

Lexical Event Structures for Verb Semantics

Stefan Engelberg
University of Wuppertal, Germany

Abstract

The paper introduces a theory of Lexical Event Structures as a means to represent the meaning of verbs. The theory is guided by the assumption that verbs refer to events that are internally structured in the sense that they consist of several subevents and states. The temporal properties and relations of these have to be specified. The occurrence of subevents is either implied or presupposed by the verb, and event participants are related to some, but not necessarily all subevents by semantic relations.

Lexical Event Structure Theory supports explanations in five domains of phenomena, namely semantics-syntax mapping, grammatical-categorial restrictions, inference behavior, selectional restrictions, and interlexematic relations like hyponymy. A wide variety of phenomena from all of these domains are extensively discussed in the paper.

Furthermore, the empirical adequacy of this, as well as any a lexical semantic theory hinges not only on a broad domain of phenomena but also on a precise characterization of the concepts the theory makes use of. Thus, it is shown how logical approaches on the one hand and cognitive ones on the other help to sharpen our understanding of event-internal temporal properties and relations.

1 Introduction

This paper is about the meaning of verbs and how it should be represented. Its purpose is to outline and motivate a lexical-semantic theory which is based on the idea that verbs refer to events whose detailed structure is linguistically relevant. This theory – Lexical Event Structure Theory – will be justified in two ways. First, a large number of syntactic and semantic phenomena will be discussed whose explanation is based on the kind of semantic distinctions provided by Lexical Event Structures. Second, steps will be taken towards guaranteeing the empirical adequacy of the theory by showing that the concepts the theory makes use of can be defined by reasoning from the viewpoint of temporal logic and cognitive psychology. Thus, it is not the aim of this paper to provide a formal account of the mapping between semantics and syntax but rather to show how concepts within a lexical semantic theory are motivated and explained.

The paper will proceed as follows: in section 2, an overview of existing theories on lexical meaning will be given. In a discussion about a particular valence alternation, I will illustrate

some empirical shortcomings of these theories. Then, Lexical Event Structures as a means for representing verb meanings will be introduced. In section 3, firstly, the relation of Lexical Event Structure Theory to other lexical semantic theories will be discussed and, secondly, I will present some considerations about which kinds of phenomena a lexical-semantic theory of verbs has to deal with. In the following two sections 4 and 5, it will be shown how the elements and structures in the representations provided by Lexical Event Structure Theory relate to the phenomena to be explained by the theory. Section 4 will be devoted to those phenomena which hinge on the representation of subevents and their participants, and section 5 to phenomena whose explanation depends on the representation of event-internal temporal relations and properties. Section 6 will demonstrate how the meaning of the predicates employed in the representations can be made precise. Particular attention will be given to temporal properties and relations within Lexical Event Structures. Section 7 presents the conclusion of the paper.

2 A Theory of Lexical Event Structures

2.1 A phenomenon and nine theories

A large number of verb semantic theories have emerged during the last decades. The meaning representations in most of these theories are based on one or more of three central concepts: thematic roles, lexical decompositions, and event structures. At the beginning of this section I want to present a short overview of nine types of verb semantic theories in order to show how they employ and combine these concepts. In the second part of this section a phenomenon will be discussed that poses a challenge to these theories. The nine theories are illustrated here by example representations for the German transitive verb *abtrocknen* 'dry / dry off' which occurs in sentences like (1). The representations are partly simplified and illustrate just the basic representational structures. They are constructed according to representations of similar verbs in the respective sources.

- (1) a. *Ron hat sein Bierglas abgetrocknet*
Ron has his beer-glass off-dried
'Ron dried (off) his beer mug'
b. *Silvia hat ihre Füße abgetrocknet* (also: *Silvia hat sich die Füße abgetrocknet*)
Silvia has her feet off-dried (also: Silvia has herself the feet off-dried)
'Silvia dried (off) her feet'
c. *Klaus hat seinen kleinen Bruder abgetrocknet*
Klaus has his little brother off-dried

'Klaus dried (off) his little brother'

The representations in **T1** through **T4** stand for different thematic-role based theories. The classical approach might be reconstructed as in **T1**, where thematic roles come with vague definitions and where it is uncertain what their logical type is. More explicit with respect to the logical type of thematic roles are Davidsonian and neo-Davidsonian theories where verbs are multi-place (**T2**) or, respectively, one-place (**T3**) predicates over events. In these theories, thematic roles are relations between thematic arguments and the event argument. More recently, prototype approaches have conceived of thematic proto-roles as derived from more basic semantic relations like causation, sentience, change-of-state, etc. (**T4**).

