# Why aktionsart-based event structure templates are not enough – A frame account of leaking and droning

Jens Fleischhauer, Thomas Gamerschlag & Wiebke Petersen
(Heinrich Heine University Düsseldorf)

**Abstract.** In the paper, we present a frame approach to emission verbs and demonstrate how this framework enables us to account for their different uses and the constructions they can occur in. The frame model we apply is based on Barsalou's ideas about frames as the fundamental structures of cognitive representation (Barsalou 1992). More precisely, frames are conceived as recursive attribute-value structures that allow one to zoom into conceptual structures to any desired degree and to access meaning components by attribute paths (cf. Petersen 2007/15). We argue that such a formal frame-based account of meaning is highly suited for capturing the way particular uses of emission verbs are constrained by the interaction of grammar and cognition. The focus of the analysis is on degree gradation of substance emission verbs such as in *sehr lecken* 'leak a lot' as well as sound emission verbs as in *sehr dröhnen* 'drone a lot'. We show that a proper treatment of both of these phenomena requires lexical decomposition that goes beyond the traditional event structural templates as applied by Rappaport Hovav & Levin (1998) among others.

**Keywords:** Emission verbs, verb gradation, frame analysis

## 1. Introduction: aktionsart and event structure templates

Starting, at least, with the seminal analysis of Vendler (1957), it has been recognized that verbs can be grouped into different aktionsart classes based on inherent temporal characteristics such as dynamicity, telicity and durativity. Dynamicity separates stative predicates from dynamic predicates which denote a 'happening' in the world. Telicity refers to the sub-classification of dynamic predicates into atelic and telic ones. Telic predicates entail that a specific endpoint is reached within the event denoted by the predicate, whereas atelic predicates do not.[1] Durativity, finally, distinguishes durative from punctual predicates. The eventuality denoted by a predicate can either happen instantaneously – in case of a punctual predicate – or be temporally extended (i.e., durative).

Dowty (1979) has proposed a sub-lexical representation of verb meaning which directly reflects aktionsart classification. This approach, well known under the notion of 'lexical decomposition', is at the heart of most current approaches to verb semantics.

[1] We refer the reader to Borik (2006) for a comparison of different theoretical explications of the notion of telicity.

Representations of this type, also called ‘event structure representations’, consist of structural and idiosyncratic meaning components. The structural meaning components represent the different aktionsart classes and are used for formulating ‘event structure templates’. A particular account on representing ‘event structure templates’ has been developed by Levin and Rappaport Hovav (e.g. Levin & Rappaport Hovav 1995, 2005, Rappaport Hovav & Levin 1998). In (1), the event structure templates applied by Levin & Rappaport Hovav (2005) are shown. Structural meaning components are written in bold face, the idiosyncratic meaning components are written in angled brackets. ACT, BECOME and CAUSE are predicates used to define aktionsart classes. The predicate ACT represents activity predicates which are dynamic and atelic while BECOME indicates change of state predications, which are often but not necessarily telic. So-called ‘degree achievement predicates’ – a notion going back to Dowty (1979) – show variable telicity, with some of them (e.g. *to grow*) being only atelic, cf. (1). Durativity is not reflected in the event structure templates, thus the contrast between punctual and durative changes is neglected. Instead causation – represented by CAUSE – is taken up as a defining event structural property. We ignore this aspect for the current discussion but see Van Valin (2005:38) for an argumentation against treating causation as a property relevant for aktionsart classification and Croft (1991) for an approach to verb classification essentially based on the notion of ‘causal chains’.

(1)
a. State predicate [x ⟨State⟩]
b. Activity predicate [x **ACT**⟨Manner⟩]
c. Achievement predicate [**BECOME** [x ⟨RESULT⟩]]
d. Accomplishment predicate [x **CAUSE** [**BECOME** [y ⟨RESULT⟩]]]

The structural components are class-building predicates, which means – for example – that every activity predicate has the event structure shown in (1b). Although *hit* and *kiss* are both activity predicates and therefore show the same event structural representation, they differ with respect to the idiosyncratic meaning component as shown in (2). The idiosyncratic meaning component is called ‘root’ by Rappaport Hovav & Levin (1998). The root acts as a (manner) modifier in case of activity predicates – modifying the ACT predicate – but serves as an argument of the BECOME predicate.

(2)
a. *hit:* [x **ACT**⟨hit⟩ y]
b. *kiss:* [x **ACT**⟨kiss⟩ y]

The aim of decompositional approaches is to represent “components of meaning that recur across significant sets of verbs” (Levin & Rappaport Hovav 2005:69). An intention is capturing those meaning components which are grammatically relevant for classes of verbs. An aktionsart-based decompositional representation accounts for combinatory restrictions of time adverbials but also for argument linking (e.g. Van Valin 2005). Certain aspects of grammatical behavior depend on the structural meaning components of event structure templates. The root, on the other hand, “is […] opaque to grammar” (Rappaport Hovav & Levin 1998:254). This means that grammatical differences should not depend on the root element.

In the remainder of the paper, we will present a case study of gradation of emission verbs which shows that there are phenomena not sufficiently captured by classical template representations. In section 3, we focus on templatic accounts since there exists some previous work (e.g. Tsujimura 2001) dealing with degree modification within such a type of approach. As an alternative to such an account, we present a sketch of how verb gradation can be dealt with by a frame account. Given the space confinements of the paper, we concentrate on a single phenomenon and will not discuss other aspects of emission verbs which call for a frame approach such as the extended use as verbs of directed motion (see Fleischhauer et al. 2017 for a frame account of this use).

## 2. Emission verbs and the limits of event structure

For illustrating the limits of approaches relying on aktionsart-based event structure templates, we focus on a single class of verbs (verbs of emission) and show that grammatical differences within this semantic class of verbs are caused by the respective root element. Verbs of emission are basically intransitive verbs denoting the emission of a stimulus like smell, sound, light or substance. Depending on the type of stimulus, four subclasses of emission verbs are distinguished (Levin 1993: 233ff.):[2]

(3) a. Verbs of smell emission: *smell, stink*
b. Verbs of light emission: *light, shine, glitter, sparkle*
c. Verbs of sound emission: *drone, bark, clapper*
d. Verbs of substance emission: *leak, bleed, fester*

Rappaport Hovav & Levin (2000:283) state that "verbs of emission fall along a continuum of stativity, with verbs of smell emission being the most stative, verbs of light emission slightly less stative, followed by verbs of sound emission and substance emission, which are the most process-like." Under this analysis, verbs of sound emission and verbs of substance emission receive the same event structural representation, as indicated for the examples in (4).

