). Frames are flexible enough to allow for zooming in and out of representations as needed.[20] This entails that details can in theory be added indefinitely, as long as the frame-structural requirements (UR, UA and UV) are observed.[21] Going to the other extreme, we can zoom out of a frame until only the central node is depicted. The level of explicitness can thus be chosen in accordance with the purpose of the frame. For example, in order to understand formations like *nonanswer* or *unconvention* (Andreou 2017), we need to zoom into a decompositional level that goes beyond lexical semantics, and that includes world knowledge (if we want to make this distinction).

Schulzek (2014) states that metonymical shifts in German *-er* derivation differ from bare metonymies in two respects. First, the shifts are not triggered by context but rather by the suffix (p. 236). Second, the suffix "freezes" the resulting frame (p. 237), preventing further metonymical shifts (**Der Spieler dauerte zwei Stunden* 'The player went two hours').

Kawaletz & Plag (2015) follow a similar approach to Schulzek (2014), investigating *-ment* nominalizations based on different subclasses of psych verbs. They are able to identify a restricted set of possible readings which can be modeled as referential shifts in the base verb frames. These shifts include both arguments and non-arguments of the base verbs, as well as eventive and non-eventive readings. Since this preliminary study has been heavily refined for this dissertation, I will skip a discussion of the frames and results discussed therein. A detailed analysis of psych verbs and their nominalizations can be found in chapter 5.

2.3.2.3 Lexical rules

Schulzek (2019), Andreou (2017, in prep) and Plag et al. (2018) introduce **lexical rules** (*lexeme-formation rules, semantic rules*) to model nominalization.[22] These are well-established in theories such as the generative grammar theory HPSG or Lieber's Lexical Semantic Framework (Lieber 2004 et seq.) to model, among other things, derivational morphology (*derivational rules*, Sag & Wasow 1999, 194; see

[20] Zooming seems to be related to the notion of *profiling*, which has been put forward in other frame approaches (e.g. Gawron 2011; Herweg in prep).

[21] A case in point is Goldschmidt et al.'s (2017) frame for *hitting playfully*, with 15 nodes and 22 attributes, and still "a number of finer points" were "glossed over" for brevity (p. 33).

[22] Andreou (2017) and Andreou (in prep) do not deal with nominalization, but with stereotype negation and evaluative morphology, respectively. The application of lexical rules is in principle the same, but the processes do not involve referential shifts. Rather, the author assumes that the affixes involved in these two processes modify an attribute value.

also Bredenkamp et al. 1996). If a lexical rule is provided with a lexical entry as input, it gives out another lexical entry which is systematically related to the input in terms of (morphological) form, part of speech, and meaning (Sag & Wasow 1999, 185).

Schulzek (2019, 119-122) assumes that the derivational rules for German *-er* and *-ung* nominalization are essentially a bundle of three processes reflected by different kinds of frame modifications: *central-node fixation, event-node fixation*, and *concept-type fixation*. Central-node fixation reflects the relationship of the nominalization's referent to the underlying event denoted by the base verb. In frames, this is represented as a shift of a frame's central node to the new referent, as discussed in the preceding section. Event-node fixation is introduced to account for the distinction between single events and multiple instantiations of an event. This is formalized by specifying the event node by a token value for readings involving single events (e.g. *driver of a car*), and by a type value for readings involving multiple instantiations (e.g. *professional driver*). Concept-type fixation relates to the constellation of arguments required by the nominalization. Schulzek approaches this by incorporating Löbner's (1985) theory of concept types (which also played a role in the investigation of metonymy, as discussed in section 2.3.2.1).[23] My dissertation tackles a desideratum posed by Schulzek (2019), namely to analyze "the semantic constraints underlying [...] nominalization, [which] would require a deeper decomposition of verb meanings" (p. 102). Thus, event-node fixation and concept-type fixation are disregarded here in favor of a deeper investigation of central-node fixation, to follow Schulzek's terminology.

The lexical rules applied in Andreou (2017, in prep), Plag et al. (2018) and in this study are not conceptualized as processes which are reflected in frames by certain operations (as in Schulzek 2019), but rather as constraints which are represented in AVMs. This format can be traced back to established approaches in the framework of HPSG (Pollard & Sag 1994; Riehemann 1998; Koenig 1999, see Müller 2015 for an overview of this framework) and other constraint-based approaches to grammar (see Bonami & Crysmann 2016 for an overview). Figure 2.18 illustrates this approach. It depicts a lexical rule for deverbal, agentive *-er* derivation (such as *walker* in Figure 2.17) and can be read as follows. The first three lines refer to the derivative, the fourth line models the base, and the last line indicates reference. The base (M-BASE) is defined as a lexeme with a phonological

[23] Apart from the concept types *sortal* (-unique, -relational; e.g. *stone*) and *functional* (+unique, +relational; e.g. *father*), Löbner (1985) postulates two further ones: *relational* (-unique, +relational; e.g. *sister*) and *individual* (+unique, -relational; e.g. *weather*).

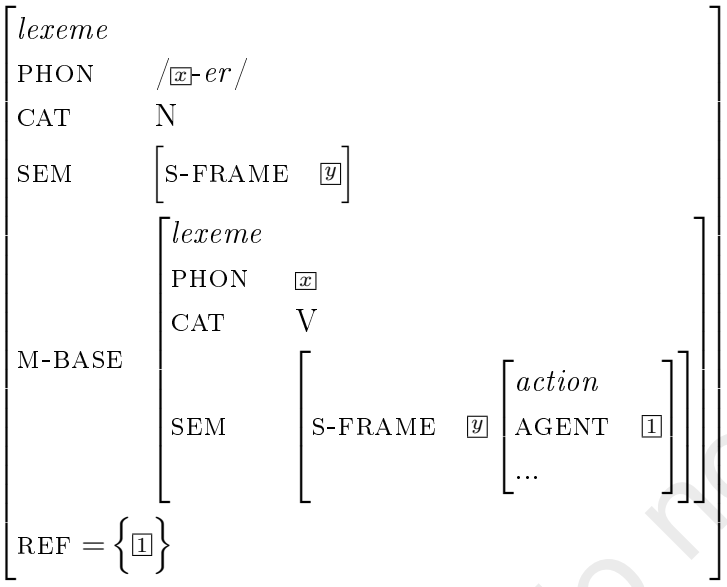


FIGURE 2.18: Lexical rule of deverbal, agentive *-er* nominalization (based on Andreou 2017, in prep; Plag et al. 2018)

form x, a syntactic category V, and semantics modeled as a semantic frame (S-FRAME y). The s-frame is an action with an AGENT attribute, and further possible attributes (indicated by "..."). The derivative's phonological form consists of the phonology of the base plus that of the suffix, and its category is N. The semantic frame of the derivative corresponds to that of the base, with one modification, namely that reference is now on the agent (index 1).

2.3.2.4 Inheritance hierarchies

Plag et al. (2018) integrate lexical rules into an inheritance hierarchy in order to derive individual meanings based on what the bases provide in terms of their semantic representations (for similar approaches see Riehemann 1998; Koenig 1999; Desmets & Villoing 2009; Booij 2010; Tribout 2010; Bonami & Crysmann 2016). This reflects the multiplicity of meaning that is evident in many derived words.

Figure 2.19 shows an inheritance hierarchy incorporating both the lexical rule in Figure 2.18 and a second lexical rule, which creates another possible reading of *-er* derivatives, namely INSTRUMENT. This hierarchy accounts for polysemies such as *walker* in the two interpretations 'person who walks' and 'walking aid.' It models deverbal nouns (*v-n*) and contains two lexical formation rules (here *lfr*). The phonology is specified to the left, while the possible readings can be found to the right. CAT is already covered by the hierarchy's specification as *v-n-lfr*. Reference is indicated by co-indexation of the referential argument REF

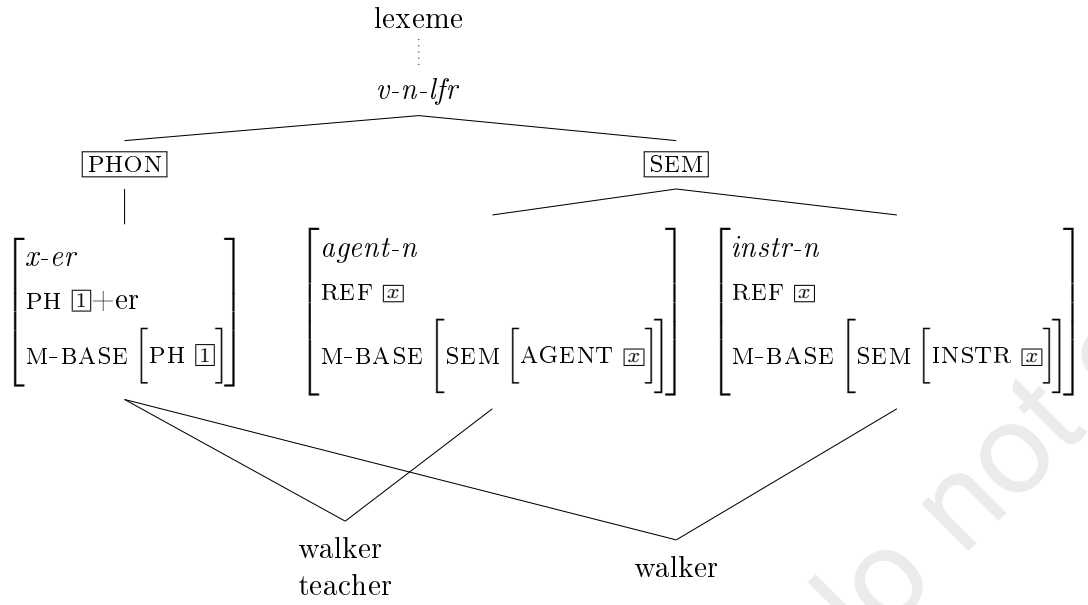


FIGURE 2.19: Partial inheritance hierarchy of lexical rules for the suffix *-er* (based on Plag et al. 2018)

with the attribute in question, i.e. AGENT and INSTR(UMENT). The existence of nominalizations in each reading is indicated under the hierarchy. More precisely, the noun *walker* can be found in both readings, while *teacher*, whose base *teach* does not have a salient INSTRUMENT argument, is not attested in an instrument reading.

This kind of inheritance hierarchy is an elegant way to model derivation since it straightforwardly depicts polysemy, and it allows the integration of various verb classes at once. Furthermore, it avoids overgeneration, which is a problem in other approaches (see Plag et al. 2018, 559-60).

The approach in Plag et al. (2018) was of a programmatic nature, modeling the underlying mechanism of derivational morphology based on some exemplary data. My dissertation presents a detailed analysis of the parts of the hierarchy which are abbreviated as SEM. In my analyses in chapters 4 and 5 I will use semantic frames as a representational format, and propose inheritance hierarchies based on my findings in sections 4.2.4.4 and 5.2.3.3. I will show how differences in the base verb frames systematically lead to different possible shifts in the nominalizations, and how this can be modeled with lexical rules and inheritance hierarchies.

Chapter 3

Methodology

In this chapter, I will present the methods which I used to elicit, choose and semantically classify the data set. In section 3.1, I will detail the procedures I applied in order to elicit the data set of *-ment* neologisms. Then, in section 3.2, I will address the semantic classification of base verbs by means of VerbNet classes. In section 3.3, I will explain how I then trimmed the data set to contain only two base verb classes, and how I revised and expanded it with more nominalizations and attestations. Finally, in section 3.4, I will describe the semantic classification of the nominalizations in context.

3.1 Identifying neologisms

I use the term **neologism** to refer to words which speakers actively form by following productive rules (see Hohenhaus 2005 for a discussion of the terminological confusion around this term). The neologisms in my data set were identified from two sources which I will present in turn: In section 3.1.1, I will explain the process of identifying neologisms in the Oxford English Dictionary Online (OED), while in section 3.1.2 I will address the extraction of neologisms from the Corpus of Contemporary American English (COCA, Davies 2008-).

3.1.1 OED neologisms

The Oxford English Dictionary Online (henceforth OED), containing 600,000 words and 3.5 million quotations, is an exceptionally detailed and comprehensive dictionary of the English language. It is continuously updated with new words and usages of existing entries, giving dates of first citation for every sense in which a

lemma is attested. It is therefore a convenient tool for the identification of neologisms.

A list of entries containing possible neologisms was retrieved using the interface provided by the OED. All nouns ending in *-ment* were extracted by searching for the corresponding orthographic string <*ment> in both the *Headword* and the *Lemma* category, restricting the part of speech to nouns. In order to exclude a large number of lexicalized forms already at this point, only entries with first citations dating from 1900 to today were included (see, for example, Plag 1999 for a similar procedure).

The resulting list of raw data was then subjected to a standard revision procedure. By manually inspecting the *etymology* section of each OED entry returned by the initial query, all types which met at least one of the following criteria were eliminated:

1. non-transparent borrowings (e.g. *ravalement*)
2. words which do not contain the suffix *-ment* (e.g. *bioelement*)
3. neologisms which are derived by any word-formation process other than suffixation (e.g. prefixation on a suffixed base as in *disempowerment*, or blends such as *edutainment*)
4. non-deverbal nominals (e.g. *foolishment*)
5. restricted technical terms (e.g. *excystment*)

The last criterion relates to those types which the editors of the OED have tagged as technical terms. These types were cross-checked with other corpora. If a reasonable number of non-technical contexts could be identified, they remained in the data set; otherwise, they were deleted. For example, *excystment* is tagged as a biological and medical term in the OED, and can indeed only be found in contexts relating to biology, medicine and paleontology in the corpora.[24] It does thus not qualify as a neologism. *Endistancement*, on the other hand, is an established technical term in theater and cinematography, but is abundantly attested also in other contexts, and was thus kept in the data set.

After these revisions of the data, the 134 hits initially returned by the OED search were reduced to the following 16 deverbal nouns:

bemusement	endistancement	piercement	stakement
embrittlement	motherment	reforestment	underlayment
encirclement	munitionment	soothment	upliftment
encoppicement	perturbment	staggerment	weldment

[24] In March 2018, all 84 *Google* hits returned by <excystment> were from these three fields.

These *-ment* derivatives were coined between 1900 and 1961. For ease of reference, I will refer to this part of the data set as the **OED data**.

3.1.2 Hapaxes in COCA

In addition to the OED neologisms, the data set was substantially extended by extracting very rare forms from COCA. **Hapax legomena** (or **hapaxes**, for short) are words which occur only once in a given context (e.g. the word *addition* in this paragraph). The notion of the hapax legomenon is central in corpus linguistics since it can be shown that the majority of neologisms in any given corpus is contained precisely in this group of hapaxes (see Plag 2003, 68). For the present study, this means two things: Hapaxes can serve as a source for neologisms, and they provide a realistic indicator of a suffix's productivity. Note that it is of course not claimed here that every hapax is indeed a neologism. In fact, a large number of hapaxes are actually very rare or specific technical terms, archaisms, non-transparent ad hoc inventions, typing errors, or errors resulting from automatic text recognition. The size of the corpus is also a decisive factor. The larger the corpus, the higher the proportion of neologisms among the hapaxes (see Baayen & Renouf 1996, Baayen 2009). This can be illustrated with a very simple example. Take this paragraph as a tiny corpus – most words in it are in fact hapaxes, although of course none of them is actually a neologism. Therefore, it is necessary to consult a sufficiently large corpus in order to predict the probability of new forms with a given suffix reliably.

Three tools were employed in this step of the process: COCA (online and on DVD), VerbNet, and Coquery. COCA had more than 450 million words produced between 1990 and 2012 at the time of data extraction, and was thus an appropriately large corpus for the identification of hapaxes as potential neologisms.[25] COCA is balanced with regard to year and genre of attestation, including spoken texts as well as texts written in the genres fiction, popular magazines, newspapers, and academic journals. The second tool, VerbNet, is a hierarchical verb lexicon of 6088 English verbs. It is based on the classification developed in Levin (1993) and includes syntactic and semantic information.[26] More details on VerbNet are given in section 3.2. The third tool is the corpus query software Coquery (Kunter 2015). In order to be able to identify a larger number of deverbal *-ment* derivatives, I

[25] In March 2020, COCA received a massive update, and now contains 1 billion words.

[26] I used *Unified Verb Index: VerbNet 3.2.4* to access the database. *Unified Verb Index: VerbNet 3.3*, which has since been made available, incorporates a number of fundamental changes.

used it to conduct an automated search of the DVD-version of COCA (Davies 2014).

Coquery probed the corpus for each listed verb in combination with the search strings <ment> and <ments>, also including orthographic variants which had been added manually (e.g. *soothement* and *soothment*). The query returned a total of 419 types of raw data. I then extracted those with a frequency of 1 or 2 for further investigation. I included also dis legomena at this point because the search results may be corrupted in various ways, concealing actual hapaxes. Take, for instance, the case of *musement*: The noun is listed with a frequency of 2 in COCA, but one of the attestations is actually *bemusement* with a wrongly placed space ("be musement"). Also, it occasionally happens that the very same context is listed twice. By including dis legomena, I increased the chances of avoiding these problems and thus finding a larger number of pertinent forms.

A second corpus search was conducted manually in order to identify *-ment* derivatives which are formed on the basis of verbs not listed in VerbNet. Using the web interface provided by Brigham Young University, COCA was searched for all words with a frequency of 1 or 2 ending in either <ment> or <ments>.

The collection of attestations resulting from the two COCA searches had to be weeded heavily. In addition to applying the five criteria already listed above for the OED neologisms, I excluded a large number of obvious typing errors (e.g. "aggreement") and a few non-English attestations (e.g. "the French n'aiment pas la sweat"). Furthermore, without any etymological data facilitating the task as in the OED, it was necessary to examine the context of each token in order to identify unwanted borrowings (e.g. French *redoublement* as a technical term in fencing) as well as spelling mistakes which happen to produce well-formed possible derivatives (e.g. the conceivable derivative *agement* in "man agement"). The OED was systematically consulted to identify whether the alleged base of each type is a legitimate base verb (e.g. $upset_{\mathrm{V}}$, $*asort_{\mathrm{V}}$). If both a verb and a word of a different part of speech were listed in the OED, the verb was regarded as a possible base and the nominalization remained in the data set.

During these revision procedures, the raw corpus data was reduced to a data set of 126 types (95 from the COCA DVD and 27 additional types from COCA online), which were produced between 1990 and 2012 (the complete range of the corpus at the time). In the following, I will refer to these parts of the data set as the *Coquery data* and the *BYU data*. The complete catalogue of *-ment* nominalizations, including the OED data, the Coquery data and the BYU data, comprises

138 types. In the next step, these types were grouped by assessing the semantics of their base verbs.

3.2 Semantic classification of base verbs

The basis for semantic classification of the base verbs was the VerbNet lexicon (Kipper Schuler 2005), which is based on Beth Levin's seminal work *English verb classes and alternations* (Levin 1993). I will first introduce my general classification process (section 3.2.1), and then discuss some issues I encountered along the way (section 3.2.2).

3.2.1 VerbNet as a basis for semantic classification

Levin (1993) bases her verb classification on the idea that verbs allow certain argument alternations, or *diathesis alternations*, and that this behavior is grounded in verb semantics. Viewed from the opposite perspective, those verbs which allow the same alternations should also share at least some meaning components. This idea was first introduced in Fillmore's (1970) study on the two verbs *break* and *hit*. He concludes that "[s]ome facts about language [...] have been shown to be explainable within a combined syntactic-semantic component" (p. 131). Levin applies this finding on a much larger scale, categorizing more than 3,000 verbs into 49 classes and 186 subclasses (including subclasses of subclasses). Each section provides a list of members, the diathesis alternations in which these are found, commentary on their semantic properties and further syntactic peculiarities, as well as a list of pertinent literature.

In the VerbNet project, the Levin classes are extended and partly revised, creating both new classes and further subclasses. At the time of writing this thesis, 6088 verbs are captured by 101 classes and 207 subclasses (*VerbNet class hierarchy* 2013). With the additional (sub-)classes, it was possible to incorporate more verbs in VerbNet, and already listed verbs have been re-categorized more fittingly. The class descriptions in VerbNet contain a list of members, a list of thematic roles represented in their predicate-argument structure, and a number of representative contexts ("frames") which are tagged syntactically and semantically. These frames largely correspond to Levin's diathesis alternations.

The fact that the Coquery data was extracted from a word list based on VerbNet entails that this part of the data set was already subdivided into base verb

classes. If a verb was cross-listed, the most adequate class for the attested context was chosen. For the OED and the BYU data, the attested base verbs were manually assigned to VerbNet classes. Nine base verbs from the OED data were classified directly since they were listed in VerbNet. The remaining 40 verbs from the OED and BYU data were classified indirectly by looking up synonyms and semantically similar verbs in VerbNet. This way, possible classes were identified, and the listed alternations were tested for the verb in question. If several verb classes were possible for a given base verb, the most appropriate verb class was chosen (see section 3.2.2 for discussion). Ultimately, the 138 types were assigned to 49 classes; 23 types were cross-listed in two (n=17), three (n=3) or four (n=3) classes.

3.2.2 Issues with the classification of base verbs

Several issues arose during the process of assigning the base verbs to Levin/VerbNet categories. These problems are due partly to general issues with the semantic categorization of corpus data, and partly to the classification system used.

The first problem was that the meaning of some nominalizations was so unclear that a categorization of the base verb became impossible. For instance, the meaning of the BYU hapax *tracement* (see (8)), and thus its base verb, could not be reconstructed by consulting the OED and *Google*. Such types were eliminated from the data set.

(8) We're always putting those things in with the long-term view of building the soil, keeping certain **tracement** oils in the ground for flavor and also for healthy growth (COCA SPOK PBS_Newshour 1990)

The second issue was presented by polysemous verbs. When the nominalization in context was clearly ascribable to one base verb class, only this class was chosen. One example is *staggerment*. The noun is described as meaning 'great amazement, astonishment' in the OED, which makes the *psych verb* reading of *stagger* more likely than its reading as a *run verb*. In other cases, however, it was not clear which class would be the most appropriate one; the distinctions were more fine-grained, and syntactic clues which distinguish one verb sense from the other disappear in the process of nominalization. An example is given in (9), where both *approve* (an *allow verb* in VerbNet) and *approve of* (a *marvel verb*) are conceivable bases. In these cases, all possible verb classes were registered in the data base.

(9) What happened is people who were looting, and thieves and hooligans, once they receive the **approvement** from the press, they will just draw the V sign and then continue their looting. (COCA NEWS NYTimes 2003)

The third issue is that not only the nominalizations in my data set, but also many of the base verbs are very rare. For instance, many native speakers do not believe that *discolor* is actually a verb. It follows that these verbs are hard to get an intuition for. In these cases, I probed the corpora for the relevant alternations and finally classified the verbs as accurately as possible given the available information. To give one example: VerbNet lists *uplift* in the class 'amuse verbs,' which describes verbs describing "the bringing about of a change in psychological or emotional state." (Levin 1993, 191). This reflects one possible reading of *uplift*, paraphrased in the OED as 'to elevate morally.' The nominalization *upliftment* can, however, also be found based on the sense 'to lift up to a higher level or more erect position.' Therefore, it was expedient to add *uplift* to the class of *remedy verbs*, a subclass of *change-of-state verbs*. In some cases, this approach involved deciding against an existing classification in Levin (1993) and/or VerbNet.

The last issue is that VerbNet, as any classification, glosses over some distinctions. A verb listed in a given verb class may not participate in one or more of the relevant alternations. Likewise, a possible alternation may not be listed in a given verb class because it has not been deemed relevant, or two verb classes may involve the same set of alternations. Similar problems have to be kept in mind with regard to the semantic roles. I will briefly discuss the semantic role label EXTENT to illustrate the problem. The subclass *verbs of calibratable changes-of-state* is the only subclass of change-of-state verbs for which VerbNet lists the EXTENT role (underlined in (10a)). Other change-of-state verbs in the data set, however, clearly also have measurable properties (e.g. *decenter, worsen*). For example, they can also be found with an EXTENT participant, as exemplified in (10b) and (10c).

(10) a. The price of milk **increased** by ten percent. (VerbNet)
b. All surfaces from the Coordinate Break onwards are **decentered** by -5 mm. (*Google* WEB customers.zemax.com 2015)
c. Of 10 patients with NAFL who had fibrosis progression, 3 **progressed** by 1 stage, 5 by 2 stages and 2 by 3 stages (*Google* ACAD sciencedirect.com 2014)

In such cases, I have categorized the base verbs to the best of my knowledge and into the classes they have most in common with.

3.3 Selection and revision of the data set

After the data set was grouped by base verb class, I selected a subset for further analysis (section 3.3.1) and prepared it by adding more attestations (section 3.3.2) and by making some final changes (section 3.3.3).

3.3.1 Selecting types

Of all elicited nominalizations, the nouns based on the two best represented base verb classes were chosen for analysis, namely *verbs of change-of-state* (henceforth **COS verbs**, n=13) and *verbs of psychological state* (henceforth **psych verbs**, n=20). Their respective nominalizations will be called **COS nouns** and **psych nouns**. As a next step, the 33 nominalizations set were subjected to a final evaluation with regard to their status as neologisms. For this, I applied OED frequency bands (OED: Key to frequency) as an independent measure. There are eight frequency bands, which are based on recent (1970-) Google Books Ngrams data in combination with other corpora. Nominalizations which fall into frequency bands 0 to 2 were categorized as neologisms (section 3.3.1.1), those falling into frequency bands 3 or 4 were used as *supplementary data* (section 3.3.1.2), and types in a frequency band of 5 or higher were eliminated from the data set.

3.3.1.1 Neologism data

First, those nominalizations with a frequency band of 1 or 2 were classified as neologisms (see Table 3.1). Two nominalizations are found in frequency band 1, which contains "extremely rare words unlikely ever to appear in modern text," for instance *abaptiston*, *grithbreach* or *zeagonite* (OED: Key to frequency). Their frequency per million words in the above-mentioned corpora and time span is given as zero. Next, 11 nominalizations from the data set can be found in frequency band 2, which contains words "which are not part of normal discourse and would be unknown to most people" (ibid.). Examples are *abactinal, unwhigged* and *acicularly.* Words in this frequency band occur less than 0.0099 times per million words.

Four derivatives are included in the OED without a frequency band since they are listed under their respective base verb. These derivatives were looked up in Merriam-Webster's Dictionary (*Merriam-Webster.com* 2021), where none of them was listed. They were therefore also regarded as neologisms.

Finally, 12 nominalizations are not listed in the OED at all. These were again looked up in Merriam-Webster's Dictionary, and 11 types, which did not have

an entry, were categorized as neologisms. The only exception, *besmirchment*, was checked in the *Google Books Ngram Viewer* (2013), where its highest frequency between 1970 and 2008 (the whole range of the corpus) is under $2{\cdot}10^{-7}\%$. Since this value is well under the benchmark for frequency band 2 (which would correspond to an average of $9.9{\cdot}10^{-7}\%$), *besmirchment* was categorized as a neologism as well.

All nominalizations whose status as neologisms has been confirmed are given in Table 3.1 with their respective frequency band and noun class. The neologism data collected from hapaxes and OED neologisms contains 29 types, of which 11 are COS nouns and 18 are psych nouns. Three types did not meet the criteria and were recategorized as supplementary data, as I will explain below.

TABLE 3.1: Data set of *-ment* neologisms (hapaxes and OED neologisms). Subscript numbers indicate variants of polysemous base verbs

Frequency band	COS nouns (n=11)	Psych nouns (n=18)
1 (n=2)		soothment staggerment
2 (n=11)	congealment debauchment discolorment worsenment	affrightment annoyment approvement enragement perturbment worriment$_1$ worriment$_2$
none (n=4)	bedragglement befoulment	reassurement upsetment
unlisted (n=12)	besmirchment decenterment embetterment jugglement progressment	bumfuzzlement confoundment dumbfoundment endullment enrapturement musement nonplusment

In order to be able to make better generalizations, I decided to expand the data set again. More precisely, nominalizations with higher frequencies on the COCA DVD were added consecutively, as long as they met the neologism criteria described above. Starting with dis legomena, continuing with tris legomena, et cetera, I was able to add five more types to the neologism data set. They are given in Table 3.2. The most frequent type is *dispersement* with a frequency of ten on

TABLE 3.2: Data set of *-ment* neologisms (dis legomena, tris legomena, and rare forms). Subscript numbers indicate variants of polysemous base verbs

Frequency band	COS nouns (n=3)	Psych nouns (n=2)
2 (n=4)	increasement$_1$ increasement$_2$	abashment disheartenment
unlisted (n=1)	dispersement	

the COCA DVD. The combined neologism data set contains 14 COS nouns and 20 psych nouns.

3.3.1.2 Supplementary data

Those types which were eliminated in the preceding section may not be neologisms, but they can nevertheless be regarded as unusual forms which are unknown to many native speakers, as my experience presenting them at conferences has shown. Therefore, rather than eliminating them from the study, they were moved to a second data set, which will be called *supplementary data*. By subdividing the data set into neologism and supplementary data, it is possible to compare the neologisms with more frequent types, testing whether the latter are more restricted in their possible readings.

In the supplementary data we find nominalizations with frequency bands 3 and 4. Frequency band 3 contains words which "are not commonly found in general text types like novels and newspapers, but at the same time they are not overly opaque or obscure" (OED: Key to frequency). There is a spectrum between technical terms (*agglutinative, argentiferous*) and very colloquial words (*crackers, dirt-cheap*). In frequency band 4 we find words which are "recognizable to English-speakers, and are likely be [sic] used unproblematically in fiction or journalism" (ibid.). *Insectivore, egregious* and *surrepticiously* are examples.

Again, types of higher frequencies on the COCA DVD were added consecutively, as long as they were in frequency bands 3 or 4. The supplementary data set is given in Table 3.3. The types' frequencies on the COCA DVD range from one (*convincement*, a recategorized hapax), over several frequencies in the lower double-digit range (e.g. *disbandment* with 12 attestations), to 131 (*diminishment*).

TABLE 3.3: Supplementary data set of *-ment* nominalizations. Subscript numbers indicate variants of polysemous base verbs

Frequency band	COS nouns (n=7)	Psych nouns (n=2)
3 (n=2)		bemusement convincement
4 (n=7)	abridgement diminishment$_1$ diminishment$_2$ disbandment embrittlement unfoldment upliftment	

3.3.2 Adding attestations

A general problem that arises from the chosen data collection method is ambiguity. Take, for instance, the definition of *embrittlement* in the OED: 'The action of embrittle$_v$, or the result of such action; loss of ductility.' Such ambiguity is of course problematic when investigating hapaxes, which are by definition attested only once in a given corpus. In any such unique attestation, one of two things may happen: Either, the hapax is unambiguous in the given context, making it impossible to know which further readings are conceivable. Or, the hapax is ambiguous in this context, so that it cannot be determined which meaning was intended by the speaker. Since most of the types in the data set are very rare, it is practically impossible to get the complete picture from the COCA attestations alone. A related problem occurs in the dictionary data. Although the OED aims at wide coverage, for obvious reasons it does not include every meaning variant ever attested. Since, however, it is exactly this kind of innovative, spontaneous, and fully transparent formation that is of interest for this study, it was indispensable to support the data set with further attestations. Therefore, a number of other corpora were probed for all types of the four semantic classes under investigation. The following corpora and sources contained data which I have included in the database and/or as illustrative examples in this thesis, in alphabetical order:

- BYU corpora
  - BNC (*British National Corpus,* Davies 2004-)
  - COCA (*Corpus of Contemporary American English,* Davies 2008-)
  - COHA (*Corpus of Historical American English,* Davies 2010-)

  - GloWbE (*Corpus of Global Web-Based English*, Davies 2013)
  - HC (*Hansard Corpus*, Davies 2015a)
  - iWeb (Davies 2018-)
  - NOW (*News on the Web*, Davies 2016-)
  - SOAP (*Corpus of American Soap Operas*, Davies 2011-)
  - TIME (*TIME Magazine Corpus*, Davies 2007-)
  - WIKI (*The Wikipedia Corpus*, Davies 2015b)
- *Google* (n.d.)
- GB (*Google Books* n.d.)
- OED (*Oxford English Dictionary Online* 2021)
- *Twitter* (2021)
- WC (*Webcorp*, Renouf et al. 2006)

Other corpora (including all BYU corpora available at the time) were probed as well, but either did not contain the types in question at all, or only contained readings which were already well represented in the database.

All attestations in this study are tagged with the following information, in that order: Corpus, genre, source, year (e.g. *WC NEWS articles.latimes.com 2002*). The only exception is Twitter, where mentioning the genre (that is, *tweet*), would be superfluous. The following genres were distinguished:

- academic literature (ACAD)
- comment in the comment section of a website (COMM)
- private blog (BLOG)
- fiction (FIC)
- newspaper or news blog (NEWS)
- nonfiction literature (NONFIC)
- popular magazine (MAG)
- transcript of spoken language (SPOK)
- website of a company or institution (WEB)

The corpora were first searched by probing for the type in question and, for each reading which was identified in the process, adding a number of representative attestations to the database. Crucially, the approach was qualitative and not quantitative, so that the database should be regarded as a collection of possible readings rather than a sample representing realistic ratios. For instance, *bumfuzzlement* is mostly attested in a RESULT-STATE reading. Once a number of clear examples with this reading had been identified, further attestations with a RESULT-STATE were ignored. Then, the corpora were probed for syntactic contexts (e.g. arguments or temporal modifiers, see also Lieber 2015) which would evoke as yet unattested readings. For instance, <his bumfuzzlement of the> would elicit an event reading. The search for a given type in an unattested reading was terminated when either

all attestations in the above-mentioned corpora had been examined, or when the fifth page of results (around 500 attestations) had been inspected in Google, which was the last resort with regard to data collection.

This leads us to an important comment about the nature of the data sources. The rare nature of the data made it necessary to consult not only linguistic corpora but to turn to even larger sources, that is, Twitter, Google and Google Books. Such tools exhibit certain shortcomings in the context of serious linguistic investigation (e.g. unlimited corpus size, no data organization, no annotation, often unknown origin of the data). However, it has also been shown that they can be a convenient indicator for innovative language use (see Diemer 2011 and the papers in Hundt et al. 2006). In order to meet the requirements of academic research as well as possible, any indication that the author of a given text might not be a native speaker of English was taken as a reason to exclude this attestation. For this, the wider context was scanned for grammatical errors, awkward formulations or straight-forward indicators of the country of origin.

3.3.3 The final data set

These extensive corpus studies led to some final changes to the data set: First, *jugglement* was deleted because almost no analyzable attestations could be identified. Second, it was found that the COS noun *upliftment* is frequently attested in a sense of moral elevation, which conforms with *uplift*'s reading as a psych verb. It was therefore decided to cross-list *upliftment* as a psych noun and a COS noun. Finally, nouns based on verbs from the COS subclass *calibratable verbs of change-of-state* (e.g. *increase* and *diminish*) were not included in this study due to the complexity of their analysis. The modeling of scalar predicates in frames is an interesting and notorious challenge (see for instance Gamerschlag et al. 2014b; Zinova 2016), but is beyond the scope of the present work.[27] Table 3.4 gives an overview of the final data set. In the two analyses, the distinction between neologism data and supplementary data will only be made when relevant. See the Appendix for a presentation of this list by source (i.e., OED, Coquery, and BYU).

[27]Note that *increasement* and *diminishment* are still part of the data set since they are cross-listed also as 'other alternating verbs of change-of-state.' I am merely disregarding their scalar properties here.

TABLE 3.4: Final data set of *-ment* nominalizations. Subscript numbers indicate variants of polysemous base verbs

Data set	COS nouns (n=18)	Psych nouns (n=23)
Neologism data (n=32)	bedragglement befoulment besmirchment congealment debauchment decenterment discolorment dispersement embetterment increasement progressment worsenment	abashment affrightment annoyment approvement bumfuzzlement confoundment disheartenment dumbfoundment endullment enragement enrapturement musement nonplusment perturbment reassurement soothment staggerment upsetment worriment$_1$ worriment$_2$
Supplementary data (n=9)	abridgement diminishment disbandment embrittlement unfoldment upliftment$_1$	bemusement convincement upliftment$_2$

3.4 Semantic coding of derived nouns

The semantic coding of the derived nouns in context had three starting points: the semantic roles given in VerbNet, previous literature, and meaning shifts predicted by the base verb frames. In this section I will describe which categories I applied (section 3.4.1) and how the coding proceeded (section 3.4.2). Then, I will discuss issues I encountered during the coding process (section 3.4.3). In the following, I will refer to the groups and subgroups of base verbs and nouns as **(semantic) classes** without special formatting (e.g. "psych verbs" and "psych nouns"). The nominalization readings will be referred to as **(semantic) categories** and marked by small caps (e.g. "RESULT-STATE").

3.4.1 Semantic categories

The ontology of semantic categories can be split into two major groups: participants (section 3.4.1.1) and events (section 3.4.1.2).

3.4.1.1 Participants

The core participants of the relevant VerbNet classes are presented in Table 3.5 and Figure 3.1. Table 3.5 lists the definitions of the core participants and their hyperonyms, and Figure 3.1 gives an overview of the hierarchical relations between them.[28] The information presented here has been taken from Palmer et al. (2017) if not indicated otherwise (see also *Unified Verb Index: References Page* n.d.). Later on, I will revise the listed categories according to my findings.

TABLE 3.5: Definitions of participant categories and their hyperonyms, adapted from Palmer et al. (2017). Relevant core participants are indicated by bold print

Category	Definition
Actor	Participant that is the instigator of an event
Agent	Actor in an event who initiates and carries out the event intentionally or consciously, and who exists independently of the event
Causer[29]	Actor in an event (that may be animate or inanimate) that initiates the event, but that does not act with any intentionality or consciousness
Stimulus	Causer in an event that elicits an emotional or psychological response
Undergoer	Participant in a state or event that is not an instigator of the event or state
Patient	Undergoer in an event that is usually structurally changed, for instance by experiencing a change-of-state
Experiencer	Patient that is aware of the event undergone, which often involves an emotional or psychological response elicited by a stimulus
Instrument[30]	Undergoer in an event that is manipulated by an agent, and with which an intentional act is performed
Place[31]	The state in which an entity exists
Goal	Place that is the end point of an action and that exists independently of the event
Result	An outcome that comes into existence through the event

[28]The participant hierarchy is not a type hierarchy as defined in section 2.2.1.2. Including relational concepts as types in a type hierarchy leads to a variety of problems, which I have decided to avoid.

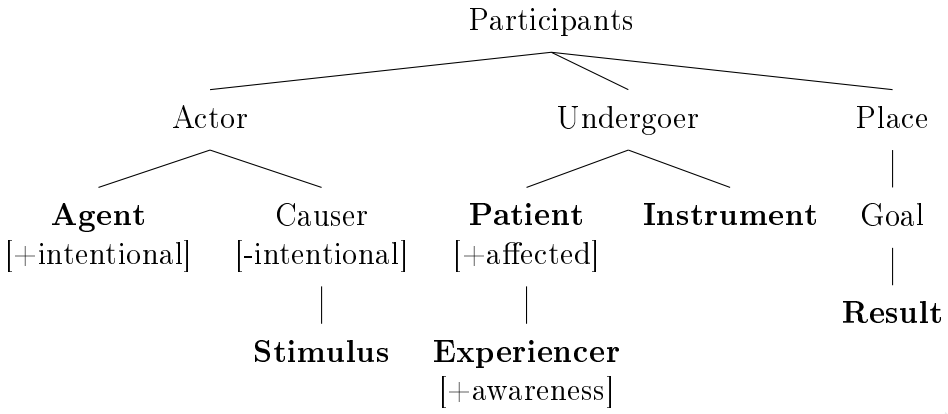


FIGURE 3.1: Participant categories for semantic coding, based on VerbNet. Relevant core participants are indicated by bold print

3.4.1.2 Eventive classes

In the semantic description of (deverbal) nouns, the term *event* has been used extensively and with varying definitions. Distinctions have been made on grounds of properties like telicity, agentivity or duration. This has resulted in contrasts between events and results (e.g. Grimshaw 1990), between events and states (e.g. Filip 1999; Barque et al. 2011), between processes, events and states (e.g. Ehrich & Rapp 2000), or between actions and non-agentive events (e.g. Sil et al. 2010). Here, the term **event** has been chosen as a hyperonym for all kinds of situational, or **eventive**, categories. Table 3.6 gives an overview of the eventive categories that I will use for the description and frame formalization of *-ment* derivatives. Note that this list should be regarded as a reference sheet; I will discuss the definitions of and motivations for the different categories in detail in chapters 4 and 5.

[29] In VerbNet, this category is called *cause*. In order to avoid confusion with the CAUSE attribute, I have decided to rename it. Coincidentally, CAUSER is also the label applied in VerbNet version 3.3.

[30] This definition of INSTRUMENT is unusual. For most authors, an instrument is defined as an entity used by an agent to carry out an event and would therefore be subsumed among the ACTOR categories rather than being defined as a subcategory of UNDERGOER.

[31] In VerbNet, PLACE is a somewhat unusual metarole which is instantiated by both physical and abstract entities. For example, its hyponym GOAL can be the physical goal of a motion action (*She reached her hand **into the cookie jar***) or a label used in a classifying action (*She classified the works as **'dangerous'***.). The daughters of PLACE are LOCATION, SOURCE, GOAL, PATH, and VALUE.

TABLE 3.6: Definitions of eventive categories, sorted by first split in the hierarchy in Figure 3.2. Abbreviations: c. = causation

Category	Definition
Event	An observable phenomenon taking place at a specific time and place[32]
Action	An actor does something (possibly with an instrument, possibly to a patient)
Psych-action	An action that is related to an experiencer's psychological or emotional state
Stimulus psych-action	The actor is a stimulus
Experiencer psych-action	The actor is an experiencer
State	State of a patient
Having-form	The patient has a shape and surface
Psych-state	Psychological or emotional state of an experiencer
Change-of-state	A patient changes in some way
Change-of-physical-form	A patient's shape or surface changes
Change-of-psych-state	An experiencer changes psychologically or emotionally
Causation	A complex event with a causing and a caused subevent
Change-of-state c.	The caused subevent is a change-of-state
Change-of-physical-form c.	The caused subevent is a change-of-physical-form
Psych-state c.	The caused subevent is a psych-state
Change-of-psych-state c.	The caused subevent is a change-of-psych-state
Experienced c.	The causing subevent is a perception-event
Agentive psych c.	The causing subevent contains an AGENT
Psych-reaction	A complex psych event with an *explanation* and a *reaction* subevent

I have translated these eventive categories into a type signature in Figure 3.2. The event types are there defined by their relation to each other (e.g. *psych-state* as a kind of *state*) as well as by appropriateness conditions which specify participants and, if applicable, subevents (see section 2.2.1.5).

Several things should be pointed out here. First, these categories do not imply statements regarding the duration or telicity of the underlying concept. For instance, a change-of-state may be punctual or durative, as well as completed or ongoing. If either of those distinctions is relevant in a given context, this will be pointed out specifically.