T1: Thematic roles as primitives of an uncertain logical type (in the tradition of Fillmore, 1968)

DRY($x^{AGENT}, y^{PATIENT}$)

T2: Thematic roles as primitives in Davidsonian approaches (following Davidson, 1967)

DRY(x, y, e) & AGENT(x, e) & PATIENT(y, e)

T3: Thematic roles as primitives in neo-Davidsonian approaches (e.g., Parsons, 1980; Krifka, 1989a)

DRY(e) & AGENT(x, e) & PATIENT(y, e)

T4: Thematic roles as prototypes based on lexically entailed relations (following Dowty, 1991):

DRY(x, y, e) & CAUSER(x, e) & SENTIENT (x, e) & ... & CHANGE-OF-STATE(y, e)
(such that x is proto-agent and y is proto-patient)

Most approaches employing lexical decompositions are based on CAUSE-BECOME structures (**T5**), although other approaches, in particular those related to Jackendoff's Conceptual Structures, use other kinds of decompositions within a theory that employs a rich ontology of events, paths, properties, etc., as in **T6** which can be paraphrased as: there is an event, in which a thing i causes a second event in which a thing j moves along a (property) path to the property DRY, whereby the actor i affects the patient j .

T5: Lexical decompositions as Lexical Conceptual Structures (LCS) (e.g., Rappaport, Laughren & Levin, 1987):

[x CAUSE [y BECOME DRY]]

T6: Lexical decompositions as Conceptual Structures (e.g., Jackendoff, 1995):

[_{event} CAUSE ([_{thing}] _{i} , [_{event} GO([_{thing}] _{j} , [_{path} TO ([_{property} DRY]))])]] AFF([] _{i} , [] _{j})

Event structure approaches in verb semantics (**T7**) are based on Pustejovsky (1988; 1991a; 1991b), who assumes that each verb refers to an event that can consist of subevents of different types, where 'processes' (P) and 'states' (S) are simple types which can combine to yield the complex type 'transition': [P S]_T. In addition to this event structure (ES), Pustejovsky assumes the level LCS', where each subevent is related to a decomposition. Out of this, a third level of Lexical Conceptual Structure (LCS) can be derived, which contains a single lexical decomposition.

T7: Event structures combined with LCS-decompositions (Pustejovsky, 1988; 1991b):
 ES: [[P] [S]]_T
 LCS': [[ACT(x,y) & ¬DRY(y)] [DRY(y)]]
 LCS: [CAUSE(ACT(x,y), BECOME(DRY(y)))]

T7 roughly says the following: *abtrocknen* refers to an event consisting of a process and a resulting state, where the process is characterized by an entity *x* acting upon a non-dry entity *y* and the result state is described as *y* being dry. From this follows that the acting of *x* upon *y* causes *y* to become dry.

Combinations of any two of the basic three approaches also occur. Grimshaw (1990) combines a hierarchical thematic-role based representation with an aspectual representation in terms of Pustejovsky's event structures. The representation in (**T8**) expresses that the agent, which is higher on the thematic hierarchy than the patient, is more involved in the first subevent, the patient more in the second subevent (= the result state). In Wunderlich's (1996) Lexical Decompositional Grammar, lexical decompositions are provided with an event argument whose event structure properties are represented as a sortal index on the argument (**T9**). Finally, Jackendoff's Conceptual Structures (**T6**) allow the derivation of thematic roles from certain positions in decompositional structures.