(4) a. *drone:* [x **ACT**⟨drone⟩ y]
b. *leak:* [x **ACT**⟨leak⟩ y]

Verbs of emission typically allow for verb gradation in English, German and other languages like Japanese (Tsujimura 2001). Gradation in general is the linguistic process of comparing two (or possibly more) degrees (Fleischhauer 2016a:16). Prototypically, gradation is associated with adjectives and degree constructions such as the comparative or superlative construction. In the comparative construction in (5), Peter's degree of height is compared to the one of his brother and it is expressed that Peter exceeds his brother on the height scale.

[2] There exists a bunch of literature (e.g. Perlmutter 1978, Gerling & Orthen 1979, Atkins et al. 1988, Atkins & Levin 1991, Levin 1991, Potashnik 2012) discussing various aspects of verbs of emission – e.g. argument realization patterns of verbs of sound emission – which are not relevant for the current discussion. The reader is referred to the mentioned literature.

(5) *Peter is taller than his brother.*

Scales figure crucially in the analysis of gradable expressions. A scale is conceived as a linearly ordered set of degrees in a certain measurement dimension (Kennedy 1999a, Kennedy & McNally 2005). A gradable adjective like *tall* is then analyzed as a measure function mapping the referent of its argument on a height scale (e.g. Kennedy 1999b, 2007).

Verb gradation turns out to be a bit more complex than gradation in the adjectival domain. The reason is that verb gradation comes in two subtypes, called 'extent' and 'degree gradation' (Bolinger 1972, Löbner 2012, Fleischhauer 2016a). (6a) is an example of 'extent gradation', the degree expression *viel* 'much' specifies the frequency of leaking events. A suitable paraphrase for (6a) is 'the pipe leaked often'. Extent gradation either consists in such a frequentative reading or in a specification of an event's temporal duration. An example of degree gradation is shown in (6b). *Sehr* 'very' specifies the quantity of the emitted liquid and the example can be paraphrased as 'the pipe emitted a large quantity of liquid'.[3]

(6) a. *Das Rohr leckte viel.*
the pipe leaked much
'The pipe leaked a lot.'
b. *Das Rohr leckte sehr.*
the pipe leaked very
'The pipe leaked a lot.'

Extent gradation is largely regular and results in the same interpretation for all dynamic predicates (see Doetjes 1997, 2007 on this issue). By contrast, the interpretational patterns of verbal degree gradation depend on the semantic class of the verb (Löbner 2012, Fleischhauer 2016a). This can easily be seen by comparing (6b) – a graded verb of substance emission – with (7): *sehr* specifies the quantity of emitted substance in (6b) but the loudness of the emitted sound in (7).

(7) *Der Motor dröhnt sehr.* [verb of substance emission]
the engine drones very
'The engine is droning a lot.'

The verbal root is relevant for determining the interpretation of verbal degree gradation. Moreover, a second interpretational contrast depends on the root element. The perfect construction in (8a) licenses a perfective interpretation (see Löbner 2002 on the aspectual interpretation of the German perfect construction). To emphasize the perfective interpretation, we provide a context which requires a sequential interpretation of the two events. The first event – the leaking of the pipe – has to be finished before the

[3] Whereas German uses different degree expressions for extent and degree gradation, English applies the same expression for both. See Doetjes (2008) and Fleischhauer (2016a, 2016b) for the cross-categorical distribution of degree expressions and also for a cross-linguistic comparison.

second event starts. Outside of such a context, the German perfect also allows for an imperfective reading, in which case (8a) is interpreted like (8b). In the perfective interpretation of (8a), *sehr* specifies the total quantity of liquid emitted in the event. The sentence can be paraphrased as 'The pipe emitted a large amount of water'. (8b) is an instance of the periphrastic *am*-progressive (e.g. Andersson 1989, Ebert 2000).[4] The progressive construction focusses on a stage of the event and *sehr* specifies the quantity of liquid emitted at that event stage. The progressive sentence requires a different paraphrase than the perfective one because 'The pipe emitted a large amount of water' does not paraphrase its meaning. A suitable paraphrase for (8b) is 'The pipe was leaking heavily/badly'.

(8) a. *Bevor der Klempner das Rohr reparierte, hat es*
before the plumber the pipe repaired has it
*sehr geleckt*
very leaked
'Before the plumber repaired it, the pipe leaked a lot.'

b. *Das Rohr war sehr am Lecken.*
the pipe was very at.the leaking
'The pipe was leaking a lot.'

The interpretations of the two sentences in (8) are clearly related, nevertheless the sentences do not necessarily entail each other. If a lot of liquid has been emitted in a single event, it does not necessarily follow that at any single stage of the event, a large quantity of liquid has been emitted. Rather, a pipe can be slightly leaking, but the overall quantity of emitted liquid can sum up as large. On the other hand, if a lot of liquid has been emitted at a single stage of the event, this does not necessarily result in a large quantity at the event's end. The pipe can be leaking for a while, only emitting a single drop but at one stage of the event, it emits a larger amount of water for a very short while. Thus, in the overall event the quantity of liquid emitted by the pipe may still count as 'small'.

Similar examples are found in other languages as well. In (9), a perfective use of the verb *saigner* 'to bleed' is contrasted with a progressive one. The periphrastic *passé composé* used in (9a) receives a perfective reading, the sentence is interpreted as 'The subject referent emitted a large quantity of blood'. The interpretation of the periphrastic progressive construction (9b) is – like in German – that a large quantity of blood is emitted at a certain stage of the event. It is nothing said about the quantity of blood emitted prior or later to that stage.

(9) a. *Il a beaucoup saigné.*
he has a lot bled
'He bled a lot.'

[4] Various varieties of German make use of a periphrastic construction for the expression of progressive aspect. As the construction is still on its way of getting grammaticalized, native speakers vary with respect to its acceptability.

b. *Il est en train de saigner beaucoup.*
he is PROG bleed.INF a lot
'He is bleeding a lot.' (Fleischhauer 2016b: 228)

As the German and French data show, the interpretation of degree gradation is dependent on grammatical aspect. The reason why aspect can affect the interpretation of degree gradation is that degree gradation of verbs of substance emission is event-dependent (Fleischhauer 2013, 2016a). The quantity of the emitted substance increases, as long as the event progresses. The interpretational difference between the perfective and the imperfective aspect results from the fact that the perfective aspect denotes complete events (e.g. Comrie 1976), whereas the progressive aspect does not but restricts denotations to a proper (not initial and not final) part of the event.