[32] This definition goes back to authors like Sil et al. (2010, 108) or Ehrich & Rapp (2000, 251)

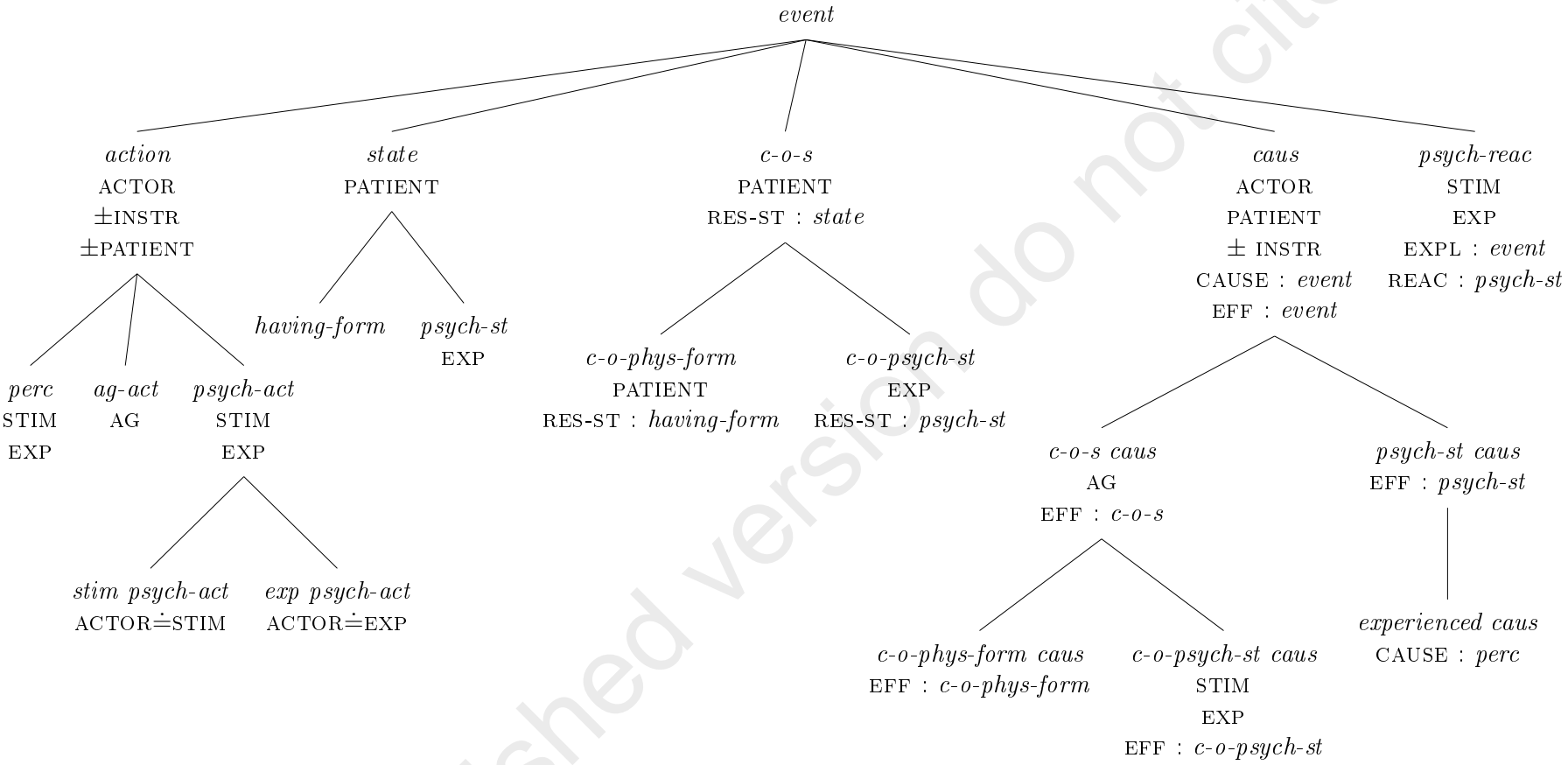


FIGURE 3.2: Type signature of eventive categories. Optionality is indicated by ±. Abbreviations: act = action, ag = agent, caus = causation, c-o-phys-form = change-of-physical-form, c-o-psych-st = change-of-psych-state, c-o-s = change-of-state, eff = effect, exp = experiencer, expl = explanation, instr = instrument, perc = perception, psych-st = psych-state, reac = reaction, res-st = result, stim = stimulus

Second, there are five relational eventive categories, namely CAUSE, EFFECT, EXPLANATION, REACTION and RESULT-STATE. Because they are relational, they are not given as types but only as attributes under the types they are introduced by. Third, the use of the symbol ± for optional participants should be seen as shorthand. It would be a cleaner solution to introduce distinct types for each kind of event, for instance an action with an instrument, and one without. However, this would greatly blow up the figure and require the use of unlexicalized labels, without much added value. Fourth, in order to reduce visual clutter, I have decided to leave out agentive psych causation types. These are implicitly depicted since the attribute ACTOR, which is listed under *causation*, can be instantiated by AGENT. Fifth, also for reasons of space, I depict hyponymy relations of participant categories separately. To spell out participant relations in a type signature, one would have to include specifications in the appropriateness conditions. For example, that EXPERIENCER is an hyponym of PATIENT would be expressed by a notation like '*psych-st*, PATIENT ≐ EXPERIENCER.' By lacking this kind of information, the type signature in Figure 3.2 is less explicit than it could be, but more readable. This also means that it needs to be interpreted in conjunction with Figure 3.1 above.

Finally, it should be kept in mind that the type signature will be revised in the course of this study. In its current state, it contains those types which are required to model previous research on the investigated verb and noun classes. We will see that it contains types which are not actually relevant to describe my data, while some relevant eventive categories, participants, and constraints are missing. Parts of the type signature are even self-contradictory due to incompatibilities between the VerbNet participant hierarchy and other literature. For example, to define the ACTOR as an EXPERIENCER, as done under the type *experiencer-psych-action*, is not allowed by Figure 3.1. At the end of chapters 4 and 5, respectively, I will incorporate my findings and propose updates to the type signature.

3.4.2 The coding procedure

The semantic categorization of each nominalization in context was conducted by three trained linguists. The coding procedure was carried out in three steps. First, each annotator inspected the attestations on their own, assigning labels and/or paraphrases. As a second step, the annotators convened personally to discuss and possibly revise their decisions, as well as streamline the chosen labels. Finally, those attestations for which an inter-annotator agreement of at least two of three

was reached were included in the database, while disputable cases were marked as such and filed for the record.

In order to assign labels to a given attestation, a number of factors were considered. First, the context was examined for clues of various kinds: Does it include an unambiguous collocation, such as the one in (11a)? Are there straightforward definitions, paraphrases or parallel constructions with the same referent, as in (11b)? Does the context of the nominalization parallel one or more arguments of the base verb, as in (11c), pointing to a transpositional reading?

(11) a. Once in the **state of enragement** she will be like a fury (*Google* BLOG tesof.com 2013)
b. [T]he tonnage would be an indication of **enragement** or as we say around these parts a "the **piss-off-edness**" indicator. (GloWbE NEWS blogs.news.com.au 2012)
c. Did you put a sound system in your car not specifically for your enjoyment but for the **perturbment of others** within three square miles? (GloWbE NEWS blogs.news.com.au 2012)

If no straightforward contextual clues could be identified, the next step was to apply substitution tests. For instance, *V-ment* was considered to express the STIMULUS category when it could be substituted by a paraphrase similar to *V-ing influence(s), something which V-s someone*, or *things which V someone*.

(12) Monitor your sites for outages, errors, and other [**worriments**] (WC angel.co 2011) [things which worry you]

When several readings were conceivable within one attestation, all of them were regarded as valid usages of the noun. In these cases, the inter-annotator agreement had to be at least two of three for each of the assigned readings. For instance, for the example given in (13), all three annotators agreed that *endullment* can be seen as a transposition of the verb's eventive reading ('avoid working toward endulling the students') or as a result-state ('avoid working toward endulled students').

(13) Regelski, for example, writes about the need to reject "methodolatry" and "taken-for-granted recipes" and avoid working toward the "**endullment**" of students. (COCA ACAD MusicEduc 2005)

3.4.3 Issues with the classification of nominalizations

While classifying my nominalization data semantically, a number of methodological issues arose, both with regard to the coding procedure and to the theoretical backdrop.

The first issue relates to the choice of semantic category labels. There is a large variety of such labels to be found in the semantic literature, and more often than not, a given author introduces some distinction or semantic detail which sets their use of a semantic label apart from other uses. In order to avoid confusion, it is essential to be very transparent regarding the use and definition of semantic categories. In the present thesis, this is achieved by adhering to the following four principles: Firstly, I chose a clear starting point. For the participant categories, the VerbNet role labels were used (see section 3.4.1.1). For the eventive categories, I have not been able to identify a classification system of the right granularity, which is why I presented my own system in section 3.4.1.2. The individual labels were largely gathered from the existing literature. Secondly, in the two sections I just mentioned, I give a definition for each semantic category. While this may seem rather basic, it is often the case that authors use a supposedly unambiguous label without specifically defining it, which then leads to misunderstandings or misinterpretations on the part of the reader. Thirdly, I locate the semantic labels in the type signature in section 3.4.1.2. Most eventive categories are non-relational, and can be included as types. The participant categories as well as some eventive ones are relational, and are therefore included as appropriateness conditions on types. This way, the relations between labels are clearly spelled out. Finally, in the course of this study, it will become necessary to adjust the VerbNet- and literature-based semantic classification to reflect the actual findings from my nominalization data. All such changes will be documented explicitly by updating both the list of definitions and the type signature (see sections 4.2.4.3 and 5.2.3.2).

The second issue is that I use the same semantic categories with two distinct purposes, namely on the one hand for descriptions of verbs, and on the other for analyses of their contexts. This has been described as a problem by Huyghe & Wauquier (2020), who work on agentivity. Specifically, they criticize approaches like VerbNet, which categorize verbs as semantically agentive or non-agentive. In reality, they state, agentivity is in most cases established by context, and thus not a matter of semantics but of pragmatics. In the present study, the starting point of my semantic formalization is precisely what they criticize, since I use the verbs' core participants as a proxy for their semantics. I chose this starting point because I prefer using, testing, and revising an existing categorization rather than starting from scratch. Therefore, the term *starting point* really is key: I will not take the list of participants as presented above at face value, but extend and revise it during the course of this study.

Next, I would like to come back to the issue of granularity of semantic categories. While categorizing readings semantically, one option is to distinguish only basic categories, such as the most general distinction between ACTOR, UNDERGOER, PLACE, TIME and CIRCUMSTANCE in VerbNet (see Palmer et al. 2017, 331). Or, semantic distinctions can be more fine-grained. On the participant level, VerbNet uses categories of medium granularity; for instance, the verb *attack* is listed with AGENT and PATIENT. An example for a more fine-grained approach is the Berkeley FrameNet project (Fillmore et al. 2003), where the two frame elements ASSAILANT and VICTIM are given for the lexical entry for *attack*. In the present study, the goal is to generalize over semantically related but distinct verbs, so that an approach with medium granularity (i.e., VerbNet) promises the best results.

Next, let me return to the issue of ambiguity, which frequently arises due to the polysemous nature of the nominalizations in my data set. As I've detailed in the previous section, I do not per se regard ambiguous attestations as a problem in this study, but deal with them systematically, regarding all possible readings as valid ones. Still, I am aware that it would be preferable to have an unambiguous attestation to show for each reading. I will take a quantitative perspective on ambiguity in my data set in chapter 6.

Finally, problems arise because a nominalization's semantics may be modified by context, producing a reading outside of the noun's lexical range. This post-lexical process is often referred to as **coercion**. Importantly, in the study of derivational semantics the readings which arise via coercion need to be distinguished from those created by affixation. To do so, I used introspection and consulted with my fellow annotators (see also chapter 8).

Keeping the issues I have just described in mind, let us now turn to the first of my two analyses, namely of *-ment* on change-of-state verb bases.

Chapter 4

Change-of-state verb bases

In this chapter, I will examine nominalizations derived from members of the verb class most commonly known as **change-of-state verbs**, henceforth abbreviated as **COS verbs**. The chapter is divided into three parts: First, I will focus on verbal semantics, proposing verb frames based on the pertinent literature (section 4.1). Second, I will analyze the *-ment* derivatives, which includes their frame-semantic formalization (section 4.2). Finally, I will consolidate my results by proposing an inheritance hierarchy for *-ment* on COS verb bases (section 4.3).

The COS nouns analyzed in this chapter are *abridgement, bedragglement, befoulment, besmirchment, congealment, debauchment, decenterment, diminishment, discolorment, disbandment, dispersement, embetterment, embrittlement, increasement, progressment, unfoldment, upliftment,* and *worsenment.*

4.1 The semantics of COS verbs

In this section, I will first give a synopsis of pertinent literature, limited to issues which are relevant for the frame formalization (section 4.1.1). Then, I will discuss the pertinent subclasses of COS verbs in Levin (1993) and VerbNet in more detail (section 4.1.2). These descriptions form the basis of a preliminary frame-semantic formalization of the base verbs (section 4.1.3). Frame-theoretical notions which go beyond the basic toolkit described in section 2.2 will be introduced en route.

4.1.1 Previous literature

Analyses of COS verbs usually distinguish external from internal causation. In this section, I will first illustrate this distinction (section 4.1.1.1) and then address how it has been formalized (section 4.1.1.2).

4.1.1.1 External vs. internal causation

The class of COS verbs, as the name suggests, is comprised of verbs which express a change-of-state, often of a physical kind. COS verbs have been widely studied, especially with regard to the Causative/Inchoative Alternation (henceforth *C/I Alternation*) and the question of how this alternation is related to external and internal causation. As I will elaborate below, there is some disagreement in the literature on how to conceptualize alternating verbs in terms of internal versus external causation. In this section I will discuss this issue since I hypothesize that the type of causation involved in the base verb may have an effect on possible nominalization readings (see section 4.2.2 for details).

Examples (14) to (16) illustrate the three possible behaviors of verbs with regard to the C/I Alternation (see Alexiadou et al. 2015 for a recent treatment): First, *dry* in (14) is an example for a verb which can undergo this alternation. Both variants of the alternation describe the same event (*drying*). The difference is that the external cause, in this case an AGENT (*James*), is only expressed in the transitive variant. Examples (15) and (16) illustrate verbs which do not participate in this alternation. For verbs like *bloom*, the causative variant in (15a) is ungrammatical, and verbs like *repair* do not exhibit the inchoative variant (16b).[33] I will henceforth refer to these three groups of verbs as **causative/inchoative (c/i) COS verbs, inchoative-only (i-only) COS verbs** and **causative-only (c-only) COS verbs**, respectively. In my data set there are only c/i COS verbs and c-only COS verbs.

(14) a. James **dried** the clothes.
b. The clothes **dried**.

(15) a. *The sun **bloomed** the bluebonnets yesterday.
b. The Bluebonnets **bloomed** yesterday.

(16) a. Bill **repaired** the tractor.
b. *The tractor **repaired**.

This syntactic alternation is closely linked to the traditional semantic distinction between internal and external causation. The notion was first introduced by Smith (1970) with the concept of **control**, and further developed by Levin & Rappaport Hovav (1995) under the label of **internal** vs. **external causality**. Discussing c/i COS verbs, Smith (1970) states that "external control of the change

[33] Although *bloom* is the standard example for a purely inchoative verb, some native speakers would accept causative constructions, for example in a poetic context.

can be assumed by an agent" (p. 101), which is reflected by the fact that they can occur in a transitive variant. At the same time, she assumes that the change-of-state happens relatively independently of an external agent since the intransitive variant is also possible for such verbs. For i-only COS verbs, the change-of-state is completely independent of any other event, and control cannot be handed over to another entity (p. 107). The change-of-state rather emerges from properties which are inherent in the verb's argument. Finally, in the case of c-only COS verbs, the change-of-state is completely dependent on the agent (p. 102).

The distinction between internal and external causation is intuitive, and there is corpus and psycholinguistic data (production as well as perception) to back it up (McKoon & Macfarland 2000). However, it has been a matter of some debate which cognitive status the internally and externally caused variants have. COS verbs have been conceptualized in (at least) three different ways: The first position is that they have two separate, unrelated lexical entries; one with internal and one with external causation. In this view, every possible argument structure of a verb would be represented by a distinct frame (as for example tested computationally by Haugereid 2011). Since the present study aims at a generalizing approach, it would not be feasible to create frames for every variant of every verb class in every possible alternation. The second and third positions assume that the two templates are related. The difference between the two is which variant is given prominence.[34] The second position is that c/i COS verbs are in principle causatives, lexicalizing a cause, and taking CAUSER and PATIENT arguments. Some verbs, like *break*, can be used in an inchoative variant without expressing an external cause. Such uses are taken to be a special, elliptic case which is achieved by deleting an event, but our world knowledge tells us that an external cause must exist (see Levin & Rappaport Hovav 1995, 93). In contrast, advocates of the third position (for instance Smith 1970 as discussed above, and also Pinker 1989) regard c/i COS verbs as intransitives that can have a causative variant. In this view, the causative structure is derived from the inchoative one by adding an event.[35]

4.1.1.2 Formalization of COS verbs in the non-frame literature

Before turning to the frame formalization of COS verbs in section 4.1.3, I will first present existing non-frame formalizations of both inchoative and causative COS

[34] See Levin & Rappaport Hovav (2011a,b) for a concise overview of both positions.

[35] An argument in favor of this position is that there are several languages in which derivation can create causative constructions. For instance, the Korean suffix *-(h)ita* can causativize a verb (e.g. *pota* 'see' > *po-ita* 'make see;' see Dixon (2000)).

verbs (and verb variants). Rappaport Hovav & Levin's (1998) proposal will serve as a stand-in in order to communicate the general idea.

Causative verbs are typically regarded as complex events with two subevents, that is, a causing subevent and a caused subevent (see e.g. Dowty 1979; Levin & Rappaport Hovav 1995; Pustejovsky 1991). The causing subevent can be any kind of event, for instance a situation, an event, a process or an action (Van Valin & LaPolla 1997, 84), but is most often an action (Rappaport Hovav & Levin 1998, 104).[36] In COS verbs, the caused subevent is a change-of-state, as opposed to other changes such as a change of location or the emergence of an artifact, which would figure in the event structure of other complex verb classes. The inchoative variants, on the other hand, are thought to be best represented by a simple event structure consisting of only a change-of-state.

These two types of event are formalized in the logical structures below. (17a) and (18a) present templates, with the concrete examples of *repair* (external causation), *decay* (internal causation) and *break* (external or internal causation) given under their respective template. The structures in (17a), (17c) and (18a) have been taken from Rappaport Hovav & Levin (1998), the other three have been modeled analogously. In prose, the examples in (17) should be read as 'x acts, causing y to attain a (repaired/broken) state,' while those in (18) can be paraphrased as 'x attains a (decayed/broken) state.'

(17) a. [[x ACT$_{<MANNER>}$] CAUSE [BECOME [y <*STATE*>]]]
b. *repair*: [[x ACT$_{<\text{MANNER}>}$] CAUSE [BECOME [y <*REPAIRED*>]]]
c. *break*$_{\text{tr}}$: [[x ACT$_{<\text{MANNER}>}$] CAUSE [BECOME [y <*BROKEN*>]]]

(18) a. [BECOME [x <*STATE*>]]
b. *decay*: [BECOME [x <*DECAYED*>]]
c. *break*$_{\text{intr}}$: [BECOME [x <*BROKEN*>]]

Two comments are in order: First, both *repair* and *break* are what Rappaport Hovav & Levin (1998) call **result verbs**, lexicalizing a result but not the manner in which this result is achieved. They model this with an underspecified MANNER constant.[37] Second, I am not aware of an approach which formalizes c/i COS verbs differently from purely causative or purely inchoative verbs. Thus, their transitive variants take template (17a), while their intransitive variants take template (18a).

[36] Rappaport Hovav & Levin (1998) use the term *activity* here, which is one of the Vendler-Dowty aktionsart classes of verbs. To avoid confusion, I use the roughly equivalent term *action* as defined in section 3.4.1.2 throughout my dissertation, except if specifically referring to aktionsart.

[37] An example for a manner verb is *sweep*, where the manner is specified while the result is not lexicalized (the floor may still be dirty after sweeping).

This does not mean that authors like Rappaport Hovav & Levin (1998) assume a vast lexicon with multiple entries for all c/i COS verbs. Rather, they assume general rules which generate such entries in a principled way (p. 99).

With regard to these formalizations, one problem has been raised which does not only pertain to externally caused COS verbs, but to causative verbs in general: What is the nature of the first argument of the CAUSE operator, modeled by Rappaport Hovav & Levin (1998) as an action? Does it really have to be eventive, or can it also be a participant? As Van Valin & LaPolla (1997, 107) observe, there is much linguistic and philosophical discussion about this issue. In my frame representations, I have chosen to restrict the attribute range of CAUSE to eventive types, following such approaches as Rappaport Hovav & Levin (1998) and Van Valin & LaPolla (1997). My findings with regard to nominalization semantics will show that this analysis is indeed feasible (see section 4.2.3.8).

The notion of event structure goes hand in hand with that of participants. Thus, the change-of-state has a PATIENT participant, while the first subevent has participants in accordance with its event type (McKoon & Macfarland 2000, 835). For example, an agentive action has an AGENT participant. In addition, there may be optional participants, such as instruments. These are syntactically not necessary but can be expressed, for instance, in a prepositional phrase (e.g. *with a hammer*).

4.1.2 Levin (1993) and VerbNet

In this section, I will give an account of COS verbs in Levin (1993) and VerbNet. After a few general remarks (4.1.2.1), the remainder of the section is structured by the three subclasses of COS verbs in my data (sections 4.1.2.2 to 4.1.2.4), and concluded by a summary (section 4.1.2.5).

4.1.2.1 General remarks

Levin's (1993) class of COS verbs is very heterogeneous: It includes scalar and non-scalar verbs, the change-of-state can be externally caused or inherent in the patient, it can be of a very general kind or unique to a specific kind of entity, and it can affect different kinds of attributes of the patient (such as its shape or its material integrity). This semantic diversity is reflected in the six subclasses of COS verbs (Levin 1993, 240-248). To get a general idea of this class, Table 4.1 summarizes the semantics of the subclasses, while Table 4.2 gives an overview of

the respective semantic roles and restrictions in VerbNet. Note that the subclass of *remedy verbs* has been added in VerbNet and does not feature in Levin (1993).

TABLE 4.1: Types of COS verbs according to Levin (1993, 240-248).

Verb class	Semantics	Examples
Break verbs	change in an entity's material integrity	break, chip, crack
Bend verbs	change in an entity's shape	bend, crumple, fold
Cooking verbs	ways of food preparation	cook, steam, barbecue
Other alternating verbs of change-of-state	externally caused change of an entity's (physical) state	enlarge, blacken, acidify
Verbs of entity-specific change-of-state	change in an entity's state which is particular, and often inherent, to this entity	blossom, rust, swell
Verbs of calibratable changes-of-state	positive or negative change of an entity along a scale	decline, plunge, rise

TABLE 4.2: Semantic roles and selectional restrictions for subclasses of COS verbs in VerbNet. Abbreviations: + = core, – = non-core or not allowed, A = animate, C = concrete, IC = intentional control, S = solid, SC = scalar, sec. = secondary

	Agent	Patient	Instrument	Sec. result[38]	Attribute	Extent
Break verbs	IC	S	S	+	–	–
Bend verbs	IC	S	S	+	–	–
Cooking verbs	A	C	S	+	–	–
Other alternating verbs of change-of-state	IC	+	+	+	–	–
Verbs of entity-specific change-of-state	–	C	–	–	–	–
Calibratable verbs of change-of-state	–	+	–	–	SC	+
Remedy verbs	IC	+	+	–	–	–

I will now present the relevant subclasses of COS verbs in more detail. This overview serves three purposes. Firstly, it covers a methodological aspect in justifying why the base verbs occurring in my data set have been assigned to their

[38]In VerbNet, this role is called RESULT. However, this term only refers to secondary results in the verb classes discussed in this thesis, and primary results will play a role in my analysis. A doubling of terminology would be confusing, so that I have decided to relabel the VerbNet role.

respective subclass. Secondly, it complements Tables 4.1 and 4.2 by reviewing relevant alternations as well as differences between the subclasses, and by illustrating the respective semantic roles with example sentences. I will also motivate where and why I am adjusting some of VerbNet's terminology and assumptions. Finally, the informal presentation of the subclasses' semantics will pave the way for the frame-semantic formalization. The relevant subclasses are remedy verbs, other alternating verbs of change-of-state, and bend verbs. In the following, I will substitute these unintuitive labes by more descriptive ones which reflect their members' semantics: **causative-only COS verbs, causative/inchoative general COS verbs,** and **causative/inchoative reversible COS verbs** (abbreviated as c-only COS verbs, c/i general COS verbs, and c/i reversible COS verbs, respectively). An overview of the label matching is given in Table 4.3.

TABLE 4.3: Overview of the labels used for COS verb subclasses

Levin (1993)/VerbNet	Adjusted label	Abbreviated label
Remedy verbs	causative-only change-of-state verbs	c-only COS verbs
Other alternating verbs of change-of-state	causative/inchoative general change-of-state verbs	c/i general COS verbs
Bend verbs	causative/inchoative reversible change-of-state verbs	c/i reversible COS verbs

4.1.2.2 Causative-only COS verbs

As has been mentioned above, c-only COS verbs are a supplement of the VerbNet classification (there *remedy verbs*). It is obvious that the class was added in order to accommodate COS verbs without an inchoative variant (see section 4.1.1), which had not had a place in Levin (1993). Although VerbNet does not provide spelled-out definitions of verb classes, the verbs listed in the c-only COS subclass (e.g. *disinfect, disorganize, transplant*) are clearly externally caused changes-of-state.

I classified seven types in my data set as c-only COS verbs: *abridge, bedraggle, befoul, besmirch, debauch, embetter* and *uplift*.[39]

C-only COS verbs have three semantic roles: AGENT [+INT_CONTROL], PATIENT, and INSTRUMENT. An important observation can be made here: The roles

[39] *Uplift* will later recur as a psych verb relating to stimulating somebody morally. As a COS verb it often refers to social or economic stimulation.

listed in VerbNet are core roles, which means that they are frequently found in the respective verbs' participant structure. In reality, however, there is a continuum between verbs which always require a certain role (expressed or implied), and those that do not necessarily do so. For instance, *christianize* and *mineralize* are both c-only COS verbs, but *christianize* (presumably) always takes a volitional AGENT as an argument, while *mineralize* can also take inanimate CAUSERS such as chemical elements. In other words, *mineralize* does not actually require an AGENT with [+int_control], while *christianize* does.

4.1.2.3 Causative/inchoative general COS verbs

Most COS verbs in my data set are c/i general COS verbs (n=9): *congeal, decenter, diminish, disband, discolor, disperse, increase*, *progress* and *worsen*.

Verbs in this subclass lexicalize "externally caused change[s] of an entity's [...] state" (Levin 1993, 246). The effected change is often, but not necessarily of a physical kind (e.g. *liquefy, freeze*; *hasten, deteriorate*). Many c/i general COS verbs are de-adjectival (e.g. *americanize, blacken*), and all members prominently participate both in the C/I Alternation and in the Instrument Subject Alternation, given in (19) (from Levin 1993, 245).

(19) a. Bill **dried** the clothes with a hairdryer.
b. The hairdryer **dried** the clothes.

As regards semantic roles, c/i general COS verbs are almost identical to c-only COS verbs. All of them occur with AGENT [+INT_CONTROL], PATIENT, and INSTRUMENT roles, and a subgroup furthermore exhibits the semantic role of SECONDARY RESULT. This participant is of a different status than the other three since it only surfaces syntactically as a secondary predicate in this verb class.[40] For illustration, consider example (20). Since the verb *smooth* is a result verb (see section 4.1.1.2), it lexicalizes a result-state: After the event, the extensions will be smooth (or at least smoother than before). It has been observed that, if a resultative construction is added to such a verb, the lexicalized result is further specified. Thus, the sheets will not only be smooth, but, more precisely, flat (see Levin & Rappaport Hovav 1995, 50; Levin 2013, 7).

(20) Diane applies half a head, which is 12 wefts taped around the sides and back of my head [...]. That night in bed I have to keep **smoothing** them **flat** so they don't pull. (NOW MAG VogueAustralia 2013)

[40] All semantic roles in VerbNet are called *participants*, no matter their syntactic realization.

The difference between lexicalized and secondary results is reflected in the VerbNet frames as follows (my emphasis, PATIENT is abbreviated as PAT):[41]

(21) Example: The clothes **dried**.
Syntax: PAT V
Semantics: STATE(**RESULT**(E), ENDSTATE, PAT)

(22) Example: The clothes **dried** wrinkled.
Syntax: PAT V RESULT
Semantics: STATE(**RESULT**(E), ENDSTATE, PAT) PRED(RESULT(E), PAT)

In (21), there is only a *dry*-state, which is lexicalized in the verb and thus represented on the semantic level of the representation. In (22), there is an additional *wrinkled*-state, which is represented on both the syntactic and the semantic level. In order to avoid confusion, I will call only primary results RESULT, while the label for secondary results will correspondingly be SECONDARY RESULT.

In the c/i general COS subset of my data, only *congeal* and *discolor* seem to allow resultative secondary constructions. This can be concluded from corpus data as well as native speaker judgments.[42]

4.1.2.4 Causative/inchoative reversible COS verbs

The smallest subclass of COS verbs in my data set is that of c/i reversible COS verbs (n=2). It is represented by *embrittle* and *unfold*.

C/i reversible COS verbs refer to reversible changes in the shape of an entity (Levin 1993, 243). This seems to include surface structure, since verbs like *wrinkle* and *crinkle* can also be found in this class. They are semantically similar to c/i general COS verbs in that both subclasses share the same participant structure, differing only in the requirement [+solid] on the PATIENT and INSTRUMENT roles of c/i reversible COS verbs. Furthermore, both subclasses participate in the C/I Alternation, the Middle Alternation, and the Instrument Subject Alternation. What distinguishes them syntactically is that c/i reversible COS verbs are found in various additional resultative constructions which are not possible with c/i general COS verbs, as can be seen for example in (23).

(23) a. Tony **folded** the flaps open with his feet.
b. *Bill **dried** the clothes wrinkled with a hairdryer.

[41] Compare Jackendoff (1990), who represents the fact that a participant is completely incorporated into the verb meaning by leaving it unindexed in the verb's LCS (e.g. p. 164).

[42] An informant pointed out that *increase* can be found in the result-like construction *increase abundant*. However, the grammatical status of *abundant* is unclear, and other informants have rated the construction as archaic.

Assigning verbs into this class is problematic since the subclasses of c/i reversible COS verbs and break-COS verbs are syntactically identical and semantically very similar: Both participate in the same alternations given in Levin 1993 and VerbNet, and their semantics differs only in the aspect of reversibility, with break-COS verbs denoting irreversible changes-of-state (p. 242). Especially for *embrittle*, assignment into this subclass should be taken with a grain of salt: The reversibility of brittleness depends on the patient, so that *embrittle* could be considered both a break-COS verb and a c/i reversible COS verb. It is in fact often a matter of personal opinion whether a given change-of-state is reversible or not, and thus whether a verb is a c/i reversible COS verb or a break-COS verb.

4.1.2.5 Summary

The 18 base verbs in the COS data set can be assigned to three subclasses. These differ but also partly overlap with regard to their semantics, syntactic behavior (i.e. alternations), and participants. The similarities and differences are summarized in Table 4.4. Next, I will propose how to model these properties in frames.

TABLE 4.4: Properties of the COS base verbs in my data set. Abbreviations: alt. = alternation, ext. = external, int. = internal, int_control = intentional control, sec. = secondary

	C-only COS (n=7)	C/i general COS (n=9)	C/i reversible COS (n=2)
Event properties			
C/I Alt.	causative	alternating	alternating
Causation	ext.	ext. or int.	ext. or int.
Type of change	state	state	physical form
Participants			
Agent	int_control	int_control	int_control
Patient	+	+	solid
Instrument	+	+	solid
Sec. result	-	-/+*	+
Verbs	abridge bedraggle befoul besmirch debauch embetter uplift	congeal* decenter diminish disband discolor* disperse increase progress worsen	embrittle unfold

One last remark is in order before doing so. Recall that the participants listed in VerbNet are those *typically* occurring with a given verb. Accordingly, a "-" in Table 4.4 (and all similar tables) does not necessarily imply that a given participant cannot occur in the context of the verbs in this subclass. For instance, some c/i general COS verbs do allow for constructions with EXTENT, underlined in the following attestation:

(24) NASS itself reports that in 2005-06, students' average reading scores **progressed** by 1.5 grade levels (COCA ACAD EducationWeek 2007)

4.1.3 Frame decomposition of COS verbs

In this section, I will model the semantics of COS verbs in frames. The section is organized by type of causation: I will start with those verbs which are exclusively externally caused (c-only COS verbs, section 4.1.3.1), and then extend the formalization to those verbs which can be either externally or internally caused (c/i general COS verbs, section 4.1.3.2, and c/i reversible COS verbs, section 4.1.3.3). Since each frame developed in this section represents one subclass of COS verbs in VerbNet, I will call them **VerbNet-based frames** for later reference. The event decomposition is geared to the event frames as introduced in section 2.2, and further frame-related literature will be introduced as needed. The participants correspond to VerbNet semantic roles as discussed in section 4.1.2.[43]

4.1.3.1 Causative-only COS verbs

C-only COS verbs are modeled in causation frames, which are frequently discussed in the frame literature. We have already seen such a frame for the causative variant of the c/i verb *break* in section 2.2. Verbs which only have a causative variant are modeled with the same event structure template. For example, Kallmeyer & Osswald (2012, 50) model the caused motion verb *throw* as a complex causation-event with a CAUSE and an EFFECT subevent. I can therefore use the event structure template for causative (variants of) verbs provided in the literature, and adjust it to match the semantics of c-only COS verbs according to VerbNet. Figure 4.1 depicts a first attempt at modeling the class of c-only COS verbs accordingly. The frame is a generalized lexical frame as motivated in section 2.3.2.3.

In the AVM, we first find the frame type, *change-of-state causation*. As defined in the type signature, this event type has a change-of-state as the second subevent.

[43] Semantic roles are correlate attributes for events (Löbner 2018, 4).

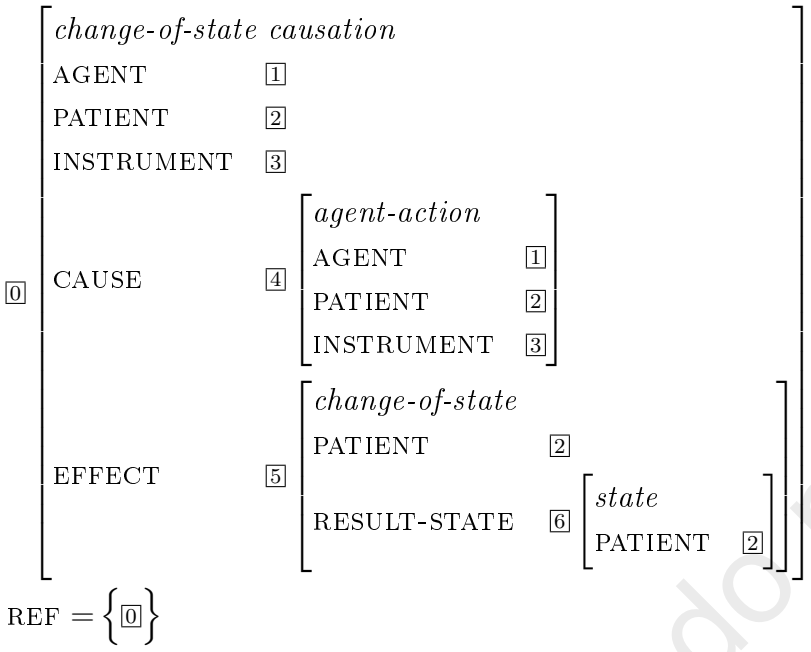


FIGURE 4.1: Frame for c-only COS verbs, e.g. *bedraggle*

Next come the participants of the complex event. These three attributes are the semantic roles given for c-only COS verbs in VerbNet. They are followed by the event decomposition. The first subevent, CAUSE, is an agentive action, which accounts for the fact that VerbNet only lists an AGENT as a causing entity (as opposed to other subtypes of ACTOR). The first subevent also has an INSTRUMENT and a PATIENT participant.[44] The second subevent, EFFECT, is a change-of-state which at some point reaches a result-state, the only participant of which is the PATIENT of the complex event.[45] The subevents are unspecified with regard to direct versus indirect causation as well as with regard to punctual versus durative change.

Below the semantic decomposition, the referent of the frame is specified by a mathematical set (see section 2.3.2.2). Strictly speaking, reference in an AVM would standardly be assumed to be on 0 anyway, but it is included here for the sake of explicitness and comparability to later frames.

[44]For my purposes, it is irrelevant whether or not a participant is obligatory or just frequent; I am only interested in its status as a core role of a given verb class. Optionality of a participant in a given event type is fixed in the type signature (see Figure 3.2).

[45]In some talks and publications preceding this thesis, I modeled the change-of-state subevent also with an INITIAL STATE. Now, I think that the initial state is not in fact part of the base verb semantics, but is only presupposed. In other words, that there is some sort of starting point at the beginning of a change-of-state can be regarded as world knowledge rather than lexical knowledge. This is in line with other frame-semantic approaches to COS verbs, such as Kallmeyer & Osswald (2013) or Osswald & Van Valin (2014), and also with other formal approaches such as Rappaport Hovav & Levin's (1998) modeling of result verbs.

4.1.3.2 Causative/inchoative general COS verbs

The first subclass of COS verbs which allows for the C/I Alternation is that of c/i general COS verbs. In the frame literature, verbs participating in this alternation are represented by separate frames, a complex event frame for the causative variant and a simple event frame for the inchoative variant (e.g. Osswald & Van Valin 2014; Seyffarth 2018). These are related to each other in that the inchoative frame is embedded in the causative frame.[46] The causative frame of a c/i general COS verb does not, however, differ from the frame of a c-only COS verb.

I propose two options for representing c/i general COS verbs, which can then be tested with my nominalization data. The two options reflect two positions in the literature (see section 4.1.1), namely that the inchoation can either depend on a CAUSE or happen independently of it. In this line of thinking, the approach assuming embedded frames would reflect that inchoation can indeed happen independently since the inchoation frame can exist on its own. The corresponding frame for c/i general COS verbs is given in Figure 4.2.

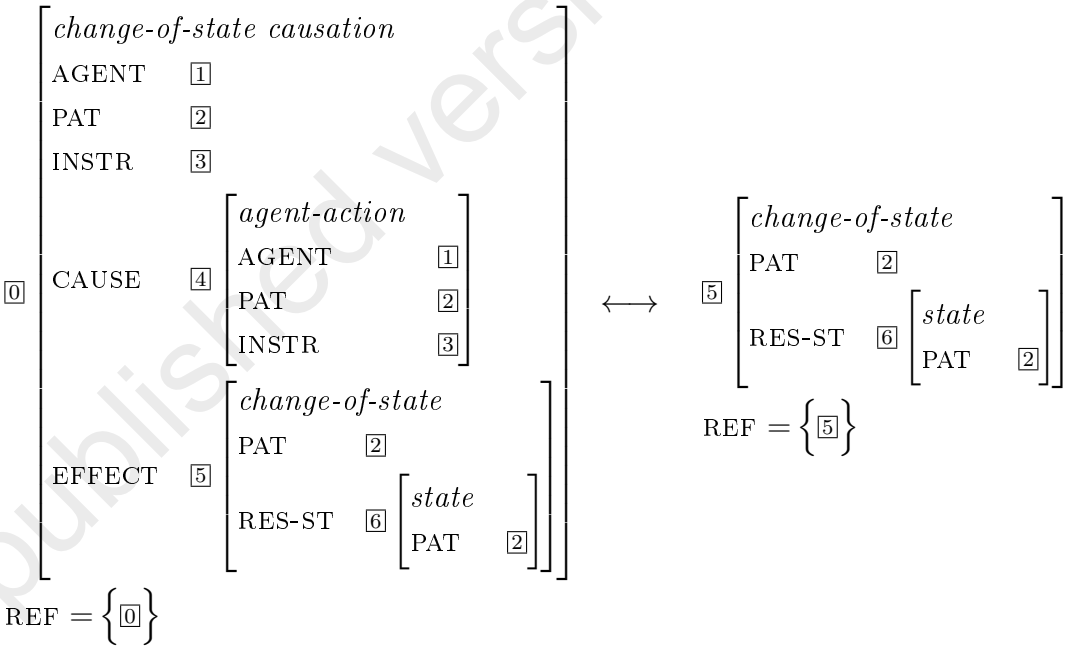


FIGURE 4.2: Frame for c/i general COS verbs (e.g. *congeal*; embedded subevent), inspired by Osswald & Van Valin (2014). Abbreviations: pat = patient, instr = instrument, res-st = result-state

[46] A joint, underspecified frame could cover the shared semantics of both variants (Seyffarth 2018). This frame would, however, not model event structure, which is required for this study.

In this figure we can see a complex event frame to the left, and a change-of-state frame to the right. The two-headed arrow connecting them reflects two things: First, that these two frames are connected, and second, that I am not making a statement as to which variant is primary. That one is embedded in the other is also expressed by co-indexation of the *change-of-state* node (5).

The second approach builds on the idea to indicate reference as a mathematical set within the frame. As can be seen in Figure 4.3, the possible referents can be identified as either the complex event (0), or the change-of-state (5). This represents the position in the literature that the inchoation event cannot happen independently; the *change-of-state* 5 is always linked to the causing *agent-action* 4 by way of the complex event 0.

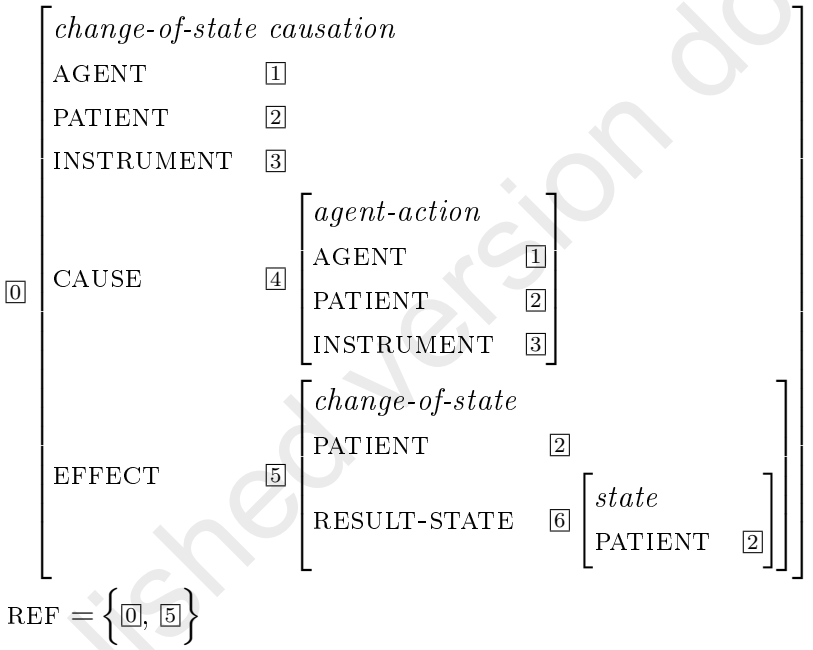


FIGURE 4.3: Frame for c/i general COS verbs (e.g. *congeal*; single frame)

Note that the frames in Figures 4.2 and 4.3 do not reflect that some c/i general COS verbs allow a secondary result of the type *The clothes dried wrinkled* in their argument structure. In VerbNet, this is reflected by the semantic role RESULT (re-labeled by me as SECONDARY RESULT). Modeling a secondary result-state in frames is rather complex since this construction is at the syntax-semantics-interface. The mechanism which is best suited to model contexts like this is that of frame modification. For example, Balogh & Osswald (in press) use a combination of frames and Role and Reference Grammar (RRG; Van Valin 2005) to model the interaction between semantics and syntax in the resultative modification of verbal

particles in Hungarian.[47] I will not go into the details of their approach here, since secondary result predicates are not imminently relevant for the semantic analysis of derivation: Being modifiers which act on the frame of certain base verbs, their semantics cannot be accessed by an affix. Further research on the syntax-semantics-interface will be necessary to determine why only *congeal* and *discolor* allow for secondary resultative modification while the other verbs in the data set do not.[48]

4.1.3.3 Causative/inchoative reversible COS verbs

C/i reversible COS verbs have the same participant structure as those c/i general COS verbs with a secondary result-state, and they participate in the same alternations, including the C/I Alternation. Therefore, the two frame options for c/i general COS verbs also hold for c/i reversible COS verbs, with a few specifications (see Figures 4.4 and 4.5).[49]

First, these verbs describe reversible changes. In VerbNet, this is reflected by the semantic primitive PHYSICAL_FORM. Irreversible change, on the other hand, is indicated by an additional primitive DEGRADATION_MATERIAL_INTEGRITY (as, for example, in the description of break-COS verbs). PHYSICAL_FORM is applied in lieu of the STATE primitive, which is present in the semantic description of c-only COS and c/i general COS verbs, and which I have so far translated into frames as a *change-of-state* subevent. Correspondingly, the frames which I propose for c/i reversible COS verbs do not include a *change-of-state*, but rather its subtype *change-of-physical-form*, including the corresponding attribute-value combination RESULT-STATE : *having-form*.

Second, VerbNet introduces a selectional restriction [+solid] on both the PATIENT and the INSTRUMENT roles. This can straightforwardly be modeled in frames by introducing a PHYSICAL-STATE attribute and specifying it with the value *solid*.

[47] See also Osswald & Kallmeyer (2018) for a frame-syntactic approach to English adjectival resultative constructions (*kick open, wipe clean*), and Petersen & Gamerschlag (2014) for a frame model of depictive secondary predicates.

[48] I have observed that the nominalizations can be found in the same constructions as their base verbs, semantically speaking (e.g. *yellow discolorment, solid congealment, white congealment*). It can therefore be assumed that the approach put forward by Balogh & Osswald (in press) for verbs can rather easily be adapted to model the modification of nominalizations.

[49] C/i reversible COS verbs participate in a larger number of resultative constructions compared to c/i general COS verbs. These, however, are syntactic details which do not concern us here, as I have justified in the previous section.