T8: Thematic roles as primitives linked to an aspectual hierarchy based on event structures (Grimshaw, 1990):
 (agent(patient))
 1 2

T9: Lexical decompositions in Lexical Decomposition Grammar combined with a sortal event structure index (Wunderlich, 1996):
 $\lambda x \lambda y \lambda e^{<P,T>} \text{CAUSE}(x, \text{BECOME}(\text{DRY}(y))) (e)$

Having acknowledged the abundance of verb semantic theories one might wonder about the urge to supply the lexical semantics community with another one. My discomfort with **T1** through **T9** originally arose from the investigation of a particular diathesis in German: Some transitive verbs in German exhibit a valence alternation between an accusative NP and a PP headed by *an*. The sentences with the prepositional construction are said to bear a partitive meaning (Krifka, 1989b).¹

- (2) a. *Rebecca baute eine Hundehütte / an einer Hundehütte*
Rebecca built a doghouse / at a doghouse
approximately: 'Rebecca built / was building a doghouse'
b. *Rebecca streichelte ihre Katze / *an ihrer Katze*
'Rebecca petted / was petting her cat'
c. *Rebecca sprengte die Brücke / *an ihrer Brücke*
'Rebecca blew up / was blowing up the bridge'
d. *Rebecca kniff ihren Freund / *an ihrem Freund*
'Rebecca pinched / was pinching her boyfriend'

As the examples in (2) show, it is only a subclass of transitive verbs like those in (3a) that allow the *an*-construction, while other transitive verbs do not (3b).

- (3) a. *an*-construction possible: *waschen*, 'wash'; *schreiben*, 'write'; *bügeln*, 'iron'; *reparieren* 'fix'; *stricken*, 'knit'; *manipulieren*, 'manipulate'; *kochen*, 'cook'; *rechnen*, 'calculate'; *nähen*, 'sew'.
b. *an*-construction not possible: *kennen*, 'know'; *quälen*, 'tease / torture'; *photographieren*, 'photograph'; *sehen*, 'see'; *sprengen*, 'blow up'; *stehlen*, 'steal'; *lösen*, 'solve'.

The *an*-alternation turned out to be restricted to verbs which express an event of a certain duration that leads to a result state (2a). Neither durative verbs without a result state (2b) nor punctual verbs either with (2c) or without a result state (2d) are admissible here².

If we look back at theories **T1** through **T9** it becomes obvious that these restrictions are not easily expressed in any of the nine theories. The first condition "result state" doesn't cause many problems for event structure and decompositional theories. It is explicitly expressed in event structure theories like **T7**. Decompositional theories like **T5** capture the same condition via the semantics of the BECOME predicate. Thematic roles of the traditional sort (**T1** – **T3**) are too coarse for such a distinction. Patients not only include participants which change like the object of *abtrocknen*, but also participants which are merely affected, like the object of *hit*.

Thus, we need more elaborate approaches to semantic relations like Dowty's protorole theory (T4). The second condition for our valence alternation ("durativity") is more challenging for the nine theories. Since duration and punctuality are predicates of events or event times, representations which are not based on any kind of event semantics are inappropriate, like simple thematic role approaches (T1) or traditional decompositions (T5). All other approaches as they stand do not provide a distinction between durativity and punctuality. This is particularly problematic for those theories which claim to be able to represent all the information relevant for linking in their semantic structures. Surely the alternation in (2) belongs to that body of phenomena. Thus, for this reason alone it is necessary to extend or modify the theories T1 through T9 with respect to their ability to express this distinction.

This short overview is of course not intended to provide a general criticism of theories T1 to T9, which all have merits and faults whose discussion goes beyond the scope of this paper. It should, though, give a first idea of what kind of theory the investigation of the valence alternation has led me to, namely a theory that focusses heavily on the structure and properties of events.

3.2 The basic idea of Lexical Event Structures

In contrast to decompositional theories, the mereological structure of an event, its temporal properties, and the kind of involvement of participants in the event lie at the core of the theory that I will refer to as 'Lexical Event Structure Theory'. Its basic idea is that the meaning of a verb is to be represented as a Lexical Event Structure (LES) which has the following characteristics:

- (i) Complexity of events: Verbs refer to events that are internally structured in the sense that they can consist of different subevents (e^1, e^2, \dots) and a state (s).
- (ii) Sorts of subevents: The subevents are durative (e^{DUR}) or punctual (e^{PCT}).
- (iii) Relations between subevents: Subevents stand in temporal relations to each other, e.g., a subevent e^1 can precede subevent a e^2 completely ($e^1 < e^2$), or e^1 can overlap with e^2 ($e^1 \circ e^2$). (This idea will be elaborated in more detail in section 6.1)
- (iv) Participation in subevents: The event participants which correspond to the arguments of the verb are not necessarily involved in all subevents, but rather only in some of them; semantic functions like 'control', 'move', 'volition' etc. relate participants and subevents.³
- (v) Implication vs. presupposition: The occurrence of a subevent is either entailed (\rightarrow_I) or presupposed (\rightarrow_p) by the open proposition in the semantic translation of the verb, i.e. by an expression like 'VERB(x,y,e)'.