Verbs of sound emission represent event-independent degree gradation. This is illustrated by the examples in (10). The perfect construction in (10a) again licenses a perfective interpretation. *Sehr*, as already discussed above, specifies the loudness of the emitted sound. The degree of loudness is indicated as being 'high'. The progressive construction in (10b) results in the same interpretation: the emitted sound is very loud. Both sentences receive the same interpretation, irrespective of grammatical aspect.

(10) a. *Der Motor hat sehr gedröhnt.*
the engine has very droned
'The engine droned a lot.'
b. *Der Motor war sehr am Dröhnen.*
the engine was very at.the droning
'The engine was droning a lot.'

The crucial difference between verbs of substance emission and verbs of sound emission is that the quantity of substance emitted in the event increases when the event unfolds. The loudness of the sound emitted in the event does not (necessarily) increase if the event progresses. Thus, there is a homomorphic relationship between the progression of the event and the quantity of substance emitted, while there is no such relationship between the event's progression and the loudness of the emitted sound.

Accounting for the contrast between event-dependent and event-independent degree gradation within the class of emission verbs requires lexical decomposition of the root element since the gradation scales are differently related to the emission process. In the next section, we present a further need for deeper lexical decomposition – meaning decomposition beyond event templates – based on a distinction between lexically scalar and lexically non-scalar verbs.

## 3. Lexically scalar verbs

One particular question with respect to verbal degree gradation is: Which verbs license a particular modifier like German *sehr* or English (*very*) *much; a lot*. The question has not been discussed in much detail in the previous literature, two notable exceptions are a paper by Tenny (2000) and one by Tsujimura (2001). Tenny (2000) argues that measure adverbs like *completely* and *partly* only combine with verbs having a core event in

their event structural representation. She associates core events – also called inner events – with the expression of changes and the attainment of a final result state. Thus, only verbs having a BECOME predicate in their event structural representation have a core event. Verbs having a core events also have a scale – which Tenny calls measure or path – as part of their lexical meaning. Tenny (2000: 296) states that in such cases the final state of the core event is a gradable predicate, which admits degree modification.

In her analysis, Tenny makes a statement about the use of degree expressions like *completely*. Tenny states that such adverbs combine with verbs having a core event, which are change of state verbs (e.g. *break*), verbs of directed motion (e.g. *run to NP*) and incremental theme verbs (e.g. *eat*). Ernst (2002) – building on Tenny's analysis – adds degree adverbs like (*very*) *much* to the expressions which require a core event in the event structural representation of the verb they modify.

In the last section, we already saw examples of graded verbs of sound/substance emission. These verbs neither qualify as result verbs – see below – nor as verbs having a core event (they do not express a change of state). It can also easily be shown that (*very*) *much* modifies verbs which neither qualify as result verbs nor verbs having a core event. One particular example at hand is the verb *to love* in (11). (For a more detailed criticism of Tenny's analysis see Fleischhauer 2016a: 93ff.).

(11) *The boy hates his teacher very much.*

Tsujimura (2001) provides an analysis of Japanese gradable verbs within a templatic approach. She aims at showing that a deep connection between a verb's event structure and the licensing of the degree modifier *totemo* 'very' exists. She basically states (p. 47) that a verb admits degree modification by *totemo* if: (i) the verb has a state component in its event structural representation, (ii) the state component refers to a gradable property, and (iii) the gradable property must have a nontrivial standard (i.e., non-maximal/minimal degree).[5] One predication of this analysis is that verbs, which do not have a state component in their event structure representation, do not license *totemo*. Contrary to fact, however, activity predicates license *totemo*, as the example in (12) shows.

(12) *Taroo-wa totemo waratta.*
Taro-TOP very laughed
'Taro laughed very much.' (Fleischhauer 2016a: 100)

The same is true for German and English as verbs of substance emission are clearly activity predicates. This is seen for English by the fact that – in difference to stative verbs – verbs like *to bleed* and *to drone* receive a habitual interpretation if used in the simple present.

In the limited number of studies devoted to degree modification of verbs, gradability has usually been related to event structural properties. But, as the discussion above has shown, gradability is independent from a verb's event structure. Nevertheless, we like taking up the previous studies relating event structure and scalarity as they show, in our

[5] The notion of a 'trivial/non-trivial standard' goes back to Kennedy & McNally (1999). A trivial standard defaults with an endpoint of a scale, whereas a nontrivial standard does not.

view, one crucial difference between two classes of gradable verbs. We follow Rappaport Hovav & Levin's (2010) analysis of results verbs as denoting scalar changes. The authors basically argue that verbs like *to break* and *to crack* express a directed change within a single scalar dimension. Stating the truth conditions of such verbs always requires a comparison of degrees. The clearest instances are degree achievement predicates such as *to widen, to darken* and *to lengthen*. To evaluate whether the sentence in (13) is true, one has to compare the crack's width at the beginning of the event and its width at the event's end. Only if the crack's width increased, the sentence in (13) can be true.

(13) *The crack widened.*

In the analysis of Rappaport Hovav & Levin (2010), manner verbs do not denote a directed change along a single scalar dimension but can either denote undirected changes or changes in multiple dimensions.[6] Manner verbs, as for example the sound emission verb *drone*, do not require the comparison of (at least) two degrees to evaluate whether a sentence like the one in (14) is true. The sentence in (14) neither means 'the engine droned more than some other mechanical device/the engine droned more than usual' nor 'the engine droned with a specific loudness'.

(14) *The engine droned.*

The same holds for the substance emission verb *to leak*. *The pipe leaked* does not mean 'the pipe leaked more than something else/than it did at some other occasion' and it also does not mean 'the pipe emitted a specific quantity of liquid'. The meaning of *leak* is simply that some unspecified amount of liquid is emitted out of a container. Stating the truth conditions of the predicate does not require a comparison of degrees and it is not obvious what would be compared. However, *leak* requires that at least some liquid is emitted and *drone* requires that the emitted sound exceeds some volume, otherwise the predicates could not truthfully apply. But this only means that there is some quantity of emitted liquid, resp. some loudness of the emitted sound. But it does not follow that the verbs make a predication about the quantity degree, resp. loudness degree. The quantity degree/loudness degree is only relevant within a degree context. Thus, only a construction like *to drone a lot* requires a comparison of degrees – the actual loudness degree has to exceed the standard of comparison introduced by the degree expression – but not the ungraded verb *to drone*.

To capture the intuitive difference between verbs like *to widen* on the one hand and verbs like *to leak* and *to drone* on the other hand, Fleischhauer (2015, 2016a, 2018) introduces the notion of a 'lexically scalar predicate', which is defined as in (15). The crucial notion of the definition of lexically scalar predicate is 'scalar predication'.

[6] Manner/result complementarity, as explicated by Rappaport Hovav & Levin (2010), only applies to dynamic predicates since the discussion crucially relies on the notion of 'change'.