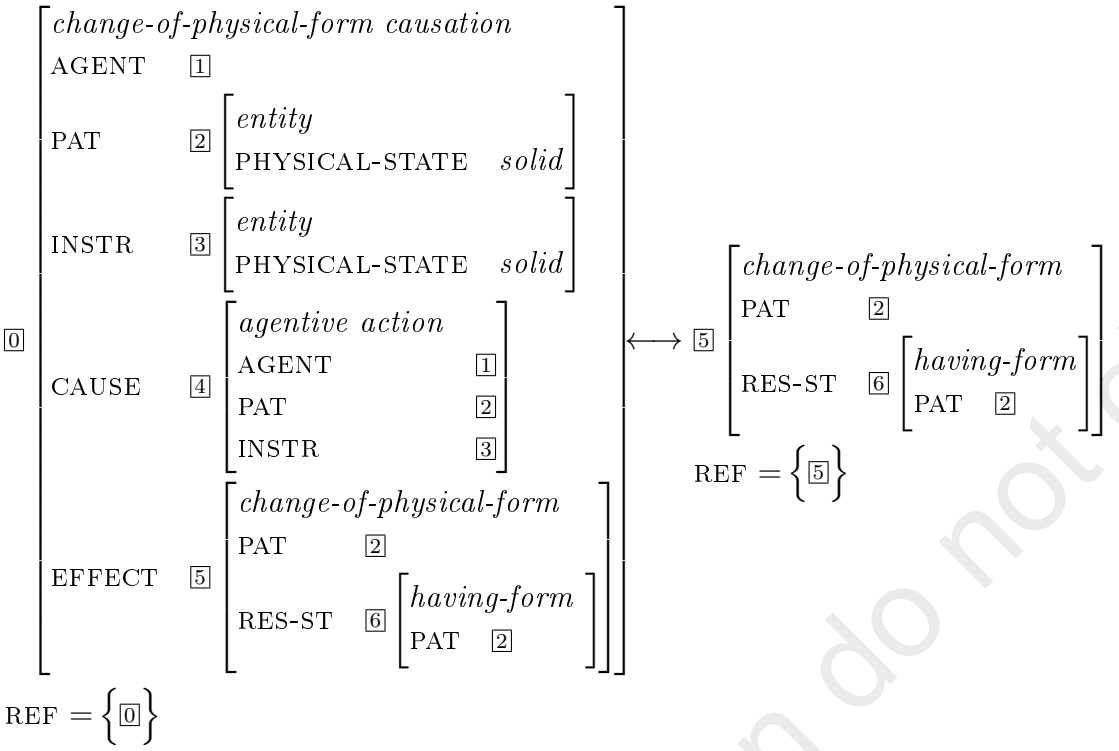


FIGURE 4.4: Frame for c/i reversible COS verbs (e.g. *embrittle*; embedded subevent). Abbreviations: PAT = PATIENT, INSTR = INSTRUMENT, RES-ST = RESULT-STATE

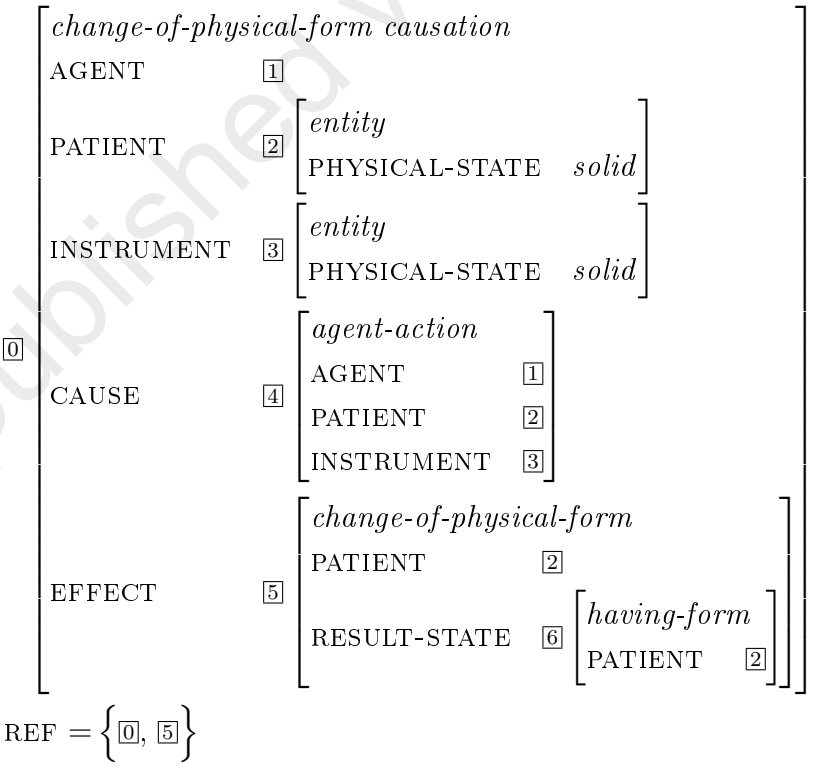


FIGURE 4.5: Frame for c/i reversible COS verbs (e.g. *embrittle*; single frame)

4.2 The semantics of COS nouns

In this section, I will first summarize the literature dealing with *-ment*'s general semantics (section 4.2.1). Based on this information and the preceding discussion of COS verb bases, I will then describe what can be expected for the semantics of COS nouns (section 4.2.2). I will then present an informal survey of readings attested in COS nominalizations, relating these findings to the literature (section 4.2.3). Finally, I will proceed to the formalization of COS nominalization (section 4.2.4). Based on my findings regarding *-ment* derivatives, I will be able to revise the VerbNet-based frame-semantic analyses as presented in section 4.1.3.

4.2.1 The semantics of *-ment*

There are a number of (traditional) accounts describing the semantics of *-ment* in some detail. Table 4.5 gives an inventory of five representatives, including the semantic categories used by these authors to describe *-ment* derivatives. From these accounts, it is obvious that *-ment* is (and has been) a versatile suffix which can produce a whole range of readings, including both eventive categories (e.g. ACTION, STATE, EVENT) and non-eventive ones (e.g. MEANS, PATIENT, PRODUCT).

The first listed account, Gadde (1910, 77-85), analyzes dictionary data and finds that English *-ment* derivatives most often denote abstract ideas such as ACTIONS or STATES, but can also be found denoting MEANS or RESULTS of an action (which he calls *quasi-concretes*). Least productively, *-ment* nominalizations may express concrete notions such as 'something written.'

Marchand's (1969, 332) findings are similar: He reports "the meanings which are usual with deverbal substantives," with STATE readings being the most productive. These are formed mainly on the basis of verbs which denote mental or emotional states (ibid.). In the present study, these formations will be dealt with in chapter 5 under the label of **psych verbs**. The author furthermore mentions a small group of PLACE nouns in *-ment*.

A recent corpus study investigating *-ment* neologisms can be found in Bauer et al. (2013). In their data extracted from COCA and the BNC, the authors find a range of readings which is similar to the ones sketched for established formations

[50]Note that the terms *instrument* and *means* are used inconsistently in Bauer et al. (2013). In chapter 10, both are used synonymously. Later, a distinction is being made, with an instrument such as *beeper* being defined as being directly involved, while a means such as *stroller* is something that permits one to perform an action (see p. 241). It is for this reason that table 11.1 in Bauer et al. (2013, 231) lists MEANS as a secondary reading for *-ment*, and excludes INSTRUMENT.

TABLE 4.5: Possible readings of *-ment* derivatives as stated in the literature

Author	Category	Example
Gadde (1910)	action	repayment
	state, condition	astonishment
	means	embarrassment
	result (product)	entrenchment
	concretes	advertisement
Marchand (1969)	act, fact, instance	enthronement
	something concrete or material	equipment
	state	amazement
	place	settlement
Bauer et al. (2013)	eventive	ceasement
	state	contentment
	result	improvement
	product	pavement
	instrument/means[50]	refreshment
	patient/theme	investment
	location	establishment
Lieber (2016)	event/state	appointment
	result	impeachment
	instrument/means	adornment
	[-animate] patient	investment
	location	development
Lloyd (2011) (Middle English)	collective	vesselment
	agent	parlement
	action: fact	attainement
	action: quality	jugement
	object	wonderment
	result/state	consentement
	action: instance	confermement
	instrument	encumberment

by Gadde (1910) and Marchand (1969). The authors state that the suffix primarily forms EVENT and STATE readings, with a secondary function of forming a number of participant nouns. Within this second group, the RESULT reading is "by far the most frequent one exhibited" and may thus be considered the "default non-eventive interpretation" (212).

Lieber (2016) continues some of the work done in Bauer et al. (2013). The author introduces a new category [-animate] PATIENT (as opposed to [+animate]

PATIENT), which subsumes both the inanimate members of the traditional PATIENT category as well as Bauer et al.'s PRODUCT (Lieber 2016, 19). EVENT, STATE and RESULT readings are predominant readings found with *-ment* (p. 60).

Finally, I have included Lloyd (2011), who treats the semantics of *-ment* in Middle English. While most categories found in Middle English neologisms correspond to those described for contemporary English, we find two additional ones. The two denominal formations *vesselment* and *utensilment* signify 'group of Ns,' representing the category of COLLECTIVE (p. 40). The author's second category contains two deverbal formations and is therefore more interesting in the context of my study: *parlement* and *governement* were both coined in the 14th century and have since kept their senses of 'executive body' and 'body of people who govern' (p. 40, p. 46). While Lloyd (2011) summarizes the two under the label AGENT, something like Melloni's (2011) label AGENTIVE-COLLECTIVE seems to be more appropriate. She finds that Italian nominalizations like *amministrazione* 'administration,' and *redazione* 'editorial staff' lack an agentive value and thus cannot denote agents, with the exception of AGENTIVE-COLLECTIVE readings. These are defined as "groups of people agentively and volitionally involved in the performance of a certain activity" (p. 121). In English, this reading is very rare, and the standard suffixes for this purpose are not *-ment*, but *-age* and *-ery* (see Lieber 2004, 148 ff.). Those AGENTIVE-COLLECTIVE derivatives which do exist with *-ment* (*government, management, parliament*, and the now opaque *department*, as well as *scholarment* – a nonce word by James Joyce, according to the OED), also lexicalize habituality, or even profession.

Apart from *-ment's* ability to form various readings on different kinds of bases, the polysemy of its individual formations has also been recognized. Thus, Marchand (1969, 332) states that "[m]any words join several sense groups," and Gadde (1910) finds a systematic sense extension from MEANS and PRODUCT to ACTION (p. 80). This interplay between polysemy and systematicity is one of the starting points of this dissertation.

4.2.2 Expectations regarding the semantics of COS nouns

Based on the existing literature on *-ment* as well as the COS verb frames, what can we expect with regard to semantics of COS nouns? In this section, I will first give an overview of expected possible and impossible readings (section 4.2.2.1). Then, I will elaborate on the contexts in which we can expect the different COS

nouns, based on the type of causation denoted by the respective base verb (section 4.2.2.2).

The expectations formulated in this section serve two main purposes. Firstly, they provide a structure for later discussion, making the rather complex analysis more accessible. Secondly, they offer reference points for testing the validity of the frames proposed above. If an expectation is not met by the data, the frames have to be adjusted accordingly. This interplay between frames and language data will allow for an appropriate and useful formalization.

4.2.2.1 (Im-)possible readings

A summary of expected possible and impossible readings is given in Table 4.6. It is sorted by category, more precisely by type of node (event vs. participant), and alphabetically.[51] Since the starting point of this dissertation is the assumption that derivational processes can target nodes in the base verb frame, very generally we can expect that morphological processes can target any node which fulfills the frame-theoretical requirements for shifts (see section 2.3.2.2). Therefore, only the presence or absence of nodes in the base verb frames predict the (im-)possibility of shifts at this point (second column).[52] Obviously, the literature is more differentiated and realistic. Some readings are expected (e.g. RESULT-STATE), while some are expected under certain conditions (e.g. [-animate] PATIENT, but not [+animate] PATIENT). Others are not expected (e.g. BEHAVIOR), while one reading (CAUSE) has not been addressed in the literature as of yet.[53]

Whether or not these expectations are met by the data has different consequences for the frames proposed above. If I fail to find referential shifts to some of the nodes, this needs to be explained and modeled accordingly. If, on the other hand, I find shifts to readings which are not modeled in the base verb frames, there are two options: Either the frame is incomplete, so that the respective nodes need to be introduced into the base verb semantics, or it would have to be argued that the nodes are somehow introduced into the frame during the derivation process by a unification mechanism (initiated by the suffix, or by the context).

[51] Since there is no unified terminology for these categories in the semantic literature, I have taken the labels from two of the most detailed analyses, namely Bauer et al. (2013) and Lieber (2016).

[52] Obviously, there are restrictions related to a given derivational process: Readings will be more or less likely or frequent, and some readings will not be attested at all. The frame formalizations as given above, however, do not yet point to any such tendencies.

[53] The list of unexpected readings is largely based on Lieber's (2016) Table 4.1. Further categories are irrelevant here because they are very affix-specific and/or do not take verbal bases: ABSTRACT (*happiness*), INHABITANT/LANGUAGE (*New Yorker*), and BELIEF (*atheism*).

4.2.2.2 Contexts

I will now turn to the effects that the base verb's type of causation may have on its derived noun. More precisely, I hypothesize that the contexts that COS nouns occur in depend partly on whether their base verb denotes internal or external causation (see section 4.1.1). This is also related to the question of which frame-semantic representation is the best fit for c/i COS verbs (see section 4.1.3).

As discussed in section 4.1.1, Smith (1970) claims that the change-of-state included in the semantics of c-only COS verbs is completely dependent on some external entity. The change-of-state in the semantics of c/i COS verbs can also be brought about by an external causer, but is at the same time thought to be relatively independent of one. These two assumptions can be tested by examining the contexts of c-only COS nouns and c/i COS nouns in CHANGE-OF-STATE readings. First, for c-only COS nouns in a CHANGE-OF-STATE reading, an external entity should always be expressed in context, or at least implied. This is modeled by the complex event structure, which by definition includes an external cause. Second, for c/i COS nouns in a CHANGE-OF-STATE reading, it could be possible to leave out external causes in context if the inchoative base exists independently of its

TABLE 4.6: Expected and unexpected shifts in COS verb frames. Abbreviations: lit. = literature, n.a. = not available

Reading	Predicted by frame	Predicted by lit.
Eventive readings		
change-of-state causation	yes	yes
cause	yes	n.a.
change-of-state	yes	yes
result-state	yes	yes
Participant readings		
adherent/follower	no	no
agent	yes	collective
behavior	no	no
experiencer	no	no
instrument	yes	yes
location	no	yes
measure	no	no
path	no	no
patient	yes	inanimate
product	no	yes
result	no	yes

causative counterpart. This, in turn, needs to be reflected in the frame formalization. If the cause is always expressed or implied in context, a complex event frame with reference on the change-of-state node should be used both for c/i COS nouns in a CHANGE-OF-STATE reading and for the inchoative variant of c/i COS verbs. In this case, c/i COS nouns (i.e. c/i general COS and c/i reversible COS nouns) would behave the same as c-only COS nouns in this respect. The CHANGE-OF-STATE reading comes about by a shift from the complex event node in the verb to the change-of-state subevent node in the noun. If, however, we do not find expressed or implied causes in the contexts of c/i COS nouns, the most adequate representation for their CHANGE-OF-STATE reading, and for the inchoative variant of c/i COS verbs, is a simple event frame with reference on the central node. In this case, the CHANGE-OF-STATE reading comes about by transposition from the inchoative variant of the verb. To summarize:

1. C-only COS verb bases: In CHANGE-OF-STATE readings of c-only COS nouns, external causes are either expressed in the context, or implied.
2. C/i COS verb bases: In CHANGE-OF-STATE readings of c/i general COS nouns and c/i reversible COS nouns, ...
   (a) ...external causes are either expressed in the context, or implied; or,
   (b) ...external causes are not expressed in the context, nor implied.

4.2.3 Survey of possible readings

In this section, I will first present and discuss participant readings (sections 4.2.3.1 to 4.2.3.4) and then move on to eventive categories (sections 4.2.3.5 to 4.2.3.8). Shifts which have not been found attested will be treated last (section 4.2.3.9), and a summary can be found in section 4.2.3.10.

4.2.3.1 Inanimate patient

Shifts to PATIENT readings can easily be found for five nominalizations, as exemplified in (25). The remaining noinalizations are attested as RESULTS or PRODUCTS instead. I will discuss this distribution in the respective sections below.

(25) a. I set down the scrap of doll's dress, a **bedragglement** of loose lace hem (COCA FIC Bk:MournersBench 1999)

b. "When yoga was in its womb in India, it was safe and protected, but as it ventures into the harsh world, it is in danger of disintegrating," [...] Gerson refers to most of the newer yoga classes as "**debauchment**." Yoga purists such as Gerson are calling for a return to teaching yoga in its original form (WC NEWS articles.latimes.com 2002)

Note that *debauchment* is ambiguous here: It can be interpreted as an INSTRUMENT (new yoga classes debauch the tradition) or as a PATIENT (yoga is something that has been debauched by new classes). This is a typical case of insufficient context. It is obvious that the speaker only intended one of the two readings, but without an unambiguous cue (such as *because they debauch the tradition* indicating an INSTRUMENT reading) it is impossible to know.

Lieber (2016) found that *-ment* can only produce [-animate] PATIENT readings, which is why I did not expect to find any [+animate] PATIENT readings. I can corroborate her claim, with very few exceptions like this one:

(26) A short, squallid [sic] woman with a face like a toad wearing a horrible pink cardigan pattered past, turning up her nose in distaste at this **befoulment** sitting on her ministry bench. (WC FIC fanfiction.net 2007)

In this attestation, which I have categorized as ambiguous between a PATIENT and a CAUSER reading (see section 4.2.3.4, where CAUSER is introduced), the *befoulment* is a person. This, however, is a typical example for a post-lexical shift coerced by context. Examples can easily be found in the corpora (see also section 5.2.2.1; Löbner 2008):

(27) You are such a **comfort** to me, dear (COCA FIC Bk:BasketBrigadeChristmas 2016)

The limitation to [-animate] PATIENT readings does not go back to the base verb semantics, since animate patient participants are possible for most base verbs in the data set. For example, something may *bedraggle the most noble among us* (GB) or *befoul one family after another* (iWeb). Some verbs only allow collective [+animate] patients (*disperse the Germans, iWeb; disband the committee*, COCA). Only a few do not allow for animate patients at all (*abridge, embrittle*). It can thus be concluded that the restriction to [-animate] PATIENT readings in the *-ment* nominalizations must originate from preferences of the suffix.

4.2.3.2 Result

The next reading, attested for nine types in my data, is that of RESULT:

(28) a. The performance **increasement** and the darker interface are looking gorgeous! #photoshop #cs6 bit.ly/xzlsAV (*Twitter* @maxlewe 2012)

b. No one could say that he was going bald – he is grateful for that – but his hair has lost its luxuriance and, once jet black, is gray now, and he keeps it cropped short to conceal the **diminishment** (COCA FIC Bk:LoveMyYouth 2011)

c. In 2010 only, 2627 cases of morbidity were reported followed by an **increasement** of 9% in 2011 with 2865 reported cases. (*Google* ACAD ijergs.org 2014)

This finding is especially interesting because, according to VerbNet, the only context in which the RESULT role surfaces for the base verbs in question is in secondary predication (as in *strangle **to death***). Therefore, as justified above (section 4.1.3.2), RESULT has so far not been included in the base verb frames – a decision which needs to be revised in the final frame formalization.

RESULT and PATIENT readings are found in complementary distribution in my data: If a type can denote a patient, it will not denote an implicit product, and vice versa. Thus, *bedragglement, befoulment, congealment, debauchment* and *unfoldment* are only attested in PATIENT readings, while *abridgement, besmirchment, decenterment, diminishment, dispersement, embetterment, increasement, progressment* and *worsenment* are only attested as RESULTS. I will come back to this distribution in the next section.

4.2.3.3 Implicit product

Following the VerbNet definition (see Palmer et al. 2017, 319), a product is a "[r]esult that is a concrete object." While this semantic role is not listed for COS verbs, I have found PRODUCT readings for two nominalizations: *discolorment* and *embrittlement*.[54] Consider the following examples for illustration:

(29) a. Interior is generally very well kept, just some **discolorment** on the steering wheel (*Google* COMM sfbay.craigslist.org 2017)

b. After 8 weeks of hydrolytic degradation, the nonwoven fabric was broken. There is an obvious **embrittlement** and cracking on the nonwoven fabric (Figure 6.5b). (GB ACAD Cellulose Based Composites 2014)

The underlined parts in these attestations illustrate that the PRODUCT nominalizations in my data set denote what I will call **implicit products**. In such contexts, two entities are involved in the event: A patient is affected, and a product, which is inherently related to the patient, is created. As Osswald (2019, 264) observes: "Injuries and damages are objects on a par with stains and holes – dependent on the object they are attached to," stating further that "something is implicitly 'created' ." For example, an embroidery (IMPLICIT PRODUCT) is created

[54] PRODUCTS have also been called RESULT OBJECTS (e.g. Schulzek 2019), or EFFECTED OBJECTS, in opposition to AFFECTED OBJECTS, which correspond to PATIENTS (see e.g. Motsch 1999, 343; Hopper 1986).

while embroidering a pillow (PATIENT).Implicit products can be distinguished from **explicit products** such as *building*. Here, the action denoted by the base verb *build* also produces something, but it does not affect a patient in the process. I need the distinction between implicit and explicit products for two reasons: First, the two categories are modeled differently in frames, and second, only implicit products are attested in my data.

Importantly, the implicit products created by discoloring and embrittling, respectively, do not surface syntactically. Therefore, like the primary RESULT reading discussed in the preceding section, IMPLICIT PRODUCT is not listed as a participant in VerbNet, and is therefore not included in the VerbNet-based frames.

It can be a bit tricky to distinguish IMPLICIT PRODUCT from PATIENT nominalizations in corpus data. Disentangling the participant structure of a given attestation helps in this case. For example, compare the PATIENT attestation in (25a) to the IMPLICIT PRODUCT attestation in (29a). Both examples have a PATIENT, but a product is created only in the second example. In (25a), *bedragglement* is co-referential with *the scrap of doll's dress* (the PATIENT), while in (29a), the *discolorment* (PRODUCT) is on *the steering wheel* (PATIENT).

Let us now return to the distribution of PATIENT and RESULT categories. I have mentioned in the preceding section that these are in complementary distribution in my data, and the same observation can be made for IMPLICIT PRODUCT – a subtype of RESULT: *discolorment* and *embrittlement* are only attested in IMPLICIT PRODUCT readings. This pattern is not predicted by the VerbNet-based frames since it is not systematically related to the VerbNet classes. In other words, introducing the categories RESULT and PRODUCT into the mix creates subdivisions of the data which do not correspond to VerbNet classes. An overview is given in Table 4.7. For example, 50% of c/i reversible COS verbs are attested in a PATIENT

TABLE 4.7: Distribution of PATIENT, IMPLICIT PRODUCT and RESULT readings across COS noun subclasses, rounded to the nearest percent. Abbreviations: impl = implicit, n.a. = not attested

Noun class	PATIENT	IMPL. PRODUCT	RESULT	n.a.
c-only COS	43%	0%	43%	14%
c/i general COS	11%	11%	67%	11%
c/i reversible COS	50%	50%	0%	0%

reading, while the other 50% can produce an IMPLICIT PRODUCT reading. However, PATIENT readings were also found both for 43% of c-only COS nouns and for 11% of c/i general COS nouns.

Based on this distribution, we can formulate the following pattern: All events denoted by the base verbs in my data set affect a PATIENT participant. If, additionally, an IMPLICIT PRODUCT or a RESULT is created in the process, the *-ment* nominalization will refer to this entity, respectively, and not to the PATIENT.

4.2.3.4 Instrument and inanimate causer

As expected, I have found shifts to INSTRUMENT readings in all COS subclasses. An example is given in (30), where *congealment* clearly refers to something that is used by an agent to congeal the blood.

(30) Minimal bleeding and I didn't have to have any guaze[sic]/tissue in my mouth at all to try and stop it? I'm thinking that they must have used a **congealment** or something to make it clot while I was under or something? (GloWbE COMM forums.whirlpool.net.au 2010)

Clear INSTRUMENT readings were attested for eight types in the data set: *befoulment, besmirchment, congealment, dispersement, embetterment, embrittlement, increasement* and *progressment*. For ten types, I found readings which are more appropriately categorized as CAUSERS. A causer is a participant that "initiates the event, but that does not act with any intentionality or consciousness" (Palmer et al. 2017, 317). It is conceptually similar to an instrument, but it is not manipulated by an agent and is therefore a subtype of ACTOR rather than of UNDERGOER in VerbNet. CAUSER has already been introduced as a hyperonym of the STIMULUS category, which will be needed for the formalization of psych verbs and nouns.

CAUSERS in my data include a variety of inanimate entities, for example *the phial* in (31a), *Seifer's blood* in (31b), or *an approach* in (31c). Inconclusive attestations in which the nominalization can be paraphrased as 'something which causes V-ing' have been categorized as ambiguous between a CAUSER and an INSTRUMENT reading, since it can neither be determined nor ruled out that an intentional agent is involved. An example is given in (31d).

(31) a. You see, almost directly after sipping the potion, I noticed the **befoulment** on Severus's otherwise orderly working area. Yes... the phial in which rested the forbidden love-potion. (*Google* FIC fanfiction.net 2006)

b. I stood, looking at the rip that ran through the back of the black material, surrounded in **discolorment** I classified as Seifer's blood. (*Google* FIC fanfiction.net 2001)

c. Besides, such an approach is seen not as a **diminishment** of public health but rather as a net zero-sum game in which the source of funding gets changed but not the overall funding level. (COCA ACAD EnvironHealth 2002)

d. @OfficialMCPB They've been a great view **increasement** for me, They got me the views and I got accepted to The Game Station Network :) (*Twitter* @ShotbowNetwork 2012)

The distribution between INSTRUMENT and CAUSER readings is partly complementary. That is, most nominalizations have been found attested as either one or the other (e.g. *congealment* as an INSTRUMENT, *discolorment* as a CAUSER), but some types can also denote both instruments and causers (e.g. *befoulment*). Attempts to explain this pattern are speculations at this point, but it seems likely that it is to a large extent due to a frequency effect of the base verb participants. Thus, speakers may tend to use verbs like *congeal* more often with an agent and an instrument participant, as in (32a), and verbs like *discolor* more often with a causer, as in (32b), while the distribution of *befoul* may be rather balanced, as in (32c) and (32d). Spot checks in the corpora verify that there are definitely tendencies in this direction, but a robust quantitative analysis will have to be left for future research.

(32) a. Baking powder is often times [sic] used in sauces (like this one) to help **congeal** the ingredients together. (iWeb COMM acozykitchen.com 2015)

b. Over time, food, beverages and other substances will form another layer on top of the enamel called a pellicle film, which is a buildup of foreign materials that can **discolor** the surface of teeth and lead to stains. (iWeb WEB fsastore.com 2020)

c. This [...] removes the necessity of paying $8000.00 to U-haul and **befouling** the air with diesel. (iWeb COMM thetinylife.com 2012)

d. [...] a flock of up to 30 turkey vultures spend the night **befouling** an upper crust roof befeore [sic] catching the morning thermals to cruise the Huron river for carrion.... (iWeb COMM annarbor.com 2011)

Two types have been found in neither an INSTRUMENT nor a CAUSER reading (*decenterment* and *disbandment*). This also seems to be a frequency effect. *Decenter* can rarely be found with a causer instead of an agent, instruments are also highly infrequent. Similarly, *disband* seems to always denote an intentional event, allowing no causers at all, while contexts with an instrument are possible but very rare.

Finally, a note on the selectional restrictions of the INSTRUMENT and CAUSER categories is in order. First, [+solid] is given in VerbNet for instrument participants of c/i reversible COS verbs. This restriction indeed applies to most attestations, with some exceptions such as the one in (33).

(33) Supercaustics, also called supercorrosives, are powerful acids that quickly eat through polymers (rubber and plastic) and metals. They include acids known as **embrittlements** which weaken metals, and ones which dissolve polymers called depolymers. (WC BLOG newworldwar.org 2011)

Second, all identifiable referents both of INSTRUMENT and of CAUSER nominalizations are inanimate. This will play a role in the modeling of (im-)possible readings.

4.2.3.5 Transposition of a complex event

Transposition is generally regarded as a change of syntactic category of a word without a change in the semantics (though see Lieber 2015 for criticism of this notion). In this study, this means that the complex event denoted by a given base verb is also a possible reading of its nominalization. As has also been observed by Bauer et al. (2013, 207), such readings are most easily identifiable when the complete argument structure of the verb is present, as exemplified with a constructed sentence in (34a) and a corresponding attestation in (34b). Transpositions of complex events were identified for all types in the data set.

(34) a. Hydrides **embrittle** the cladding.
b. Hydrides then form and can limit the fuel lifetime due to their **embrittlement** of the cladding. (*Google* WEB imperial.ac.uk 2014)

The complex event structure demands an external cause which, I have argued, can be expressed in the context of the nominalization, or merely implied. Indeed, in most examples, identifying a cause is as straightforward as in (34b). An example for an implied cause is given in (35): World knowledge dictates that rural areas don't just uplift themselves; they need someone to act or something to happen to be uplifted.

(35) Nor have hopes and expectations for the **upliftment** of the rural areas been aroused as the Busia group managed to do in the late 1960s. (COCA ACAD AfricaToday 1991)

4.2.3.6 Change-of-state

In parallel to the transposition of a complex event, nominalizations can denote a transposed simple event if a given base verb has a simple event structure. There is no nominalization based on an inchoative verb in the data set, so I am using the calibratable-COS noun *dwindlement*, which is not in the data set, for illustration:

(36) Gnathal, it's time for your **dwindlement** into Civil Death. (*Google* FIC CellU.R.Tales 2009)

In the data set, CHANGE-OF-STATE readings were attested both for nominalizations of c/i COS verbs, and for those of c-only COS verbs. I will discuss both in turn.

The examples in (37) show CHANGE-OF-STATE readings of the c/i COS nouns *embrittlement* and *increasement*. They also illustrate the strategies which the group of annotators applied to identify such readings. First, contextual clues such as *transition* in (37a) can indicate that we are dealing with a CHANGE-OF-STATE reading. Second, as exemplified in (37b), the causing subevent can be spelled out in relation to the caused subevent. Here, the causing subevent is *the protocol is used as a sub-protocol*, with the caused subevent *the rapid increasement of network traffic and computational complexity*. This second strategy also exemplifies a simple yet effective advantage of frames: It is often instructive to draw a frame structure and fill the nodes with the elements of the given attestation. This simple procedure has proven to facilitate the task of categorizing, as well as of explaining a given categorization.

(37) a. Biodegradation is characterized by **embrittlement**, or the transition of plastic from solid pieces into tiny particulates (COCA ACAD IntlAffairs 2005)

b. The biggest problem for the oblivious transfer protocol is the rapid **increasement** of network traffic and computational complexity if the protocol is used as a sub-protocol (*Google* ACAD springer.com 2007)

The finding that CHANGE-OF-STATE readings are possible for c/i COS nouns contributes to a topical controversy: According to what Borer (2013, 587) has called the **Transitivity Effect** in compounding, the head of a synthetic compound based on a c/i COS verb should only get a complex event reading, including either an explicit or at least an implied external argument. This alleged effect can straightforwardly be translated to the subject of derivation as well. Lieber (2016), however, finds evidence counter to this claim in corpus data: She identifies both

synthetic compounds (*water-boiling*, p. 158; *glacier melting*, p. 156) and derivatives (*Hezbollah's expansion*, p. 49) with clear inchoative interpretations in context. My data corroborates her counter-evidence.

We can regard such CHANGE-OF-STATE readings as either shifts to part of the complex verb frame, or as transpositions of the simple event variant of the base verb. At this point, it seems that both options may exist in parallel. Consider again example (37b). Here, the complex event structure is spelled out in the attestation: The first subevent is *the protocol is used as a sub-protocol*, and the second subevent is *the rapid increasement of network traffic*. This points to the conclusion that we are dealing with a shift in a complex event frame, since the cause is still part of the representation in a CHANGE-OF-STATE reading of *increasement*. In examples such as (37a), on the other hand, it is a question of world knowledge, or even expert knowledge, whether a given change can occur on its own, or whether there has to be a cause. Finally, there are attestations with c/i COS nouns which are clearly transpositions of a simple event, as exemplified in (38). Here, an external cause is neither expressed nor implied.

(38) Because of the baby boomers and their rapid **progressment** to an older age, it is natural for them to start taking more medications (*Google* COMM sectalk.com 2012)

Thus, as regards c/i COS nouns, both zooming into the change-of-state subevent and transposing the semantics of a simple base verb variant are valid mechanisms. The cause is most often, but not necessarily, expressed or implied.

That zooming into the change-of-state subevent is a valid, systematic mechanism is further corroborated by nouns with transitive base verbs, i.e. c-only COS nouns. Only one of the seven c-only COS nouns in the data set, *befoulment*, has not been found in a CHANGE-OF-STATE reading. Consider the following examples for illustration:

(39) a. When our citizens feel a need to change their constitution for their **embetterment** – it will be because they want it because they changed. (*Twitter* @HaneenKnown 2014)

b. It has been contemplated in the present treatise that expansion of the earth has taken place due to gradual **upliftment** of the semi-fluid mantle, in response to tidal bulge of that medium (GB ACAD Earth: The Planet Extraordinary 2007)

In both attestations given in (39), the nominalization can exhibit a CHANGE-OF-STATE reading, and in both cases, the causing subevent is spelled out (underlined in

the examples). Thus, we can conclude that speakers are using the nominalizations to zoom in on part of the complex event (see also section 2.3.2.2).

In section 4.2.2, I have hypothesized that the cause needs to be expressed or implied in c-only COS nouns. However, there is one attestation which can exhibit an isolated CHANGE-OF-STATE reading, indicated by the parallel phrase *things are getting better* (see (40)).[55]

(40) Actually, if anyone has read this far down, it's my opinion that things are getting better all the time: just not as fast as we would like or in the way that we expect, and the **embetterment** process also riles up the crazies (*Google* COMM unfogged.com 2009)

The most likely explanations for this attestation are variation of the base verb, or analogy. While intransitive constructions with *embetter* cannot be found on Google (or in the smaller corpora), there is a recent trend to create reflexive constructions with it (e.g. *service seems to have embettered itself*, Google COMM yelp.ca 2012). Therefore, a CHANGE-OF-STATE reading without a cause could be based on the reflexive variant of *embetter*. Second, the attestation may have been created in analogy with the semantically similar, lexicalized nominalizations *betterment* and *improvement*, both of which have c/i COS base verbs. All things considered, I have decided that this attestation does not challenge the assumption that c-only COS verbs need an expressed or implied cause.

With regard to CHANGE-OF-STATE readings of COS nouns, we can thus summarize that they are possible for all COS subclasses. For c/i COS nouns, two mechanisms are possible, namely both transposition of the simple event variant and shifting/zooming, while those based on c-only COS verbs can only shift/zoom.

4.2.3.7 Result-state

RESULT-STATE readings were easily found for 13 types in the data set, as exemplified by the attestations in (41).

(41) a. I encounter the dates – a dozen sellers offering them in different states of **congealment**, from the deep-brown gooey *Khejur* oozing syrup to bone-dry *Khormas* and orange-yellow unripe dates. (GloWbE BLOG backtobangladesh.blogspot.de 2010)

[55] It has been pointed out to me that, being the first part of a compound, *embetterment* may have an implicit agent which is not necessarily expressed in context (Lieber p.c., 11.11.2019). The context is therefore ambiguous: There may or there may not be an implied cause.

b. They seemed as eager to see if I was as wasted away as rumour had it as anything else, sizing me up as if to say my state of **bedragglement** was scandalous (GB FIC Bk:ColonyUnrequitedDreams 2000)

In many attestations it was hard to decide between annotators whether we are dealing with a RESULT-STATE or some other sort of abstract result which is not a state. Consider the examples in (42). Is the skin in a state of having been discolored, or is *discolorment* an abstract RESULT? Similarly, is the *dispersement* the state of the balls lying scattered on the ground?

(42) a. I read that permanent **discolorment** of the skin can happen from using the cream. (*Google* COMM askapatient.com 2007)

b. I got a large and a small bucket (about 100 balls) because I wanted to just hit a ton with my wedges and dial their distances in better and work on my iron and driver swing. [...] Now the **dispersement** is something I need to work on but thats more of my aim and alignment than anything else. (*Google* COMM thesandtrap.com 2010)

In this respect, one group of nominalizations, namely those which denote a change which is typically or often measured on a scale, is notoriously unclear. For *diminishment, embetterment, increasement, progressment* and *worsenment*, only attestations like (43a) and (43b) (repeated from (28a) and (28b)) have been found. While discussed in section 4.2.3.2 under the label RESULT, these attestations (and others in the data set) actually tend to be ambiguous, depending on the informant. A RESULT-STATE reading is not available for all speakers, and it is never regarded as the most likely option in a given context. Why prominently scalar base verbs present such a fuzzy picture with regard to RESULT-STATE readings in their nominalizations will have to be the subject of further research, since I have decided to omit the modeling of scalarity in this study (see also section 3.3.3).

(43) a. The performance **increasement** and the darker interface are looking gorgeous! (*Twitter* @maxlewe 2012)

b. No one could say that he was going bald [...] but his hair has lost its luxuriance and, once jet black, is gray now, and he keeps it cropped short to conceal the **diminishment** (COCA FIC Bk:LoveMyYouth 2011)

Interestingly, prominently state-forming suffixes such as *-ness* can coerce these scalar base verbs into less ambiguous RESULT-STATE readings:

(44) Who would like to bet that Dell gives up on this experiment pretty quickly – I know I won't be suprised [sic] if **embetterness** is quickly replaced by embitteredness on Ubuntu's part. (*Google* COMM mattcutts.com 2007)

This example shows that RESULT-STATE readings are possible, given a suffix for which this reading is prevalent. We may thus be dealing with a partial blocking effect, where speakers prefer specialized suffixes like *-ness* over the more diversified *-ment*.

To sum up, 13 *-ment* neologisms in the data set readily produce RESULT-STATE readings, while five prominently scalar types produce RESULT-STATE readings only in very ambiguous contexts, and only for some speakers. The STATE-forming suffix *-ness* is more successful in turning the five base verbs in question into RESULT-STATE nouns. Therefore, it can be concluded that prominently scalar base verbs disprefer being shifted to a RESULT-STATE reading by *-ment*. Due to the complexity of modeling scalar concepts in frames, clarifying the reasons for this observation will be left for future research.

4.2.3.8 Cause

In the literature, the causing subevent is claimed to be most often an action, while other types of event are also possible (see section 4.1.1.2). In the nominalization semantics, we find the same situation: Most of the time, the denoted causing event is an ACTION, as exemplified in (45a), where the cause is an agentive action. However, it can also be another kind of event, such as the CAUSING STATE reading in (45b) and the non-agentive ACTION reading in (45c).

(45) a. The puke-related world-**embetterments** in this thread are blowing my mind. When people come to my house, I pretty much always offer them a cup of tea. (*Google* COMM theppk.com 2011)

b. The staff waited on the Blundens, devoted, and prescient, too, anticipating their desires. When they skipped meals, the waiters would say, "We missed you last night," as though their absence were a **diminishment**. (COCA FIC NewYorker 2006)

c. The white of the breast feathers was turned a dull gray by the rain's **bedragglement** (*Google* FIC forgottenbooks.com 1922)

It should be noted that finding attestation for the CAUSE reading was not easy: Of the 18 types in the data set, ten have this reading attested, and only three attestations are not ambiguous. The first intuition may be to assume that the base verbs of the eight unattested types are not complex events after all, that is, they might not have a causing subevent. This was checked in the corpora, where all base verbs in question were found to be more or less frequently attested in

a context with a causing subevent.[56] Therefore, it can be concluded that we are dealing with a gap due to scarcity of data, and that CAUSE is a rare but possible reading of COS nouns (see also chapter 6).

4.2.3.9 Unattested shifts

In the following, I will discuss the shifts that are systematically not attested in my data. These patterns can be explained by two factors: Preferences of *-ment*, and properties of the base verb classes. The concrete changes necessary to reflect these factors in my frames will be elaborated on in the frame analysis of COS nouns in section 4.2.4.

There are seven readings which are commonly produced by derivation, but which are not possible in *-ment* derivatives (see section 4.2.2). I have not found these in my data either. Five of these readings are not represented in the VerbNet-based frames in, namely PATH, ADHERENT/FOLLOWER, BEHAVIOR, MEASURE and EXPERIENCER. These need not be addressed further since no shifts are predicted by the base verb frames in the first place. Two of the seven readings not predicted in the literature, however, are represented in the VerbNet-based frames, namely AGENT and [+animate] PATIENT. Therefore, the formalization needs to represent that *-ment* does not allow the corresponding shifts. For AGENT, this can be straightforwardly done by not including the corresponding indices in the set of possible referents below the frame. To prevent shifts to [+animate] PATIENTS, a constraint is required, since shifts to the PATIENT node are allowed as long as the PATIENT is inanimate. A similar conclusion has been drawn by Melloni (2011, 115, 237), who investigates Italian nominalizations in *-mento*: A shift to the – prototypically [+animate] – EXPERIENCER reading is not possible since the referent has to be [-animate] and [-sentient]. Instead, Italian makes use of its present participle suffix to express sentient categories such as AGENT and EXPERIENCER.

The second factor governing possible readings are the properties of the base verbs. More precisely, if a base verb frame does not include a given participant or subevent, no shift to this participant or subevent is expected. I have already mentioned the participants PATH, ADHERENT/FOLLOWER, BEHAVIOR, MEASURE and EXPERIENCER, which are also not predicted by the existing literature. In addition, the established literature gives LOCATION and AGENTIVE-COLLECTIVE as possible readings for *-ment* derivatives. However, there are no corresponding

[56] iWeb was probed with the query <V* * _nn* by> and the results were manually checked. For *congeal*, no results were found, but a Google search for <"congealed the * by"> yielded the desired constructions.

nodes in the COS verb frames, and, as expected, no LOCATION and AGENTIVE-COLLECTIVE readings were attested.[57]

4.2.3.10 Summary

The findings presented in this chapter confirm some of the expectations discussed in section 4.2.2, while disputing others. I will summarize these findings now, and then move on to the formalization of COS nominalization in section 4.2.4. Where the VerbNet-based frames evoke incorrect predictions, the formalization will be revised accordingly. For a rough overview of my findings at a glance, I am including Table 4.8, which is an updated version of Table 4.6. Changes in this modified table as compared to the original one are highlighted by bold print.

TABLE 4.8: Expected shifts in COS frames and results of corpus study. Findings which require changes in the VerbNet-based frames are marked by bold print. Abbreviations: c. = causation, lit. = literature, n.a. = not available

Reading	Expected shift (frame/lit.)	Findings
Eventive readings		
change-of-state c.	yes/yes	yes
change-of-state	yes/yes	yes
result-state	yes/yes	**yes**
Participant readings		
adherent	no/no	no
agent	yes/only collective	**no**
behavior	no/no	no
cause	yes/n.a.	yes
experiencer	no/no	no
instrument	yes/yes	**instrument or causer**
location	no/yes	no
measure	no/no	no
path	no/no	no
patient	yes/only inanimate	**inanimate (subset)**
product	no/yes	**implicit product (subset)**
result	no/yes	**yes (subset)**

[57] Groups of people can of course be the AGENTS of a COS event, and in the case of *disband* even prominently so. However, I have argued above that the AGENTIVE-COLLECTIVE category as attested in *-ment* derivatives like *government* also requires this group to act habitually and/or professionally. This is not the case for the AGENT participants of the COS verbs in the data set.

As in previous literature, I systematically found EVENT, RESULT-STATE, RESULT, PRODUCT, INSTRUMENT and [-animate] PATIENT readings. Of these, RESULT and PRODUCT are not part of the VerbNet-based frames. Shifts to LOCATION and AGENTIVE-COLLECTIVE are discussed in the literature but are not represented in my data. This indicates that it was correct to assume that these attributes are not part of the base verb semantics to begin with.

In this study, I have identified some semantic details which have, to my knowledge, not been addressed in the literature so far. First, the eventive categories can be differentiated further than has been done in the literature to date. As suggested by the frame structure, I found CHANGE-OF-STATE CAUSATION and CHANGE-OF-STATE readings as well as different kinds of CAUSES such as ACTIONS and STATES. Second, as to the PRODUCT category, I have argued that a distinction between IMPLICIT PRODUCTS and EXPLICIT PRODUCTS is sensible. Only IMPLICIT PRODUCTS are attested in my *-ment* nominalizations. Finally, I have found that the category CAUSER is needed in addition to INSTRUMENT in order to account for all attested instrument-like readings.

Regarding the assumed impossible readings, my nominalizations behave as expected: I did not find the readings [+animate] PATIENT, AGENT, EXPERIENCER, PATH, ADHERENT/FOLLOWER, BEHAVIOR, or MEASURE. EXPERIENCER, PATH, ADHERENT/FOLLOWER, BEHAVIOR and MEASURE are not part of the frame formalizations to begin with, while the impossibility of shifts to AGENT and [+animate] PATIENT will be formalized below.[58]

I have also observed distributions of possible readings which are not predicted by the VerbNet-based frames. The first observation which I have discussed is the complementary distribution of PATIENT, IMPLICIT PRODUCT and RESULT readings. The pattern can be summarized by two principles: First, IMPLICIT PRODUCT and RESULT can be shifted to if the base verb has the corresponding node, respectively. Second, if a base verb has neither an IMPLICIT PRODUCT nor a RESULT participant, the PATIENT can be shifted to. The second observation is that we can find shifts either to INSTRUMENT or to CAUSER, to both, or to neither of the two, depending on the base verb.

Apart from the participants of COS-events I also investigated their event structure. Three findings are central in this respect: First, I have found that external

[58] MEASURE, or a related category such as VerbNet's EXTENT role, will figure in future formalizations of scalar base verbs.

causes are either expressed or implied in the context of CHANGE-OF-STATE CAUSATION readings of COS nouns, which confirms the complex event structure applied in the VerbNet-based frames. Second, as claimed in the literature, the first subevent is most often an action, but can also be any other type of event. This can be concluded both from the subtypes of CAUSE readings in which I found the nominalizations, and from the contexts in which they are attested. Finally, I looked at the contexts of CHANGE-OF-STATE readings and found that whether external causes are present depends on the base verb: For c-only COS verbs, external causes are expressed or implied. For c/i COS verbs, an external cause is most often, but not always expressed or implied. I have argued that this reflects two different mechanisms: If an external cause is present, we are dealing with a complex event, the reference of which has been shifted to the frame's *change-of-state* node. If no external cause is present, we are dealing with a transposition of the base verb's simple event variant.