This basic idea is illustrated by the following examples of the German verbs *abtrocknen* 'dry off', *fahren* 'drive', *erschießen* 'kill by shooting', and *fangen* 'catch'. Although most of what is said here can be easily transferred to the corresponding English verbs, German examples are used to facilitate the discussion of phenomena in later sections.

The two-place verb *abtrocknen* 'to dry off' as in (1) (section 2.1) refers to a complex event where the first subevent e^1 has a certain duration ("DUR"), i.e., is not punctual, and involves two participants, an agent and a patient, e.g., Ron's acting upon the beer mug (probably with a towel). Almost simultaneously ("o"), a second durative event e^2 occurs which only involves the patient, namely the beer mug becoming dry. This results in a following (" $<$ ") state s of the beer mug being dry.⁴ This is captured in the Lexical Event Structure (LES) of *abtrocknen* 'to dry off' as follows:

<i>abtrocknen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{ABTROCKN}(x,y,e)]$
	LES: $(\rightarrow_1 e^1[+\text{DUR}]: x^{\text{AGENT}}, y^{\text{PATIENT}}) \circ (\rightarrow_1 e^2[+\text{DUR}]: y^{\text{PATIENT}}) < (\rightarrow_1 s: y^{\text{PATIENT}})$

Lex 1: *abtrocknen* 'dry off'.

The first line in the lexical entry Lex 1 expresses the syntactic valency of the verb ("SYN"), which states that *abtrocknen* requires an accusative and a nominative NP. By convention, the first item of the syntactic valency corresponds to the first lambda-bound variable in the semantic translation ("SEM")⁵.

The causative but non-resultative *fahren* 'to drive', as in *sie fuhr ihren neuen Volkswagen* 'she drove her new Volkswagen', requires a structure similar to causal resultatives like *to dry off* with the difference that it lacks a result state in its non-directional variant:

<i>fahren</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{FAHR}(x,y,e)]$
	LES: $(\rightarrow_1 e^1[+\text{DUR}]: x^{\text{AGENT}}, y^{\text{PATIENT}}) \circ (\rightarrow_1 e^2[+\text{DUR}]: y^{\text{PATIENT}})$

Lex 2: *fahren* 'drive'.

Besides the two subevents, e^1 and e^2 , a second verb variant with a representation of a result state has to be assumed if a directional phrase occurs, as in *er fuhr den Wagen gegen einen Baum* 'he drove the car into a tree'.⁶

While the event structure properties of causative *erschießen* 'kill by shooting', as in *die Miliz erschoss den Demonstranten* 'the militia shot (and killed) the demonstrator', are similar in many respects to those of verbs like *abtrocknen* 'to dry off', *erschießen* implies a different temporal relation between the causing and the caused subevent, since the causing subevent completely precedes the caused one, in contrast to *abtrocknen*. Furthermore, the subevents are punctual:

<i>erschießen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{ERSCHIESS}(x, y, e)]$
	LES: $(\rightarrow_I e^1[+\text{PCT}]: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_I e^2[+\text{PCT}]: y^{\text{PATIENT}}) < (\rightarrow_I s: y^{\text{PATIENT}})$

Lex 3: *erschießen* 'kill by shooting'.

Finally, the verb *fangen* 'to catch', in the sense of 'catch a flying object', e.g., *sie fing den Ball* 'she caught the ball', is distinct from the verbs above due to the presupposed rather than implied occurrence of the first subevent, i.e., we can still infer from the negated sentence *sie fing den Ball nicht* 'she didn't catch the ball' that the ball was flying:

<i>fangen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{FANG}(x, y, e)]$
	LES: $(\rightarrow_P e^1: y^{\text{PATIENT}}) < (\rightarrow_I e^2[+\text{PCT}]: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_I s: x^{\text{AGENT}}, y^{\text{PATIENT}})$

Lex 4: *fangen* 'catch'.