(15) (a) Scalar predication: A predication is taken to be scalar iff it expresses a comparison of degrees on a scale.
(b) Lexically scalar predicate: A predicate is lexically scalar iff it expresses a scalar predication in every context of use.
(Fleischhauer 2015:58; 2016a:174, 2018: 240)

Given the definition in (15), gradable adjectives qualify as scalar. An adjective such as *tall* compares the degree of the referent of its individual argument with a comparison degree. *The boy is tall* can mean something like 'the boy is tall for a boy of his age/for a basketball player' (e.g. Kennedy 1999b). Result verbs, in the sense of Rappaport Hovav & Levin, also qualify as lexically scalar. This is obvious for degree achievement predicates as explicating the truth conditions of a verb like *to widen* requires comparing degrees.

Adopting the view that emission verbs are lexically non-scalar results in the need to explain where the gradation scale comes from. It is implausible to assume that the scale is introduced by the degree expression. As discussed in the last section, *sehr* – and similarly *a lot* in English – applies to different scales, e.g. quantity scales (verbs of substance emission), loudness scales (verbs of sound emission) and further scales in the context of other gradable verbs (e.g. intensity scales in the context of psych verbs like *to hate* and *to frighten*). The degree expression requires a gradation scale which is somehow contributed by the graded predicate and that is activated in a degree context.

A principle account of the activation of gradation scales in lexically non-scalar verbs is required which needs to answer the following questions:

(i) How are gradation scales licensed?

What licenses the activation of a quantity scale in verbs of substance emission and the activation of a loudness scale in verbs of sound emission? In both cases, the scale represents a property of the emittee, which is an implicit event participant (Goldberg 2005: 20f. speaks of an implicit theme argument). As we are dealing with properties of implicit event participants, the implicit argument has to be part of the semantic representation too.

(ii) How are gradation scales constrained?

Why does degree gradation of verbs of substance emission exactly apply to the quantity scale of the emittee argument and not to a different scale? Irrespective of the type of emitted substance, it is always only the quantity scale the degree expression applies too. The examples in (16) exemplify different types of emitted substances – *hair* (a), *fester* (b), *dust* (c) – which does not affect degree gradation (e.g., it is not the case that 'sehr' specifies that the lost hair in (16a) is very long).

(16) a. *Die Katze hat sehr gehaart.*
The cat has very lost.hair
'The cat lost a lot of hair.'

b. *Die Wunde hat sehr geeitert.*
The wound has very festered
'The wound festered a lot.'

c. *Die Bücher haben sehr gestaubt.*
The books have very raised.dust
'The books raised a lot of dust.'

An answer to the second question also requires answering why degree gradation singles out a unique scale within a certain semantic class (e.g. always loudness in case of verbs of sound emission) but different scales for different semantic verb classes (e.g. a loudness scale in the case of sound emission verbs but a quantity scale in the case of substance emission verbs). We are not addressing this question in the current paper but see Fleischhauer (2015, 2016a) for a discussion of this question.

## 4. Frame analysis

### 4.1 Dynamic frames

In the previous sections it has turned out that traditional aktionsart-based event structural approaches are not fine-grained enough in order to account for the different distributional patterns and interpretational restrictions coming with the semantic class of emission verbs. The examples we have discussed show that the following information must be part of a semantic representation of emission verbs:

1. The relations between an event and the objects participating in it, which may be either explicitly stated (e.g., *the pipe* in *the pipe leaks*) or not (e.g., *the liquid* in *the pipe leaks*), must be represented.

2. The internal structures of the objects involved in an event must be represented by specifying their properties and mereological structures (e.g., it is the engine of a motorbike that drones and that means that the sound emitted by the engine is of a specific quality).

3. Events may change some properties of objects involved in the event (e.g., the quantity of the emitted liquid in *the pipe leaks*). Thus, a semantic representation has to capture the temporal evolution of the event and the changing of object properties in order to account for the aspectual and entailment restrictions described in the previous sections.

To account for these requirements and to overcome the coarse-graininess of aktionsart-based event templates, we will use a dynamic frame approach instead. Static frames are recursive attribute-value structures in which attributes act as functions that assign unique values to entities. Naumann (2013) points out that simple attribute-value structures are static descriptions that are not sufficient to represent the dynamic nature of events. Therefore, Naumann (2013) develops a dynamic theory of frames that provides

the desired representational levels needed to capture the dynamic evolution of an event. An illustration of his account is given in the following figure representing the example *The boy has grown 5 cm*.

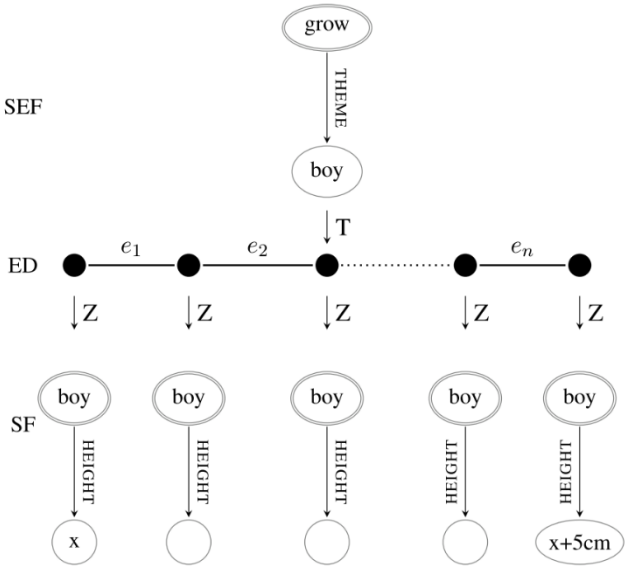


Figure 1: dynamic frame for 'The boy has grown 5cm'

The relations between event participants (here *the boy*) and the event (here *grow*) are captured in a 'static event frame' (SEF, top of the figure).[7] In such a SEF the objects undergoing a change are represented as atoms that are statically linked to the event node. On this level it is not possible to specify the properties of the objects as they are not static but undergo a change. That is why objects at the level of SEFs are atoms. The properties of the objects are represented at the level of 'situational frames' (SFs, bottom of the figure), which are originally termed 'temporalized SEFs' (t-SEFs) in Naumann (2013). At this level, the object representations are temporalized, that is participating objects like motorbikes, boys, engines or liquids are at any time point described by the properties that hold for the object. The properties and relations to other objects are represented by a static attribute-value structure. The SEF- and the SF-level are connected by the 'event decomposition level' (ED, middle of the figure) which represents the temporal evolution of the event and that links the temporalized representations of the objects participating in the event to the stages of the event. On the event decomposition

[7] In the frame graphs, we mark the central node of a frame that specifies what the frame is about by a double line. For a graph-based definition of static frames see Petersen (2007/15).

level, the event is decomposed into a temporal sequence of subevents. From the boundaries of the subevents one can zoom into the object representations at the SF-level. The formal details of the temporalization and the zooming relation are given in Naumann (2013). Often it is not necessary to temporally decompose an event into more than one subevent in order to grasp its main properties. However, sometimes it is not sufficient to only represent the changed values at the beginning and the end of the full event and it is necessary to represent the value changes while the event evolves; this can be captured by a decomposition into subevents.