It should always be kept in mind that these findings relate to those readings which are systematically attested, or systematically unattested. However, this does not mean that there are no exceptions: The annotators have not been able to identify every single reading for every type in the data set. All cases of unattested readings which I have not explicitly discussed in this section can be considered gaps in the data. For example, no CHANGE-OF-STATE reading was found for *befoulment* and *abridgement*, but it was attested for all other types, and I have not been able to identify a possible motivation behind this other than scarcity of data. In section 6 I will take a quantitative perspective on gaps in my data set.

On the whole, my findings regarding possible and impossible nominalization semantics show that the VerbNet-based frames do not suffice to predict all possible and impossible readings. In the next section, I will address all necessary modifications to the frame formalization.

4.2.4 Formalization of COS nominalization

I will now address how the VerbNet-based frames need to be modified in order to reflect the findings with regard to nominalization semantics. First, in section 4.2.4.1, I will introduce a notation for indicating possible readings, revise the participants which have so far been based on the semantic roles given in VerbNet, revisit the event structure, address the issue of representing probabilities in frames, and finally I will tidy up all loose ends by proposing frame formalizations for COS

nouns. Then, as part of the inheritance hierarchy for *-ment*, I will propose an animacy constraint and model the interplay of PATIENT, IMPLICIT PRODUCT and RESULT readings (section 4.2.4.2). As a next step, I will update the participant hierarchy and the type signature to include all labels and types required for the frame formalization and the inheritance hierarchy (section 4.2.4.3). I conclude this section by proposing a set of nine lexeme formation rules (LFRs) for *-ment* on COS verb bases, embedded in an inheritance hierarchy (section 4.2.4.4).

4.2.4.1 Frame representations

Indicating possible readings Possible nominalization readings will be indicated by using the notation which I have already introduced to model the difference between c/i COS verbs and c-only-COS verbs, namely by means of a mathematical set of indices under the AVM. As a next step, the reference sets of all nominalization frames can be compared and then translated into an inheritance hierarchy for *-ment*. The complete inheritance hierarchy will be given in the chapter summary in section 4.3.

Revision of participants The participant which can be added most straightforwardly to the frames is CAUSER. In the participant hierarchy, AGENT and CAUSER are the only hyponyms of the ACTOR role, with AGENT being [+intentional] and CAUSER being [-intentional]. Therefore, the easiest solution to include both AGENT and CAUSER as possible participants is by including ACTOR instead (see e.g. the frame in Figure 4.9 below).

The second participant which needs to be added to the frame structures is IMPLICIT PRODUCT. As I have argued above, this kind of product is something intrinsically connected to the patient of some verbs. I will use an embroidering-event as an example to illustrate how this can be modeled in frames. In Figure 4.6, we see that the patient, *pillow*, has an attribute ON-REGION, which represents its surface. In other words, all points located on the pillow are contained in its on-region (see also Kallmeyer & Osswald 2013, 38).[59] At the same time, the implicit product *embroidery* has an attribute REGION, which represents the space it occupies. The fact that the embroidery is located on the pillow is expressed by a mereological part-of relation between the values of REGION and ON-REGION. This kind of relation between two nodes is not functional, and is therefore not

[59]In order to account for my data, only ON-REGIONS are required, which allows modeling implicit products like *embroidery*. For modeling implicit products like *hole*, an IN-REGION is needed instead.

$$\boxed{0}\begin{bmatrix} \textit{embroidering-event} & \\ \text{PATIENT} & \boxed{1}\begin{bmatrix} \textit{pillow} \\ \text{ON-REGION} \quad \boxed{3} \end{bmatrix} \\ \text{PRODUCT} & \boxed{2}\begin{bmatrix} \textit{embroidery} \\ \text{REGION} \quad \boxed{4} \end{bmatrix} \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{2}\right\}$$
$$\textit{part-of}\,(\boxed{4}, \boxed{3})$$

FIGURE 4.6: Frame for the implicit product *embroidery*

modeled as an attribute. The notation used here, '*part-of* (4, 3),' was introduced by Kallmeyer & Osswald (2013, 35-6).

In the *embroidery*-frame in Figure 4.6, PRODUCT is attached directly to the central node *embroidering-event*. This is not satisfying in terms of event decomposition. One way to include PRODUCT as well as its hyperonym RESULT more appropriately in a complex event frame is to introduce it into the caused subevent. This presents us with the problem that, in the VerbNet-based frames, the caused subevent is a change-of-state, and not a come-into-being-event. However, the fact that we do find PRODUCT and RESULT readings in some nominalizations suggests that such an event is present in the corresponding base verb semantics. I propose to tackle this issue by introducing a complex type '*change-of-state* ∧ *come-into-being*.' This type expresses that there is a change-of-state with an accompanying come-into-being-event. Formally, it is a subtype with two parents: *change-of-state* and *come-into-being*. Figure 4.7 integrates the complex type and the frame for *embroidery* as introduced in Figure 4.6. Here, we see that the patient *pillow* undergoes a change-of-state which results in an embroidered-state, and at the same time, the embroidery comes into being. With regard to my data set, I propose this kind of frame for *discolor* and *embrittle* and their respective nominalizations. In addition, PRODUCT can be exchanged for its hyperonym RESULT when modeling the nominalizations with a possible RESULT reading, and their base verbs.

Whether speakers conceptualize such a combined event primarily as one of change-of-state or of come-into-being, or whether both are equal, is surely a matter of debate. What is clear from my data at this point is that different contexts can focus on one or the other, and that there is variation between different base verbs. More precisely, a spot check in iWeb shows that, for *discolor*, the product is frequently made explicit in the wider context, while for *embrittle* it is largely left

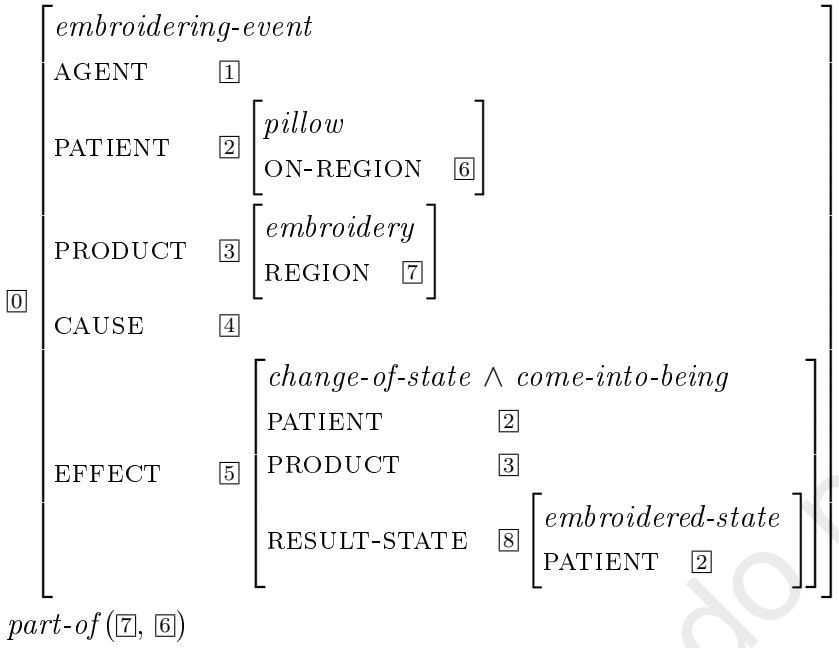


FIGURE 4.7: Complex frame for an embroidering-event

implicit. For *embroider*, the product is in all likelihood more cognitively salient in speakers' representations since it can be found easily and frequently in the participant structure of the verb.

Event structure Let us now look at the event structure of COS verbs and nouns. I have shown that, as expected, the most adequate frame structure for c-only COS verbs is that of a complex event, and that the CHANGE-OF-STATE reading comes about by a shift to the change-of-state node. For c/i COS verbs and their nominalizations, the data showed a mixed picture: Contexts with an expressed or implied cause greatly outnumber those without, but the latter are definitely possible. I have therefore concluded that both suggested frame structures seem to be viable. As a reminder, the two patterns are given in Figure 4.8.

Next, let us address the first subevent, CAUSE. In the VerbNet-based frames, CAUSE is typed with *action*, but it is more useful for my purposes to swap the *action* type for the more general *event*, which can then be specified in a given context. Since the participants of the first subevent change substantially depending on the different possible types of event (e.g. *state* versus *action*), they are best left underspecified in the generalized frame, as depicted in Figure 4.9. The only specification is that the actor of the causation event also has to be a participant of the causing event. Therefore, ACTOR is co-indexed with PARTICIPANT.

$$\boxed{0}\begin{bmatrix} \textit{change-of-state causation} & \\ \text{ACTOR} & \boxed{1} \\ \text{PATIENT} & \boxed{2} \\ \text{INSTRUMENT} & \boxed{3} \\ \text{CAUSE} & \boxed{4}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT } \boxed{1} \end{bmatrix} \\ \text{EFFECT} & \boxed{5}\begin{bmatrix} \textit{change-of-state} & \\ \text{PATIENT} & \boxed{2} \\ \text{RESULT-STATE} & \boxed{6} \end{bmatrix} \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{0}\right\}$$

FIGURE 4.9: Change-of-state causation with an underspecified first subevent

In order to illustrate how fundamentally the first subevent changes over different contexts, I am also including two instantiated frames here. In Figure 4.10, the participant structures of the contexts in (46) and (47) are modeled.

(46) The white of the breast feathers was turned a dull gray by the rain's **bedragglement** (*Google* FIC forgottenbooks.com 1922)

(47) Well, David Glasner is on fire, another post! I guess a real economist (such as Glasner), after having **befouled** himself by reading a Wall Street Journal editorial, has to "take a cleansing tonic" in the form of reading Hayek. (*Google* COMM uneasymoney.com 2011)

In the left frame, *rain* as the causer of the bedraggle-event is co-indexed with the theme of the causing subevent since it is the rain's raining which causes the breast

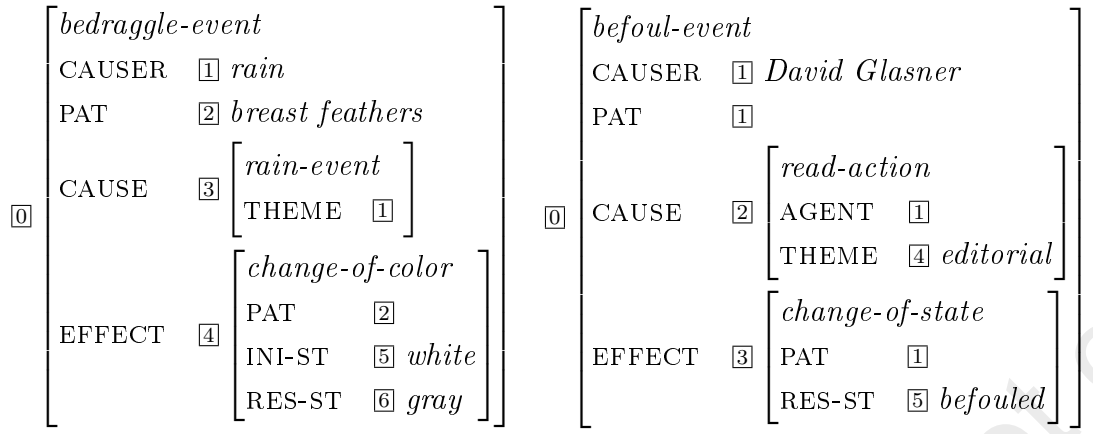
$$\boxed{0}\begin{bmatrix} \textit{c-o-s causation} \\ \text{CAUSE} \quad \boxed{1} \\ \text{EFFECT} \quad \boxed{2}\ \textit{c-o-s} \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{0}, \boxed{2}\right\}$$

(a) Single frame

$$\boxed{0}\begin{bmatrix} \textit{c-o-s causation} \\ \text{CAUSE} \quad \boxed{1} \\ \text{EFFECT} \quad \boxed{2}\ \textit{c-o-s} \end{bmatrix} \longleftrightarrow \boxed{2}\begin{bmatrix} \textit{c-o-s} \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{0}\right\} \qquad \text{REF} = \left\{\boxed{2}\right\}$$

(b) Embedded subevent

FIGURE 4.8: Frame variants for c/i COS nouns (e.g. *congealment*)



(a) *Bedraggle-event*, example (46) (b) *Befoul-event*, example (47)

FIGURE 4.10: Instantiated causation events. Abbreviations: ini-st = initial state, pat = patient, res-st = result-state

feathers to become bedraggled.[60] In the right frame, the causer of the causation event does something to himself by conducting the action in the first subevent. Therefore, CAUSER, AGENT and PATIENT are co-indexed here.

Representing gradient phenomena in frames In the discussion of INSTRUMENT and CAUSER readings in section 4.2.3.4, I have stated that their distribution seems to be related to the frequency with which INSTRUMENT and CAUSER participants are attested with a given base verb. Representing such a gradient phenomenon in frames poses a challenge. Here, I will address the instrument/causer distribution by means of **stochastic frames**, that is, frames which include information about probabilities. Testing my hypothesis by gathering co-occurrence data and then modeling the results in stochastic frames would exceed the scope of this thesis, which is why I have decided to merely sketch the literature, illustrate the issue in a tentative frame, and leave the rest for future research. Since dealing with gradience is a fundamental problem in formal approaches, I will return to the issue in the general discussion of this thesis (chapter 7).

In research based on Barsalou frames, stochastic frames have recently piqued some researchers' interest (see Schuster et al. in press for a discussion of exemplary applications). Since the notion is comparatively new, we do not yet find a unified approach, but rather different starting points. The only available approach which is

[60] The semantics of *bedraggle* would standardly call for something like *soggy* as a result-state, but the accompanying change of color is focused on here. Note also that reference is on [0]: The frame depicts a bedraggle event, and not the reading of *bedragglement* in this context, which has been classified as a CAUSE.

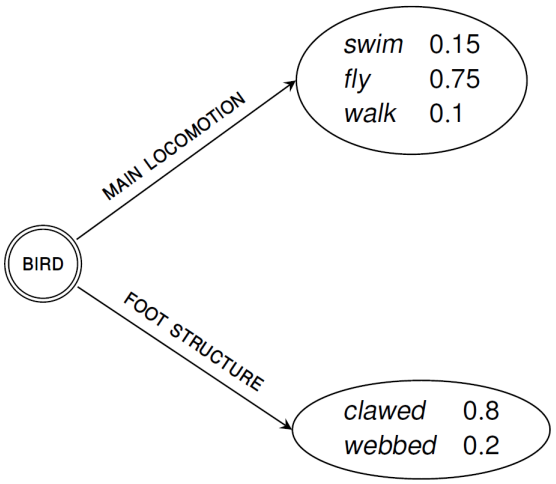


FIGURE 4.11: Representing probabilistic information in frames (adapted from Schuster et al. in press, 4)

formally fleshed out is that of Schuster et al. (in press), who assume that attributes can take probability distributions as values. An example is given in Figure 4.11, where a frame for *bird* is enriched with probabilistic information. Here, we see that *bird* has two relevant attributes, MAIN LOCOMOTION and FOOT STRUCTURE. Birds can have three possible types of locomotion, *swim, fly* or *walk*, with *fly* being the most likely. Likewise, a bird's foot structure can be either *clawed* or *webbed*. Note that the probabilities of one cluster of values add up to 1.

Importantly, the authors mention that not only values, but also attributes can have a probability (Schuster et al. in press, 2). Since I want to model how likely INSTRUMENT and CAUSER participants are with a given base verb, this is what I need. Thus, the frequency with which COS verbs are attested with INSTRUMENT and CAUSER can be translated into probabilities, and cutoff points can be identified empirically and then defined in the inheritance hierarchy. This is illustrated with devised numbers in the tentative frames and inheritance hierarchy in Figures 4.12 and 4.13, respectively. In the three depicted frames, we find probabilities for INSTRUMENT and CAUSER participants for the base verbs *abridge* (equal distribution), *congeal* (high/low) and *discolor* (low/high). With a cutoff point of 0.5 defined in the inheritance hierarchy ($\geq$0.5), we correspondingly find shifts to both INSTRUMENT and CAUSER for *abridge*, to INSTRUMENT for *congeal*, and to CAUSER for *discolor*.

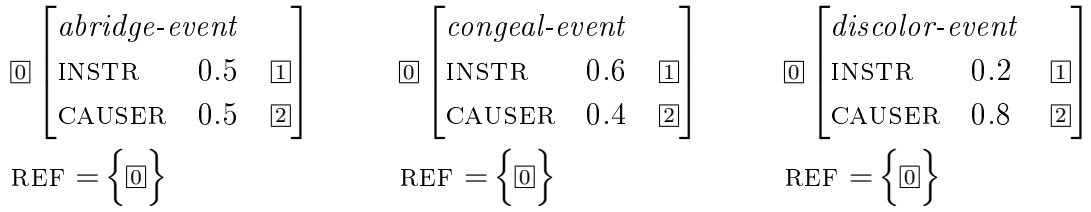


FIGURE 4.12: Weighted participant attributes in tentative frames for *abridge*, *congeal* and *discolor*. Abbreviations: instr = instrument

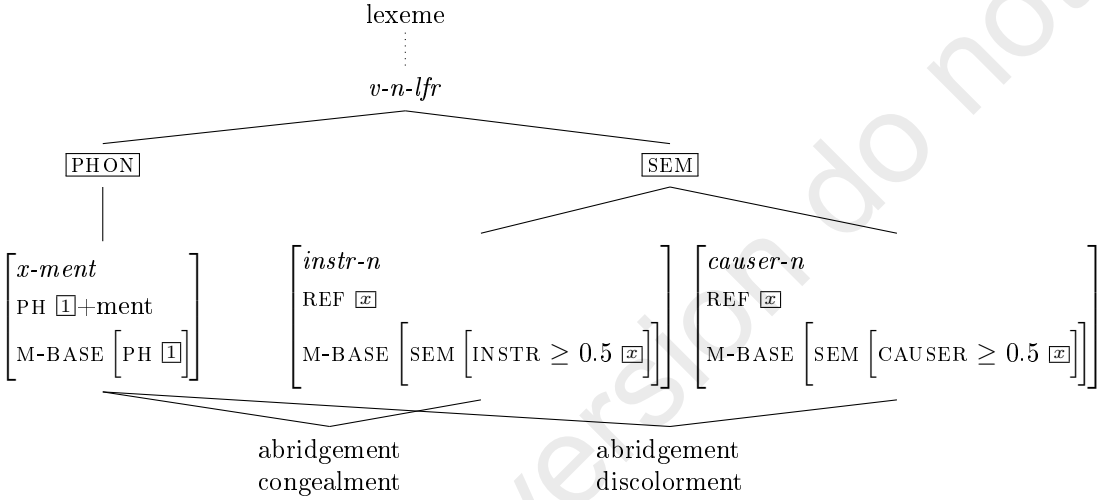


FIGURE 4.13: Introducing probabilities into the inheritance hierarchy of lexical rules for the suffix *-ment* (partial hierarchy). Abbreviations: instr = instrument

However, obtaining feasible probabilities is not trivial (see e.g. Petersen & Gamerschlag 2014, 201). Fundamental problems arise mainly with regards to gathering reliable data and to capturing the interdependence of different participants in absolute or relative probabilities (e.g. instruments depend on agents, and causers are mutually exclusive with agents).

Therefore, although stochastic frames are a promising approach to tackle gradient linguistic phenomena, I will not use them in this study. Rather, I will translate the assumed gradient distribution into a binary decision: An attribute is either present, or not. To stay with the three verbs used for illustration in Figure 4.12: I am assuming that the frame for *congeal* has an INSTRUMENT attribute, the frame for *discolor* has a CAUSER, and the frame for *abridge* has both. Figure 4.14 depicts how Figure 4.12 can be modified accordingly.

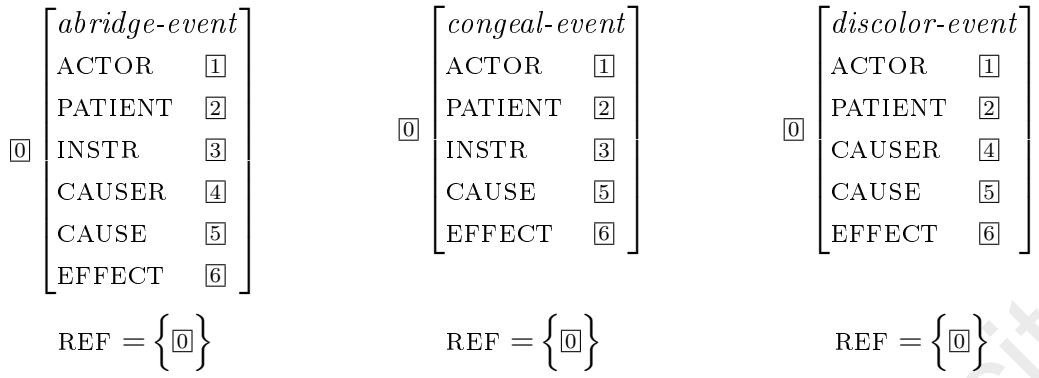


FIGURE 4.14: Revised frames for *abridge, congeal,* and *discolor*. Abbreviations: instr = instrument

COS-noun frames The frames as introduced in section 4.1.3 have to be revised from the ground up. Looking at the subclasses of COS verbs, it becomes obvious that the VerbNet-based frames do not predict the patterns which I found in my nominalizations: The three subclasses are distinguished by type of causation, type of change, selectional restrictions of the PATIENT and INSTRUMENT participants, and the presence or absence of a secondary result participant. My findings with regard to possible nominalization readings, however, show that relevant differences are the presence or absence of INSTRUMENT, CAUSER, IMPLICIT PRODUCT and (primary) RESULT. I will now first present a frame which generalizes over all COS verbs in my data set, and then discuss three exemplary COS noun frames addressing the patterns I found in my data. For ease of comparison, the indices are kept constant over all remaining frames in this section.

The generalized COS verb frame in Figure 4.15 incorporates all formal decisions I have made in this section: First, the causing entity is an actor and can thus be either an agent or a causer. Second, I added the participant attributes RESULT and IMPLICIT PRODUCT (the latter being shorthand for the frame notation introduced in Figure 4.6). These two attributes, along with INSTRUMENT, are optional, as defined in the type signature. Third, the first subevent is typed with the most general eventive type *event* and the most general participant PARTICIPANT. Fourth, the second subevent is typed as *change-of-state*; it can be specified as its subtype *change-of-state* $\wedge$ *come-into-being* if required.

Two things should be noted in this generalized frame with regard to optionality. First, in the set indicating reference I have included [7] in square brackets, representing that not all base verbs have an inchoative variant. More accurately, these should be represented by a second, almost identical frame with a reference

set of [1]. Second, INSTRUMENT, IMPLICIT PRODUCT and RESULT are not relevant for all types of causation event. This is modeled in the type signature (see Figure 4.23 in section 4.2.4.3).

Let us now move to the subclasses of COS verbs and nouns. Going by the distribution of INSTRUMENT versus CAUSER and of PATIENT versus IMPLICIT PRODUCT versus RESULT readings in the nominalizations, the types in my data set can be organized into ten groupings of verbs and corresponding nouns, six of which have only one member (an overview is given in Table 4.11). Since I don't think that showing frames for all ten groupings has much added value over showing just a few representative frames, I am opting for the latter.

$$
\begin{bmatrix}
\textit{change-of-state causation} & \\
\text{ACTOR} & \boxed{1} \\
\text{PATIENT} & \boxed{2} \\
\text{INSTRUMENT} & \boxed{3} \\
\text{RESULT} & \boxed{4} \\
\text{IMPLICIT PRODUCT} & \boxed{5} \\
\boxed{0}\ \text{CAUSE} & \boxed{6} \begin{bmatrix} \textit{event} \\ \text{PARTICIPANT} \quad \boxed{1} \end{bmatrix} \\
\text{EFFECT} & \boxed{7} \begin{bmatrix} \textit{change-of-state} & \\ \text{PATIENT} & \boxed{2} \\ \text{RESULT-STATE} & \boxed{8} \begin{bmatrix} \textit{state} \\ \text{PATIENT} \quad \boxed{2} \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

$$
\text{REF} = \left\{ \boxed{0}\ \boxed{7} \right\}
$$

FIGURE 4.15: Generalized lexical frame for COS verbs

TABLE 4.11: Groupings of INSTRUMENT/CAUSER and IMPLICIT PRODUCT/PATIENT/RESULT distributions. Abbreviations: impl. prod. = implicit product

Instrument/causer	Patient/impl. prod./result	Nominalizations
not attested	not attested	disbandment
not attested	result	decenterment
causer	not attested	upliftment
causer	result	diminishment, increasement, worsenment
causer	implicit product	discolorment
instrument	result	dispersement, progressment
instrument	patient	congealment
instrument, causer	implicit product	embrittlement
instrument, causer	patient	bedragglement, befoulment, debauchment, unfoldment
instrument, causer	result	abridgement, besmirchment, embetterment

The frames in Figures 4.16 to 4.18 represent three exemplary patterns, namely nominalizations which have INSTRUMENT and PATIENT readings (*congealment*), those which have INSTRUMENT, CAUSER and RESULT readings (*abridgement, besmirchment, embetterment*), and those which have CAUSER and IMPLICIT PRODUCT readings (*discolorment*). As can be seen in Figure 4.16, instrument/patient-COS nouns have an AGENT, and no RESULT or IMPLICIT PRODUCT. Apart from the underspecified first subevent and the possible referents, the frame is identical to the VerbNet-based frames.

$$
\boxed{0}\begin{bmatrix}
\textit{change-of-state causation} & \\
\text{AGENT} & \boxed{1} \\
\text{PATIENT} & \boxed{2} \\
\text{INSTRUMENT} & \boxed{3} \\
\text{CAUSE} & \boxed{6}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT} \quad \boxed{1} \end{bmatrix} \\
\text{EFFECT} & \boxed{7}\begin{bmatrix} \textit{change-of-state} & \\ \text{PATIENT} & \boxed{2} \\ \text{RESULT-STATE} & \boxed{8}\begin{bmatrix} \textit{state} \\ \text{PATIENT} \quad \boxed{2} \end{bmatrix} \end{bmatrix}
\end{bmatrix}
$$

$$
\text{REF} = \left\{ \boxed{0}, \boxed{2}, \boxed{3}, \boxed{6}, \boxed{7}, \boxed{8} \right\}
$$

FIGURE 4.16: Frame for instrument/patient-COS nouns (e.g. *congealment*)

In Figure 4.17, RESULT is added and AGENT is replaced by its supertype ACTOR, allowing instantiation by either AGENT or CAUSER. If it is instantiated by AGENT, a shift to 1 is precluded by the animacy constraint in the inheritance hierarchy. If it is instantiated by CAUSER, this shift is possible. The inheritance hierarchy also prevents a shift to 2, that is, a PATIENT reading.

$$
\boxed{0}\begin{bmatrix}
\textit{change-of-state causation} \wedge \textit{come-into-being causation} \\
\text{ACTOR} \quad \boxed{1} \\
\text{PATIENT} \quad \boxed{2} \\
\text{INSTRUMENT} \quad \boxed{3} \\
\text{RESULT} \quad \boxed{4} \\
\text{CAUSE} \quad \boxed{6}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT } \boxed{1} \end{bmatrix} \\
\text{EFFECT} \quad \boxed{7}\begin{bmatrix}
\textit{change-of-state} \wedge \textit{come-into-being} \\
\text{PATIENT} \quad \boxed{2} \\
\text{RESULT} \quad \boxed{4} \\
\text{RESULT-STATE} \quad \boxed{8}\begin{bmatrix} \textit{state} \\ \text{PATIENT} \quad \boxed{2} \end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

$$
\text{REF} = \left\{\boxed{0}, \boxed{1}, \boxed{3}, \boxed{4}, \boxed{6}, \boxed{7}, \boxed{8}\right\}
$$

FIGURE 4.17: Frame for instrument/causer/result-COS nouns (e.g. *abridgement, besmirchment, embetterment*)

Finally, in Figure 4.18 RESULT is replaced by its subtype PRODUCT in combination with the attributes and specifications required to model the implicit product participant, that is, REGION, ON-REGION and *part-of* (10,9).

$$
\boxed{0}\begin{bmatrix}
\textit{change-of-state causation} \wedge \textit{come-into-being causation} \\
\text{ACTOR} \quad \boxed{1} \\
\text{PATIENT} \quad \boxed{2}\begin{bmatrix}\textit{entity} \\ \text{ON-REGION} \quad \boxed{9}\end{bmatrix} \\
\text{INSTRUMENT} \quad \boxed{3} \\
\text{PRODUCT} \quad \boxed{5}\begin{bmatrix}\textit{entity} \\ \text{REGION} \quad \boxed{10}\end{bmatrix} \\
\text{CAUSE} \quad \boxed{6}\begin{bmatrix}\textit{event} \\ \text{PARTICIPANT} \ \boxed{1}\end{bmatrix} \\
\text{EFFECT} \quad \boxed{7}\begin{bmatrix}
\textit{change-of-state} \wedge \textit{come-into-being}_{ip} \\
\text{PATIENT} \quad \boxed{2} \\
\text{PRODUCT} \quad \boxed{5} \\
\text{RESULT-STATE} \quad \boxed{8}\begin{bmatrix}\textit{state} \\ \text{PATIENT} \quad \boxed{2}\end{bmatrix}
\end{bmatrix}
\end{bmatrix}
$$

$$\text{REF} = \left\{\boxed{0}, \boxed{1}, \boxed{5}, \boxed{6}, \boxed{7}, \boxed{8}\right\}$$

$$\textit{part-of}\left(\boxed{10}, \boxed{9}\right)$$

FIGURE 4.18: Frame for causer/implicit-product-COS nouns (e.g. *discolorment*)

4.2.4.2 Constraints

Animacy constraint I have argued that some of the impossible readings (more precisely, shifts to AGENT and to [+animate] PATIENT) are prevented because *-ment* systematically does not produce animate readings. I propose to formalize this with an animacy constraint which posits that, with regard to non-eventive readings, reference can only be on inanimate event participants. In the framework applied here, the most straightforward possibility is to model this directly in the inheritance hierarchy (as opposed to a constraint given alongside each nominalization frame), namely by introducing the constraint as a supertype of the LFRs (see Figure 4.19). The notation "ANIMACY : *false*" allows shifts to inanimate participants (e.g. [-animate] patients) as well as shifts to eventive nodes, for which animacy is not a relevant parameter in the first place. This only works, however, if information about animacy is included in the type signature. It will be updated accordingly in section 4.2.4.3.

Two issues need to be addressed with regard to the animacy constraint. First, the constraint as formulated in Figure 4.19 does not capture the fact that AGENTIVE-COLLECTIVE used to be a productive reading of *-ment* derivatives. Should this be

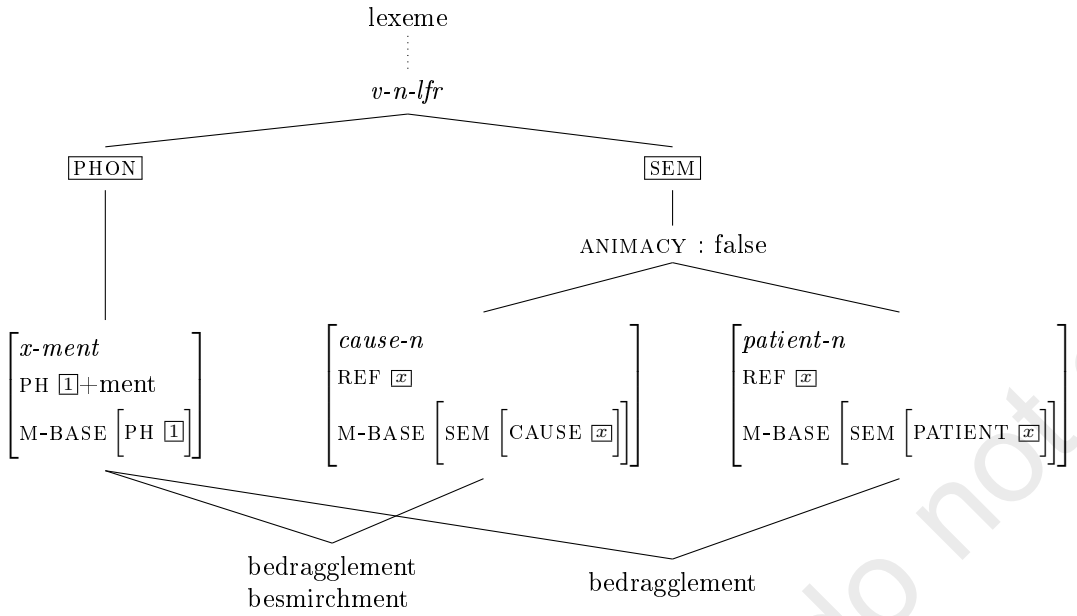


FIGURE 4.19: Introducing an animacy constraint into the inheritance hierarchy (partial hierarchy).

desired, for instance in a diachronic study, the constraint can be modified accordingly. Second, the constraint only relates to referential shifts brought about by derivation. It does not preclude post-lexical phenomena, more precisely, that the context may coerce the *-ment* derivative into an animate reading.[61]

Patient, implicit product, and result Next, we need to model that shifts to a PATIENT reading are only possible if neither a RESULT nor an IMPLICIT PRODUCT participant are present in the frame. Like the animacy constraint, this constraint is specified in the inheritance hierarchy, but since only one reading is affected, I do not introduce a supertype but rather include the information directly in the AVM in question. More precisely, the specification '¬RESULT' is included in the AVM representing PATIENT nouns (the bottom AVM in Figure 4.20).[62] This constraint prevents a shift to PATIENT as soon as RESULT or one of its subtypes is present in the base verb frame. Shifts to RESULT and IMPLICIT PRODUCT, on the other hand, are possible as soon as the corresponding attributes are present in the base verb frame, which is why the corresponding AVMs for IMPLICIT PRODUCT and RESULT nouns can straightforwardly be included in the inheritance hierarchy.

[61] One attempt to model coercion in frames can be found in Babonnaud et al. (2016), where frames are combined with LTAG and Hybrid Logic.

[62] To save space, I have flipped the usual depiction of an inheritance hierarchy by 90°, to be read from left to right instead of from top to bottom.

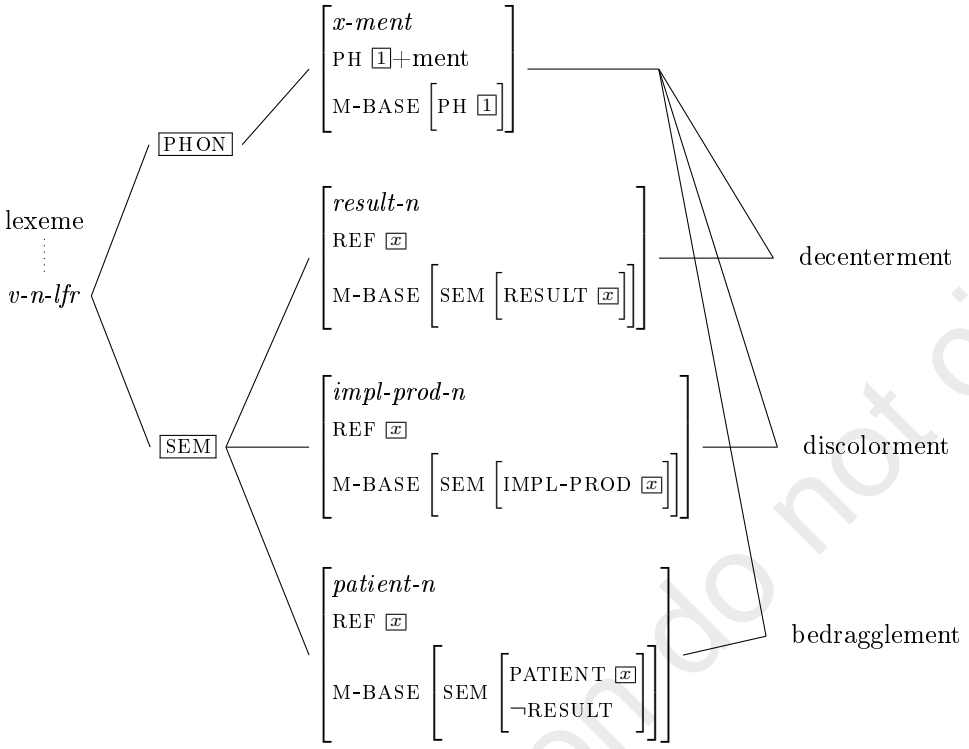


FIGURE 4.20: Introducing the interplay of PATIENT, IMPLICIT PRODUCT and RESULT into the inheritance hierarchy (partial hierarchy). Abbreviations: impl-prod = implicit product

4.2.4.3 Updated semantic categories and type signature

Let us now revisit the semantic categories and the type signature introduced in section 3.4.1. First, the IMPLICIT PRODUCT category needs to be added. Then, I will turn to the attributes needed to model it, namely REGION and ON-REGION. I will also include information about animacy in the type signature, so that the animacy constraint modeled in Figure 4.19 can take effect. The section is concluded by an updated type signature in Figure 4.23.

In Figure 4.21 and Table 4.12, IMPLICIT PRODUCT is added to the participant hierarchy and to the list of semantic role definitions, respectively. Note that PRODUCT already exists in VerbNet as a [+concrete] subtype of RESULT; I had not included it in the original list of definitions since in VerbNet it is not regarded as a core role for the verb classes under investigation. For brevity, I am only repeating the definitions for the relevant branch of semantic categories, i.e., PLACE and its hyponyms. Additionally, IMPLICIT PRODUCT will be added as an attribute to the relevant event types in the updated type signature at the end of this section.

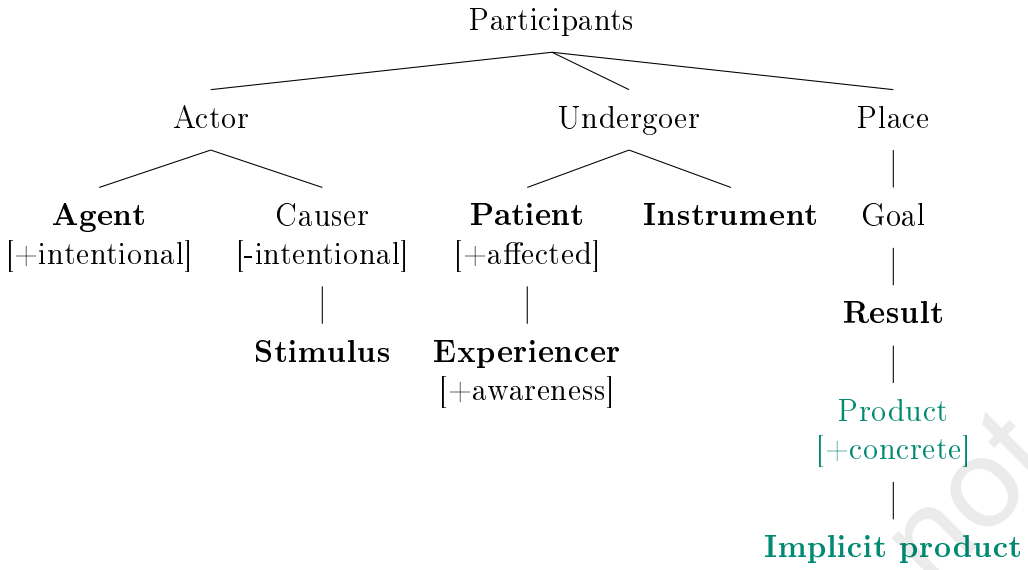


FIGURE 4.21: Participant categories for semantic coding (revised version of Figure 3.1; changes are indicated by teal)

TABLE 4.12: Introducing IMPLICIT PRODUCT into the list of participants. Revised section of Table 3.5. Relevant core participants are indicated by bold print

Category	Definition
Place	The state in which an entity exists
Goal	Place that is the end point of an action and that exists independently of the event
Result	An outcome that comes into existence through the event
Product	Result that is a concrete object
Implicit product	A product that is inherently related to the patient

So far, I have only depicted eventive types in my type signature. Now, we will need non-eventive types, which I will call **entities**, in order to introduce the attributes REGION, ON-REGION and ANIMACY. They describe properties of an entity with physical existence, namely the space it occupies (REGION), its surface (ON-REGION), and whether it is animate or not (ANIMACY). Therefore, they are not included in the type signature as independent types, but as constraints on entity types. Creating a type signature of entity types is extremely complex, opening up all sorts of problems and demanding meaningful decisions which are unnecessary in this study. Therefore, I am only giving a tentative signature in Figure 4.22, without any claim for it to be the absolute truth. For my purposes, the most straightforward solution is to split *entity* into the two types *abstract entity* and

concrete entity. *Concrete entity* then introduces the attributes REGION and ON-REGION.[63] As value labels I have chosen the geometrical terms *enclosed volume* and *surface*.

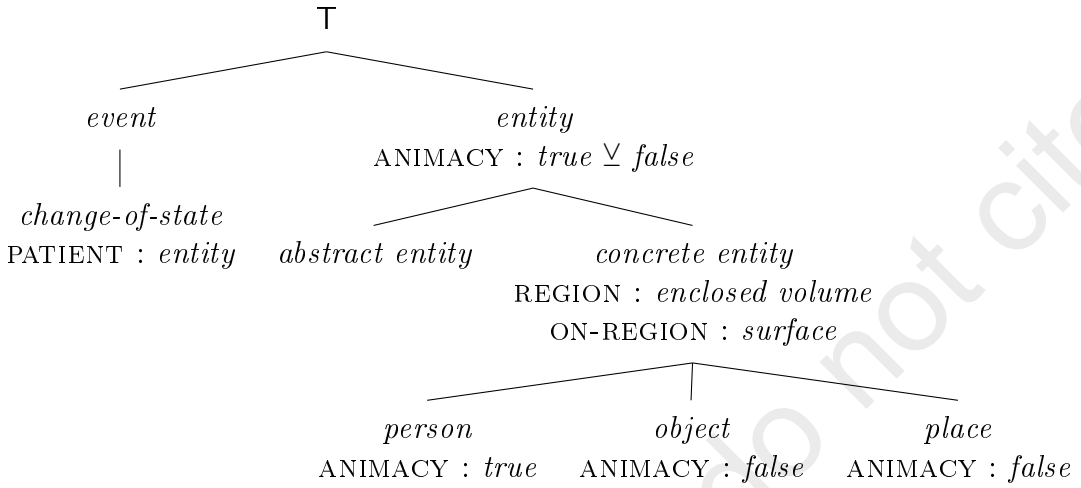


FIGURE 4.22: Introducing REGION, ON-REGION and ANIMACY into the type signature (tentative)

ANIMACY is introduced under *entity*, allowing both concrete and abstract entities to be animate (e.g. *bird* and *flock of birds*). The value of ANIMACY is specified further down in the type signature – here exemplarily by *person, object* and *place*. How does the animacy constraint as modeled in Figure 4.19 operate during, say, the creation of a PATIENT reading? In the type signature, the PATIENT attribute is introduced by *change-of-state*. Its value can be any entity. If the value is specified as a *person*, a PATIENT reading is blocked for *-ment*, since *person* is specified as [+animate] in the type signature (ANIMACY: *true*). If, however, the value of PATIENT is specified as an *object*, the animacy constraint allows a PATIENT reading.

Let us now revisit the type signature. In Figure 4.23, I am only including information which is relevant for this chapter of my thesis, leaving out types specific to psych nominalization.

[63] If a categorical split between abstract and concrete entities is not desired in the type signature, REGION and ON-REGION can also be introduced directly under ⊤ and operationalized by using a bi-implicational constraint such as 'CONCRETENESS : *true* ↔ REGION ∧ ON-REGION' (see Gamerschlag et al. 2014a, 8). It specifies that any concrete entity in the type signature automatically has the attributes REGION and ON-REGION.