In the four Lexical Event Structures given above, only temporal relations between subevents are represented. However, it is always the case that additional relations such as causal, concessive, or consecutive relations connect subevents, too. The representation of these "c-relations" won't be a concern in the remainder of the paper. Therefore, I will only give a few examples here. The two immediate subevents of *abtrocknen* 'dry off', namely the acting upon the mug and the becoming dry of the mug, stand in a causal relation. Other verbs imply relations between their subevents which are more similar to concessive or consecutive relations as expressed by conjunctions like *although* or *because*, respectively (cf. Blume, 2000).

- (4) a. *Rebecca forgave Rudolph*
 b. *Rebecca obeyed Rudolph*

If, as in (4a), Rebecca forgave Rudolph, that means she decided to no longer be upset with him ($\rightarrow_I e^2$), although he did something mean to her ($\rightarrow_P e^1$). If, as in (4b), Rebecca obeyed

Rudolph she displayed a certain behavior ($\rightarrow_I e^2$) because (among other things) Rudolph told her to do so ($\rightarrow_P e^1$).⁷

The event described in a Lexical Event Structure consists of subevents, i. e. parts which are events themselves. For an event described by *dry off* as in *Ron dried off his beer mug*, these parts are not to be conceived of as, let's say, the first ten seconds of drying off the mug and the second ten seconds of drying off the beer mug, i.e., parts which are more like temporal stages of events. Neither are the subevents in LES parts of an event at a very detailed level, e.g., the picking up of the wet mug, the rubbing of the bottom part of the mug with a towel, the rubbing of the grip of the mug, the becoming dry of the bottom part of the mug, etc. If we think of an event as structured in a hierarchical manner, such parts would be located on a lower level of this hierarchy. The subevents described in an LES are rather parts that are immediate parts of the whole event. The idea of subevents is conceived of as a transitive, antisymmetric and reflexive part-relation between events, $e^l \subseteq e$, such that immediate subevents are defined as follows:

Immediate subevents

$$\square \forall e \forall e^l [(e^l \subseteq_{\text{imm}} e) \leftrightarrow_{\text{def}} ((e^l \subseteq e) \& \neg \exists e^2 [(e^1 \neq e^2) \& (e \neq e^2) \& (e^1 \subseteq e^2) \& (e^2 \subseteq e)])]$$

Thus, an event e^l is an immediate subevent of e , iff it is a subevent of e and there is no subevent e^2 such that, firstly, e^2 is distinct from e and e^l , secondly, e^2 is a subevent of e and, thirdly, e^l is a subevent of e^2 .

Not only shall the subevents in an LES be immediate subevents, the LES of a verb should also be complete with respect to the immediate subevents of the event denoted by this verb. That is to say, a Lexical Event Structure is complete iff for the set of subevents SE described in the LES it holds that i) all subevents in SE are immediate subevents and ii) there is no subevent which is an immediate subevent and is not in SE. This is rendered by the following requirement:

Completeness of Lexical Event Structures

An LES of a verbal predicate over e must be complete, i.e., it must hold for SE, the set of subevents described in the LES, that:

$$\square \forall e^n [(e^n \in \text{SE}) \rightarrow (e^n \subseteq_{\text{imm}} e)] \& \neg \exists e^n [(e^n \subseteq_{\text{imm}} e) \& (e^n \notin \text{SE})]$$

Lex 1 through Lex 4 contain shorthand notations for more explicit semantic representations in which meaning postulates take the open proposition of the verb's translation 'VERB(x,y,e)' as an antecedent and the different information parts of LES as a consequent. These parts include the subevent information in the form of a mereological condition, e.g., $e^1 \subseteq e$, the sort of each subevent as a one-place predicate, e.g., $PCT(e^1)$, the semantic relations as two-place predicates between event participants and subevents, e.g., $AGENT(x, e^1)$, and the temporal relations as two-place relations between subevents, e.g., $e^1 < e^2$. In addition, more specific information about the subevents can be given, e.g., that the first subevent of *fangen* 'catch' in Lex 4 is a flying or moving away of something. Furthermore, causal and similar relations between subevents are represented. These are omitted in the short-hand notations because they don't play a role in the explanation of the phenomena discussed in later sections of this paper.