An alternative way of capturing the changing of a value while an event evolves has been proposed by Gamerschlag et. al. (2014) who combine Naumann's account on dynamic frames with the path semantics approach of Zwarts (2005). The key idea is that the values of the attributes that change while the event progresses leave a trace path in the value space. The following figure shows again the frame for 'The boy has grown 5cm' but this time, the change of the value of the attribute HEIGHT is represented as a path in the height space:

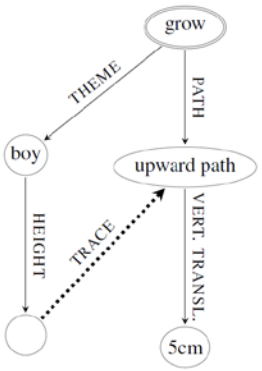


Figure 2: condensed dynamic frame for 'The boy has grown 5cm'

The trace path of the HEIGHT value has to be a path that is continuously going upwards and for which the vertical distance between its initial and end point is 5cm. Such frames are termed 'condensed dynamic frames'. Note that the formation of the trace path in the course of the event is technically captured by the 'dynamic attribute' TRACE. This special type of attribute, which is indicated by a broken line, is projected into this frame from the event decomposition frame in the preceding figure. The function of the TRACE-attribute is to map the changing values of the HEIGHT-attribute to the record of its trace in the time span of the event. Thus the value of the TRACE attribute is a path object with start and end point that is 1-dimensional and corresponds to an interval of the height scale. As usual we think of 1-dimensional scales as being vertically oriented. An increasing value thus leaves an upward trace path on such a scale (see Figure 2). The uncondensed dynamic frame in Figure 1 and the condensed one in Figure 2 are directly translatable into each other. The trace path captures the change of the object properties at the 'situational frames' level in the uncondensed dynamic frame. The two dynamic frame versions differ in the perspective they take on the represented event: While the

uncondensed frame emphasizes the different status of the relations involved in an event by capturing them at different levels (static relations versus dynamic relations), the condensed frame represents the change itself as a single object (namely a path object) and thereby enables one to express direct properties of this change.

### 4.2 Verbal degree gradation and dynamic frames

In Section 2 we have seen that while the interpretation of extent gradation is largely regular, the interpretational patterns of verbal degree gradation depend on the semantic class of the verb. In the following we will analyze verbal degree gradation with *sehr* in our dynamic frame model. Before we focus on the verbs of emission in the examples given in (6b) and (7) in Section 2, we illustrate our approach with *grow* as an example of a typical gradable change of state verb. In *Der Junge ist sehr gewachsen* 'The boy has grown a lot', the change of state verb *wachsen* 'grow' refers to a change in height. The degree expression *sehr* expresses that the height of the referent of the subject argument is not only greater than before but that it is much greater. In general, the degree expression *sehr* always operates on a scale. The scale is either a value scale or a degree of change scale. Modification by *sehr* is only licensed if a threshold value is exceeded. This threshold value is first and for all dependent on the modified verb and it is further contextually restricted by the arguments of the verb and the time span of the event. For example, a boy growing 5 cm in a month can be described as *Der Junge ist sehr gewachsen* 'The boy has grown a lot' while a water melon growing 5 cm in half a year cannot. This contrast is well-known in the literature on comparison and usually analyzed by making reference to some contextually specified comparison class (cf. Kennedy & McNally 2005 among others). We denote the contextually given threshold value for *sehr*-gradation of *wachsen* 'grow' by $\Delta_{c,t}^{\text{sehr}}(\text{grow})$. Figure 3 shows the uncondensed and condensed dynamic frames of *Der Junge ist sehr gewachsen*.

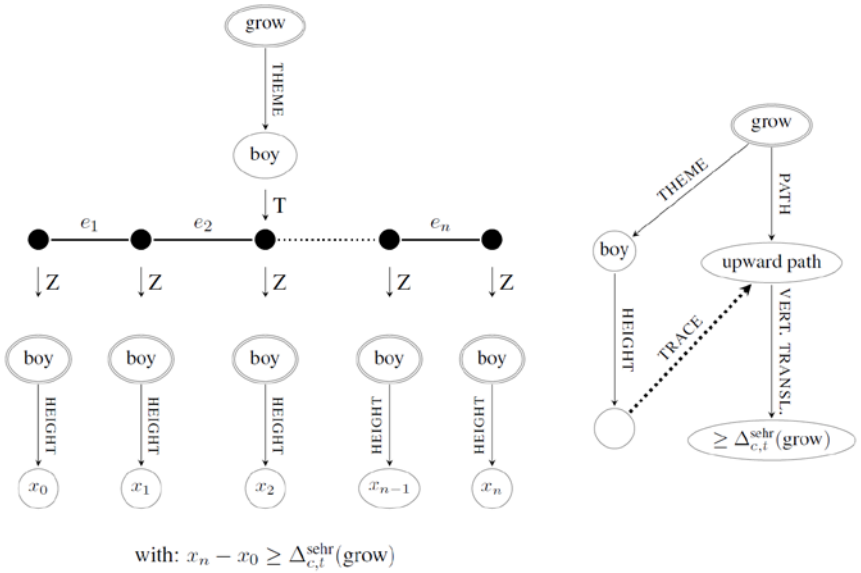


Figure 3: uncondensed and condensed dynamic frame for *Der Junge ist sehr gewachsen* 'The boy has grown a lot'

The only difference between these frames and the ones for 'grown 5 cm' in Figure 1 and 2 is the way how the amount of growth is specified. In the 'grown 5 cm' example the amount is fixed, while in the graded example it is restricted by the contextually given lower limit $\Delta_{c,t}^{\text{sehr}}$ (grow). In the uncondensed frame in Figure 3 this is depicted by the additional constraint that the difference between the height at the beginning of the event and at the end of the event has to be at least $\Delta_{c,t}^{\text{sehr}}$ (grow) ($x_n$-$x_0 \geq \Delta_{c,t}^{\text{sehr}}$ (grow)).