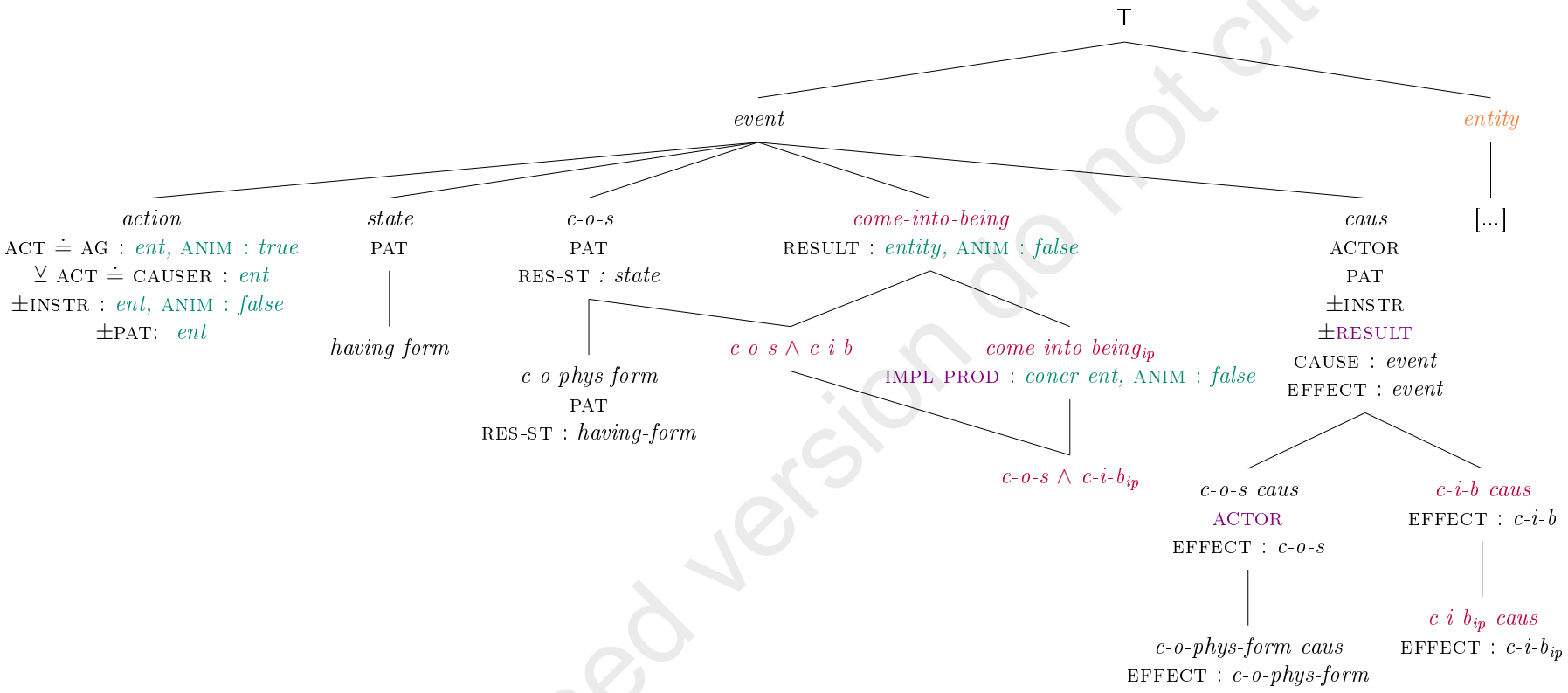


FIGURE 4.23: Revised type signature of eventive categories (COS subset). Optionality is indicated by ±, changes compared to the original type signature are indicated by color. Abbreviations: act = actor, ag = agent, anim = animacy, caus = causation, concr-ent = concrete entity, c-i-b = come-into-being, c-o-phys-form = change-of-physical-form, c-o-psych-st = change-of-psych-state, c-o-s = change-of-state, impl-prod = implicit product, instr = instrument, pat = patient, res-st = result-state

We find the following changes (from left to right): First, the values which can be taken by the participant attributes now contain information about animacy (color-coded in the figure as teal). For instance, agents are [+animate] entities (AGENT : *entity*, ANIMACY : *true*), instruments are inanimate (INSTRUMENT : *entity*, ANIMACY : *false*), and patients are underspecified (PATIENT : *entity*). For the sake of space, these specifications are only spelled out in the left-most appearance of a given attribute. Second, I have introduced six new event types (color-coded as purple) to account for RESULT and IMPLICIT PRODUCT readings: The event type *come-into-being* as well as its daughter *come-into-being*$_{\text{ip}}$, the corresponding causation event types *come-into-being causation* and *come-into-being*$_{ip}$ *causation*, and the multi-parent event types *change-of-state* $\wedge$ *come-into-being* and *change-of-state* $\wedge$ *come-into-being*$_{\text{ip}}$.[64] This leads me to the third change: I have revised three participants (color-coded as violet): RESULT and IMPLICIT PRODUCT (as shorthand for the notation introduced in Figure 4.6) were added, and ACTOR replaces AGENT in the type *change-of-state causation*.[65] Finally, I have added *entity* as a sister node to *event* (color-coded as orange). For the sake of space, the subtypes of *entity* as introduced in the tentative type signature in Figure 4.22 are not repeated here.

4.2.4.4 Lexical rules and inheritance hierarchy

The aim of this study was to establish a set of lexeme formation rules (LFRs) for *-ment* on COS verb bases. I identified nine such rules, producing nine distinct readings: CHANGE-OF-STATE CAUSATION, CAUSING EVENT, CHANGE-OF-STATE, RESULT-STATE, RESULT, IMPLICIT PRODUCT, INSTRUMENT, PATIENT, and CAUSER. Here, I am only spelling out the lexical rule for RESULT-STATE readings. The other eight LFRs differ only in the attribute label given for the base verb semantics (label CAUSER for CAUSER readings, and so forth.)

The LFR in Figure 4.24 creates a noun with the phonology /[z]-ment/ and a semantics which is specified by a frame. The input which is fed into the LFR is a verb with the phonology /[z]/. Its semantics is specified as *change-of-state causation* with, among others, a RESULT-STATE attribute. The last line tells us that reference

[64] For reasons of space, I am leaving out some event types: the causation events which have the multi-parent event types as second subevent, and all event types which would be needed to model PRODUCT (as a daughter to RESULT and a parent to IMPLICIT PRODUCT).

[65] Simply deleting the AGENT appropriateness condition would have sufficed here, but I am including ACTOR to visualize the change.

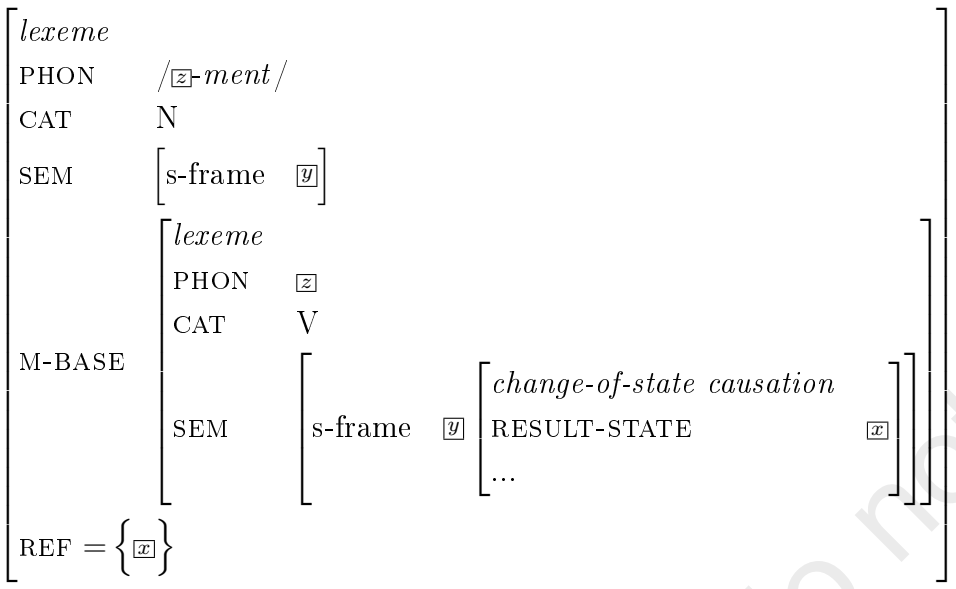


FIGURE 4.24: Lexical rule for RESULT-STATE readings of *-ment* on COS verbs

is on the node indexed '[x]' so that the depicted LFR produces a RESULT-STATE reading.

In the inheritance hierarchy in Figure 4.25, all my findings with regard to possible nominalization readings come together. The figure incorporates (abbreviated versions of) all nine LFRs and thus allows the derivation of the nine readings which I have found attested in my data. For ease of reference, I have numbered each LFR in the bottom left corner. The inheritance hierarchy also contains the constraints as introduced in Figures 4.19 and 4.20 ("ANIM : false" as a supertype and "¬ RESULT" within the *patient-n*-AVM). Since there is not enough space to include all 18 nominalizations in the figure, I am again calling upon the types which I used for illustration in Figures 4.16, 4.17 and 4.18 above: *abridgement, besmirchment, congealment, discolorment* and *embetterment*.

As described in detail in section 2.3.2.4, the mechanism depicted in the figure works on two levels: It accesses the phonology ([PHON]) and the semantics ([SEM]) of a morphological base (M-BASE) and outputs a nominalization with certain properties. On the phonological level, the nominalization takes the shape of the base plus *-ment*, as modeled in the bracket notation marked 0. On the semantic level, the animacy constraint takes effect first. It filters out animate readings (e.g. AGENT) as well as animate variants of readings (e.g. [+animate] PATIENT).

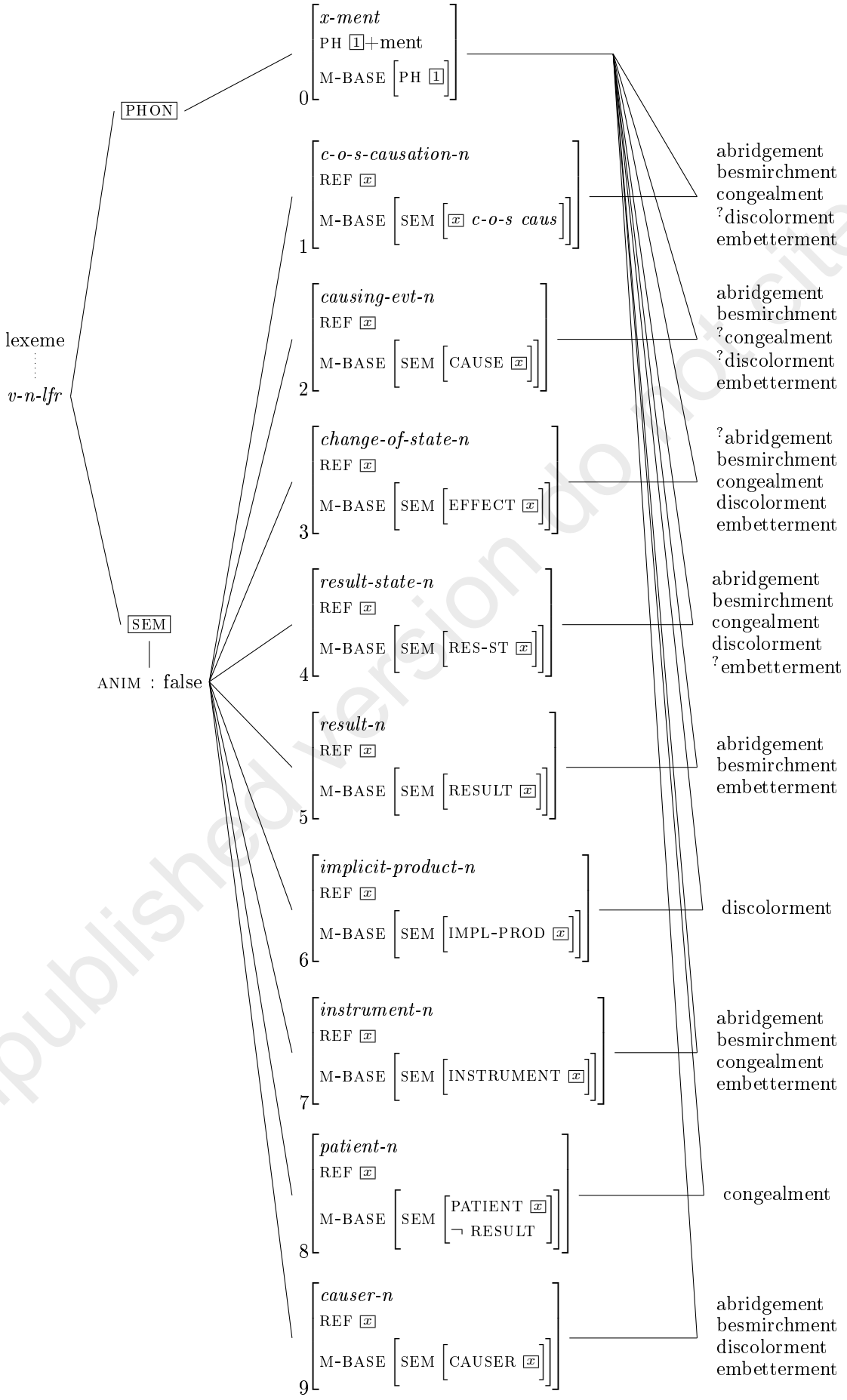


FIGURE 4.25: Inheritance hierarchy of lexical rules for *-ment* on COS verbs. Abbreviations: caus = causation, impl-prod = implicit product

Then, nine LFRs, one for each reading, become operative. The first possible reading is CHANGE-OF-STATE CAUSATION, as per LFR 1. This LFR checks for a node labeled *change-of-state causation*. Since this is the central node of all investigated base verb frames, all nominalizations can theoretically produce it. In other words, LFR 1 models the mechanism of transposition. The other eight LFRs check for attributes in the base verb frame, for instance CAUSE (LFR 2) or PATIENT (LFR 8). A reading is possible if the base verb has the corresponding attribute in its frame. For example, all five types can produce a RESULT-STATE reading (LFR 4), but only *discolorment* can produce an IMPLICIT PRODUCT reading (LFR 6). In LFR 8 we see the second constraint, which prevents shifts to a PATIENT reading if RESULT is in the base frame. Out of the five base verbs represented here, only *congeal* has neither a RESULT attribute nor its subtype IMPLICIT PRODUCT. Therefore, *congealment* is the only nominalization which is expected to have a PATIENT reading.

Finally, let me briefly address the issue of gaps in the data. Some types in Figure 4.25 are marked with a superscript question mark, for instance *discolorment* next to LFR 1. These are the types which I expected to find in a given reading, but did not. There are a number of conceivable reasons for and implications of such gaps, which I will discuss in detail in chapter 6. For now, let me just say that we are most likely dealing with mere data issues, and not with negative evidence.

4.3 Summary of chapter 4

In this chapter, I have investigated the readings which can be produced by the suffix *-ment* on COS verbs. The data set contained 18 nominalizations which I have assigned to three subclasses of COS verbs in VerbNet: c-only COS verbs, c/i general COS verbs and c/i reversible COS verbs. In VerbNet, all three share the same set of possible syntactic arguments, or participants, namely AGENT, PATIENT and INSTRUMENT. They are distinguished by their participation in the Caus/Inch-Alternation, by the type of change they lexicalize, by selectional restrictions on the PATIENT and INSTRUMENT participant, and by the possibility to express a secondary result in their participant structure.

As a next step, I devised what I called *VerbNet-based frames* by combining the information from VerbNet with the event structure templates commonly applied in frame semantics to model verbs. For this, I included the participants as

attributes, and translated VerbNet's selectional restrictions into type specifications of these attributes. C-only COS verbs were modeled with a causative event structure template. With regard to c/i COS verbs, I hypothesized that their nominalizations could shed some light on which frame is more appropriate: a complex and a simple event frame, one for each variant, or an integrated complex event frame with two possible referents. Furthermore, I decided to leave out the modeling of the secondary result for two interrelated reasons: I did not want to extend my research of morpho-semantics to the syntax-semantics interface, and I did not expect the different syntactic realizations of a secondary result to have any effect on the semantics of the derivatives in the first place.

Based on the VerbNet-based frames and on existing literature, I then formulated expectations about the possible readings and the contexts of COS nouns, and examined the corpus attestations to verify or falsify these expectations. Regarding possible readings, my study had the following results: I systematically found shifts to the eventive categories CHANGE-OF-STATE CAUSATION, CAUSING EVENT, CHANGE-OF-STATE and RESULT-STATE, as well as to the non-eventive categories RESULT, IMPLICIT PRODUCT, INSTRUMENT, PATIENT and CAUSER. Furthermore, I identified three constraints which help explain my data: First, animate readings are not produced by *-ment*. This affects AGENT, which is ruled out as a possible reading, as well as PATIENT and CAUSER, which are restricted to [-animate] instantiations. Post-lexical shifts are possible, but rare. Second, I found a complementary distribution of PATIENT, IMPLICIT PRODUCT and RESULT readings. I captured this distribution by formulating two principles: If a base verb has an IMPLICIT PRODUCT or a RESULT participant, this participant can be shifted to, respectively, and if a base verb has no IMPLICIT PRODUCT or RESULT participant, the PATIENT can be shifted to. Third, I looked at the distribution of possible readings denoting a causing entity; that is, I looked for systematic distributions of INSTRUMENT versus CAUSER. I concluded that the constellation we find (INSTRUMENT, or CAUSER, or both, or neither) depends on the base verb.

Regarding the contexts in which the nominalizations are attested, I demonstrated that external causes are either expressed or implied in the contexts of CHANGE-OF-STATE CAUSATION readings, which strengthens the traditional approach of modeling causation events as complex events. In the contexts of CHANGE-OF-STATE readings, a mixed picture emerged: For c-only COS nouns, as expected, external causes are expressed or implied. For c/i COS nouns, external causes are most often expressed or implied, but some attestations without an external cause

can be found. Therefore, I concluded that c/i COS nouns are best modeled with a complex event structure covering both variants, but that the inchoative variant may also be modeled with a simple event frame under certain conditions. Unfortunately, what exactly these conditions are has yet to be uncovered.

Based on these findings, I revised the VerbNet-based frames from the ground up. Since they only included syntactic arguments – which are thought to be the core participants of a verb – I added the semantic arguments IMPLICIT PRODUCT and RESULT. Additionally, I also modified existing frame elements. Both the AGENT attribute and the type of the first subevent, *action*, proved to be too restrictive. They were replaced by PARTICIPANT and *event*, respectively. I also discussed the possibility of representing gradient phenomena by means of stochastic frames. Unfortunately, the scope of this thesis only allowed for a tentative exploration of the topic, rather than a full-fledged quantitative analysis. The patterns which I identified (PATIENT/IMPLICIT PRODUCT/RESULT and INSTRUMENT/CAUSER) produce ten classes of nouns and base verbs, three of which I modeled by way of example. The type signature was also updated accordingly.

I concluded my analysis by suggesting LFRs for *-ment* nominalizations with COS verb bases. One LFR, producing RESULT-STATE readings, was given by way of example, and all nine proposed LFRs were incorporated into the inheritance hierarchy for *-ment* suffixation. The inheritance hierarchy also contains two constraints: A superimposed animacy constraint prevents shifts to AGENT, to [+animate] PATIENT and to [+animate] CAUSER, and a specification within the *patient-n*-LFR handles the PATIENT/IMPLICIT PRODUCT/RESULT distribution.

Chapter 5

Psych verb bases

In this study, I investigate the semantics of nominalizations derived from psychological verbs, or **psych verbs**, that is, verbs which express an emotional or psychological event or state.[66] Based on the idea that possible referents which are targeted by derivation must be available in the semantics of the base word, I will first discuss the psych base verbs in my data set (section 5.1). Psych verbs have been a widely studied topic for about 30 years, and a number of (partially conflicting) analyses have been posited. Based on this existing work, I will propose an array of eight frame-semantic formalizations. Building on the analysis of the base semantics, I will then move on to the psych nominalizations (section 5.2). I will identify and model possible readings, and thereby also determine which of the eight frame analyses are backed up by my nominalization data. For a summary of my results, see section 5.3.

The psych neologisms which form the basis of this chapter are, in alphabetical order: *abashment, affrightment, annoyment, approvement, bemusement, bumfuzzlement, confoundment, convincement, disheartenment, dumbfoundment, endullment, enragement, enrapturement, musement, nonplusment, perturbment, reassurement, soothement, staggerment, upliftment, upsetment,* and *worriment.*

5.1 The semantics of psych verbs

I will present the semantics of psych verbs in two steps: First, in section 5.1.1, I will describe the semantic ingredients which have been proposed in formal and informal accounts of psych verbs. These existing analyses in combination with

[66] Most of the data which I analyze and discuss in this chapter was also the basis of a preliminary study published in Kawaletz & Plag (2015). Since then, I have revised the data set as well as greatly modified the semantic labeling, frame formalization, and interpretation of my results.

the insights from chapter 4 will then form the basis for the frame formalizations I propose for psych verbs in section 5.1.2. There is much disagreement in the literature on psych verbs, and the different points of view will be represented by eight alternative frame analyses.

5.1.1 Semantic ingredients

The label *psych verbs* is commonly assigned to verbs which describe an emotional or psychological event or state, such as *frighten* or *fear*. Psych verbs have been widely discussed ever since Belletti & Rizzi's (1988) seminal article on the syntactic peculiarities of Italian psych verbs. Research in this vein is mostly focused on their unusual properties with regard to argument realization. For my purposes, however, a close look at their semantic properties is required. There are four topics which are relevant for a formalization of psych verbs: the distinction between different subclasses of psych verbs based on semantic and syntactic criteria (section 5.1.1.1), the participants they take (section 5.1.1.2), the notion of implicit causality (section 5.1.1.3), as well as event structure and causativity (section 5.1.1.4).

5.1.1.1 Subclasses of psych verbs

Psych verbs typically take an EXPERIENCER and a STIMULUS argument (see Levin 1993, 189). The experiencer is an animate participant who perceives or feels the event, while the stimulus is the participant evoking it. Often, English psych verbs are divided into two subclasses, depending on the syntactic realization of EXPERIENCER in a sentence.[67] If it is realized as the subject, they are called **subject experiencer psych verbs** (henceforth **SE psych verbs**), and if it is realized as the direct object, they are referred to as **object experiencer psych verbs** (henceforth **OE psych verbs**). Correspondingly, STIMULUS takes the other slot, respectively. Examples are given in (48).

(48) a. SE: Charlie **fears** Jael.
b. OE: Jael **frightens** Charlie.

A more fine-grained classification of psych verbs is employed by Levin (1993) and VerbNet. Based on two criteria, Levin (1993, 188-193) distinguishes four subtypes of psych verbs (see Table 5.1). First, she follows the traditional split between

[67] In languages which are morphologically richer than English, this subdivision is traditionally based on case assignment, see e.g. Klein & Kutscher (2005) for German and Belletti & Rizzi (1988); Varchetta (2010) for Italian.

Table 5.1: Types of psych verbs according to Levin (1993, 188-193)

	SE	OE
Transitive	admire verbs *The tourists admired the paintings.*	amuse verbs *The clown amused the children.*
Intransitive with PP complement	marvel verbs *Megan marveled at the beauty of the Grand Canyon.*	appeal verbs *This painting appeals to Malinda.*

SE and OE psych verbs. Then, she adds the dimension of transitivity, distinguishing between transitive verbs and intransitive verbs with a prepositional phrase complement.

In my data set, most nominalizations have transitive OE psych verb bases, while three bases have been categorized as intransitive SE psych verbs (see Table 5.2). Thus, two of the Levin/VerbNet classes are represented, namely amuse verbs and marvel verbs.

Table 5.2: Properties of the psych verbs in my data set, based on the classification by Levin (1993, 188-193)

	SE	OE
Transitive	Admire verbs	Amuse verbs (n=20) *abash, affright, annoy, bemuse, bumfuzzle, confound, convince, dishearten, dumbfound, endull, enrage, enrapture, nonplus, perturb, reassure, soothe, stagger, uplift, upset, worry*
Intransitive with PP complement	Marvel verbs (n=3) *approve of, muse over, worry about*	Appeal verbs

Amuse verbs denote "the bringing about of a change in psychological or emotional state" (Levin 1993, 191), while marvel verbs describe mental states (p. 193). Some psych verbs are found in transitive/intransitive pairs, which are then cross-listed as amuse verbs and as marvel verbs. Examples include *cheer, gladden,* and *thrill*, as well as, from my data set, *worry*. These participate in causative alternations, as is exemplified in (49).

(49) a. Bill **worried** about the article.
b. The article **worried** Bill.

Levin (1993, 191) mentions that further subdivisions based on agentivity may be sensible in the categorization of psych verbs. Agentivity here relates to the amount of control which the STIMULUS has over the event. Consider the sentences in (50) for illustration (from Di Desidero 1993, 11). Here, (50a) is regarded as **non-agentive**, while (50b) is generally interpreted as **agentive**.

(50) a. The mask frightened the children.
b. The man frightened the children.

The literature typically uses semantic tests to distinguish between agentive verbs (e.g. *encourage*), non-agentive verbs (e.g. *inspire*), and verbs which have both agentive and non-agentive senses (e.g. *frighten*). As with any such categorization, this threefold distinction is not as straightforward as it may seem. First of all, the contexts which are usually thought to indicate agentivity produce ambiguous results for a number of psych verbs. For example, the verb *interest* works in the *subjective adverb* test in (51a), but not in the *persuade* test in (51b) (Martin 2013, 73).

(51) a. Paul **cleverly interested** Mattel in the toy.
b. *I **persuaded** Paul **to interest** Mattel in the toy.

The verbs which show this mixed behavior are traditionally categorized as non-agentive verbs, but since they are compatible with some agentive constructions, the author dubs them "weakly agentive" (p. 72). What is clear is that semantic fuzziness is a salient problem with regard to the decision of whether a given (psych) verb is agentive, or non-agentive, or whether it can instantiate both categories.[68]

I have decided to test my psych base verbs for agentivity for two reasons. First, it is directly relevant for their frame formalization. Thus, it has been claimed that only agentive (variants of) OE psych verbs are causatives (see e.g. Di Desidero 1993; Kailuweit 2005). Agentive and non-agentive psych verbs would thus be represented by fundamentally different frames. Second, Grimshaw (1990) claims that only agentive variants of psych verbs are causatives and can thus produce transpositional readings. This, of course, is imminently relevant for my assessment of psych nominalization readings.

[68]See also Huyghe & Wauquier (2020) for a critical discussion of how the AGENT category is applied in semantic analyses.

Due to the fuzziness of the labels *agentive* and *non-agentive* delineated above, I have decided to apply a gradable notion of agentivity. More precisely, I have calculated agentivity scores based on four tests, following standard diagnostics originally proposed by Lakoff (1966):[69]

1. admissibility of an imperative (*Upset him!*)
2. contexts with *persuade* (*She persuaded him to upset the children.*)
3. contexts with agent-oriented adverbs
   (a) *reluctantly* (*She reluctantly upset the children.*)
   (b) *deliberately* (*She deliberately upset the children.*)

The contexts in (2) and (3) were looked up in iWeb, GloWbE, COCA and Google.[70] For the imperative construction, I used the search engine *Symbolhound* (n.d.), which allows searches for special characters like exclamation points. Points were assigned as follows: 0 points were assigned if the construction in question was not attested, 1 if it was attested, and 0.5 if it was attested only once. Since none of the base verbs could be found in the imperative construction, this test was supplemented by speaker judgments of two native speakers, one of which is a trained linguist. Here, 0 points were assigned if a sentence was judged unacceptable, 1 if it was perceived as well-formed, and 0.5 if the informant was insecure about a sentence's acceptability. Finally, all points were added together, resulting in a total possible agentivity score between 0 and 6. The results are given in Table 5.3.

Table 5.3: Agentivity scores of OE psych verbs

Verbs	Agentivity score
convince, reassure	5
upset	4
annoy, soothe	3.5
confound, enrage, uplift	3
bemuse, perturb, worry	2
dishearten, enrapture	1.5
bumfuzzle, dumbfound	1
abash, affright, stagger	0.5
endull, nonplus	0

However, there are two caveats to these agentivity scores: First, the tests which were applied do not disambiguate between different verb senses. The high score for

[69] Lakoff (1966) actually introduces diagnostics for stativity, but finds that some of his tests also indicate agentivity (p. I-13).

[70] The queries were <persuaded him to V>, <reluctantly Ved>, and <deliberately Ved>.

convince, for instance, may relate to its sense as a *force verb* (*convince someone to do something*). Second, some base verbs in my data set are rare, so the non-acceptability of contexts may be due to the informants not having a verb in their active vocabulary. An example for this is *abash*, which both informants stated they only use in its adjectival form *abashed*. For these reasons, we will need to take the predictive power of these scores with a grain of salt.

That said, the agentivity scores should indicate whether an OE psych verb has a causative event structure, and whether we can thus expect its nominalization in a transpositional reading, as claimed by Grimshaw (1990). Thus, we can expect verbs higher up in the table (e.g. *convince, upset,* or *annoy*) to have a causative event structure, and to produce transpositional event nouns. Contrarily, verbs further down in the table (e.g. *endull, abash,* or *bumfuzzle*) should have a non-causative event structure, and their nominalizations should not be able to exhibit transpositional readings. I will come back to this issue when discussing transpositional readings of psych nouns in section 5.2.2.4.

5.1.1.2 The participants of psych events

I have already introduced the two most frequently mentioned participants of psych verbs: EXPERIENCER and STIMULUS. While the EXPERIENCER category seems to be uncontroversial, there is some discussion about STIMULUS. Let us first have a look at subtypes of this participant. One point of view is that the STIMULI in (52) (repeated from (48)) are semantically identical and merely surface in different syntactic positions (see e.g. Belletti & Rizzi 1988; Grimshaw 1990; Levin 1993):

(52) a. SE: Charlie **fears** Jael.
b. OE: Jael **frightens** Charlie.

Other authors have identified semantic details in different instantiations of STIMULUS which are not captured by this label. For instance, Pesetsky (1995, 56-7) distinguishes between the subcategories CAUSER, TARGET and SUBJECT MATTER (see e.g. Härtl 2001b for further evidence):[71]

(53) a. Bill was very angry at **the article**. (=TARGET)
b. **The article** angered/enraged Bill. (=CAUSER)

(54) a. Bill worried about the **article**. (=SUBJECT MATTER)
b. **The article** worried Bill. (=CAUSER)

[71] In 54 I have slightly altered the original examples to streamline my account: *Bill* is originally *John* and *article* is originally *television set*.

Let us first distinguish CAUSER from the other two categories. In short, CAUSER is more loosely connected to the experienced emotion than the other two. To motivate this distinction, Pesetsky explains that the truth conditions of the (a) sentences differ substantially from those of the (b) sentences: For (53a) and (54a) to be true, Bill's emotions must be directed at the article itself, or some aspect of it. For instance, he may be angry at the writing style because he expected better from his favorite columnist, and he may be worried about how the article will be received by the audience. For (53b) and (54b) to be true, on the other hand, it is not necessary that Bill be angry at/worried about the article itself. Instead, Bill may be angry at the government because the article revealed a political scandal, and he may be worried because the article reports on critical flaws in the car he is driving. In other words, in the (b) sentences, the article causes Bill to feel an emotion which is directed at something or someone else. An additional observation concerning the distinction between CAUSER and TARGET/SUBJECT MATTER is that CAUSER is always realized as the subject of the sentence, while TARGET and SUBJECT MATTER are realized as the object (Pesetsky 1995, 56).

Now, we can tease apart TARGET and SUBJECT MATTER. The distinction is grounded in the presence or absence of an evaluation on the part of the experiencer. Pesetsky (1995, 56) explains that in (53a), Bill must have assessed the article and concluded that he dislikes some aspect of it; the article is the TARGET of emotion. A SUBJECT MATTER, on the other hand, does not require evaluation.

Another terminological distinction within the STIMULUS category is often made in connection with agentivity (see section 5.1.1.1). Depending on the amount of control the STIMULUS has over the event, it is referred to as CAUSER or AGENT, respectively. For the examples we have already seen in (50), this means that *the mask* is interpreted as a causer, while *the man* is usually interpreted as an agent:

(55) a. **The mask** frightened the children.
b. **The man** frightened the children.

Let us now look at what kinds of things in the world can actually be a STIMULUS. This participant is instantiated by the following three categories (my labeling; examples from Levin 1993, 77, 190): agentive entities (e.g. *the man*), non-agentive entities (e.g. *the mask*), properties (e.g. *Mark's single-mindedness*), and events (e.g. *the clown's antics*).

According to Levin (1993, 77), the two NPs *Mark's single-mindedness* and *the clown's antics* contain a possessor (*Mark*/*the clown*), and an attribute or an action of this possessor (*single-mindedness*/*antics*). This attribute/action is what causes

the psych-state. In the following example sentences I have marked the stimulus by bold print and underlined the respective possessor:

(56) a. **Mark's single-mindedness** terrified me.
b. **The clown's antics** amused the children.

The combination of possessor and attribute/action can be expressed not only by a single NP, but also by two distinct constituents, namely a subject (*Mark/the clown*) and a with-PP (*with his single-mindedness/with his antics*):

(57) a. Mark terrified me **with his single-mindedness**.
b. The clown amused the children **with his antics**.

Besides STIMULUS and EXPERIENCER, VerbNet uses a third participant which is relevant in the description of my data set: SECONDARY RESULT.[72][73] More precisely, some amuse verbs allow the addition of a resultative construction, as exemplified in (58) (from Levin 1993, 190, my emphasis).[74] Such resultative constructions further specify the result-state which is already included in the verb's semantics. Here, *bore* includes a result-state *bored*, which is further specified as *bored silly*.

(58) That movie bored me **silly**.

I have already discussed the SECONDARY RESULT participant in some detail in the previous chapter (section 4.1.2.3), and its usage with amuse verbs does not come with any surprises. Importantly, secondary result predicates are not imminently relevant for my study: Since they are modifiers which act on the frame of a verb, their semantics cannot be accessed by an affix.

5.1.1.3 Implicit causality

Another central notion in the research on psych verbs is that of **implicit causality** (see Kailuweit 2005, 90-2 for a summary of the origins of this concept). I discuss

[72] In VerbNet, this role is called RESULT. However, this term only refers to secondary results in the verb classes discussed in this thesis, and primary results have played a role in my analysis of COS nominalization. A doubling of terminology would be confusing, so that I have decided to relabel the VerbNet role.

[73] A fourth participant, ATTRIBUTE, is used in the description of admire verbs, which are not represented in my data set. It is defined as a "[c]ircumstance that is a property of an entity or entities, as opposed to the entity itself" (Palmer et al. 2017, 318), as for example in *I admired him **for his honesty***.

[74] Notably, the name patron of the amuse verb subclass does not allow a SECONDARY RESULT participant. Instead, Levin (1993) as well as the authors of VerbNet use *bore* for illustration (*That movie bored me silly*). Moreover, Levin (1993) does not tag the presence of a resultative phrase as an optional property of amuse verbs, although it clearly is.

it here for two reasons: First, it needs to be disentangled from the STIMULUS category. Importantly, the two notions most often coincide, but they are not identical. Moreover, although both OE and SE psych verbs have been found to be implicitly causative (Härtl 1999, 2001b), this does not necessarily mean that they also have a causative event structure (see section 5.1.1.4).

The basic idea behind implicit causality is that speakers have intuitions as to who is responsible[75] for an event. Psych verbs are thought to linguistically behave in a way which reflects these intuitions (as does the whole range of interpersonal verbs, see Härtl 2001b). In this context, different syntactic and semantic phenomena have been discussed (see e.g. Hartshorne & Snedeker 2013; Hartshorne 2014 for an overview). I will use speaker bias in pronoun resolution for illustration.

Studies have shown that, in ambiguous contexts such as in (59), speakers have a bias as to who is responsible for an event, namely *Mary* in (59a), and *Sally* in (59b) (see Hartshorne & Snedeker 2013; Hartshorne 2014).

(59) a. Sally fears **Mary** because **she** is strange.
b. **Sally** frightens Mary because **she** is strange.

Although this phenomenon was first observed almost 50 years ago by Garvey & Caramazza (1974), it remains unclear whether implicit causality is primarily a linguistic or a cognitive phenomenon, and among proponents of either position there are many different proposals (see Hartshorne 2014 for an overview).

How is implicit causality related to the stimulus of an event? Most often, the two categories coincide, as in (59). Here, speakers tend to regard the stimulus (*Mary* and *Sally*, respectively) as responsible for the event. It is also possible, however, to modify the context so that responsibility is assigned to the experiencer:

(59′) a. **Sally** fears Mary because **Sally** is strange.
b. Sally frightens **Mary** because **Mary** is strange.

In these examples, it is still the stimulus which makes the experiencer feel afraid, but the experiencer is ultimately considered responsible, for example because the stimulus is objectively speaking not scary. Importantly, *Mary* is still the stimulus in the (a) sentence, and *Sally* is still the stimulus in the (b) sentence, no matter who is considered to be ultimately responsible.

[75] While the term *cause* (and related terminology) is applied in the literature on implicit causality, in this section I am using the term *responsibility* instead, in order to avoid confusion with the frame attribute CAUSE.

5.1.1.4 Event structure and causativity

In the previous chapter, we saw that event structure and causativity are central in the formalization of COS verbs. As is virtually undisputed in the existing literature, I modeled the members of this verb class as complex events with two subevents, CAUSE and EFFECT. With regard to the event structure of psych verbs, things are not as straightforward. The one issue that authors seem to agree about is that OE psych verbs standardly denote complex events – and even in this respect, counter-examples have been claimed (e.g. German *ärgern* 'annoy,' see Hirsch 2018). SE psych verbs, on the other hand, are most often modeled as simple events, but there are also some accounts which interpret them as complex events. In the related discussion of causativity of OE psych verbs, almost any imaginable proposal can be found: Are they causatives? Non-causatives? Causatives under certain conditions? A special kind of causatives? Similar questions are asked about SE psych verbs by those who believe that they do denote complex events. In the following, I will only give a rough overview of the different existing proposals. Rather than evaluating their feasibility at this point, I will do so in hindsight and in view of my data. Thus, I will first suggest frames modeling the different points of view (section 5.1.2), and then use the nominalization semantics of my data as a contribution to the discussion of which decompositions make the most sense.

States and caused states As I have mentioned, the most common assumption is that OE psych verbs denote causatives and are therefore complex events (see e.g. Grimshaw 1990; Pustejovsky 1991; Di Desidero 1993; Pesetsky 1995; Van Valin & LaPolla 1997; Van Valin 2005; Martin 2013; VerbNet). SE psych verbs, on the other hand, are usually thought to denote non-causative, stative, simple events (see e.g. Grimshaw 1990; Di Desidero 1993; Van Valin & LaPolla 1997; Levin 2006).[76] I will use Van Valin's (2005) notation as an example for a corresponding formalization. The author models *fear* as a state (example (60)), and *scare* as its causative counterpart (example (61)).[77] Correspondingly, *fear* is modeled with the predicate **feel′**, which expresses an internal experience (p. 55). It has two arguments, an experiencer (boy) and a sensation (**afraid′**). In (61), **feel′** is embedded in the complex

[76]Note that this dichotomy may be regarded as a simplification. Causativity is a continuous property, with verbs – or verb variants – being located somewhere on a spectrum between non-causative and causative. See for instance Kailuweit (2005) for a more fine-grained classification of some French psych verbs.

[77]The lexical entry modeled in Van Valin (2005, 66) is actually *be afraid*, but I assume that the SE psych verb *fear* is modeled identically.

event structure. The causing event is an unspecified action[78], which is expressed by **do′**. Both subevents are connected by the operator-connective CAUSE.

(60) a. The boy feared the dog.
b. [**feel′** (boy, [**afraid′** (dog)])]

(61) a. The dog scared the boy.
b. [**do′**(dog, ∅)] CAUSE [**feel′** (boy, [**afraid′**])]

Two things are notable in examples (60) and (61). First, *dog* is not part of the second subevent in (61). This resembles the distinction between causer and subject matter (see section 5.1.1.2): The dog causes the boy to be afraid, but it might not be the subject matter of fear (see also Van Valin 2005, 38). Second, the cause is not the dog itself, but something it does. In Pustejovsky (1995), this is called a "metonymic reconstruction of the subject to an event" (p. 209).

Why does this first group of approaches assume that the second subevent of an OE psych verb is a state, and not a change-of-state? An explanation is given by Alexiadou & Iordăchioaia (2014). Discussing alternating SE/OE psych verb pairs such as *worry/worry about*, they state that English psych verbs do not contain a change-of-state subevent because they are incompatible with *in*-adverbials (p. 72):

(62) a. John worried about the television set for/*in an hour.
b. The television set worried John for/??in an hour.

They argue that existing transitive/intransitive verb pairs such as *worry* and *worry about* do not actually participate in the causative-inchoative alternation, and should be interpreted as idiosyncratic alternations instead (p. 54).[79] The authors attribute the lack of this alternation in English psych verbs to diachronic developments (p. 75). It used to be more common, but only a small number of psych verbs with causative and inchoative variants have survived into present times, including *sadden/sadden at, madden/?madden at, weary/weary of* and *thrill/?thrill at*. From their argumentation, it can be concluded that they would model these relics from earlier stages of English with a change-of-state subevent. I will come back to this diagnostic in relation to my data set below (p. 130).

Experienced causation Many authors who assume that OE psych verbs are causatives distinguish them from non-psych causatives in some way (see e.g. Asher

[78] Van Valin (2005) uses the term 'activity.'
[79] Further examples listed are *grieve/grieve over, puzzle/puzzle over* and *delight/delight in.*

& Pustejovsky 2000; Geuder 2000; Grimshaw 1990; Pustejovsky 1995). Famously, Pustejovsky (1995) distinguishes between *direct* and *experienced causation*.[80] In order to illustrate the differences between the two, I am giving his lexical conceptual paradigms (lcps) for the verbs *kill* (Figure 5.1) and *anger* (Figure 5.2). I will go through the differences from top to bottom. For better readability, I have marked the relevant spots teal.

An lcp consists of three levels of representation (ibid., p. 61). In the **event structure**, the event type of the lexical item is defined by stating its subevents and relating them to one another. In both types of causation, the author posits an event structure with a causing process (e_1: process) which leads to a state (e_2: state). What is different is the temporal relation between the subevents. For default causatives, he assumes that the process precedes the state ($<_\alpha$). For experienced causation, in addition to that, the experiencing process overlaps with the resulting state ($<\circ_\alpha$).[81]

$$\begin{bmatrix} \textbf{kill} & & \\ \text{EVENTSTR} & = & \begin{bmatrix} \text{E}_1 = \textbf{e}_1\textbf{:process} \\ \text{E}_2 = \textbf{e}_2\textbf{:state} \\ \text{RESTR} = <_\alpha \\ \text{HEAD} = \textbf{e}_1 \end{bmatrix} \\ \text{ARGSTR} & = & \begin{bmatrix} \text{ARG1} = \boxed{1}\begin{bmatrix}\textbf{top}\end{bmatrix} \\ \text{ARG2} = \boxed{2}\begin{bmatrix}\textbf{animate\_ind} \\ \text{FORMAL} = \textbf{physobj}\end{bmatrix} \end{bmatrix} \\ \text{QUALIA} & = & \begin{bmatrix}\textbf{direct-causation\_lcp} \\ \text{FORMAL} = \textbf{dead}(\textbf{e}_2,\boxed{2}) \\ \text{AGENTIVE} = \textbf{kill\_act}(\textbf{e}_1,\boxed{1},\boxed{2},\ldots)\end{bmatrix} \end{bmatrix}$$

FIGURE 5.1: Lcp for the verb *kill* (from Pustejovsky 1995, 208)

In the **argument structure**, the verbs' arguments and their syntactic realization are specified. Here, the first argument differs. In direct causation, 'top' stands for the most general possible type (typically expressed as $\top$ in frame theory). In

[80] For English, I have only found accounts which relate experienced causation to OE psych verbs. Nam (2009) proposes event templates to model the Korean SE predicates *cilwuha-* 'bored/-boring' and *komap-* 'thankful' as subtypes of experienced causation.

[81] Geuder (2000) makes a slightly different point, stating that psychological causation requires concomitance of cause and effect, not precedence, while default causatives are neutral in this respect (p. 195-6).

$$\begin{bmatrix} \textbf{anger} & & \\ \text{EVENTSTR} & = & \begin{bmatrix} \text{E}_1 = \textbf{e}_1\textbf{:process} \\ \text{E}_2 = \textbf{e}_2\textbf{:state} \\ \text{RESTR} = <_{\circ_\alpha} \\ \text{HEAD} = \textbf{e}_1 \end{bmatrix} \\ \text{ARGSTR} & = & \begin{bmatrix} \text{ARG1} = \boxed{1} \begin{bmatrix} \langle \boxed{2}, \langle \text{e}_1, t \rangle \rangle \end{bmatrix} \\ \text{ARG2} = \boxed{2} \begin{bmatrix} \textbf{animate\_ind} \\ \text{FORMAL} = \textbf{physobj} \end{bmatrix} \end{bmatrix} \\ \text{QUALIA} & = & \begin{bmatrix} \textbf{experiencer\_lcp} \\ \text{FORMAL} = \textbf{angry}(\textbf{e}_2, \boxed{2}) \\ \text{AGENTIVE} = \textbf{exp\_act}(\textbf{e}_1, \boxed{2}) \end{bmatrix} \end{bmatrix}$$

FIGURE 5.2: Lcp for the verb *anger* (from Pustejovsky 1995, 211)

experienced causation, argument 1 is the event e_1, in which argument 2, the experiencer, is involved. This event is an **experiencer process**. That is, the causing event is one in which the experiencer directly perceives something related to the stimulus (p. 210). This perception and its cognitive processing may happen subconsciously (Geuder 2000, 197). If argument 1 is thus necessarily an event, contexts like *Jael frightens Charlie* require metonymic reconstruction (Pustejovsky 1995, 209). more precisely, the stimulus *Jael* is reconstructed into an event, for instance Charlie seeing Jael's scarred face.

The third level of representation is the **qualia structure**, which specifies four aspects of a lexical item's meaning and relates it to other lexical items. Two of these aspects are relevant for direct and experienced causation: **FORMAL** distinguishes the lexical item within a larger domain, and **AGENTIVE** specifies its origin.[82] For *kill*, Pustejovsky (1995) states that the state e_2 of argument 2 must be 'dead.' This is brought about by e_1, a killing action in which both arguments are involved. For *anger*, the resulting state is 'angry,' and the agentive quale specifies the origin of this state as the experiencer process e_1.

Agentives are causative Not all researchers believe that OE psych verbs are always causatives. More precisely, there is some disagreement regarding the influence of agentivity on causativity. Researchers like Di Desidero (1993, 11-2) or

[82] Two aspects are not included here, namely **CONSTITUTIVE** (how an object and its constitutive parts are related) and **TELIC** (the lexical item's purpose and function).

Kailuweit (2005) state that a difference in agentivity also seems to reflect a difference in event type. Thus, a sentence like *The mask frightened the children* describes a reaction event with a simple event structure. A sentence like *The man frightened the children*, on the other hand, presupposes that the subject has performed some action. This sentence thus has (at least) two subevents. Elsewhere, however, it has been found that both agentive and non-agentive (variants of) psych verbs are best modeled as causatives (Martin 2013, 71).