Thus, the shorthand notation of *fahren* 'drive' in Lex 2 can be obtained from the following full-blown representation:

<i>fahren</i>	
SYN:	V, /acc/nom
SEM:	$\lambda y \lambda x \lambda e[FAHR(x,y,e)]$
MP-I - <i>fahren</i> :	$\square \forall y \forall x \forall e[FAHR(x,y,e \rightarrow_1$
	(selectional restrictions:) ANIMATE(x) & VEHICLE (y) &]
MP-II- <i>fahren</i> :	$\square \forall y \forall x \forall e[FAHR(x,y,e \rightarrow_1$
	(subevents:) $\exists e^1 \exists e^2[$ $e^1 \subseteq_{imm} e \&$ $e^2 \subseteq_{imm} e \&$
	(sort of subevents:) DUR(e^1) & DUR(e^2) &
	(temporal relations:) $e^1 \circ e^2 \&$
	(causation:) CAUSE(e^1, e^2) &
	(semantic relations:) CONTROL(x, e^1) & MOVE(y, e^2) & ...]]

Lex 2': *fahren* 'drive'.

3 Empirical issues of lexical-semantic theories

3.1 Thematic roles, decompositions and event structures revisited

Obviously, the Lexical Event Structure Theory, for short the tenth theory **T10**, shares a number of features with the theories **T1** through **T9**. In this section I will point out some of the similarities and differences between **T10** and the other theories and try to show in how far it overcomes some of the empirical problems connected with the other theories.

The use of thematic roles as primitives in explaining linking phenomena proved to be problematic for a number of reasons: i) it is unclear how many roles there are and what kind of principles should guide a decision about the number of roles, ii) the semantic content of thematic roles is vague, which often leads to circular argumentation in linking theories when roles are assigned to particular arguments, iii) the logical type of thematic roles is highly debatable, iv) a wide range of the phenomena mentioned in the last section cannot be explained in terms of thematic roles, e.g., interlexematic relations and many co-occurrence restrictions. Without a doubt, more recent approaches to thematic roles have shed more light on their semantics. In particular, prototype approaches to thematic roles (Dowty, 1991) and explorations of their properties in formal semantic frameworks (Dowty, 1989; Krifka, 1989a; 1998) have proven fruitful. Although thematic roles alone are not sufficient for the explanation of most of the phenomena to be discussed in the next sections, I consider thematic roles or, more precisely, those semantic relations between events and event participants like 'volition', 'control', 'sentience', 'movement', etc., which are entailed by the verb and underlie thematic roles in proto-role approaches like Dowty (1991), as indispensable.

Lexical decompositions in verb semantics as in **T5** are usually built around the predicates CAUSE, BECOME and sometimes DO, POSS and others. Until the seventies, these kinds of decompositions had been understood as deep structure analyses of sentences. Ever since Dowty (1979) they are nowadays mostly employed at a level of lexical semantic representation. Lexical decompositions have been mainly used in linking theories, but there are also approaches which try to express aspectual distinctions in decompositional structures, which are not well suited for doing so. Dowty (1979) was the first to try to capture Vendler's

aspectual distinctions in terms of CAUSE, BECOME and DO in a Montague semantics framework.⁸ Somewhat simplified, the assumed correspondences between decompositions and the so-called Vendler-classes are as in (5), where "p" is a variable for a proposition and "P" stands for a predicate. More common decompositional approaches, which do not employ the DO predicate and conceive of CAUSE as a relation between a thing / person and a proposition, would capture the aspectual differences as in (6).