Next, we turn to verb gradation of verbs of sound emission. Although the example in (7), *Der Motor dröhnt sehr* ('The engine is droning a lot'), involves a threshold value as well, the example differs fundamentally from the *grow*-example. The degree expression *sehr* is licensed for a growing event only if the HEIGHT values at the beginning and at the end differ by at least the given threshold value. Thus, it addresses the vertical translation of the full trace path of the HEIGHT value and not the HEIGHT value as such. In contrast, in a droning event *sehr* is licensed if the loudness of the droning sound is at least of the degree of a given threshold value. Hence, *sehr* is not determining the minimal difference between two values but setting an absolute minimal value. Therefore, the trace path of the loudness value is of no interest and it is sufficient to model the expression as a static event frame.

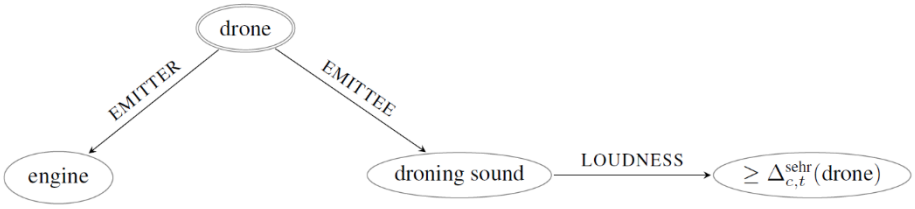


Figure 4: static event frame for *Der Motor dröhnt sehr* 'The engine is droning a lot'

By contrast, with verbs of substance emission such as *leak*, the degree expression *sehr* targets the quantity of the substance which is emitted in the course of the event and thus specifies an amount of change (how much more liquid has been emitted at the end of the event than at its beginning). Thus, an example such as *Das Rohr hat sehr geleckt* 'The pipe has leaked a lot', is analyzed in parallel to verb gradation of *wachsen*/*grow*: *sehr* is licensed if the vertical translation of the trace path of the quantity value of the emitted substance is at least as big as the given threshold value (see Figure 5).

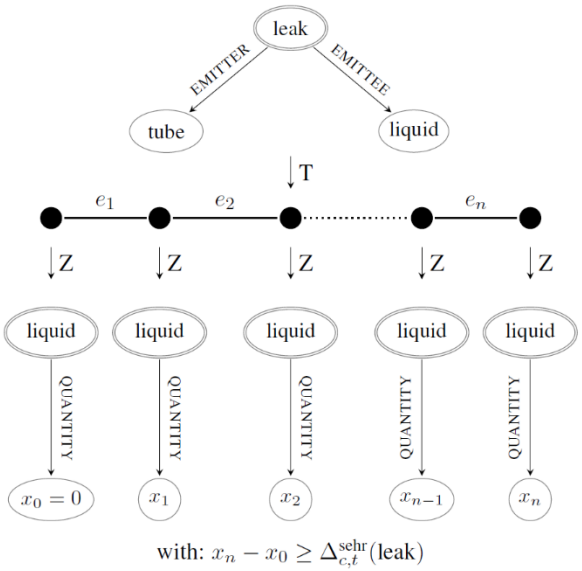


Figure 5: dynamic frame for *Das Rohr hat sehr geleckt* 'The pipe has leaked a lot'

The contrast between event-dependent and event-independent degree gradation as described in Section 2 shows up immediately in the frames for *sehr dröhnen* (Figure 4) and *sehr lecken* (Figure 5). While the *sehr dröhnen*-frame does not refer to any global property of the trace path as such, the *sehr lecken*-frame specifies a minimal vertical

translation of the full trace path. Remember that the minimal threshold value is among others contextually determined by the time span of an event. In a perfective interpretation of (8a) the time span of the described event is the entire leaking event. In contrast, the *am*-progressive construction in (8b), *Das Rohr war sehr am lecken* 'The pipe was leaking a lot', picks out a single stage of the event. Thus, the minimal amount of liquid that has to be emitted in (8a) in order to license the construction is bigger than the one that licenses the construction in (8b). The frame for the *am*-progressive is given in Figure 6.

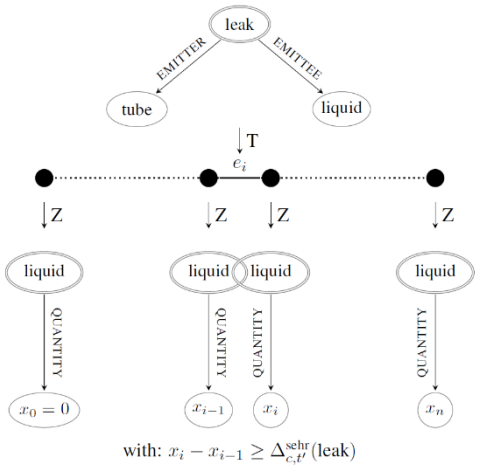


Figure 6: dynamic frame for *Das Rohr war sehr am lecken*
'The pipe was leaking a lot'

The frames in Figure 5 and Figure 6 show that for *sehr lecken* the perfect construction in (8a) and the *am*-progressive in (8b) do not entail each other. The threshold value $\Delta_{c,t}^{\text{sehr}}(\text{leak})$ in Figure 5 differs from $\Delta_{c,t'}^{\text{sehr}}(\text{leak})$ in Figure 6 as the considered time span $t'$ in the *am*-progressive case is shorter than the considered time span $t$ in the perfect case. It is possible to reach the threshold value $\Delta_{c,t}^{\text{sehr}}(\text{leak})$ for the whole leaking event, without reaching $\Delta_{c,t'}^{\text{sehr}}(\text{leak})$ in any single subevent. At the same time, reaching the threshold value $\Delta_{c,t'}^{\text{sehr}}(\text{leak})$ in one subevent does not entail that $\Delta_{c,t}^{\text{sehr}}(\text{leak})$ is reached for the whole leaking event. In contrast, in the case of *sehr dröhnen*, the vertical translation of the trace path is not restricted and thus the threshold value is not time dependent. Hence, both, the perfect and the progressive of *sehr dröhnen* can be represented by the frame in Figure 4. It follows that both propositions necessarily entail each other. By means of the event decomposition level, a dynamic frame analysis is able to account for the contrast between event-dependent and event-independent degree gradation.