Finally, it has been claimed that agentive-causative OE psych verbs differ with regard to the salience of the subevents: Di Desidero (1993, 13, 17-8) finds linguistic evidence that, depending on the verb, either the first or the second subevent is salient. The author states that, for verbs like *frighten* and *amuse*, the causing action is salient: The AGENT acts intentionally, volitionally, and with control to elicit a certain reaction – they choose to cause it, and the verb meaning contains a high probability that the reaction is indeed going to happen. For verbs like *amaze* and *delight*, on the other hand, the reaction of the experiencer is salient. Here, an agent can only intend to elicit a certain reaction, but they cannot choose to.

Complex event structure So far, I have only referred to approaches which assume a complex event structure for OE psych verbs and a simple one for SE psych verbs. A rather different approach also exists, stating that both verb classes have a complex event structure. A proponent of this view is Tantos (2006), who argues that a unified account for all psych verbs is desirable, giving lexical evidence from Greek (where the equivalents of *fear* and *frighten* share the same verb stem, p. 127-8). For both SE and OE psych verbs, he assumes a causing subevent and a caused subevent, the difference being that SE psych verbs highlight the result-state while the cause fades into the background (p. 129). Formally, this is expressed by two juxtaposed rhetorical connections:[83] *result* for OE psych verbs, and *explanation* for SE psych verbs. They differ in that the two subevents are switched:[84]

(63) a. Result: e1 = Exp (e, x, y), e2 = afraid(e1, y)
b. Explanation: e1 = afraid(e1, y), e2 = Exp (e, x, y)

[83]The author bases his analysis on work by Asher & Pustejovsky (2000). In their formalization, rhetorical relations are added to lexical entries in order to tackle the connection between the discourse level and the lexical level.

[84]This notation has been simplified for expository purposes. In the original, the author follows the representation format used in Asher & Pustejovsky (2000).

Importantly, Tantos (2006) questions the assumption that psych verbs constitute a variant of causative verbs. Instead, he assumes some sort of "'weaker' notion of impact" (p. 123) which leads up to a mental state.

A similar approach is found in VerbNet, where the semantics of amuse verbs and of marvel verbs are modeled as follows (for a better overview, I have marked predicates by bold print):[85]

(64) The clown amused the children
CAUSE(STIMULUS, E) **EMOTIONAL_STATE**(RESULT(E), EMOTION, EXPERIENCER)

(65) Megan marveled at the Grand Canyon.
EMOTIONAL_STATE(RESULT(E), EMOTION, EXPERIENCER) **IN_REACTION_TO**(E, STIMULUS)

The semantic decomposition in (64) contains two predicates, a CAUSE and an EMOTIONAL STATE. The CAUSE involves one participant, namely a STIMULUS, and it is true at all times in the event (E). The EMOTIONAL STATE, on the other hand, is true only in the consequent stage of the event (RESULT(E)), and it involves an EXPERIENCER participant which has an EMOTION. As with Tantos (2006), in the event structure of marvel verbs the order of the two predicates has been swapped. In addition, the CAUSE predicate is replaced by IN REACTION TO. This predicate represents an alternative type of causation alongside CAUSE (which we have seen used for causative COS verbs in the previous chapter, section 4.1.2.3). IN REACTION TO is used in a number of VerbNet classes such as *respond verbs* ('a social interaction in reaction to a theme') or *see verbs* ('a perception in reaction to a stimulus').

Change-of-psych-state subevent The next group of approaches models the second subevent of some OE psych verbs not as a state, but as a change-of-state. This change-of-state is then terminologically distinguished from default changes-of-state by labeling it *change-of-mental-state* (e.g. Hartshorne et al. 2016), *change-of-psychological-state* (e.g. Prakasam & Anvita 2018), or *change-of-emotional-state* (e.g. Wanner 1999). In formal accounts, the semantic decomposition then looks something like in (66). In this example from Rapp (1997, 68-79), both punctual and gradual changes-of-psych-state are accounted for, with BECOME denoting a punctual and DEV denoting a gradual change.

(66) CAUSE (x, BECOME/DEV (PSYCH(y)))

[85] See Kipper Schuler (2005) for a documentation of the semantic predicates used in VerbNet.

Assuming that OE psych verbs can indeed have a change-of-psych-state subevent, how can I determine which ones of my base verbs do, and which do not? I have decided to use an array of seven diagnostics as proposed by Van Valin (2005, 35):

1. Progressive (*The ice is melting.*)
2. Dynamic adverbs (*Pat ran energetically to the park.*)
3. Pace adverbs (*John slowly realized his mistake.*)
4. *for*-PP (*Mary danced for ten minutes*)
5. *in*-PP (*Tom drank the glass of beer in an hour*)
6. Stative modifier (*the shattered window*)
7. Causative paraphrase (*The dog caused the boy to be afraid.*)

Technically, these tests are used to determine aktionsart, but Van Valin's aktionsart classes can be used as a proxy for the question at hand: The author models **causative achievements** and **causative accomplishments** as complex events with a change-of-state subevent, and **causative states** as complex events with a state subevent. Thus, if my verbs fall into one of these three classes, I have a reference point as to whether they should contain a change-of-state subevent, or not (see also Alexiadou & Iordăchioaia 2014, who use test 5 with the same goal).

Based on these diagnostics, my OE base verbs are indeed covered by two of Van Valin's classes, namely causative accomplishments (*endull, enrage, soothe* and *uplift*) and causative states (*abash, affright, annoy, bemuse, bumfuzzle, confound, convince, dishearten, dumbfound, enrapture, nonplus, perturb, reassure, stagger, upset,* and *worry*). The outcome of each of the seven tests in relation to these two classes is given in Table 5.4.[86]

TABLE 5.4: Van Valin's diagnostics for causative states and causative accomplishments. Abbreviations: acc. = accomplishment, dyn. = dynamic, prog. = progressive, stat.mod. = stative modifier

Class	Prog.	Dyn.	Pace	*for*-PP	*in*-PP	Stat.Mod.	Cause
Causative state	Yes	Yes	No	Yes	No	Yes	Yes
Causative acc.	Yes	Yes	Yes	Irrelevant	Yes	Yes	Yes

These results indicate that most of my OE psych bases should include only a state, while four base verbs should lexicalize a change-of-psych-state. I can test this with my nominalization data; We can expect to find CHANGE-OF-STATE readings

[86]See Van Valin (2005, 33-9) for an overview of the features used to distinguish between the twelve aktionsart classes, as well as an in-depth discussion of the applied tests.

only for *endullment, enragement, soothement,* and *upliftment.* The logical structures provided by Van Valin (2005, 45) are as follows, where α stands for any kind of event:

causative state	α CAUSE [**predicate′** (x) or (x, y)]
causative accomplishment	α CAUSE [BECOME **predicate′** (x) or (x, y)]

Conceptual causativity The next approach which I would like to present is that of Härtl (1999, 2001a,b). This author makes a distinction between the conceptual level on the one hand, and the lexico-semantic, grammatical level on the other (Härtl 2001b, 206). He argues that, conceptually, both OE psych verbs and SE psych verbs are implicitly causative (p. 209, see also section 5.1.1.3). Grammatically, however, most psych verbs do not display causativity, so that it is not contained in their semantic representation. Rather, the author states, OE psych verbs are best described as activities, while SE psych verbs are states with an additional THEME/STIMULUS argument. Härtl (2001b) finds evidence for this in the temporal homogeneity of OE psych verbs (p. 206) as well as in the agentive properties of their STIMULUS argument (p. 207).

The author makes two concessions: First, he states that SE psych verbs can denote activities if they can be connected to a canonical perception-event (Härtl 1999, 192-3). Thus, German *bewundern* ('admire') can be used agentively in the sense of 'examine admiringly' in sentences like *Peter bewundert gerade das Bildnis mit einer Lupe* ('Peter is admiring the portrait with a magnifying glass right now'). Second, some psych verbs do have grammatically causative variants and should be analyzed as (psychological) achievements (p. 193). Examples from German are *erschrecken* ('give a scare') and *verblüffen* ('perplex,' Härtl 2001a, 191).

States and actions Mostly, it is assumed that SE psych verbs denote states. However, in my data set, I had the suspicion that the experiencer of *muse over* is more active than those of *approve of* and *worry about* (see also Kawaletz & Plag 2015). In order to test this, I employed Van Valin's (2005) diagnostics once again. The results indicate that, in terms of the author's aktionsart classes, *muse over* is an activity, while *approve of* and *worry about* are states. The diagnostics which led to this conclusion are given in Table 5.5.

TABLE 5.5: Van Valin's diagnostics for states and activities. Abbreviations: dyn. = dynamic, prog. = progressive, stat.mod. = stative modifier

Class	Prog.	Dyn.	Pace	*for*-PP	*in*-PP	Stat.Mod.	Cause
State	No	No	No	Yes	No	Yes	No
Activity	Yes	Yes	Yes	Yes	No	No	No

In the corresponding formalizations, the author indicates the difference by an additional **do′** predicate for activities (p. 45):

state **predicate′** (x) or (x, y)
activity **do′** (x, [**predicate′** (x) or (x, y)])

In my frame approach, the difference is reflected by using two different event types as defined in the type signature, namely *state* and *action*.

Summary There are vastly different opinions with regard to the complexity and causativity of psych verbs. In terms of complexity, OE psych verbs are standardly regarded as denoting complex events, while SE psych verbs are usually considered to denote simple events. Regarding causativity, OE psych verbs are often regarded as a special kind of causatives, while SE psych verbs are considered non-causatives. There is also some discussion regarding the impact of agentivity on causativity, and regarding the saliency of subevents. A rather different approach has been put forward as well, assuming that all psych verbs denote complex events but are not as strongly causative as default causatives. Furthermore, it has been claimed that all psych verbs express causatives conceptually, but that lexico-semantically they denote activities (OE psych verbs) and states (SE psych verbs). All in all, we have seen that the event structure of psych verbs is far from uncontroversial.

5.1.2 Frame decomposition of psych verbs

In this section, I will model the semantics of OE and SE psych verbs in frames. There are two challenges in this endeavor: First, as we have seen in the previous section, the event decomposition of psych verbs is highly debatable. Second, in the frame-semantic discourse there is no published material to build on.[87] I will tackle both issues by translating the different approaches from the non-frame literature

[87] At the time of writing, there is unpublished work by Rolf Kailuweit, by Sebastian Löbner and Harald Stamm, and by Robert Van Valin Jr, which served as an inspiration for this section.

into eight frame variants – five for OE psych verbs (section 5.1.2.1) and three for SE psych verbs (section 5.1.2.2). In section 5.2, I will then investigate which attributes in the formalization of the base verbs account for possible readings in their nominalizations. In other words, I will use my nominalization data to test which of the eight analyses make sense.

5.1.2.1 OE psych verbs

In Figure 5.3, we see the first frame analysis. Let us first look at the participants. I have chosen the standard labels STIMULUS and EXPERIENCER; STIMULUS can of course easily be swapped for more precise labels such as Pesetsky's (1995) categories $\text{CAUSER}_{\text{stim}}$[88], TARGET or SUBJECT MATTER if desired (see section 5.1.1.2). These two participants will figure in all frame analyses in this section.

$$\boxed{0}\begin{bmatrix} \textit{psych-state causation} & \\ \text{STIMULUS} & \boxed{1} \\ \text{EXPERIENCER} & \boxed{2} \\ \text{CAUSE} & \boxed{3}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT} \quad \boxed{1} \end{bmatrix} \\ \text{EFFECT} & \boxed{4}\begin{bmatrix} \textit{psych-state} \\ \text{EXPERIENCER} \quad \boxed{2} \end{bmatrix} \end{bmatrix}$$

$$\text{REF} = \left\{\boxed{0}\right\}$$

FIGURE 5.3: Frame for OE psych verbs with a caused psych-state (e.g. Charlie being in a frightened-state because of some event Jael is involved in)

Now, let us turn to the eventive nodes. The frame is typed as a *psych-state causation*. As defined in the type signature (Figure 3.2 in section 3.4.1.2), this label is used for psych causation events with a state as the second subevent: The attribute EFFECT has the value *psych-state*. I will use the sentence *Jael frightens Charlie* for illustration. In this first analysis, the second subevent is the *frightened-state* Charlie is in because of what is taking place in the first subevent. In turn, the first subevent, CAUSE, is whatever Jael is involved in that frightens Charlie. This subevent is underspecified, with a type *event* and a participant attribute PARTICIPANT. For example, *event* may be instantiated by an action (e.g. *Jael frightened Charlie by telling a scary story*), or by a state (e.g. *Jael frightened*

[88] I am using the notation $\text{CAUSER}_{\text{stim}}$ in order to distinguish Pesetsky's category from the more general category CAUSER I have used in chapter 4.

Charlie with his badly scarred face). The only specification is that the stimulus of the complex event (here: *Jael*) also be a participant in the first subevent (that is, also *Jael*). This is indicated by co-indexation.

The second analysis (Figure 5.4) is based on Pustejovsky's (1995) *experienced causation*. The first subevent is specified as *perception* (a label which I find more intuitive than *experiencer process*). It has two participants, a STIMULUS and an EXPERIENCER. The stimulus of the perception-event is not necessarily co-indexed with the stimulus of the complex event (STIMULUS [1] $\trianglerighteq$ [5]). To stay with the example I have used above, *Jael frightens Charlie*, the perception-event can be Charlie seeing Jael's scarred face. In this case, the stimulus of the causing event (*Jael's face*) is not co-indexed with the stimulus of the complex event (*Jael*), but with something related to it, indexed with [5]. This relation is captured by '$\cdots$,' which represents an attribute path of undefined length leading from [1] to [5]. If [1] does have the same referent as [5], the length of the attribute path is 0.

$$
\boxed{0}\begin{bmatrix}
\textit{experienced causation} & \\
\text{STIMULUS} & \boxed{1}\begin{bmatrix}\textit{entity}\\ \cdots\ \boxed{5}\end{bmatrix} \\
\text{EXPERIENCER} & \boxed{2} \\
\text{CAUSE} & \boxed{3}\begin{bmatrix}\textit{perception} & \\ \text{STIMULUS} & \boxed{1} \trianglerighteq \boxed{5} \\ \text{EXPERIENCER} & \boxed{2}\end{bmatrix} \\
\text{EFFECT} & \boxed{4}\begin{bmatrix}\textit{psych-state} & \\ \text{EXPERIENCER} & \boxed{2}\end{bmatrix}
\end{bmatrix}
$$

$$
\text{REF} = \left\{\boxed{0}\right\}
$$

FIGURE 5.4: Frame for OE psych verbs with a causing perception-event (e.g. Charlie being in a frightened-state because of seeing Jael's scarred face)

The third frame analysis, given in Figure 5.5, models the psych causation subtype of **agentive psych causation**. For our example, this means that Jael is now purposely frightening Charlie. The complex event has four participant attributes, with INSTRUMENT and STIMULUS being co-indexed. This indicates that, whatever Jael is using to frighten Charlie (i.e. the INSTRUMENT), is also what causes Charlie to be scared (i.e. the STIMULUS). This instrument/stimulus is also a participant in the first subevent; there, the corresponding attribute is unspecified in order to allow for all kinds of different scenarios. That is, PARTICIPANT gets specified as

$$
\boxed{0}\begin{bmatrix}
\textit{agent psych-state causation} & \\
\text{AGENT} & \boxed{1} \\
\text{INSTRUMENT} & \boxed{2} \\
\text{STIMULUS} & \boxed{2} \\
\text{EXPERIENCER} & \boxed{3} \\
\text{CAUSE} & \boxed{4}\begin{bmatrix} \textit{agent-action} & \\ \text{AGENT} & \boxed{1} \\ \text{PARTICIPANT} & \boxed{2} \end{bmatrix} \\
\text{EFFECT} & \boxed{5}\begin{bmatrix} \textit{psych-state} & \\ \text{EXPERIENCER} & \boxed{2} \end{bmatrix}
\end{bmatrix}
$$

$$
\text{REF} = \left\{ \boxed{0} \right\}
$$

FIGURE 5.5: Frame for the agentive variant of OE psych verbs (e.g. Charlie being in a frightened-state because of something Jael does with the intention to scare Charlie)

soon as more context is available. For example, if the first subevent is a wearing-event (*Jael frightened Charlie with a scary mask*), the PARTICIPANT attribute is specified as a THEME, and if the first subevent is a narrating-event (*Jael frightened Charlie with ghost stories*), it is specified as a TOPIC.

The introduction of an INSTRUMENT participant into the frame leads to some complications with regard to co-indexation. Stated in non-frame-theoretic terms, the assignment of participant roles to the participants in the event is problematic. Consider the assignment of participants in (67). Since there is no instrument participant, *Jael* is assigned both the agent and the stimulus role. This is in line with VerbNet, where *the clown* is tagged as STIMULUS in the sentence *The clown amused the children* (see also Kailuweit 2005, 190).

(67) Jael frightened Charlie
AG/STIM EXP

When an INSTRUMENT participant is added to the context, we have to decide whether *Jael* is an AGENT-STIMULUS, as in (68a), or whether *a scary mask* is an INSTRUMENT-STIMULUS, as in (68b).

(68) a. Jael frightened Charlie with a scary mask
AG/STIM EXP INSTR

b. Jael frightened Charlie with a scary mask
AG EXP INSTR/STIM

Yet another option would be to model a metonymic reconstruction of the INSTRUMENT or the INSTRUMENT-STIMULUS to the first subevent (see Pustejovsky 1995, 209 for a discussion of this process):

(69) a. Jael frightened Charlie by wearing a scary mask
AG/STIM EXP INSTR

b. Jael frightened Charlie by wearing a scary mask
AG EXP INSTR/STIM

Ultimately, what we are dealing with here is the conceptual question of what it is that scares Charlie: Jael, the mask, or Jael wearing the mask. For my purposes, I do not need to answer this question. What is important is that all three candidates for the STIMULUS role (AGENT/*Jael*, INSTRUMENT/*a scary mask*, and CAUSE/*wearing a scary mask*) are represented in the base verb frame, so that I can investigate whether a shift to the respective node is possible.

The three frame analyses presented so far share the same type of second subevent, namely a psych-state. In the fourth frame analysis, given in Figure 5.6, the second subevent is a change-of-psych-state. This is also made explicit by the frame type (*change-of-psych-state causation*). Note that the frame also contains a node labeled *psych-state*, but it is embedded more deeply into the frame structure than in the previous analyses.

$$\boxed{0}\begin{bmatrix} \textit{change-of-psych-state causation} \\ \text{STIMULUS} \quad \boxed{1} \\ \text{EXPERIENCER} \quad \boxed{2} \\ \text{CAUSE} \quad \boxed{3}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT} \quad \boxed{1} \end{bmatrix} \\ \text{EFFECT} \quad \boxed{4}\begin{bmatrix} \textit{change-of-psych-state} \\ \text{RESULT-STATE} \quad \boxed{6}\begin{bmatrix} \textit{psych-state} \\ \text{EXPERIENCER} \quad \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$$\text{REF} = \left\{\boxed{0}\right\}$$

FIGURE 5.6: Frame for OE psych verbs with a change-of-psych-state subevent (e.g. Charlie attaining a frightened-state because of an event Jael is involved in)

If this frame analysis is valid, it can be used to model four OE psych verbs, namely those which have a change-of-state subevent according to Van Valin's (2005) diagnostics (see section 5.1.1.4). Of course, the other verbs in the data set

also presuppose a change-of-state of the experiencer; otherwise, Charlie would be in a perpetual state of fear. However, verbs like *endull, enrage, soothe* and *uplift* focus on the change, while other verbs (e.g. *abash, affright, annoy*) focus on the resulting state – and this is what is represented in the respective frame.

One last frame analysis is presented in Figure 5.7. It is based on Härtl's (1999; 2001a; 2001b) claim that OE psych verbs are activities with an additional participant. The frame thus models a psych-action with two participants, the traditional STIMULUS and EXPERIENCER. As before, the experiencer entity is in some psychological state, signified by the attribute PSYCH-STATE. In addition, the STIMULUS is cross-indexed as an ACTOR to capture which participant has the active part in the event. This is also made explicit in the frame type (*stimulus psych-action* as opposed to *experiencer psych-action*, see below).

$$\boxed{0}\begin{bmatrix} \textit{stimulus psych-action} & \\ \text{STIMULUS} & \boxed{1} \\ \text{ACTOR} & \boxed{1} \\ \text{EXPERIENCER} & \boxed{2}\begin{bmatrix} \textit{entity} & \\ \text{PSYCH-STATE} & \boxed{3} \end{bmatrix} \end{bmatrix}$$

$$\text{REF} = \left\{\boxed{0}\right\}$$

FIGURE 5.7: Frame for OE psych verbs as psych-actions (e.g. Jael doing something and Charlie being in a frightened-state)

Note that the experiencer and their psych-state are introduced by a reversed attribute compared to what we have seen in Figures 5.3 to 5.6. There, the psych-state has an experiencer participant, while here, an entity has a psych-state. While this may seem like a conceptual difference, it is better interpreted as a bidirectional relationship between the experiencer entity and their psych-state (see section 2.3.2.1). In other words, the two attribute directions show different sides of the same coin. I do not depict bidirectional functionality within an AVM, since this introduces a lot of visual clutter while at the same time not being essential to my approach.

I would like to add a final note about the possible causativity or non-causativity of psych verbs in my data set: Three of the base verbs, *endull, enrage* and *enrapture*, contain the prefix *en-*, which – among other things – produces causative readings (see e.g. Gelderen 2014, 109). Therefore, one of the causative analyses can be regarded as the appropriate one at least for these three types (if not for all OE psych verbs). Such a causative en-prefixed psych nominalization is also mentioned

by Pesetsky (1995), who states that *embitterment* is "unique among nominalizations of causative Experiencer predicates in retaining its causative force" (p. 321).

5.1.2.2 SE psych verbs

Most approaches analyze SE psych verbs as states. The corresponding frame in Figure 5.8 has an EXPERIENCER and a STIMULUS attribute. To make the EXPERIENCER the center of attention, I have switched the order of the participants in the frames for SE psych verbs compared to the frames for OE psych verbs. This is a matter of personal taste; the order of attributes is not formally significant.

$$\boxed{0}\begin{bmatrix} \textit{psych-state} & \\ \text{EXPERIENCER} & \boxed{1} \\ \text{STIMULUS} & \boxed{2} \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{0}\right\}$$

FIGURE 5.8: Frame for SE psych verbs as psych-states (e.g. Charlie being in a frightened-state)

The second analysis I propose for SE psych verbs is that of an *experiencer psych-action* in Figure 5.9. This formalization is based on my intuition that *muse over* involves a rather active experiencer participant, and on the results from the diagnostics I applied to test this intuition. The frame can be seen as a counterpart to the *stimulus psych-action* modeled for OE psych verbs (Figure 5.7). The crucial difference is the co-indexing of the participants. Here, the experiencer takes on the more active part, so that it is co-indexed with the actor.

$$\boxed{0}\begin{bmatrix} \textit{experiencer psych-action} & & \\ \text{EXPERIENCER} & \boxed{1} & \begin{bmatrix} \textit{entity} & \\ \text{PSYCH-STATE} & \boxed{2} \end{bmatrix} \\ \text{ACTOR} & \boxed{1} & \\ \text{STIMULUS} & \boxed{3} & \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{0}\right\}$$

FIGURE 5.9: Frame for SE psych verbs as psych-activities (e.g. Charlie actively musing over Jael)

The third approach is to model SE psych verbs as complex events similar to the standard analysis of OE psych verbs. The frame in Figure 5.10 differs from those for OE psych verbs, however, in that the event type is not a psych causation or an experienced causation, but a **psych-reaction**. Borrowing the terminology from Tantos (2006), I correspondingly do not include the attributes CAUSE and EFFECT, but EXPLANATION and REACTION. It should be noted that I follow VerbNet in staying on a descriptive level here; The distinction between CAUSE/EFFECT and EXPLANATION/REACTION is not formalized.[89] In order to do so and model Tantos's (2006) claim that SE psych verbs highlight the result-state, one would need to veer towards the semantics/pragmatics interface, which is outside the scope of this thesis.

$$
\boxed{0}\begin{bmatrix}
\textit{psych-reaction} & \\
\text{STIMULUS} & \boxed{1} \\
\text{EXPERIENCER} & \boxed{2} \\
\text{EXPLANATION} & \boxed{3}\begin{bmatrix}\textit{event} \\ \text{PARTICIPANT} \quad \boxed{1}\end{bmatrix} \\
\text{REACTION} & \boxed{4}\begin{bmatrix}\textit{psych-state} \\ \text{EXPERIENCER} \quad \boxed{2}\end{bmatrix}
\end{bmatrix}
$$
$$
\text{REF} = \left\{\boxed{0}\right\}
$$

FIGURE 5.10: Frame for SE psych verbs as psych-reactions (e.g. Charlie being in a frightened-state as a reaction to some event Jael is involved in)

5.1.2.3 Summary

In this section, I have given a formal account of the psych verb bases in my data set, proposing eight frame analyses (five for OE psych verbs and three for SE psych verbs). These are typed as *psych-state causation, experienced causation, agent psych-state causation, change-of-psych-state causation* and *stimulus psych-action* (OE psych verbs), as well as *psych-state, experiencer psych-action* and *psych-reaction* (SE psych verbs). They differ in their event structure (simple vs. complex event), the attributes they contain (e.g. CAUSE vs. EXPLANATION), and the target nodes these attributes are specified by (e.g. CAUSE: *event* vs. CAUSE: *perception*). The differences between the frames account for an array of different

[89] In Tantos (2006)' account, the order of the two subevents differs (see section 5.1.1.4), but this is because his approach is located in discourse representation theory, and not concerned with the decomposition of events per se.

findings and assumptions which have been proposed in the literature on psych verbs in general, as well as for properties of my base verbs specifically.

In the second part of this chapter, I will turn to the semantics of psych nouns. Using the conclusions which can be drawn from my nominalization data, I will be able to test which of the eight frames best represent the semantics of the psych verbs in my data set.

5.2 The semantics of psych nouns

In this section, I will first present which readings can be expected for psych nouns with *-ment*, based on existing literature and the frame representations of the base verbs (section 5.2.1). Next, I will turn to my results. I will first provide an informal survey of attested readings (section 5.2.2), and then formalize my findings (section 5.2.3). In the process, I will be able to determine which of the VerbNet-based frame-semantic analyses as presented in section 5.1.2 are adequate.

5.2.1 Expectations regarding the semantics of psych nouns

5.2.1.1 Previous literature

In previous literature, *-ment* has been found to produce a wide range of readings: EVENT, STATE, AGENTIVE-COLLECTIVE, INSTRUMENT/MEANS, LOCATION, PATIENT/THEME, PRODUCT, and RESULT (see e.g. Gadde 1910; Marchand 1969; Bauer et al. 2013; Lieber 2016; see also the more comprehensive literature summary in the previous chapter, section 4.2.1). Obviously, only a subset of these should be relevant for psych verb bases, but I am not aware of literature dealing specifically with psych nominalizations in *-ment*.

Let us therefore have a look at derived psych nouns in general, starting with SE psych nouns. These are not often discussed in linguistic research. As far as I know, only one reading has been mentioned explicitly, namely the transpositional PSYCH-STATE reading (see Grimshaw 1990, 119; Van Valin & LaPolla 1997, 659). However, STIMULUS can also be regarded as a documented reading: In the OED, several lexicalized derivatives of SE psych verbs are listed with this sense, for instance *cheerer* ('a person who or thing which brings gladness, comfort, or solace') or *thrill* ('a thrilling experience or incident').

Concerning OE psych nominalizations, the most prevalent claim is that they can only denote states or stimuli (see e.g. Pesetsky 1995, 72). It has also been

claimed that (some) agentive variants of OE psych verbs can produce transpositional readings (Grimshaw 1990, 119; Iordăchioaia 2020). This is presumably illustrated in the sentences in (70) and (71). According to Grimshaw, *humiliate* has an agentive variant, while *depress* is non-agentive. This leads to the following behavior, according to the author: The (a) sentences do not contain a subject. *Humiliation* is interpreted either as a transpositional event, or as a state, while *depression* can only be interpreted as a state. The (b) sentences have an agentive interpretation. This is only possible with *humiliation*; for *depression*, the sentence in ungrammatical. Finally, the (c) sentences are non-agentive and ungrammatical.

(70) a. The **humiliation** of the audience
b. John's **humiliation** of the audience
c. *The joke's **humiliation** of the audience

(71) a. The **depression** of the patients
b. *John's **depression** of the patients
c. *The drug's **depression** of the patients

In order to be able to formulate predictions for the psych noun semantics, let us come back to the agentivity scores I calculated earlier. For convenience, I am repeating Table 5.3. Based on this data, transpositional EVENT readings are expected for nouns based on verbs higher up on the scale (e.g. *convince, upset*). Correspondingly, this reading should not be possible for verbs further down (e.g. *nonplus*, *affright*). For verbs with medium agentivity, no sensible prediction can be made. Of course, the cutoff-points are arbitrary. However, if the Grimshaw's (1990) claim is correct, the agentivity scores should dictate a tendency.

TABLE 5.6: Agentivity scores of OE psych verbs (repeated from Table 5.3)

Verbs	Agentivity score
convince, reassure	7
upset	6
soothe	5,5
enrage	5
annoy, confound, uplift	4,5
dishearten	3,5
enrapture, perturb, worry	3
assuage, bemuse	2,5
bumfuzzle	2
dumbfound, stagger	1,5
abash	1
affright, endull	0,5
nonplus	0

A summary of the expected readings of OE and SE psych nominalizations based on the literature is given in Table 5.7. The option "possibly" indicates that there is some dispute regarding the reading in question. Some readings can theoretically be produced by *-ment*, but do not figure in the discussion of psych nouns. These are tagged as "not pertinent" in the table.

TABLE 5.7: Expected readings of psych nouns based on the literature

Reading	Prediction
Eventive readings	
OE: transposition	possibly (agentive base verbs)
OE: psych-state	yes
SE: transposed psych-state	yes
Participant readings	
agent	collective
stimulus/instrument	yes
location	not pertinent
[-animate] patient	not pertinent
product	not pertinent
result	not pertinent

5.2.1.2 Frame-based predictions

A nominalization is only expected to be attested in a given reading if the corresponding node is represented in the nominalization's base verb frame. With regard to participants, STIMULUS and EXPERIENCER are shared in common among all of my proposed psych verb analyses, and one proposed analysis incorporates two additional participants, namely AGENT and INSTRUMENT. Of these three participants, two are defined as [+animate] categories, namely AGENT and EXPERIENCER. In the previous chapter, I identified and modeled an **animacy constraint**, which states that *-ment* does not derive [+animate] readings. Therefore, we can predict that only the STIMULUS/INSTRUMENT participant can be shifted to.[90]

Furthermore, there are a number of conceivable eventive readings. An overview is given in Table 5.8 alongside the exemplary contexts I used to illustrate the frames in Figures 5.3 to 5.10. Let us first look at possible transpositional readings. Representing the different analyses in the literature, there are eight different central

[90] In some frames I have additionally used the supertypes ACTOR and PARTICIPANT. These are co-indexed with more informative participant roles (i.e., STIMULUS, EXPERIENCER, INSTRUMENT or AGENT) and thus do not yield any additional information with regard to expected nominalization semantics.

TABLE 5.8: Overview of conceivable eventive readings in psych nouns. Abbreviations: c. = causation

Reading	Exemplary context
Transpositional readings	
1. psych-state c.	Charlie being in a frightened-state because of some event Jael is involved in
2. experienced c.	Charlie being in a frightened-state because of seeing Jael's badly scarred face
3. agent psych-state c.	Charlie being in a frightened-state because of something Jael does with the intention to scare Charlie
4. change-of-psych-state c.	Charlie attaining a frightened-state because of some event Jael is involved in
5. stimulus psych-action	Jael doing something and Charlie being in a frightened-state
6. psych-state	Charlie being in a frightened-state
7. experiencer psych-action	Charlie actively musing over Jael
8. psych-reaction	Charlie being in a frightened-state as a reaction to some event Jael is involved in
Non-transpositional readings	
1. cause/explanation	
– event	Jael having a badly scarred face
– perception-event	Charlie seeing Jael's badly scarred face
– agent-action	Jael telling a scary story
2. psych-state	Charlie being in a frightened-state
3. change-of-psych-state	Charlie attaining a frightened-state

node types in the base verb frames. In my frames, I prefer to be precise with regard to type labels so that differences between frames can be spotted right away. For the summary of possible readings, however, this approach would be confusing due to the sheer number of event types. Therefore, I will use the general label PSYCH CAUSATION to cover half of these potential readings, and use the more precise labels as given in the table only when the distinction is relevant.

In addition to these transpositional readings, I distinguish three eventive readings which could result from shifts. These are given in the lower part of Table 5.8. The first subevent is either introduced by the attribute CAUSE or by the attribute EXPLANATION, depending on the analysis. In addition, I am listing three possible event types for these attributes here: The underspecified *event* stands for the complete array of possible events, that is, all of its subtypes. Two of these subtypes, namely *perception-event* and *agent-action*, were used in my frame representations,

and are therefore listed here as well. These three instantiations of CAUSE/EXPLANATION will be referred to when relevant. Note that the reading PSYCH-STATE is included twice in the table because it can be produced either by transposition, or by a shift, depending on the frame type.

It is obvious that distinguishing between five (or nine) potential transpositional readings is not trivial. In essence, the decision will be made based on two indicators. The first hint will be given by the contexts in which I find my nominalizations. For example, if a nominalization should only allow agentive stimuli, its frame will be typed as an *agent psych-state causation*. Second, other possible readings of the same nominalization play a role. For example, if I only find RESULT-STATE readings, but no CHANGE-OF-PSYCH-STATE readings, this speaks in favor of an analysis without a change-of-psych-state subevent for the nominalization (and base verb) in question. Thus, nominalization semantics allow valuable insights into the event type and causativity/non-causativity of the base verbs. My data will therefore contribute to the discussion of which (frame) analyses are to be preferred for modeling psych verbs and nouns.

5.2.2 Survey of possible readings

In this section, I will first present and discuss the only attested participant reading, STIMULUS (section 5.2.2.1) and then the eventive ones (sections 5.2.2.2 to 5.2.2.6). Since the examination of psych contexts is directly related to the attestation of transpositional readings, this topic will be addressed in the corresponding sections (5.2.2.4 and 5.2.2.5). Readings which have not been found attested will be treated last (section 5.2.2.7), and a summary can be found in section 5.2.2.8.

5.2.2.1 Stimulus

As predicted by the animacy constraint, the only participant category which I have found attested in my nominalization data is STIMULUS, as exemplified in (72). Only the SE noun *approvement* and the OE noun *endullment* cannot be found in this reading, which I attribute to scarcity of data.

(72) a. The Education Secretary arrived having just [...] made her first big policy declaration – dressed up as a **reassurement** to Middle England that A-levels will be retained (OED NEWS DailyMail 2005)

b. [...] movies in which racial slurs towards Asians [...] (or anyone else) are used; and other 'artistic' works which may be an **abashment** to a certain group of people (*Google* COMM revleft.space 2002)

There are also attestations in which the stimulus can be cross-classified as an instrument. In these contexts, it is something used intentionally by an agent to evoke a certain psychological response. In (73a), the wordplay *(a)musements* refers to items with two purposes: to be mused over by customers, and to amuse them. The example in (73b) demonstrates a typical ambiguity which can often be found in the data, namely between STIMULUS and CAUSE readings. More precisely, *enrapturements* in this excerpt from a book report can be anything Lily has devised to enrapture other people. In all, STIMULUS/INSTRUMENT readings are not as frequent as non-instrumental STIMULUS readings.

(73) a. Passage des perles Style over fifty; delights, (a)**musements** and resources for women (WC BLOG passagedesperles.blogspot.com 2014)

b. the reader [...] becomes ever concerned with the ever changing, mysteriously engrossing bad girl. I was left with confounded feelings as young Lily had played out her last cancerous **enrapturements** (*Google* COMM amazon.com 2008)

In section 4.2.3.1 of the preceding chapter, I showed a single example of a [+animate] PATIENT reading, and interpreted this as an instance of coercion. In the psych data, there is a similar example, given in (74). While this is the only instance of a [+animate] STIMULUS in my data set, this reading is frequent in lexicalized psych nominalizations such as *disappointment* (see its entry in the OED, which contains the paraphrase 'a thing which or person who disappoints').

(74) I am an **abashment** to myself sometimes. I have a frailty of mind that complicates simple matters into unsolvable dilemmas. (GB NONFIC Silence-Screams 2015)

Still, I suspect that this reading is not produced by derivation. Rather, we may be dealing with coercion: the [+animate] referent, which is incompatible with the lexical properties of the *-ment* noun, overwrites these properties and coerces a [+animate] reading (see e.g. Michaelis 2004 for a discussion of this process). Notably, when probing the corpora for [+animate] stimulus readings, I found that they are only attested in copula constructions.[91] These are semantically extremely flexible; the following attestations from iWeb show that, semantically speaking, anything can go into the slot taken by *abashment* above:[92]

[91] I would like to thank Sven Kotowski, who noticed this in the first place.

[92] The corpus was searched with the query <is an _nn* to himself>, and the list in (75) includes one line per returned noun type (e.g. *embarrassment*). The query was formulated in the third person singular because the first person singular yielded only one result, namely *an embarrassment to myself*.

(75) a. Pete is an **embarrassment** to himself
b. Every man is an **evidence** to himself
c. He is an **object** to himself
d. He is an **island** to himself
e. The fool is an **enemy** to himself
f. Every man is an **end** to himself
g. Every obstacle [he] throws in the way [...] is an **injury** to himself
h. A man is an **honor** to himself

This shows that what happens in example (74) should not be attributed to *-ment*, and thus does not need to be modeled in this study. Rather, it is a post-lexical shift which is coerced by the context (but see chapter 8 for ideas on how this judgment could be further corroborated in future research).

5.2.2.2 Cause and explanation

In the previous section, we saw that STIMULUS is a frequent reading of psych nominalizations. Its eventive counterpart, CAUSE, is also possible, at least with regard to the OE subset of the data set:

(76) a. The transition has never been a threat or a **disheartenment** to me, but sometimes in my newfound yuppy life I am caught off guard when I realize that hardly anyone I know or work with has, say, been on food stamps before. (*Google* BLOG crushingkrisis.com 2007)
b. Revocation of his American Express card would have been a more consequential **abashment**. (TIME November 22, 1971)

There are only two nouns without attestations for this reading, namely *reassurement* and *soothement*. Again, this can be attributed to scarcity of data.

The fact that CAUSE is such a frequent reading in OE psych nouns indicates that the corresponding node (CAUSE: *event*) must be present in the frame representation. Therefore, we can conclude that a complex event analysis is more adequate than a simple psych-action. Furthermore, the causing events which can be found in my data represent all imaginable kinds of event. For example, *transition* in (76a) refers to a change-of-state, while *revocation* in (76b) is an action. Importantly, I did not find perception-events as causing events. Therefore, an adequate frame analysis should include the event which has caused the psych-state, and the fact that this event needs to be perceived by the EXPERIENCER can be regarded as a presupposition. Of course, presuppositions can be included in frames, but they are not relevant for modeling derivational processes.

As regards SE psych nouns, *approvement* and *musement* have not been found in an EXPLANATION reading (recall that EXPLANATION in a psych-reaction frame is the counterpart to CAUSE in a psych-causation frame). *Worriment* can be found in contexts which allow this interpretation, as exemplified in (77), but of course this nominalization is cross-listed as an OE psych noun. Therefore, the conclusion that this reading is based on the OE psych verb *worry*, and not on the SE psych verb *worry about*, suggests itself.

(77) Monitor your sites for outages, errors, and other **worriments** with Stella. (WC WEB cbinsights.com 2014)

The fact that a shift to EXPLANATION was not attested for SE psych nouns indicates that the event-type PSYCH-REACTION is less likely than the other two possible event types proposed for SE verbs (EXPERIENCER PSYCH-ACTION and PSYCH-STATE). This assumption will be confirmed by the transpositional readings of SE nouns as discussed in section 5.2.2.5.

5.2.2.3 Change-of-state

CHANGE-OF-STATE readings were attested for four psych nouns: *endullment, enragement, soothement,* and *upliftment*. Each type is exemplified in (78). Note that examples (78b) and (78c) are ambiguous. Especially in (78c), CHANGE-OF-STATE needs to be regarded as the less likely reading. Here, *soothement* and *soothing* are either co-referential, both referring to the process of becoming calm, or they refer to the stimulus (*soothement*) and the change-of-state (*soothing*).

(78) a. **Endullment** is the dulling of people's minds as a result of their non-participation (GB NONFIC ManagingTeamEnvironment 1998)
b. In her own case, Miss Reuben said, the **enragement** began when a professor told her that it really wouldn't matter if she finished her doctoral thesis. (*Google* MAG news.Google.com 1972)
c. IrishDayDreamer –TOO weird for me!! Some **soothement**, maybe? some soothing, I hope, coming up! (*Google* COMM dance.net 2009)
d. [H]alf-breeds stimulated and intensified anxieties regarding the deleterious effects of alcohol on Indians, and how drunkenness might trouble their moral **upliftment** and eventual assimilation into white society. (COCA ACAD CulturalGeog 2010)

The fact that I found only these four types in a CHANGE-OF-STATE reading is in line with the predictions I made in section 5.2.1.2. Using aktionsart diagnostics, I determined that the second subevent of only the verbs *endull, enrage, soothe*

and *uplift* is expected to be a change-of-psych-state (EFFECT: *change-of-psych-state*). All other OE psych verb bases have only a psych-state instead (EFFECT: *psych-state*; section 5.1.1.4). This distribution perfectly predicts the attestation of CHANGE-OF-STATE readings in my data.

This is not to say that change on the part of the experiencer is absent in the real world. Of course, they are not abashed/affrighted/annoyed/... before the event, but are so during (and after). However, these verbs and their nominalizations cannot focus on this change. This is indicated both by the results of Van Valin's (2005) and Alexiadou & Iordăchioaia's (2014) diagnostics, and by the results I presented in this section.

5.2.2.4 Transposition of a complex event: Psych causation/reaction

With regard to transpositional readings, it has been claimed that only agentive variants of OE psych verbs are causative, and can thus produce eventive readings, while contexts like *the joke's humiliation of the audience* are ungrammatical (see section 5.2.1.1; Grimshaw 1990). In order to test this claim, I calculated agentivity scores for the psych base verbs in my data set. Based on this data, transpositional EVENT readings can be expected for nouns based on verbs higher up on the agentivity scale (e.g. *convince* and *upset*). Correspondingly, this reading should not be possible for verbs further down on the scale (e.g. *affright, endull* and *nonplus*). Based on my data, I can conclude that this is not the case since I have found transpositional readings for all OE psych nouns, as exemplified in (79).

(79) a. Anybody who has watched the quadrennial **abashment** of ITV in a variety of idyllic locations around the world will be familiar with this picture. (*Google* NEWS telegraph.co.uk 2010)

b. Hello... Again. Sorry for the constant **annoyment**, but I can't log on now, it just gets stuck at 100 percent, and when I even managed to log on, I couldn't even check my about page. (*Google* COMM ourworld.com 2014)

What is more, my data also indicates that a low agentivity score of the base verb does not, in fact, preclude agentive contexts for its nominalization. For example, both *affright* and *endull* have an agentivity score of 0.5, and their nominalizations can still be found in clearly agentive contexts:

(80) a. The campaign of terrorism and **affrightment** of investors. (OED ACAD PolitSciCityNewYork 1920)

b. All of this is well-thought-out, like a military campaign of blitzkrieg **endullment**. [...] While the Indians and Chinese and all are getting smarter, we're getting enstupidated at a hell of a pace. (*Google* BLOG unz.com 2006)

Furthermore, if Grimshaw (1990) is correct, transpositional readings should only be possible with an agent/stimulus participant, and not with a non-agentive stimulus. This, however, is not the case either. For example, the stimulus in (81) is a book:

(81) And after the interview she congratulated him on the book and its **enragement** of Trump. (*Twitter* @brithume 2018)

What can be said is that unambiguously transpositional readings can be found much more easily in agentive contexts. In non-agentive or underspecified contexts, attestations for transpositional readings tend to be ambiguous, most frequently between a transpositional and a STIMULUS reading:

(82) a. If our wicket-keeper avoids a **nonplusment** I believe our city can win the Planet-Wide Affair of Honour. (*Twitter* @PaulMelancon 2012)
b. The rest of the week is given over to unravelling these **dumbfoundments**, befiddlements, general bafflegab and more. Wednesday eve is the only ease. (*Google* MAG keywordspy.com)

In all, the verdict is clear: All OE psych nouns allow agentive contexts, and eventive readings are by no means limited to agentive stimuli, contra Grimshaw's (1990) claim.

5.2.2.5 Transposition of a simple event: State and psych-action

Transpositional readings of SE psych nouns come in two event types: PSYCH-STATE and EXPERIENCER PSYCH-ACTION. As predicted by the results of Van Valin's (2005) event diagnostics, *approvement* and *worriment* occur in PSYCH-STATE readings, as exemplified in (83). *Musement*, on the other hand, clearly has a PSYCH-ACTION reading, as in the context in (84).