- | | | |
|--------|---|-------------------|
| (5) a. | $P(x', \dots, x^n)$ | "States" |
| b. | $DO(x', P(x', \dots, x^n))$ | "Activities" |
| c. | $BECOME(P(x', \dots, x^n))$ | "Achievements" |
| d. | $CAUSE(p, BECOME(P(x', \dots, x^n)))$ | "Accomplishments" |
| (6) a. | <i>Susan fixed her bike</i> | |
| | <i>fix:</i> [x CAUSE [BECOME fixed(y)]] | "Accomplishment" |
| b. | <i>the car broke</i> | |
| | <i>break:</i> [BECOME broken(x)] | "Achievement" |
| c. | <i>she jogged</i> | |
| | <i>jog:</i> [jog(x)] | "Activity" |

Although this maps the aspectual differences onto different verb representations, the aspectual behavior of many other verbs is not captured in simple CAUSE-BECOME decompositions. In particular, since the work of Krifka (1989a; 1998) it has become clear that theories on Vendler classes need a different and more elaborate lexical semantic basis even for the explanation of the aspectual meaning of the examples in (6). The point here is that the representations do not even provide enough lexical distinctions between verbs on a descriptive level. E.g., the equation of achievements with BECOME-verbs does not preserve much of Vendler's original concept of achievements as expressions of punctuality. On the one hand, there are quite a lot of punctual verbs that do not involve any change that could be expressed by the BECOME operator, e.g., *prick, stab, bite, knock, sneeze*. On the other hand, most one place verbs that involve a change of state are not punctual in nature and therefore are modifiable by an *in*-PP: *schmelzen* 'to melt', *trocknen* 'to dry'. Finally, some verbs which express a gradual change but do not lead to a definite result state – as defined by the end of a scale – do not in fact behave as accomplishments⁹; these verbs are compatible with *for*-adverbials, but are less acceptable with *in*-PPs:

- (7) a. *the temperature rose for some days / ??in some days*
 b. *the number of visitors increased for a while / ??in some days*

Furthermore, McCawley (1976: 117f) points out that causative verbs are aspectually heterogeneous. Some have achievement properties (8a), some behave like activities (8b), and only some like accomplishments (8c):

- (8) a. *John shot Mary at 2:37 P.M.*
 b. *John boiled the eggs for five minutes*
 c. *John dressed the child in five minutes*

There are additional properties of the internal temporal structure of verbs that are not expressed in decompositional structures at all, but which nonetheless have an impact on the semantic behavior of verbs. These properties determine the inference properties of verbs, co-occurrence restrictions and linking properties, and will be discussed in section 5.

At this point, a comparison with Pustejovsky's event structure theory seems in order. The following examples illustrate its relationship to Vendler classes:

- (9) a. *the door is closed*
 ES: [S]
 LCS': [closed(the-door)]
 LCS: closed(the-door)
- b. *Mary ran*
 ES: [P]
 LCS': [run(mary)]
 LCS: run(mary)
- c. *Mary ran to the store*
 ES: [[P] [<P,T>]]_T
 LCS': [[run(mary)] [at(mary,the-store)]]
 LCS: cause(act(mary), become(at(mary,the-store))) BY run)
- d. *the door closed*
 ES: [[P] [S]]_T
 LCS': [[¬closed(the-door)] [closed(the-door)]]
 LCS: become[closed(the-door)]
- e. *John closed the door*
 ES: [[P] [S] ..]_T
 LCS': [[act(john,the-door) & ¬closed(the-door)] [closed(the-door)]]
 LCS: cause(act(john,the-door), become[closed(the-door)])

In terms of Vendler classes (9a) describes a state, (9b) an activity and (9c) and (9e) accomplishments. (9d) illustrates Pustejovsky's interpretation of achievements: Achievements and accomplishments have in common that they lead to a result state and are distinguished in that achievements do not involve an act-predicate at LCS'.

Pustejovsky's theory addresses several phenomena that cannot easily be handled in simple decompositions. This holds for phenomena from the domain of aspectuality and adverbial modification in particular. Nevertheless, some shortcomings of this theory have to be mentioned. The first concerns Pustejovsky's approach to achievements. Since the ability of verbs to combine with aspectual adverbials is based on ES-level restrictions, differences between achievements and accomplishments with respect to these adverbials cannot be expressed anymore, since both have the same ES-representation, namely $\tau_1[P,S]$. A further, empirically problematic consequence of this treatment of achievements is that both achievements and accomplishments include a BECOME predicate. According to Pustejovsky (1991b: 75), semantic participants that are involved in a predicate opposition at LCS' and are therefore embedded under BECOME at the LCS level, as 'the-door' in (7d) is, will be mapped onto the d-structure object position. This conception of achievements as non-agentive BECOME-verbs suggests that the class of achievements and the class of unaccusative verbs is coextensive, or at least that unaccusatives are a subclass of achievements. As has been criticized above with respect to decompositional theories, this is definitely not the case. The verbs *platzen* 'to burst', *steigen* 'to rise', and *gelifieren* 'to gel' are unaccusatives with respect to all four of the standard criteria of unaccusativity in German: they do not allow impersonal passive constructions, their past participle can be used attributively, they form the perfect tenses with the auxiliary *sein* 'to be', and they don't allow agent nominalizations. Nevertheless, each of these verbs exhibits different aspectual behaviour:¹⁰