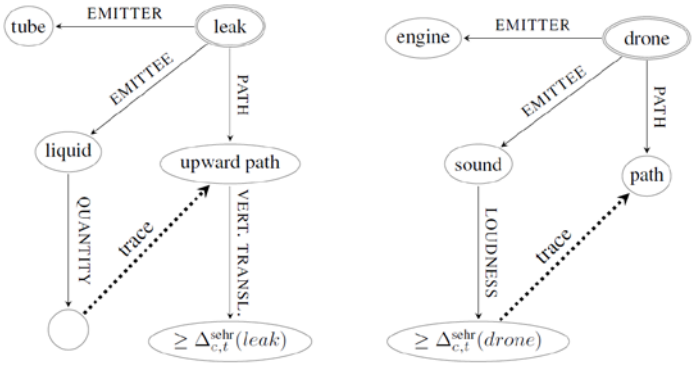


Figure 7: condensed dynamic frames for 'The pipe leaked a lot' (left) and 'The engine droned a lot'

Finally, Figure 7 shows the condensed dynamic frames for *the pipe leaked a lot* and *the engine droned a lot*. In the condensed frames, the difference between event dependent and event independent degree gradation is expressed by whether the threshold value introduced by the intensifier *sehr* restricts the spread of the trace path or not. In the case of an event dependent gradation (e.g. *the pipe leaked a lot*) the contextually given threshold value restricts the trace path by specifying its minimal vertical translation, while in the event independent case (e.g. *the engine droned a lot*) the spatial dimensions of the trace path are not restricted.

## 5. Conclusion

The way in which *sehr*-gradation targets a particular attribute and its scale in the frame of verbs belonging to specific lexical classes can be summarized as follows:

- *wachsen* 'grow' (change of state verbs): in a *wachsen*-event the HEIGHT value increases in the course of the event. The degree expression *sehr* intensifies this value change. In our frame account this is captured by specifying a contextually specified minimal vertical translation of the trace path of the HEIGHT value.
- *lecken* 'leak' (verbs of substance emission): a *lecken*-event involves a change of the QUANTITY of the liquid that is leaking. Again *sehr* increases the minimal vertical translation of the trace path of the changing QUANTITY value.
- *dröhnen* 'drone' (verbs of sound emission): verbs of this class express the emission of a lexically specified sound. Degree gradation increases the value of the LOUDNESS attribute.

In Section 2 we have raised the two major questions how a particular gradation scale is selected by degree gradation and how its values are constrained. In this regard the verb class specific generalizations formulated above are only a first approximation. Our preliminary hypothesis towards the formulation of a universal rule is that the gradation

scale targeted by *sehr* has to be introduced by an attribute that is already 'pre-activated' by the verb. In this sense a verb frame attribute counts as pre-activated if the verb either restricts its value space or if the verb expresses a change of the value along the attribute scale. For instance, the sound emission verb *dröhnen* 'drone' is only licensed for sounds of a minimal loudness and cannot be applied to situations in which some kind of sound emission has a value of loudness below this level. Therefore, the verb can be said to pre-activate the attribute LOUDNESS. By contrast, *klingen* 'sound' as in *heiser klingen* 'sound hoarse' is neutral with respect to intensity and does not pre-activate a particular sound attribute. In this case, *sehr*-gradation operates on the degree of the externally realized sound quality as in *sehr heiser klingen* 'sound very hoarse' while it cannot target a scalar attribute of the sound emission verb alone such as LOUDNESS.

Of course, the data set we have looked at so far is only exemplary and does not suffice to secure our hypothesis. Moreover, as already mentioned in the beginning there are other aspects of sound emission verbs such as the extended motion verb use as discussed by Fleischhauer et al. (2017) which can be treated in a particularly fruitful way in a frame account giving access to the necessary aspects of verb meaning as well as to fine-grained semantic properties of the verb's arguments. Therefore, further research has to be done with regard to emission verbs to arrive at a full-fledged phenomenology of this verb class and the way it can be treated within a frame account.

**Acknowledgements.** The research presented in this paper was funded by the Deutsche Forschungsgemeinschaft (DFG) with a grant to the Collaborative Research Centre (SFB) 991 "The Structure of Representations in Language, Cognition, and Science". We are grateful to the two reviewers of this paper for many valuable comments. We would also like to thank the audiences of TbiLLC 2017 for their feedback on an earlier version.

## References

Andersson, Sven-Gunnar. 1989. *On the Generalization of Progressive Constructions*. Ich bin das Buch am Lesen – *status und usage in three Varieties of German*. In Lars-Gunnar Larsson (ed.), *Proceedings of the Second Scandinavian Symposium on Aspectology*, 95-106. Uppsala: Almqvist & Winkel.

Atkins, Beryl T., Judy Kegl & Beth Levin. 1988. Anatomy of a Verb Entry: from Linguistic Theory to Lexicographic Practice. *International Journal of Lexicography* 1(2). 84–126.

Atkins, Beryl T. & Beth Levin. 1991. *Admitting Impediments*. In Zernik Uri (ed.), *Lexical Acquisiton: Exploiting On-Line Resources to Build a Lexicon*, 233–262. Hillsdale, NJ: Lawrence Erlbaum.

Barsalou, Lawrence W. 1992. Frames, concepts, and conceptual fields. In Adrienne Lehrer & Eva Feder Kittay (eds.), *Frames, fields, and contrasts. New Essays in Semantic and Lexical Organization*, chap. 1, 21–74. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Bolinger, Dwight. 1972. *Degree words*. The Hague: Mouton.

Borik, Olga. 2006. *Aspect and Reference Time*. Oxford: Oxford University Press.

Comrie, Bernard. 1976. *Aspect*. Cambridge: Cambridge University Press.

Croft, William. 1991. *Syntactic categories and grammatical relations*. Chicago: University of Chicago Press.