(83) a. The TETRA paper was presented at the conference by Intetics President and CEO, Boris Kontsevoi[...]. The presentation received a round of applause and **approvement** of the international technology community. (*Google* WEB intetics.com 2019)
b. We can learn to let go of the agitated states of mind, such as anger, **worriment**, resentment and fear (*Google* BLOG patch.com 2013)

(84) When a Peircean pragmatist assesses logically an experience of free and spontaneous **musement** over "the three Universes of experience" [...], such a logician will recognize [...] an example of abductive reasoning (GB ACAD GracingHumanExperience 2007)

Interestingly, both base verb variants, *worry* and *worry about*, can be found with transposed semantics in their nominalizations. *Worriment about* is found in the expected syntactic-semantic constellation, namely with the about-PP introducing the stimulus, as in (85a). Parallel to that, an of-PP would be expected to be an indicator for a transpositional reading of *worry*, introducing the experiencer (parallel to *abashment of ITV* in example (79a) above). This construction, however, seems to only be used for PSYCH-STATE readings, as in (85b). In this context, the of-PP introduces the stimulus. *Worriment* in a complex event reading with a full eventive structure as in the constructed example in (85c) is not attested.

(85) a. it shed lights on the **worriment about** the relevance of age-related deterioration in physical [...] capacities (NOW NEWS QSWOWNew 2019)
b. Berger's essay expresses his **worriment** of the role publicity takes in our lives. (*Google* BLOG blogs.baruch.cuny.edu 2017)
c. *John's$_{\text{EXP}}$ constant worriment of me$_{\text{STIM}}$

5.2.2.6 Psych-state

Unsurprisingly, OE psych nouns are very easily found denoting PSYCH-STATES, the reading most frequently discussed in the literature on psych nominalizations (see e.g. Pesetsky 1995). Two examples form my data set are given in (86).

(86) a. I know a lot of our compatriots also feel the same angst, consternation and **confoundment**. (GloWbE NEWS leadership.ng 2012)
b. People get surprised by the level of **upsetment** in fandom. (*Google* COMM planetmondas.com 2014)

With regard to SE psych nouns, we need to distinguish between different kinds of PSYCH-STATE readings. For *approvement* and *worriment*, as discussed in the previous section, this reading is transpositional.[93] *Musement*'s central node is a psych-action, but its frame also contains a psych-state node. The corresponding reading is therefore produced by a meaning shift:

(87) A cock was crowing in the distance. He studied the countryside with **musement**. Here forms were gentle on the eye. (GloWbE BLOG kaganof.com 2012)

[93]For *worriment*, a more fitting formulation would be 'potentially transpositional,' since PSYCH-STATE readings can either be transpositional (from *worry about*), or non-transpositional (from *worry*) – if *worriment* occurs without 'about,' there is no way to know.

5.2.2.7 Unattested shifts

First of all, as predicted, no shifts to EXPERIENCER or to AGENT readings can be found in the corpora. This is in line with the finding from the previous chapter that *-ment* does not allow [+animate] readings. The finding is also consistent with previous research by Melloni (2011), who does not find EXPERIENCER readings for Italian *-mento* nominalizations either. As was the case with the COS data, there was a single data point as an exception to this rule, namely a sole [+animate] STIMULUS reading. I have attributed this to a post-lexical shift.

Furthermore, there are a number of readings which *-ment* can produce according to the literature, but which were not expected to be relevant for psych nominalizations. The corresponding shifts were not attested in the corpora. These readings are AGENTIVE-COLLECTIVE, LOCATION, [-ANIMATE] PATIENT, PRODUCT, and RESULT. Since these five readings are not represented in the base verb frames, we need not concern ourselves with these further.

5.2.2.8 Summary

In this section, I have been able to identify a clear range of readings which is possible for (certain subsets of) OE and SE psych verbs. Together with a thorough investigation of the contexts these readings occur in, I have also been able to draw conclusions about their event structure and causativity.

With regard to OE psych verbs and nouns, I have concluded that they are best modeled as complex causation events. As expected, most OE psych verbs and nouns have a PSYCH-STATE as the second subevent, and a subset of four has a change-of-psych-state instead. For SE psych nouns, three different event types had been proposed, and I was able to show that *muse over* is best modeled as a psych-action, while *approve of* and *worry about* denote states.

Corresponding to these event types, there are four kinds of transpositional reading represented in my data: PSYCH-STATE CAUSATION or CHANGE-OF-PSYCH-STATE CAUSATION for OE psych verbs, and EXPERIENCER PSYCH-ACTION or PSYCH-STATE for SE psych verbs. Contra existing claims in the literature, agency does not play a role in the availability of transpositional eventive readings at all.

Non-transpositional eventive readings are attested as well: PSYCH-STATE is attested for all psych verbs, CAUSE for all OE psych verbs, and CHANGE-OF-PSYCH-STATE for the expected subset of OE psych verbs.

With respect to participant readings, I only found shifts to STIMULUS/INSTRUMENT attested. This was expected for two reasons: First, the other readings reported for *-ment* (e.g. LOCATION or PRODUCT) are not pertinent for psych base verbs. Second, AGENT and EXPERIENCER readings are prevented by the animacy constraint as proposed in the preceding chapter.

5.2.3 Formalization of psych nominalization

Based on my findings, I will now model the nominalization of psych verbs. First, I will revisit the VerbNet-based frames for the different psych events (section 5.2.3.1). Then, I will update the type signature to include all types required for the frames and the inheritance hierarchy (section 5.2.3.2). I will conclude this section by proposing an inheritance hierarchy for *-ment* on psych verb bases (section 5.2.3.3).

5.2.3.1 Frame representations

The psych nouns in my data set can be modeled by means of four frame analyses, corresponding to the four event types represented in the base verbs: psych-state causation and change-of-psych-state causation for OE psych nouns, as well as psych-state and experiencer psych-action for SE psych nouns. Table 5.9 lists the event type for each psych noun in my data set.

TABLE 5.9: Event types of psych nouns in my data set

Event type	Nominalizations
psych-state causation	abashment, affrightment, annoyment, bemusement, bumfuzzlement, confoundment, convincement, disheartenment, dumbfoundment, enrapturement, nonplusment, perturbment, reassurement, staggerment, upsetment, worriment
change-of-psych-state causation	endullment, enragement, soothement, upliftment
psych-state	approvement, worriment
experiencer psych-action	musement

The frame in Figure 5.11 models the majority of psych nouns in my data set, namely those based on psych-state causation verbs, that is, OE psych verbs which do not contain a change-of-psych-state in their semantics. Possible referent nodes

$$\boxed{0}\begin{bmatrix} \textit{psych-state causation} & \\ \text{AGENT} & \boxed{1} \\ \text{INSTRUMENT} & \boxed{2} \\ \text{STIMULUS} & \boxed{2} \\ \text{EXPERIENCER} & \boxed{3} \\ \text{CAUSE} & \boxed{4}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT} \quad \boxed{2} \end{bmatrix} \\ \text{EFFECT} & \boxed{6}\begin{bmatrix} \textit{psych-state} \\ \text{EXPERIENCER} \quad \boxed{2} \end{bmatrix} \end{bmatrix}$$

$$\text{REF} = \left\{\boxed{0}, \boxed{2}, \boxed{4}, \boxed{6}\right\}$$

FIGURE 5.11: Frame for OE psych nouns with a caused psych-state (e.g. Charlie being in an annoyed-state because of some event Jael is involved in)

are 0, 2, 4, and 6. Shifts to 1 and 3 are prevented by the animacy constraint, which is modeled in the inheritance hierarchy. Two things should be noted: First, I am keeping the indexing constant across all frames in this section, which will facilitate comparisons. For example, STIMULUS is indexed with 2 in all four frames. Second, I have included the participants AGENT and INSTRUMENT here. In the type signature, these participants are defined as optional. In other words, the modeled contexts are not necessarily, but potentially, agentive.[94]

The frame in Figure 5.12 models OE psych nominalizations with bases which have a change-of-psych-state as their second subevent. Apart from the second subevent, it is identical to the previous frame. Correspondingly, 5 is added to the set of possible referents, indicating that a shift to CHANGE-OF-PSYCH-STATE readings is possible for these nominalizations.

[94]The base verbs allow agentive contexts to different extents, as I have shown with the agentivity scores in section 5.1.1.1. The probability of an AGENT attribute could be included in the frame for a given verb (see section 4.2.4.1 for how this could be achieved), but since agentivity did not have an effect in my data set, this would not provide any added benefit.

$$\boxed{0}\begin{bmatrix} \textit{change-of-psych-state causation} & \\ \text{AGENT} & \boxed{1} \\ \text{INSTRUMENT} & \boxed{2} \\ \text{STIMULUS} & \boxed{2} \\ \text{EXPERIENCER} & \boxed{3} \\ \text{CAUSE} & \boxed{4}\begin{bmatrix} \textit{event} \\ \text{PARTICIPANT} \quad \boxed{2} \end{bmatrix} \\ \text{EFFECT} & \boxed{5}\begin{bmatrix} \textit{change-of-psych-state} \\ \text{RESULT-STATE} \quad \boxed{6}\begin{bmatrix} \textit{psych-state} \\ \text{EXPERIENCER} \quad \boxed{2} \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$$\text{REF} = \left\{\boxed{0}, \boxed{2}, \boxed{4}, \boxed{5}, \boxed{6}\right\}$$

FIGURE 5.12: Frame for OE psych nouns with a caused change-of-psych-state (e.g. Charlie attaining an uplifted-state because of an event Jael is involved in)

Figure 5.13 presents a formalization of SE psych nouns derived from stative base verbs. They are modeled as states with two participants, an experiencer and a stimulus.

$$\boxed{6}\begin{bmatrix} \textit{psych-state} & \\ \text{EXPERIENCER} & \boxed{3} \\ \text{STIMULUS} & \boxed{2} \end{bmatrix}$$

$$\text{REF} = \left\{\boxed{6}, \boxed{2}\right\}$$

FIGURE 5.13: Frame for SE psych nouns with state bases (e.g. Charlie approving of Jael)

The last frame in this section, Figure 5.14, is for *musement*, which is based on the experiencer psych-action verb *muse over*.[95] Here, the frame type and the co-indexation of EXPERIENCER with ACTOR indicate that it is the experiencer of the psyche-event that takes over an active role.

[95]Since the other proposed subtype of *psych-action*, *stimulus psych-action*, did not turn out to be relevant as a frame type, I could technically simply call this frame *psych-action*. However, I have decided to stick with the more precise label for clarity.

$$\boxed{0}\begin{bmatrix} \textit{experiencer psych-action} & \\ \text{EXPERIENCER} & \boxed{3}\begin{bmatrix} \textit{entity} \\ \text{PSYCH-STATE} \quad \boxed{6} \end{bmatrix} \\ \text{ACTOR} & \boxed{3} \\ \text{STIMULUS} & \boxed{2} \end{bmatrix}$$
$$\text{REF} = \left\{\boxed{0}, \boxed{2}, \boxed{6}\right\}$$

FIGURE 5.14: Frame for SE psych nouns with experiencer psych-action bases (e.g. Charlie actively musing over Jael)

5.2.3.2 Updated semantic categories and type signature

I will now incorporate the insights gained in this analysis into the participant hierarchy and the type signature. In chapter 3, I already hinted that the original figures are partly contradictory. More precisely, VerbNet's STIMULUS is categorized as a hyponym to CAUSER, but it can actually be co-referential with AGENT or INSTRUMENT. Moreover, EXPERIENCER is a grandchild to UNDERGOER, which clashes with the event type *experiencer psych-action*. I will solve both issues by allowing multiple parents in the hierarchy.[96] Still, the hyponymy-relations as represented in VerbNet do reflect the most frequent constellations, which is why I use dashed lines to indicate the less frequent relations. The revised participant hierarchy is given in Figure 5.15. Core participants are indicated by bold print.

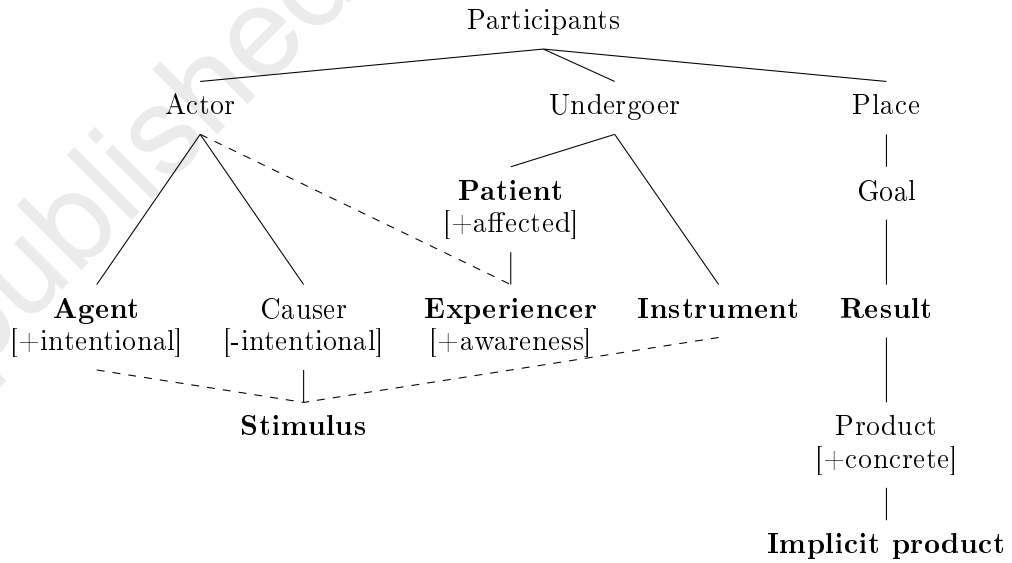


FIGURE 5.15: Revised participant categories for semantic coding

[96] It may be more accurate to include complex subtypes of stimulus and experiencer instead, for instance *instrument* ∧ *stimulus* as a child of instrument and stimulus.

Let us turn to the type signature in Figure 5.16. For readability, only information which is relevant for this chapter of my thesis is included, leaving out types needed to model COS nominalizations only. The type signature includes only those eventive types that are either possible readings of psych verbs (e.g. *experiencer-psych-action*), or that are needed as frame elements (e.g. *change-of-psych-state*). The original type signature can thus be slimmed down by eliminating those types which are not required to formalize my data. To save space, I also leave out the intermediate types *psych-action* and *change-of-state causation*, and include their appropriateness conditions in their respective bottom-most descendant instead (*exp psych-action* and *change-of-psych-state causation*). Types which I have used to label the central node of my psych frames are color-coded as teal.

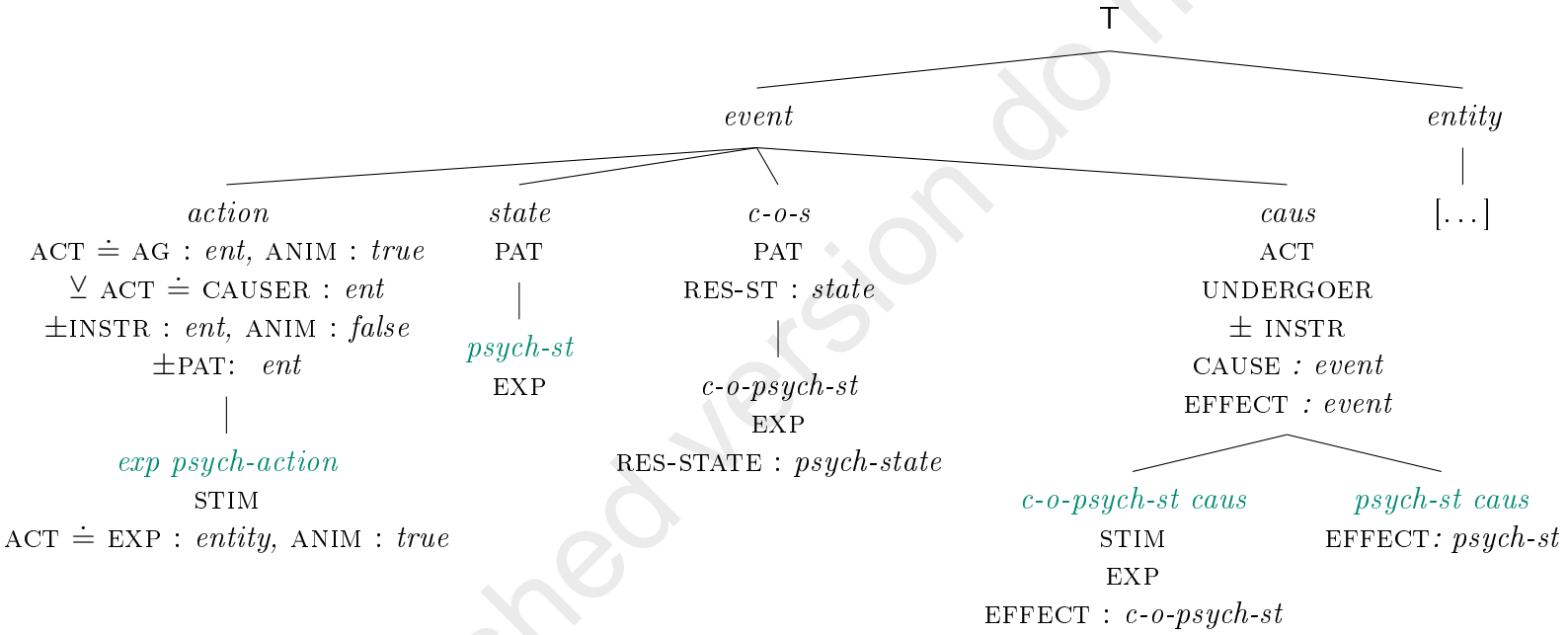


FIGURE 5.16: Revised type signature of eventive categories (psych subset). Optionality is indicated by ±, possible central node types of psych nouns are indicated by teal. Abbreviations: act = actor, ag = agent, anim = animacy, caus = causation, c-o-psych-st = change-of-psych-state, c-o-s = change-of-state, ent = entity, exp = experiencer, instr = instrument, pat = patient, psych-st = psych-state, res-st = result-state, stim = stimulus

5.2.3.3 Lexical rules and inheritance hierarchy

For psych nouns, I found seven distinct readings: The eventive readings EXPERIENCER PSYCH-ACTION, PSYCH-STATE, CHANGE-OF-PSYCH-STATE CAUSATION, PSYCH-STATE CAUSATION, CAUSING-EVENT and CHANGE-OF-PSYCH-STATE, as well as the participant reading STIMULUS. I will use seven LFRs to model the derivation of these readings.

In the previous chapter, I spelled out one exemplary LFR, namely the one producing RESULT-STATE readings (section 4.2.4.4). Let us have a look at the corresponding reading for psych verbs, namely PSYCH-STATE. For COS verbs, the LFR checked for an attribute labeled RESULT-STATE in the base verb frame, and produced a shift to its target node if it found this attribute. In psych nominalization, the situation is more complex since the psych-state is introduced in different ways: The corresponding node typed *psych-state* is either the central node of the frame, or it is introduced by one of three different attributes (RESULT-STATE, PSYCH-STATE or EFFECT). The LFR I propose to model this can be seen in Figure 5.17: The central node of the s-frame is typed as *event*. The fact that it is some sort of psych event is ensured by the presence of a node $\boxed{x}$, which is typed as *psych-state*. The notation '$\cdots$' indicates an attribute path of unspecified length from the central node to $\boxed{x}$. If *psych-state* is itself the central node (recall that *state* is a subtype of *event* in my ontology), the attribute path is of length 0. That is, $\boxed{x}$ and $\boxed{y}$ are co-referential in that case.

$$\left[\begin{array}{ll} \textit{lexeme} & \\ \text{PHON} & /\boxed{z}\text{-}\textit{ment}/ \\ \text{CAT} & \text{N} \\ \text{SEM} & \left[\text{s-frame} \quad \boxed{y}\right] \\ \text{M-BASE} & \left[\begin{array}{ll} \textit{lexeme} & \\ \text{PHON} & \boxed{z} \\ \text{CAT} & \text{V} \\ \text{SEM} & \left[\text{s-frame} \quad \boxed{y}\left[\begin{array}{l}\textit{event} \\ \cdots\ \boxed{x}\ \textit{psych-state}\end{array}\right]\right] \end{array}\right] \\ \text{REF} = \left\{\boxed{x}\right\} & \end{array}\right]$$

FIGURE 5.17: Lexical rule for PSYCH-STATE readings of *-ment* on psych verbs

The seven LFRs which are required to model my nominalization data are incorporated into the inheritance hierarchy in Figure 5.18 (for a detailed description of how to read an inheritance hierarchy, see section 2.3.2.4). For better readability, I am using only four nominalizations for illustration, one for each class of psych noun: *annoyment* for psych-state causation, *upliftment* for change-of-psych-state causation, *approvement* for psych-state, and *musement* for experiencer psych-action.

According to this inheritance hierarchy, psych nominalization proceeds as follows. As proposed in the previous chapter, the animacy constraint takes effect first. It precludes shifts to AGENT and EXPERIENCER readings from the get-go. Next, seven LFRs come into play, producing seven distinct readings. Six of these readings are eventive, and one is a participant reading. Of the eventive readings, four are transpositional (LFRs 1 to 4). The innermost level of their AVMs does not include an attribute, but rather the type of the respective central node. Note, however, that LFR 2 also produces non-transpositional PSYCH-STATE readings since *psych-state* occurs as a non-central node in the base verbs as well. The bottom three LFRs check for attributes in the base verb frame, for instance CAUSE in LFR 5. If the base verb has the respective attribute in its frame, the corresponding reading is produced by shifting reference to the attribute's value. As in the COS data set, there are some gaps in the psych data. That is, I have not been able to find all nominalizations in all expected readings. In Figure 5.18 one such gap is represented; it is marked with a superscript question mark.

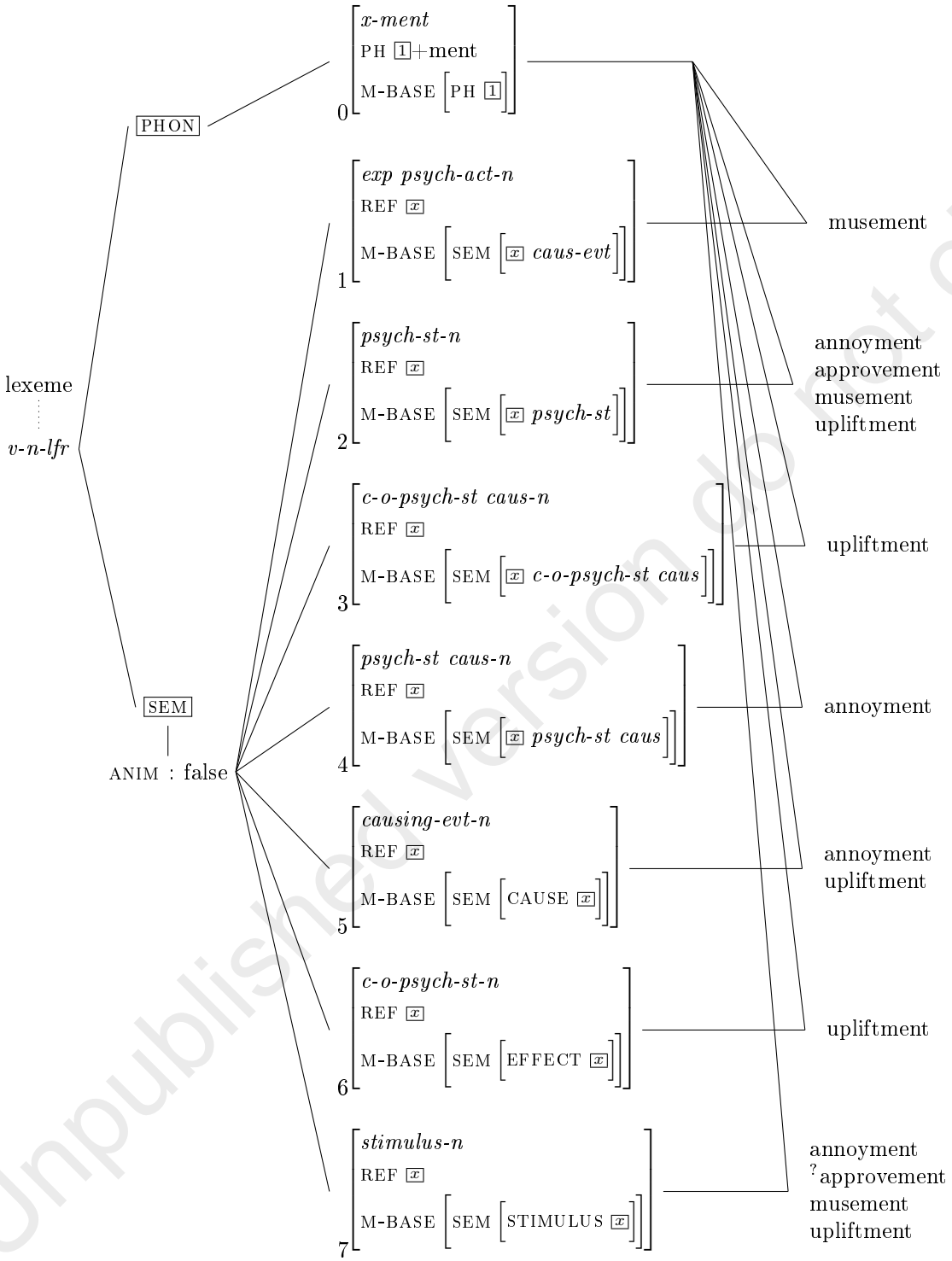


FIGURE 5.18: Inheritance hierarchy of lexical rules for *-ment* on psych verbs. Abbreviations: causing-evt = causing-event, c-o-psych-st = change-of-psych-state, c-o-psych-st caus = change-of-psych-state causation, exp psych-act = experiencer psych-action, psych-st = psych-state, psych-st caus = psych-state causation, res-st = result-state

5.3 Summary of chapter 5

In this chapter, I have investigated which readings *-ment* can produce on psych verb bases. The data set consisted of 23 nominalizations, more precisely, three SE psych nouns and 20 OE psych nouns. The main issue in this chapter was the variety of opinions and approaches which can be found in the existing literature on the base verbs. There is disagreement with regard to their semantics, their event structure, and their participants. Applying a range of tests, I also identified differing properties with regard to the base verbs' agentivity and aktionsart.

I addressed this variety of analyses by proposing eight frame variants. The ones for OE psych verbs differed with regard to complexity (complex versus simple event), the first subevent (perception-event versus underspecified event), the second subevent (psych-state versus change-of-psych-state), and agentivity (agentive versus non-agentive). For SE psych verbs, two frames modeled a distinction going back to aktionsart (activity versus state), while one analyzed verbs from this subclass as complex, but non-causative events.

Based on these frames and on existing literature, I then formulated expectations with regard to the possible readings of psych nouns, and examined corpus data to verify or falsify these predictions. Regarding noun semantics, my study had the following results: I systematically found transpositional readings and, contrary to the claim made by Grimshaw (1990) and others, agentivity of the base verb did not play a role for the availability of these readings at all. I also found shifts, namely to the eventive categories CHANGE-OF-PSYCH-STATE and PSYCH-STATE, as well as to the non-eventive category STIMULUS. A shift to a CHANGE-OF-PSYCH-STATE reading was only possible for the four base verbs which I had previously determined to have a change-of-psych-state node in their frame representation. Furthermore, I confirmed the animacy constraint as proposed in the previous chapter. For psych nouns, it rules out AGENT and EXPERIENCER as possible readings produced by derivation. As before, post-lexical shifts to an AGENT reading are attested, but very rare.

Based on my data, I concluded that psych nominalizations and their base verbs can appropriately be modeled by four distinct frame types: *experiencer psych-action, psych-state, change-of-psych-state* causation, and *psych-state causation*. These frame types had been predicted by the results of applying Van Valin's (2005) aktionsart diagnostics. I concluded my analysis by suggesting a set of seven LFRs for *-ment* nominalizations with psych verb bases. These were incorporated into an inheritance hierarchy for *-ment* suffixation, alongside the animacy constraint.

Chapter 6

Gaps and ambiguity

A critical issue in my research for this thesis has been the relative sparseness of neologism data, and thus the difficulty to find attestations for readings that I assume to be possible for a given *-ment* derivative. This has two observable effects in my data set. First of all, it exhibits gaps. That is, readings which are in principle possible for *-ment* in general, or for a given derivative specifically, are not always attested. Second, those attestations I did find are often ambiguous between two or even more readings.

In this chapter, I am taking a quantitative perspective on these two issues. I will first discuss to what extent my data exhibits gaps, both from an onomasiological and from a semasiological point of view (section 6.1). That is, I will examine the percentage of gaps with regard to the different readings, and with regard to the different nominalizations. Then, I will take a closer look at the attestations in my data set, assessing how many readings and nominalizations are unambiguously attested, and for how many I have only been able to identify ambiguous attestations (section 6.2).

6.1 Gaps

Table 6.1 gives an overview of how well COS nouns are attested. In the leftmost column, the COS nominalizations are given in alphabetical order. The remaining columns indicate whether a given reading has been found attested ("att."), or not ("gap"). For instance, *abridgement*, not being attested in a CHANGE-OF-STATE reading, has a gap indicated in the sixth column. For a better overview, the two rightmost columns indicate the total number and the percentage of gaps per nominalization (e.g. "1" and "14" for *abridgement*), and the bottom two rows

TABLE 6.1: Attested and unattested readings of COS nouns.[97]

Nominalization	Transposition	Instrument	Causer	Causing-event	Change-of-state	Result-state	Pat/impl-prod/result	Gaps total	Gaps per cent
abridgement	att.	att.	att.	att.	**gap**	att.	att.	1	14
bedragglement	att.	att.	att.	att.	att.	att.	att.	0	0
befoulment	att.	att.	att.	att.	**gap**	att.	att.	1	14
besmirchment	att.	att.	att.	att.	att.	att.	att.	0	0
congealment	att.	att.	**gap**	**gap**	att.	att.	att.	2	29
debauchment	att.	att.	att.	att.	att.	att.	att.	0	0
decenterment	att.	**gap**	**gap**	**gap**	att.	att.	att.	3	43
diminishment	att.	**gap**	att.	att.	att.	att.	att.	1	14
disbandment	att.	att.	att.	att.	att.	att.	**gap**	1	14
discolorment	**gap**	**gap**	att.	**gap**	att.	att.	att.	3	43
dispersement	att.	att.	**gap**	**gap**	att.	att.	att.	2	29
embetterment	att.	att.	att.	att.	att.	att.	att.	0	0
embrittlement	att.	att.	att.	att.	att.	att.	att.	0	0
increasement	att.	att.	att.	att.	att.	att.	att.	0	0
progressment	att.	att.	**gap**	att.	att.	att.	att.	1	14
unfoldment	att.	att.	att.	att.	att.	att.	att.	0	0
upliftment	att.	**gap**	att.	att.	att.	att.	**gap**	2	29
worsenment	att.	**gap**	att.	**gap**	att.	att.	att.	2	29
Gaps total	1	5	4	5	2	0	2	**19**	-
Gaps per cent	6	28	22	28	11	0	11	-	**15**

indicate the total number and the percentage of gaps per reading (e.g. "1" and "6" for TRANSPOSITION). In the bottom right corner, the total number of gaps and the overall percentage of gaps are indicated. To facilitate the counting of gaps per reading, the three complementarily distributed readings PATIENT, IMPLICIT PRODUCT and RESULT are collapsed into one column. A visual representation of the ratio between attestations and gaps is given in Figures 6.1 (gaps per reading) and 6.2 (gaps per nominalization).

[97] The figures and tables in this section contain the following abbreviations: For readings, c-o-s = change-of-state, c-o-p-s = change-of-psych-state, evt = event, impl-prod = implicit product, instr = instrument, pat = patient, res =result, res-st = result-state, stim = stimulus, trans = transposition; further abbreviations are amb. = ambiguous, att. = attested, unamb. = unambiguous.

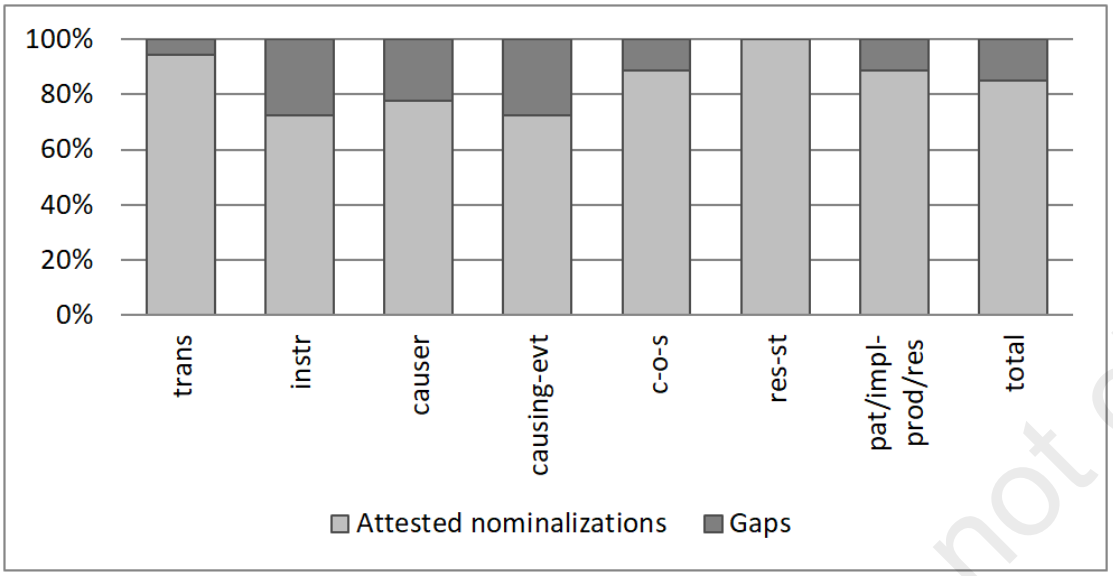


FIGURE 6.1: Ratios of attested and unattested COS readings

Let us first take an onomasiological point of view. In Figure 6.1, which visualizes Table 6.1 by column, gaps are represented by dark gray. We see that there are comparatively few gaps per reading, given that I have investigated neologisms. In total, as represented by the rightmost column, only 15% of all expected combinations of readings and nominalizations are not attested. RESULT-STATE readings, with no gaps at all, are best attested, closely followed by transpositional readings. The readings with the highest percentage of gaps are INSTRUMENT and CAUSING EVENT, with five (28%) gaps each, followed by CAUSER with four gaps (22%).

There is a clear pattern in the distribution of gaps for COS nouns. The three most poorly attested readings (INSTRUMENT, CAUSING EVENT, and CAUSER) share the semantics of 'something that causes Ving' (henceforth ORIGINATOR readings). That ORIGINATORS are comparatively infrequent can be attributed to two possible factors. First, it may be an artifact of my sampling strategy, since these readings are harder to identify by selective corpus searches. Thus, when probing the corpora for contexts which favor a specific reading, some contexts are more helpful than others. For example, <"state of V-ment"> can be used to quickly find attestations for *V-ment* in a RESULT-STATE reading, while contexts which may indicate an ORIGINATOR reading are much less specific. Contexts that I used were, for example, the indefinite article (<"a V-ment">), or the plural (<V-ments>). Second, the finding may reflect reality. ORIGINATOR readings may actually be less frequent than other *-ment* readings, which would make it less likely to find them attested in the first place. A possible explanation for the sparseness of ORIGINATOR

readings could be that these are subject-oriented, for which other nominalizing suffixes are preferred (e.g. *-er* and *-ant*, see e.g. Lieber 2004).[98] Thus, it is possible that we are dealing with a partial blocking effect, with subject-oriented suffixes making ORIGINATOR readings less likely for *-ment* derivatives.

Illustrating the semasiological point of view, Figure 6.2 visualizes Table 6.1 by row. Most nominalizations are well or even perfectly attested, with no gaps for a total of seven nouns. Some nominalizations, however, are lacking multiple readings. The highest percentage of gaps is exhibited by *decenterment* and *discolorment*, with three gaps each (43%).

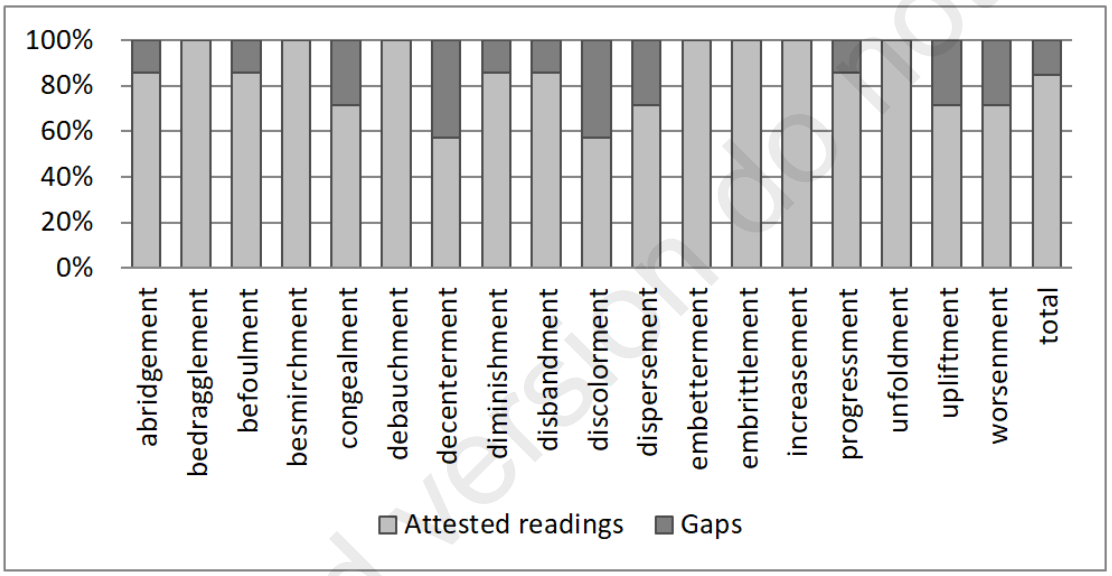


FIGURE 6.2: Ratios of attested and unattested COS nouns

These gaps can indicate one of two things: Either, *decenterment* and *discolorment* are less flexible in their range of readings, or I did not find instantiations of readings which are in principle possible. I propose that the second option is more likely for three reasons: First, the gaps for these two nominalizations seem to be related to the lack of ORIGINATOR readings I discussed above. *Decenterment* is not attested in either of the three ORIGINATOR readings, and *discolorment* is not attested in an INSTRUMENT, CAUSER or transpositional reading. Second, both nominalizations have other very dominant readings, namely IMPLICIT PRODUCT (*discolorment*) and RESULT-STATE (both). These may make the search for less frequent readings prohibitively difficult by dint of the sheer number of examples of the more common readings. Third, both nominalizations are extremely infrequent,

[98] I extend thanks to Rochelle Lieber, who pointed me to the dichotomy of subject- versus object-preferring suffixes.

compared to most other nominalizations in the data set. In iWeb (14 billion words as of October 2020), *decenterment* is attested once and *discolorment* is attested twice, and neither is attested in GloWbE (1.9 billion words).

The gaps in the psych data are summarized in Table 6.2. It is constructed in parallel to Table 6.1, with the addition that empty cells indicate irrelevant combinations of nominalization and reading. For example, the CHANGE-OF-PSYCH-STATE reading is relevant for only four nominalizations, so that the remaining cells in this column are empty. The percentage of gaps per reading and per nominalization is visualized in Figures 6.3 and 6.4, respectively. Overall, we see that the number of gaps is even smaller compared to the COS data: There are only five gaps, which corresponds to 6% of the expected combinations of nominalization and reading.

TABLE 6.2: Attested and unattested readings of psych nouns

Nominalization	Transposition	Stimulus	Causing-event	C-o-p-s	Result-state	Gaps total	Gaps per cent
abashment	att.	att.	att.		att.	0	0
affrightment	att.	att.	att.		att.	0	0
annoyment	att.	att.	att.		att.	0	0
approvement	att.	**gap**				1	50
bemusement	att.	att.	att.		att.	0	0
bumfuzzlement	att.	att.	att.		att.	0	0
confoundment	att.	att.	att.		att.	0	0
convincement	att.	att.	att.		att.	0	0
disheartenment	att.	att.	att.		att.	0	0
dumbfoundment	att.	att.	att.		att.	0	0
endullment	att.	**gap**	att.	att.	att.	1	20
enragement	att.	att.	att.	att.	att.	0	0
enrapturement	att.	att.	att.		att.	0	0
musement	att.	att.			att.	0	0
nonplusment	att.	att.	att.		att.	0	0
perturbment	att.	**gap**	att.		att.	1	25
reassurement	att.	att.	**gap**		att.	1	25
soothment	att.	att.	**gap**	att.	att.	1	20
staggerment	att.	att.	att.		att.	0	0
upliftment	att.	att.	att.	att.	att.	0	0
upsetment	att.	att.	att.		att.	0	0
worriment	att.	att.	att.		att.	0	0
Gaps total	0	3	2	0	0	**5**	–
Gaps per cent	0	14	9	0	0	–	**6**

Figure 6.3 illustrates the proportion of attested and unattested readings. Irrelevant combinations have been excluded. Strikingly, only two readings have gaps in the first place, namely STIMULUS and CAUSING EVENT. The remaining three readings are instantiated in every expected psych noun of my data set. Thus, it is again the ORIGINATOR category that is not as well represented in the data. This supports my conclusion that ORIGINATOR readings are in principle possible, but overall less frequent.

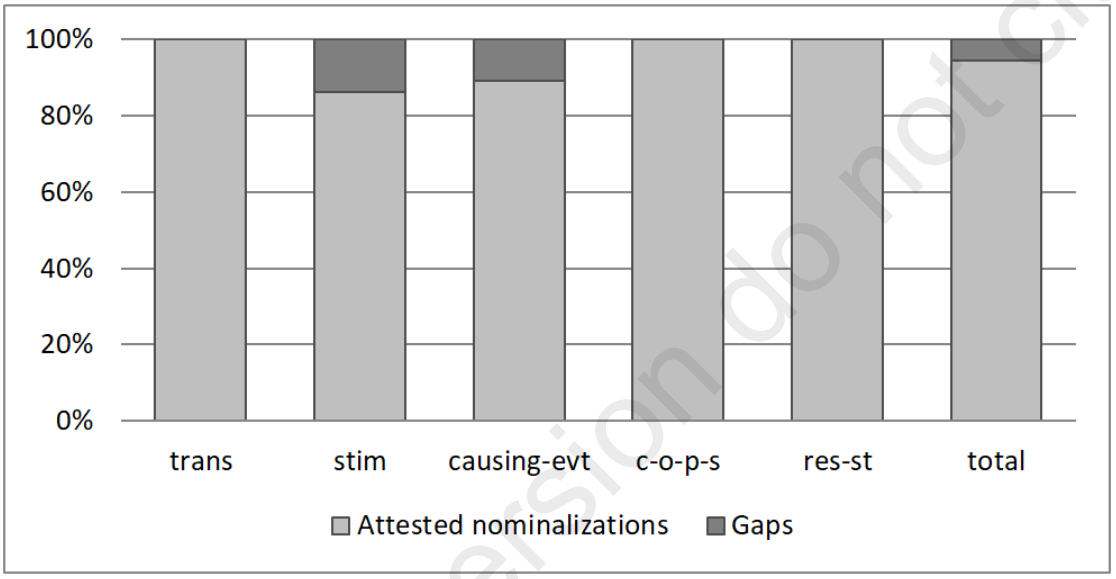


FIGURE 6.3: Ratios of attested and unattested psych readings

In Figure 6.4, we see that the percentage of gaps per nominalization is also low: Five nominalizations have one unattested reading each.

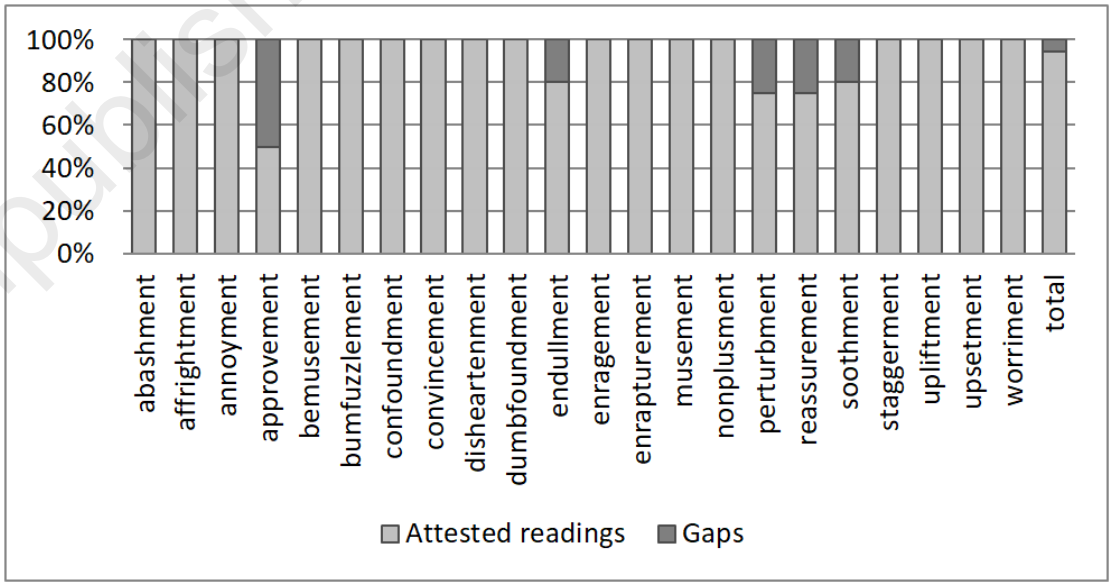


FIGURE 6.4: Ratios of attested and unattested psych nouns

All things considered, the gaps in my data can most likely be attributed to scarcity of data in combination with a partial blocking effect of standardly subject-denoting suffixes, and should not be regarded as (indirect) negative evidence for a given combination of nominalization and reading being impossible. As can be expected, I have observed that overall the availability of data is very limited for a data set of neologisms such as the one investigated here. For example, in iWeb and GloWbE, the total frequency of the nominalizations in my data set has a median of 17 and 3, respectively (with an average of a rounded 203 and 61). For comparison, lexicalized *-ment* derivatives in iWeb range in the millions (e.g. *development* with 3,639,970 or *government* with 3,466,979 attestations). Therefore, it comes as no surprise that the less central readings are harder or impossible to find, even after extending my search to corpora in the wider sense (that is, Google and Twitter).