Doetjes, Jenny. 1997. *Quantifiers and Selection*. Dordrecht: Holland Institute of Generative Linguistics.
Doetjes, Jenny. 2007. Adverbs and quantification: Degree versus frequency. *Lingua* 117: 685–720.
Doetjes, Jenny. 2008. *Adjectives and degree modification*. In Louise McNally & Christopher Kennedy (eds.), *Adjectives and Adverbs - Syntax, Semantics and Discourse*, 123–155. Oxford: Oxford University Press.
Dowty, David. 1979. *Word meaning and Montague Grammar*. Dordrecht: Reidel.
Ebert, Karen. 2000. *Progressive markers in Germanic languages*. In Östen Dahl (ed.), *Tense and Aspect in the Languages of Europe*, 605-653. Berlin: Mouton de Gruyter.
Ernst, Thomas. 2002. *The Syntax of Adjuncts*. Cambridge: Cambridge University Press.
Fleischhauer, Jens. 2013. *Interaction of telicity and degree gradation in change of state verbs*. In Boban Arsenijevic, Berit Gehrke & Raphael Marin. (eds.). *Studies in Composition and Decomposition of Event Predicates*, 125-152. Dordrecht: Springer.
Fleischhauer, Jens. 2015. *Activation of Attributes in Frames*. In V. Pirrelli; C. Marzi & M. Ferro (eds.) *Word Structure and Word Usage*, 58−62. http://ceur-ws.org.
Fleischhauer, Jens. 2016a. *Degree Gradation of Verbs*. Düsseldorf: Düsseldorf University Press.
Fleischauer, Jens. 2016b. *Degree expressions at the Syntax-Semantics Interface*. In Jens Fleischhauer, Anja Latrouite & Rainer Osswald. (eds.). *Explorations of the Syntax-Semantics-Pragmatics-Interface*, pp. 209-246. Düsseldorf: Düsseldorf University Press.
Fleischhauer, Jens. 2018. Graduierung nicht skalarer Verben. *Zeitschrift für germanistische Linguistik* 46 82): 221-247.
Fleischhauer, Jens, Thomas Gamerschlag & Wiebke Petersen. 2017. A frame-analysis of the interplay of grammar and cognition in emission verbs. In Stefan Hartmann (ed.), *Yearbook of the German Cognitive Linguistics Association*, vol. 5, 177–194. Berlin: Mouton de Gruyter.
Gamerschlag, T., W. Geuder & W. Petersen. 2014. Glück auf der Steiger kommt – a frame account of extensional and intensional ‘steigen’. In D. Gerland, Ch. Horn, A. Latrouite & A. Ortmann (eds.), *Meaning and grammar of nouns and verbs*, 115–144. Düsseldorf: Düsseldorf University Press.
Gerling, Martin & Norbert Orthen. 1979. *Deutsche Zustands- und Bewegungsverben. Eine Untersuchung zu ihrer semantischen Struktur und Valenz*. Tübingen: Narr.
Goldberg, Adele. 2005. *Argument realization: The role of constructions, lexical semantics and discourse factors*. In Jan-Ola Ostman & Mirjam Fried (eds.), *Construction Grammars: Cognitive Grounding and Theoretical Extensions*, 17–43. Amsterdam: John Benjamins.
Kennedy, Christopher. 1999a. Gradable adjectives denote measure functions, not partial functions. *Studies in Linguistic Sciences* 29(1). 65–80.
Kennedy, Christopher. 1999b. *Projecting the Adjective – The Syntax and Semantics of Gradability and Comparison*. New York: Garland.
Kennedy, Christopher. 2007. Vagueness and grammar: the semantics of relative and absolute gradable adjectives. *Linguistics and Philosophy* 30(1). 1–45.
Kennedy, Christopher & Louise McNally. 1999. *From Event Structure to Scale Structure: Degree Modification in Deverbal Adjectives*. In Tanya Matthews & Devon Strolovitch (eds.), *Proceedings of Semantics and Linguistics Theory 9*, 163–180. Ithaca: CLC Publications.
Kennedy, Christopher & Louise McNally. 2005. Scale Structure, Degree Modification, and the Semantics of Gradable Predicates. *Language* 81(2). 345–381.
Levin, Beth. 1991. Building a Lexicon: The Contribution of Linguistics. *International Journal of Lexicography* 4(3). 205–226.
Levin, Beth. 1993. *English verb classes and alternations*. Chicago: Chicago University Press.

Levin, Beth & Malka Rappaport Hovav. 1995. *Unaccusativity: At the syntax-lexical semantics interface*. Cambridge, MA: MIT Press.

Levin, Beth & Malka Rappaport Hovav. 2005. *Argument realization*. Cambridge: Cambridge University Press.

Löbner, Sebastian. 2002. *Is the German Perfekt a perfect Perfect?* In Ingrid Kaufmann & Barbara Stiebels (eds.), *More than Words*, 369-391. Berlin: Akademie-Verlag.

Löbner, Sebastian. 2012. *Sub-compositionality*. In Markus Werning, Wolfram Hinzen & Edouard Machery (eds.), *The Oxford handbook of compositionality*, 220–241. Oxford: Oxford University Press.

Naumann, R. 2013. An outline of a dynamic theory of frames. In G. Bezhanishvili, S. Löb-ner, V. Marra & F. Richter (eds.), Logic, Language, and Computation. 9th International Tbilisi Symposium on Logic, Language, and Computation, TbiLLC 2011, Kutaisi, Georgia, September 26–30, 2011, Revised Selected Papers, vol. 7758 *Lecture Notes in Computer Science*, 115–137. Springer.

Perlmutter, David M. 1978. Impersonal Passives and the Unaccusativity Hypothesis. *Proceedings of the 4th Annual Meeting of the Berkeley Linguistics Society*, 157–190.

Petersen, W. 2007/2015. Decomposing concepts with frames. *Baltic International Yearbook of Cognition, Logic and Communication* 2, 151–170. Reprint 2015 in T. Gamerschlag, D. Gerland, R. Osswald & W. Petersen (eds.), *Meaning, frames, and conceptual representation*, 43–67. Düsseldorf: Düsseldorf University Press.

Potashnik, Joseph. 2012. *Emission Verbs*. In Martin Everaert, Marijana Marelj & Tal Siloni (eds.), *The Theta System*, 251–278. Oxford: Oxford University Press.

Rappaport Hovav, Malka & Beth Levin. 1998. *Building verb meanings*. In Miriam Butt & Wilhelm Geuder (eds.), *The projection of arguments: Lexical and syntactic constraints*, 97–134. Stanford: CSLI Publications.

Rappaport Hovav, Malka & Beth Levin. 2000. Classifying single argument verbs. In Peter Coopmans, Martin Everaert & Jane Grimshaw (eds.), *Lexical specification and insertion*, 269–304. Amsterdam/Philadelphia: John Benjamins.

Rappaport Hovav, Malka & Beth Levin. 2010. *Reflections on Manner/Result Complementarity*. In Malka Rappaport Hovav, Edit Doron & Ivy Sichel (eds.), *Lexical Semantics, Syntax and Event Structure*, 21–38. Oxford: Oxford University Press.

Tenny, Carol. 2000. *Core events and adverbial modification*. In Carol Tenny & James Pustejovsky (eds.), *Events as Grammatical Objects*, 148-185. Stanford: CSLI Publications.

Tsujimura, Natsuko. 2001. Degree words and scalar structure in Japanese. *Lingua* 111: 29–52.

Van Valin, Robert D. jr. 2005. *Exploring the Syntax-Semantics Interface*. Cambridge: Cambridge University Press.

Vendler, Zeno. 1957. Verbs and times. *Philosophical Review* 56. 143–160.

Zwarts, Joost. 2005. Prepositional aspect and the algebra of paths. *Linguistics and Philosophy* 28 (6), 739–779.