Having said that, finding attestations for the more central readings of a noun (for instance RESULT-STATE for psych nouns) proved to be surprisingly straightforward in most cases. In all, considering that finding attestations for neologisms is no trivial task, I regard the number of gaps in my data as astonishingly low.

6.2 Ambiguity

Let us now turn to the subset of attested readings. In the following, I will assess the percentage of readings and nominalizations for which unambiguous attestations are available, versus the percentage of only ambiguously attested readings and nominalizations.

Table 6.3 gives an overview of the combinations of nominalizations and readings for COS nouns. A combination is marked as "amb." if only ambiguous attestations are represented in the data set. For example, I have not found an unambiguous attestation for *abridgement* in an INSTRUMENT reading. As soon as I found at least one unambiguous attestation for a given combination, this is indicated by "unamb." (e.g. *abridgement* in a transpositional reading). Empty cells represent gaps in the data (see section 6.1). The numbers in the last two columns indicate how many of the eight possible readings are only attested ambiguously for each nominalization, in total numbers and in percentages. Likewise, the numbers in the last two rows indicate how many of the 18 COS nominalizations are only attested ambiguously in a given reading. The total number and the overall percentage of ambiguous combinations is given in the bottom right corner.

TABLE 6.3: Ambiguous and unambiguous readings of COS nouns

Nominalization	Trans	Instr	Causer	Causing-evt	C-o-s	Res-st	Pat	Impl-prod	Res	Amb. total	Amb. per cent
abridgement	unamb.	**amb.**	**amb.**	**amb.**		**amb.**			unamb.	4	67
bedragglement	unamb.	**amb.**	**amb.**	unamb.	**amb.**	unamb.	unamb.			3	43
befoulment	unamb.	**amb.**	unamb.	**amb.**		unamb.	**amb.**			3	50
besmirchment	unamb.	**amb.**	**amb.**	**amb.**	unamb.	unamb.			unamb.	3	43
congealment	unamb.	unamb.			unamb.	unamb.	unamb.			0	0
debauchment	unamb.	**amb.**	**amb.**	unamb.	unamb.	unamb.	**amb.**			3	43
decenterment	unamb.				unamb.	unamb.			unamb.	0	0
diminishment	**amb.**		unamb.	unamb.	unamb.	**amb.**			unamb.	2	33
disbandment	unamb.	**amb.**	**amb.**	**amb.**	**amb.**	unamb.				4	67
discolorment			unamb.		**amb.**	unamb.		unamb.		1	25
dispersement	**amb.**	unamb.			unamb.	unamb.			unamb.	1	20
embetterment	unamb.	**amb.**	unamb.	unamb.	unamb.	**amb.**			**amb.**	3	43
embrittlement	unamb.	**amb.**	**amb.**	**amb.**	unamb.	**amb.**		unamb.		4	57
increasement	unamb.	**amb.**	**amb.**	**amb.**	unamb.	**amb.**			unamb.	4	57
progressment	unamb.	**amb.**		**amb.**	unamb.	**amb.**			unamb.	3	50
unfoldment	unamb.	**amb.**	**amb.**	**amb.**	unamb.	unamb.	**amb.**			4	57
upliftment	**amb.**		unamb.	**amb.**	unamb.	**amb.**				3	60
worsenment	unamb.		**amb.**		unamb.	**amb.**			unamb.	2	40
Amb. total	3	11	9	9	3	8	3	0	1	**47**	–
Amb. per cent	18	85	64	69	19	44	60	0	11	–	**44**

Figure 6.5 visualizes Table 6.3 by column. It is immediately obvious that the percentage of nominalizations for which only ambiguous attestations have been found is rather high for most readings. Only IMPLICIT PRODUCT has a perfect score, followed by RESULT with 11% ambiguously attested nouns, and TRANSPOSITION with 18%. The highest percentage of only ambiguously attested nouns can be seen for INSTRUMENT (85%), CAUSING EVENT (69%) and CAUSER (64%). In total, 44% of the attested combinations of reading and nominalization have no unambiguous attestation to show.

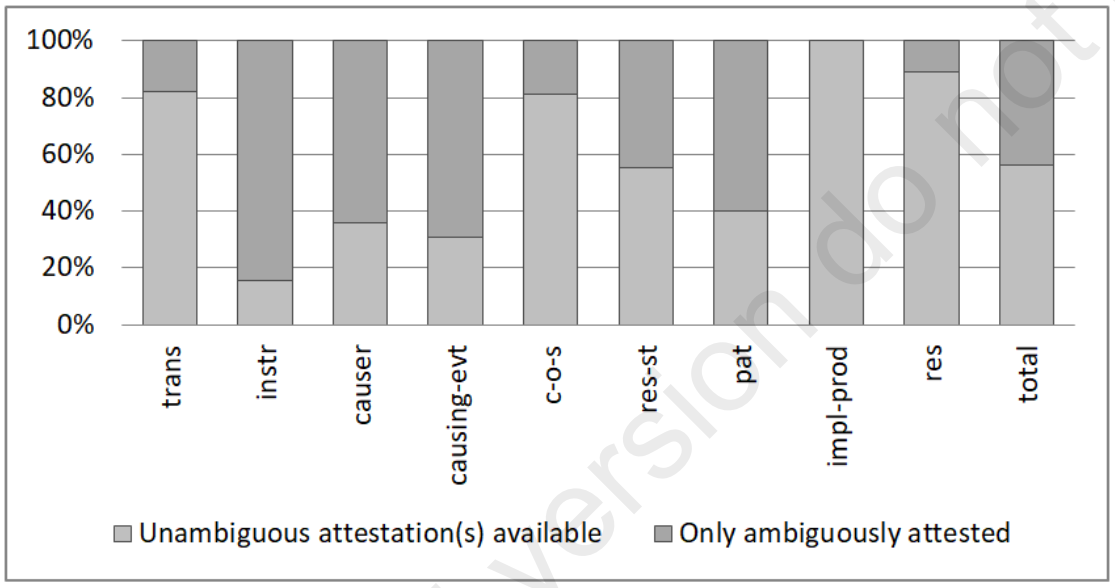


FIGURE 6.5: Ratios of ambiguously and unambiguously attested COS readings

These findings are in line with my observations from the previous section. Again, ORIGINATOR readings are the ones which stand out negatively. This may lead to the conclusion that not only are they harder to find attested, but if they are, their contexts do not disambiguate as well as for other readings. However, this is only true on the level of granularity I have chosen in this study, that is, distinguishing between INSTRUMENT, CAUSER and CAUSING-EVENT in the first place. In fact, the ambiguity is largely between these three categories, and not between ORIGINATOR and other categories. In other words, it is actually not that hard to disambiguate between ORIGINATOR and other readings, but the context does then often not allow distinctions on a more fine-grained level. Quantitatively speaking, only 18% of COS nouns (a total of 4) have no unambiguous attestations for the concatenated ORIGINATOR category.

Let me also add a note on the fact that IMPLICIT PRODUCT has a perfect score. One might be tempted to attribute this to IMPLICIT PRODUCT being a dominant

reading. However, only two nouns in the data set have this reading in the first place, so that generalizations of that sort are hardly feasible.

Figure 6.5 shows that the proportion of only ambiguously attested readings per nominalization is rather high and quite evenly distributed, with most nominalizations being in the middle of the spectrum: Exactly two thirds have between 40% and 60% unambiguously attested readings. *Abridgement* and *disbandment* have the highest percentage of ambiguously attested readings (67%). On the other side of the spectrum, *congealment* and *decenterment* have a perfect score. All things considered, I do not think that this distribution is systematic. That is, it does not seem to be the case that properties of a nominalization (e.g. frequency) correlate with its level of ambiguity.

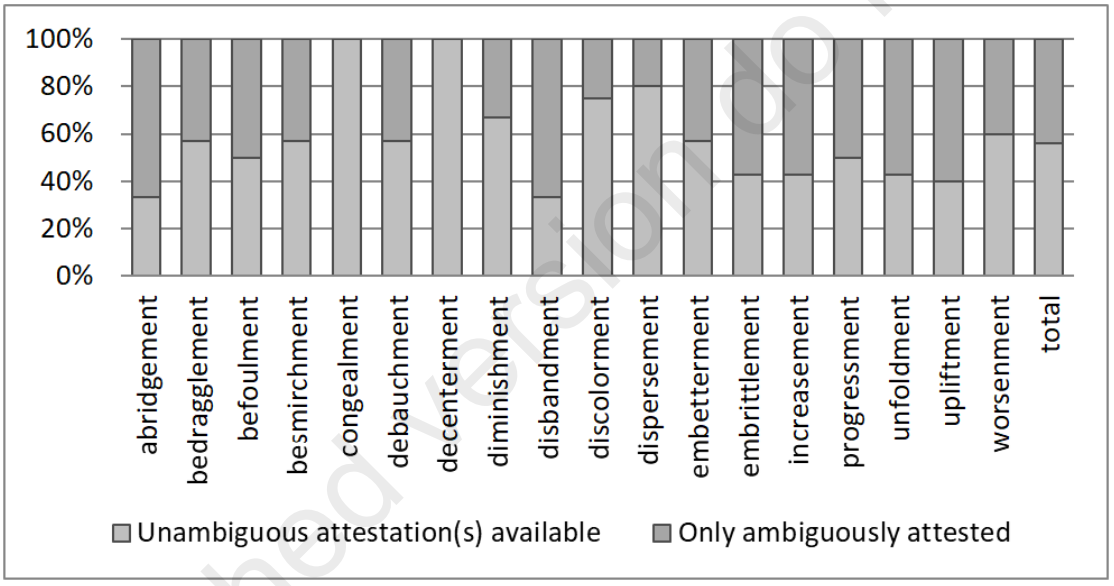


FIGURE 6.6: Ratios of ambiguously and unambiguously attested COS nouns

For psych verbs, we see a similar picture, as is summarized in Table 6.4 as well as in Figures 6.7 and 6.8. Although the psych part of the data set has fewer gaps (see previous section), at 44% the extent of ambiguity is identical to the ambiguity in the COS data.

TABLE 6.4: Ambiguous and unambiguous readings of psych nouns

Type	Trans	Stim	Causing-evt	C-o-p-s	Res-st	Ambiguous total	Ambiguous per cent
abashment	unamb.	unamb.	unamb.		unamb.	0	0
affrightment	unamb.	**amb.**	**amb.**		unamb.	2	50
annoyment	unamb.	unamb.	unamb.		unamb.	0	0
approvement	unamb.					0	0
bemusement	**amb.**	unamb.	unamb.		unamb.	1	25
bumfuzzlement	unamb.	**amb.**	**amb.**		unamb.	2	50
confoundment	**amb.**	**amb.**	**amb.**		unamb.	3	75
convincement	unamb.	unamb.	**amb.**		unamb.	1	25
disheartenment	**amb.**	unamb.	unamb.		unamb.	1	25
dumbfoundment	**amb.**	**amb.**	**amb.**		unamb.	3	75
endullment	unamb.		**amb.**	unamb.	**amb.**	2	50
enragement	unamb.	**amb.**	**amb.**	unamb.	unamb.	2	40
enrapturement	**amb.**	**amb.**	**amb.**		unamb.	3	75
musement	unamb.	unamb.			unamb.	0	0
nonplusment	**amb.**	**amb.**	**amb.**		unamb.	3	75
perturbment	unamb.		**amb.**		unamb.	1	33
reassurement	**amb.**	unamb.			**amb.**	2	67
soothment	**amb.**	unamb.		**amb.**	unamb.	2	50
staggerment	**amb.**	**amb.**	**amb.**		unamb.	3	75
upliftment	**amb.**	unamb.	unamb.	unamb.	unamb.	1	20
upsetment	**amb.**	**amb.**	**amb.**		unamb.	3	75
worriment	unamb.	**amb.**	**amb.**		unamb.	2	50
Ambiguous total	11	10	13	1	2	**37**	–
Ambiguous per cent	50	45	65	25	10	–	**44**

As visualized in Figure 6.7, all psych readings have a portion of only ambiguously attested nominalizations. With only 10%, RESULT-STATE scores best. The readings for which the identification of unambiguous attestations was most difficult are CAUSING EVENT (65% only ambiguously attested nominalizations), TRANSPOSITION (50%) and STIMULUS (45%). Again, these results confirm my previous observation that ORIGINATOR categories exhibit the most patchy data availability. With regard to transpositional readings, it is interesting that psych nouns have a much higher percentage of nominalizations with only ambiguous attestations, namely 50%, compared to 18% of COS nouns. A possible explanation is the factor of agentivity as discussed in section 5.2.2.4. There, I described that unambiguously transpositional readings for psych nouns can be found much more easily in agentive contexts. Assuming that COS nouns generally exhibit a higher degree of agentivity, it is logical that they be found more easily in unambiguous transpositional readings as well. Of course, this suspicion would have to be verified empirically.

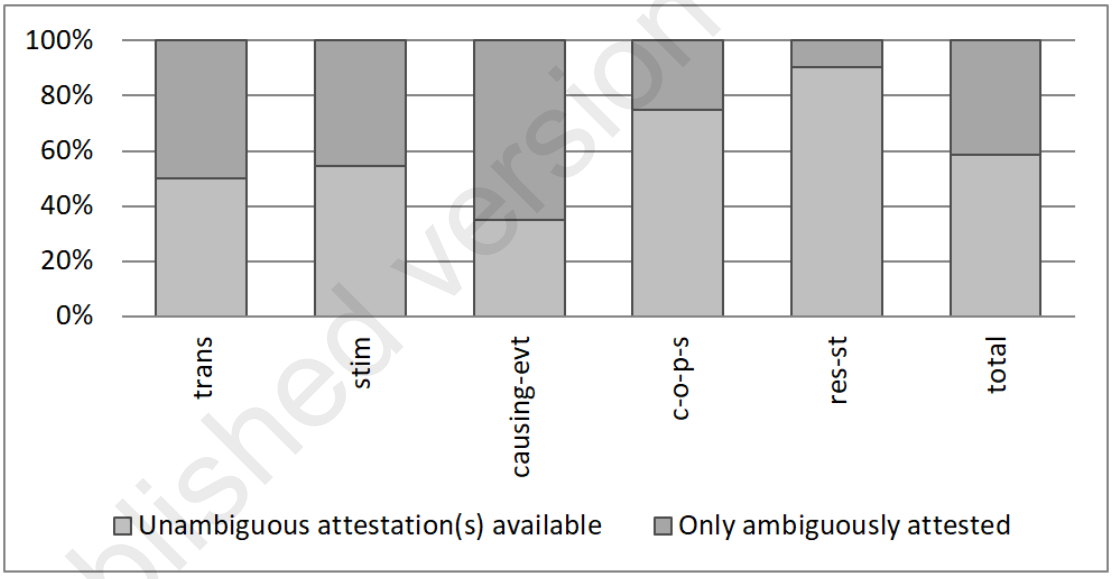


FIGURE 6.7: Ratios of ambiguously and unambiguously attested psych readings

From a semasiological point of view, the psych data is more widely distributed than was the case for the COS data, as can be seen in Figure 6.8. For the psych data, 77% of the nominalizations range between 25% and 75% unambiguously attested readings (for most COS nouns, the range is between 40% and 60%). There are four psych nominalizations with a perfect score (*abashment, annoyment, approvement* and *musement*). Of course, it has to be kept in mind that *approvement* has only one attested reading to begin with. At the lower end of

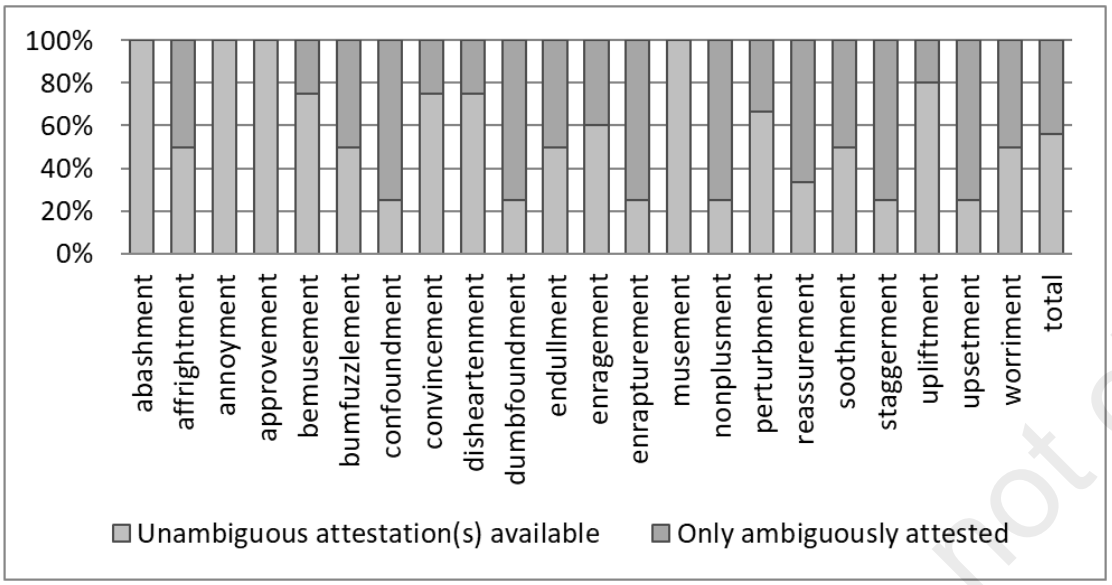


FIGURE 6.8: Ratios of ambiguously and unambiguously attested psych nouns

the spectrum are *confoundment, dumbfoundment, enrapturement, nonplusment, staggerment* and *upsetment* with 25% unambiguously attested readings each.

The conclusion that we can draw from this overview is that, on the whole, my data tends to be quite ambiguous. Both from an onomasiological and from a semasiological point of view, there are comparatively few unambiguous attestations. On a more general scale, this shows us that neologism data is very often ambiguous. During data collection, it was a decided goal to identify as many unambiguous attestations as possible, and still ambiguity is widespread in my data. Of course, this observation is very subjective. In future research, it would be interesting to compare the ambiguity of neologisms with that of lexicalized nominalizations in a sample of random attestations, or to investigate whether there are systematic patterns in the ambiguities I found.

Chapter 7

Discussion

In chapters 4, 5 and 6, I have presented studies of productively formed contemporary *-ment* derivatives based on COS verbs and psych verbs. In the present chapter, I will now summarize and discuss which general insights can be gained from my results. I will do so by first providing answers to my research questions (section 7.1), and then evaluating my methodological decisions (section 7.2).

7.1 Answers to my research questions

1. Which readings are possible in newly formed *-ment* derivatives?

According to the existing literature (e.g. Bauer et al. 2013; Lieber 2016, see section 4.2.1), *-ment* is a versatile suffix, being attested in the eventive readings STATE and EVENT as well as in the non-eventive readings INSTRUMENT/MEANS, RESULT, PRODUCT, LOCATION and [-animate] PATIENT/THEME.[99] Therefore, it is not surprising that I found a range of different readings for my *-ment* neologisms as well.

Compared to previous literature, however, I made use of more fine-grained distinctions, which allowed me to paint a more detailed picture of *-ment*. In my studies, I distinguished a total of 16 different attested readings; ten eventive and six non-eventive. Table 7.1 contrasts my categories with those from previous studies.

Let us first have a look at the eventive readings. First of all, I distinguish between transpositional eventive readings and shifts to eventive nodes that are embedded more deeply in the semantic representation (e.g. transpositional CHANGE-OF-STATE CAUSATION and the shifts to its subevents CAUSING EVENT and CHANGE-OF-STATE). Second, with regard to transpositional readings, I distinguish between

[99] Note that some labels differ between authors.

TABLE 7.1: Established readings produced by *-ment* according to the literature, compared with the readings identified in this study

Literature	This thesis
event	change-of-(psych-)state causation psych-state causation experiencer psych-action causing event change-of-(psych-)state
state/condition	psych-state result (psych-)state
instrument/means	instrument causer stimulus
result	result
product	implicit product
location	n.a.
[-animate] patient/theme	[-animate] patient

different kinds of transposition, depending on the frame type. For example, the psych base verb *uplift* is modeled with a frame typed as *change-of-psych-state causation*, while *annoy* is modeled with a *psych-state causation* frame. This distinction carries over into the nominalization frames, resulting in two separate transpositional readings CHANGE-OF-PSYCH-STATE CAUSATION (for *uplift*) and PSYCH-STATE CAUSATION (for *annoy*).

Regarding non-eventive readings, I have confirmed those which have been posited in previous literature, with the exception of LOCATION. Furthermore, I have refined the PRODUCT category, finding that only the subtype IMPLICIT PRODUCT is attested in my data. Both gaps, LOCATION and EXPLICIT PRODUCT, can be traced back to the semantics of the base verbs investigated here: Neither COS verbs nor psych verbs have LOCATION as one of their core attributes, nor do they denote the creation of an explicit product. Finally, I have identified two new readings, namely CAUSER and STIMULUS. These have so far not been distinguished from the related categories INSTRUMENT/MEANS and AGENT.

The semantic versatility of *-ment* is also observable on the level of the individual nominalizations: Every single derivative in my data set is polysemous, exhibiting a range of possible readings. The fewest readings can be found for SE psych nouns of the subtype psych-state, which can be found in two readings. The largest number of readings can be found for the noun class I have dubbed

instrument/causer/result-COS nouns, with as many as seven different readings per type. In a specific context, one or more of these possible readings is selectable. Importantly, a quantitative exploration of my data has shown that the context is often not able to fully disambiguate a newly formed derivative: I have not been able to find unambiguous attestations for as much as 44% of all combinations of nominalization and reading.

From these results, it is obvious that *-ment* is an extremely versatile suffix. In new derivatives, it can produce a semantically diverse range of readings, while also heeding a clearly identifiable set of constraints. These constraints are provided partly by the base verb semantics, and partly by the suffix itself. This brings us to research question 2.

2. What are the semantic contributions of the base and of the affix?

I started out this thesis from the assumption that semantically similar base verbs will have semantically similar derivatives. While the initial categorization of base verbs ended up having to be rather significantly revised (see section 7.2 for an evaluation), we can conclude that this assumption is correct. More precisely, I have found transpositional readings as well as shifts to components which are more deeply embedded in the verbs' semantics. These components are of three kinds: First, components that form the event structure can be targeted (e.g. CHANGE-OF-STATE or RESULT-STATE). Second, the target of a shift can be a participant that frequently occurs in the direct syntactic neighborhood of the base verb (e.g. STIMULUS).[100] Finally, I have found shifts to non-argumental participants (i.e. RESULT and IMPLICIT PRODUCT). I have thus been able to show that the readings in which a deverbal nominalization is attested provide an informative basis for the base verb's semantic representation. An investigation of derivational semantics can therefore complement insights gained from syntax-based word classifications such as VerbNet or FrameNet.

The semantic contribution of the base is also manifested in negative evidence. Thus, according to the literature, *-ment* can be found in LOCATION and PRODUCT (in my terminology: EXPLICIT PRODUCT) readings. As expected, I have not identified these readings because LOCATION and PRODUCT are not elements of the semantic representation of my base verbs.[101]

[100] Where to draw the line between a frequent and an infrequent participant, however, remains to be seen (see also the discussion of INSTRUMENT and CAUSER readings in section 4.2.3.4).

[101] Both LOCATION and EXPLICIT PRODUCT are attested in a number of neologisms which for reasons of space were not discussed in this dissertation. For example, LOCATION can be denoted by

In both studies, I have also observed that not all components which are present in the semantic representation of a given base verb are also attested as readings in its derivative. This can mainly be attributed to properties of derivation with *-ment*. The three unattested readings are AGENT, [+animate] PATIENT, and EXPERIENCER, which is a finding that corresponds to previous literature (e.g. Lieber 2016).[102] The three readings share the feature [+animate], which has led me to the conclusion that *-ment* generally disprefers [+animate] readings.

From this interplay of base and affix, an array of possible readings arises for each nominalization in my data set. For example, the psych noun *confoundment* can have the transpositional reading PSYCH-STATE CAUSATION, the eventive readings PSYCH-STATE and CAUSING EVENT, and the participant reading STIMULUS. Out of these possibilities, then, one or more is selected in context.

So far in this discussion, I have addressed two central aspects of derivational semantics, namely affix polysemy and the compositionality of the derivational process. In answer to research question 3, I will now review the formal aspects of my analysis.

3. How can the semantics of derivation be modeled in a frame approach?

In order to model the process of nominalization with *-ment* on COS and psych verb bases, I applied an approach in which the semantics of the base verbs and that of the resulting nouns are modeled in separate frames. A type signature specifies the properties of and relations between all components used in the frames. The frames for the base verbs and for the nominalizations are then integrated into a lexeme formation rule (LFR), which expresses the relation between the two. Due to the extensive polysemy of *-ment* and the wide variety of base verb components identified in my study, the most feasible approach is to model the derivation of the individual readings in one LFR each. All LFRs are then incorporated in an inheritance hierarchy.

The range of possible readings for a given derivative is determined by an interplay between the type signature and the inheritance hierarchy for *-ment*. Where

embedment, emplacement and *trapment*. These are based on **verbs of putting** (see Levin 1993, 111-122) – a verb class which has a change of location in its semantics. EXPLICIT PRODUCT, on the other hand, is attested for instance in derivatives based on **build verbs** (p. 173-4). Example neologisms which did not make it into the data set presented here are *carvement, knitment* and *whittlement*.

[102] There are further readings which are neither part of the base verbs frames, nor were they expected to be attested with *-ment* in the first place, namely PATH, MEASURE, COLLECTIVE, ABSTRACT, BEHAVIOR, INHABITANT/LANGUAGE, BELIEF, and ADHERENT (see Lieber 2016).

no incompatibilities arise, inheritance is successful, resulting in a range of possible readings for the *-ment* derivative. For instance, a shift from the psych verb *annoy* to a RESULT-STATE reading in *annoyment* is possible because the attribute RESULT-STATE is compatible with psych verbs, as is defined in the type signature, and with *-ment*, as is fixed in the inheritance hierarchy. When incompatibilities do arise, inheritance fails and certain readings are excluded. For example, a shift from *annoy* to an EXPERIENCER reading in *annoyment* fails because the range of the attribute EXPERIENCER is fixed to [+animate] entities, so that the animacy constraint blocks the inheritance mechanism.

7.2 Methodological issues

This section presents a critical evaluation of the methodological decisions I have made in the course of this thesis. More precisely, I will reflect on issues related to the investigation of neologisms (section 7.2.1), to semantic categorizations (section 7.2.2), and to the frame approach (section 7.2.3).

7.2.1 Neologism data

I have investigated neologisms in order to set the focus on actual speaker intuition, rather than on lexical idiosyncrasies that have developed over decades or even centuries. This choice led to a number of methodological issues: First, the status of a formation as a neologism is not always clear. I therefore relied on a number of external measures to decide whether a given derivative could be considered a neologism (e.g. frequency band in the OED, attestation as a hapax legomenon). Second, it is in the nature of neologisms that they are less frequently attested than lexicalized words. I therefore extended my corpus study to corpora in the wider sense (i.e., Google and Twitter). As a consequence, I had to be very conservative regarding any clues that a given attestation may not have been produced by a native speaker. Third, despite this expansion of the data base, the available data was scarce for most nominalizations, and finding attestations proved to be laborious. However, I was able to find most expected combinations of nominalization and reading, with only 11% gaps (15% for COS nouns and 6% for psych nouns). The final issue presented by the neologism data was that, while speakers of English do have an intuition of what a new *-ment* formation may mean out of context, its full range of readings becomes available only in context. Therefore, in the semantic categorization of my nominalization data, the annotators had to rely completely

on contextual cues, vague as they may be. Of course, this is exactly what happens when a speaker encounters a neologism "in the wild." Therefore, the annotation process was more similar to reality than one might think, but also less categorial and straightforward than one might like.

The question arises: Was investigating neologisms worthwhile? The short answer is: Yes. In my study, I have been able to shape an image of the contemporary, productive process of *-ment* derivation, despite the difficulties just described.

However, what I have also found is that there is no difference between the two subcategories of my data set (neologism data versus supplementary data, see section 3.3.1). The formations which, in the OED, are categorized as uncommon but recognizable to speakers of English exhibit the same range of possible readings as those that are extremely rare (including those that are not listed in the OED in the first place). For example, the two psych-state-causation nouns in the supplementary data set, *bemusement* and *convincement*, behave exactly like their counterparts in the neologism data set (e.g. *annoyment* or *affrightment*).

In future research, it would therefore be interesting to conduct a quantitative investigation, examining at what point frequency effects can be detected: Does a higher frequency of a derivative relate to the (non-)availability of readings? To what extent do frequent (lexicalized) readings of a given derivative block its usage in rare (or even unexpected) readings? For example, even very frequent derivatives like *government* or *equipment* are sometimes attested in atypical readings:

(88) a. An anonymous author [...] wrote that part of the "natural liberty" Englishmen and [...] other individuals did not part with when they entered into a "state of **government**" was "the right that every one has to speak his sentiments openly [...]" (*Google* ACAD scholarship.law.columbia.edu)

b. Fundamental to this purpose was Allah's **equipment** of the female with an instinctive desire and a strong natural passion (iWeb ACAD iupui.edu)

Thus, *government* in (88a) does not exhibit one of its lexicalized readings (e.g. 'the governing power in a country or state' or 'a period of rule,' (OED), but rather a STATE reading. Likewise, *equipment* in (88b) does not reflect the usual definition of 'anything used in equipping' (OED), but a clearly transpositional reading.[103]

[103]The transpositional reading is actually listed in the OED as 'the action or process of equipping or fitting out,' but a manual inspection of COCA shows that this reading is uncommon: The first 100 hits of the search string <equipment> do not contain a single instance of a transpositional reading.

7.2.2 Semantic categorization

The core of this thesis is formed by the semantic categorization of the base verbs and their nominalizations, and the semantic decomposition based on these categories. Now, I would like to look back and evaluate two aspects of this approach: the usefulness of nominalization readings as a tool to access base verb semantics, and the simplifying nature of categorical distinctions.

7.2.2.1 Nominalization readings and verb semantics

A notorious issue in semantic investigations is the arbitrariness of the applied semantic categories. I approached this issue by starting my investigation from a set of clearly defined semantic categories which were based on previous research. For participants of events, I relied on VerbNet, and for the event structure, I consulted a wide range of (formal) literature. I then adapted my VerbNet-based semantic decomposition in accordance with my observations from the corpus data.

I found that the verb categorization offered by Levin (1993) and VerbNet does not suffice to predict all participant readings that I found in the nominalizations. This is because the basis of their classification is syntactic, so that non-argumental participants (such as, for instance, IMPLICIT PRODUCT) are not included. Obviously, the assumption that syntactically similar verbs are also semantically similar does hold to some extent, resulting in intuitively reasonable verb classes such as *psych verbs* or *COS verbs*. However, the Levin/VerbNet classification does not offer a complete semantic decomposition (nor do the authors claim that it should). In this thesis, however, I have shown that decomposition is necessary for an understanding of the process of nominalization and of the resulting noun semantics.

All changes that I made to the initial set of central participants are strictly data-driven. For example, I introduced PRODUCT with the additional distinction between IMPLICIT PRODUCT and EXPLICIT PRODUCT because I noticed that PRODUCT, but not all kinds of PRODUCT, is attested in my data. Another example is the feature [±animate]. In order for the animacy constraint to work, I introduced this feature, resulting in such distinctions as [+animate] PATIENT versus [-animate] PATIENT. Other distinctions were irrelevant for my data, or even made wrong predictions. For example, I eliminated the requirement [+solid] on the PATIENT and INSTRUMENT roles of c/i reversible COS verbs.

Apart from the identification of central participants, my results offer valuable insights with regard to the event-semantic decomposition of verbs and nouns. More precisely, I found that *-ment* derivation can induce semantic shifts to subevent

nodes (e.g. the CHANGE-OF-STATE reading), and I identified clues in the contexts of some nominalizations that indicate a complex event structure for the respective base verbs as well (e.g. contexts of the kind *x's V-ment of y with z*). For COS verbs, I have been able to support the traditionally assumed complex event structure. For psych verbs, I have contributed a new perspective in the discussion of which event types are adequate to model them. Thus, I have been able to show that the range of readings in which a deverbal nominalization is attested provides an informative, additional basis for decomposing the base verb's semantics.

Conversely, however, it is obvious that the VerbNet-based verb frames did not suffice to predict all possible nominalization readings: I based these frames on VerbNet, which only takes into consideration those participants which frequently figure syntactically in a verb's contexts. Therefore, for more predictive power of the base verb frames, further sources of information are required. In the conclusion of this thesis (chapter 8), I will delineate which other frameworks could complement the frame-semantic approach to reach this goal.

7.2.2.2 Categorical decisions

Any categorization means controlled loss of information. In this thesis, this was an especially pronounced issue, since I made a number of categorical decisions: I partitioned my data set into verb classes and subclasses, I proposed one or more frame representations for each subclass, and I used semantic labels such as [±solid] as well as semantic categories such as INSTRUMENT. In doing so, I had to assume a number of clear-cut distinctions, which at times proved problematic.

Take, for example, the subcategorization of COS verbs. Based on VerbNet, there are three subcategories represented in my data set. My findings, however, point to a total of ten different groupings of base verbs, based on the availability of certain readings in the nominalizations (see section 4.2.4.1 for details). For example, apart from those readings shared by all COS nouns, *diminish* produces CAUSER and RESULT readings in its *-ment* derivative, while *congeal* produces INSTRUMENT and PATIENT readings instead, and *disperse* produces INSTRUMENT and RESULT.

Based on this complex distribution of readings, the first reaction may be to assume that the best predictor for a COS noun's range of readings is the individual base verb, and that assuming subcategories of COS base verbs does not make very much sense at all. However, some of the emerging groups are intuitively reasonable. For example, the inherently scalar verbs *diminish, increase* and *worsen* show the

same pattern in their nominalizations, as do *bedraggle, befoul* and *debauch* (forming something like a *staining* group).

Another example for a problem with clear-cut semantic categories is the distribution of INSTRUMENT and CAUSER readings. I hypothesized that we are dealing with a gradient phenomenon, with the (non-)availability of these readings being related to the frequency with which INSTRUMENT and CAUSER participants are attested with a given base verb (see section 4.2.4): The more frequently either of the two is attested with a given base, the more likely its nominalization may be to exhibit the corresponding reading.

These examples do not illustrate problems that arise specifically with the frame approach, or with my data, but rather they represent a fundamental issue with categorical formalizations in general: An attribute is represented in a frame, or it is not; a feature is plus, or minus – all categorical approaches have to break down gradient phenomena into distinct categories at some point.[104]

7.2.3 Frames

After having applied the frame approach in two extensive studies, my overall assessment is that frames provide a useful tool for the modeling of derivational semantics (see also my answer to research question 3, section 7.1). Due to their flexible, recursive structure, they allow a detailed and expressive deconstruction of lexical semantics, and can straightforwardly be combined with other formalisms (here: LFRs and inheritance hierarchies) in order to model and comprehend complex linguistic mechanisms. That said, there are several issues that need to be considered when working with frames.

One question that often arises when discussing frame semantics with other researchers is whether frames are indeed too flexible. While the procedure of creating a frame representation is built on a number of regulations (e.g. the uniqueness conditions, see section 2.2.1.3), it often appears as though attributes and values can be added to a frame to suit the researcher's fancy. In this thesis, I have addressed this issue by implementing a data-driven approach: While revising the VerbNet-based frames, I included only those elements which are required to model the *-ment* nominalization readings in my data set. That is, the final frames contain nodes which are targets of referential shifts, and the attribute paths leading to them. On the other hand, those frame elements in the VerbNet-based frames which are not

[104] Of course, there is a whole debate on gradience in linguistics. For a general overview see, for example, Hay & Baayen (2005), Aarts (2007) and Lappin (2015).

involved in derivation with *-ment* were confirmed or contested by examining the *-ment* derivatives' contexts.

Additionally, because the frame format is so flexible, it is necessary to explicitly preclude arbitrary attribute-value combinations. For the purposes of this thesis, I have chosen to spell out the pertinent appropriateness conditions in a type signature. While this adds to the transparency of my approach, it is no trivial task, and I had to apply a number of simplifications and shorthands in order to reduce the type signature to a manageable size.

At the outset of this thesis, I formulated a number of prerequisites for a framework to be useful for modeling affix polysemy: Such a framework needs to allow for semantic composition and decomposition, thus allowing the researcher to model the semantic contribution of the base in the process of derivation. It needs to be flexible enough to incorporate all possible nominalization readings, and at the same time restricted enough to preclude impossible ones. All things considered, I have made the case that the frame approach is an appropriate, even exceptional tool to model affix polysemy.

Chapter 8

Conclusion and outlook

In this dissertation, I have investigated affix polysemy by analyzing corpus attestations of a data set of English *-ment* neologisms with psych verb and COS verb bases. For this, I combined a decompositional frame-semantic approach with LFRs and inheritance hierarchies. Based on an in-depth study of the semantic contributions of both the base and the affix, I have been able to determine how a derivational process acts on the semantics of a given base. In this, I have shown that an explicit semantic decomposition of the base is essential for the analysis of the resulting derivative's semantics. From the perspective of the derivative, I have demonstrated that identifying possible readings provides evidence for the semantics of the base verb as well.

My results show that *-ment* can target a highly restricted set of elements in the frame of a given base verb. By doing so, the suffix produces a range of possible readings in the derivative, which becomes ultimately interpretable only within a specific context. The derivational process is governed by an interaction of properties of the affix (e.g. the animacy constraint) and of the base (i.e. the presence or absence of nodes). For instance, a shift from the psych verb *annoy* to a RESULT-STATE reading in *annoyment* is possible because the frame attribute RESULT-STATE is compatible with psych verbs, as defined in the type signature, and with *-ment*, as fixed in the inheritance hierarchy. Meanwhile, a shift from *annoy* to an EXPERIENCER reading in *annoyment* fails because the value range of the attribute EXPERIENCER is fixed to [+animate] entities, so that *-ment's* animacy constraint blocks the inheritance mechanism.

Furthermore, a quantitative analysis of gaps in my data set reveals that the availability of data is surprisingly high. Thus, despite having analyzed neologisms, I have found most expected combinations of nominalization and reading. Within

the subset of attested combinations, ambiguity is widespread: Both from an onomasiological and from a semasiological point of view, there are comparatively few unambiguous attestations. Interestingly, gaps and ambiguity in my data are especially pronounced for one group of readings, which I dubbed ORIGINATOR readings (i.e. INSTRUMENT, CAUSING EVENT, CAUSER and STIMULUS). Therefore, a further finding of the quantitative analysis is that ORIGINATOR readings are likely being partly blocked for new *-ment* derivatives by more standardly subject-denoting suffixes such as *-er* or *-ant*, but further research is needed to corroborate this finding statistically.

Overall, I have shown that a decompositional frame-semantic approach applied to corpus data succeeds in modeling the derivational process of one suffix on two kinds of base verb. In order to devise a comprehensive model for derivation, the next step is to broaden the scope of research to different kinds of bases (e.g. nouns or adjectives) and derivational processes (e.g. category-preserving derivation, which includes prefixation). This way, further constraints and properties of derivation can be identified, and it can be determined whether my findings for deverbal *-ment* nominalization conform to more general principles. I have made the case that, in this endeavor, it will be essential to make the semantics of the respective base explicit. While studies following this approach do exist (see e.g. Zinova 2016, investigating Russian prefixation), more research is needed to be able to identify both language-specific and – possibly – universal principles in the interaction of base and affix.

In addition, my corpus-based, frame-semantic approach should be supplemented with other methods in order to validate my findings and to refine my proposed frame representations. Specifically, I suggest to use computational tools and experimental methods to tackle some issues which have remained unresolved in this thesis.

First, my frames and the predictions they yield should be further tested by implementing them computationally. A framework which has already been successfully applied to do this for English nominal *-al* is eXtensible MetaGrammar (XMG, Crabbé et al. 2013; see Andreou & Petitjean in press). This implementation has shown that, by introducing type constraints (such as my animacy constraint) into the frame architecture, those readings which are possible for a given combination of base and affix can indeed be predicted and generated.

Second, I propose to add probabilistic elements to the frame representations in order to achieve a more fine-grained model. In this thesis, I have predicted nominalization readings based on the presence or absence of frame attributes, governed by constraints. Here, more detailed predictions could be achieved by including probabilistic information about the base, for instance based on co-occurrence frequencies of the base verb with its participants (as sketched for the prediction of INSTRUMENT versus CAUSER readings in COS nouns in section 4.2.4.1). In this vein, frames could also be combined with analogical models (AM, e.g. Skousen & Stanford 2007). In an AM approach, a computational algorithm uses a lexicon of stored forms and properties to predict an item's probability for a given property. The main challenge here would be to devise a detailed but constrained set of cogent input properties, especially since AM has only rarely been applied in the field of semantics.

Third, including probabilistic information can be beneficial also with regard to the assessment of possible readings. In this thesis, I have assessed the range of possible nominalization readings based on the availability or non-availability of attestations. In other words, I distinguished only between possible and (presumably) impossible readings, without considering the proportions between readings. A quantitative analysis of randomly sampled corpus data would not only offer a more realistic representation of the available data, but the identified proportions could also be compared to the AM results, testing the model's predictive power. On the other hand, very infrequent readings may easily be missed in a random sampling approach, as opposed to the purposeful sampling approach applied here.

The fourth issue is also related to the predictive power of the base frames: My initial categorization of the base verbs, based on the semantic-syntactic approach in VerbNet, did not capture all semantic distinctions that turned out to be relevant for nominalization semantics. The accuracy of base verb categorization could be improved with Distributional Semantics Models (DSM, e.g. Boleda 2019; Marelli & Baroni 2015). In a DSM approach, context is used to model a vector for a word's meaning. According to the *distributional hypothesis*, semantically similar words are thought to occur in similar contexts (e.g. words with eventive readings occurring with temporal modifiers such as *continuous*). Similar words will thus have vectors that are close together in the vector space. DSM could thus be used to group the base verbs semantically. Here, an advantage would be that the researcher does not have to devise a set of properties; rather, the semantic similarity of the words would be computed automatically. However, determining the actual semantic properties

of the resulting groups of words is an intricate and laborious task involving both the manual inspection of contexts (see e.g. Lapesa et al. 2018) and/or quantitative approaches (see e.g. Wauquier 2020).

The final issue I want to mention is related to my finding that the context plays a critical role in derivational semantics, being responsible for the final disambiguation of readings. The question arises how the disambiguation of polysemy can be distinguished from coercion, that is, context-induced, post-lexical meaning shifts. In my two studies, I used introspection and consulted with my fellow annotators. In future research, this approach may be complemented by using experimental methods (as suggested by Löbner 2008, 195-6). For example, based on fMRI or reaction time experiments, it has been reported that coerced readings require more cognitive effort (see e.g. Lai et al. 2017). The crux for such an investigation of my data set, however, would be to distinguish the processing cost of coercion from the high cognitive load that comes with processing neologisms.

To conclude, the present thesis shows that the semantics of derivation can be successfully modeled by using a decompositional frame-semantic approach. It is also clear, however, that my two studies have merely scratched the surface of what is possible and desired, and that further research is needed to devise a comprehensive model of derivational semantics.

Appendix:
Data set of *-ment* nouns by source

TABLE A1: Final data set of *-ment* derivatives by source. Subscript numbers indicate variants of polysemous base verbs

Source	COS nouns (n=18)	Psych nouns (n=23)
OED (n=7)	*embrittlement* *upliftment*$_1$	*bemusement* *perturbment* *soothment* *staggerment* *upliftment*$_2$
Coquery (n=25)	*abridgement* *congealment* *diminishment* *disbandment* *discolorment* *dispersement* *increasement* *progressment* *unfoldment* *worsenment*	*abashment* *annoyment* *approvement* *confoundment* *convincement* *disheartenment* *dumbfoundment* *enragement* *enrapturement* *musement* *nonplusment* *reassurement* *upsetment* *worriment*$_1$ *worriment*$_2$
BYU (n=9)	*bedragglement* *befoulment* *besmirchment* *debauchment* *decenterment* *embetterment*	*affrightment* *bumfuzzlement* *endullment*

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Ich erkläre hiermit, dass ich die vorliegende Arbeit selbständig und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt und die aus fremden Quellen direkt oder indirekt übernommenen Gedanken als solche kenntlich gemacht habe und dass die Arbeit bisher in gleicher oder ähnlicher Form keiner Prüfungsbehörde vorgelegt und auch noch nicht veröffentlicht wurde. Bereits veröffentlichte Teile sind in der Arbeit gekennzeichnet.

Hilden, den 27. Februar 2021

Unterschrift

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Hilden, den 27. Februar 2021