- (10) a. *der Ballon platzte (in dem Moment / ??eine Stunde lang / ??in einer Stunde)*
 'the balloon burst (at that moment / for one hour / in one hour)'
 b. *die Temperatur stieg (??in dem Moment / eine Stunde lang / ??in einer Stunde)*
 'the temperature rose (at that moment / for one hour / in one hour)'
 c. *der Wackelpudding gelierte (??in dem Moment / ??eine Stunde lang / in einer Stunde)*
 'the jello gelled (at that moment / for one hour / in one hour)'

Besides this untenable equation between aspectual and syntactic classes, the examples in the following sections will show that Pustejovsky's event structure is not detailed enough to capture all the relevant aspectual distinctions in the meaning of verbs.

Furthermore, doubts can be raised that the event structures and the LCS structures contain much independent information. Transitions on the ES level correspond to BECOME predicates on the LCS level while processes and states occur on the ES level if there is no BECOME predicate present at LCS. That leaves the distinction between states and processes

as the only new information given on the ES level. Thus, except for providing the semantics with subevent variables as anchors for adverbial modification, not much additional information is given in Pustejovsky's event structures. We have seen that **T10** differs from Pustejovsky's theory in several different respects: it skips the decompositional part and instead elaborates on the ES-level. In particular, verbs like transitive *open* exhibit a tripartite event-structure (see Lex. 5, section 4.1) which is justified by its supportive function in explaining adverbial modification (see section 4.1).

3.2 The empirical domain of verb semantics

Lexical verb semantics in modern linguistics originated from the need to solve problems that were posed within two domains of phenomena: the relationship between semantic arguments and their syntactic realization (linking phenomena) and aspectual and aktionsart phenomena, in particular phenomena related to Vendler-classes such as the compatibility of verbs and verb phrases with adverbs like *for five minutes* and *in five minutes*. The most influential earlier work in the domain of linking was done within thematic-role based theories such as Gruber's dissertation from 1965 (Gruber, 1976) and Fillmore (1968), followed by decompositional approaches first in generative semantics and later in lexical semantics proper. Aspectual phenomena were brought into play some time later.¹¹ Verkuyl (1972) and Platzack (1979) were among the first important works to tackle the intricate semantic problems behind the aspectual classes, which had been described in Vendler's (1957) groundbreaking paper. Aspectuality studies and linking theories developed quite independently from each other for a while. It was not until the late 80's that linking theories took data from theories on aspectuality into account (e.g., Tenny, 1987a; 1987b, Voorst, 1988) just as event structure theories tried to integrate the two different domains of verb semantic phenomena (e.g., Pustejovsky, 1988; 1991b).

Which phenomena need to be taken into account by verb semantics has long been a highly theory-dependent question. From the standpoint of formal sentence semantics, the meaning of words can be characterized as "a matter of the systematic effects they have on the semantic and pragmatic properties of (utterances of) sentences containing them, properties like entailments, presuppositions, incompatibility, and perhaps some kinds of implicatures. [...] That is, word meanings must be able to provide an appropriate finite base for an adequate recursive theory of indefinitely many sentential meanings" (Chierchia & McConnell-Ginet,

1990: 349). The consideration of the meaning of so-called non-logical words in Montague-style formal semantics is, in any case, a late development in formal semantics. The main influence on this development is Dowty (1979) and later work on aspectuality and/or thematic roles (e.g., Dowty, 1989; Krifka, 1989a; 1989b).

It was not in formal semantics that linking theories originated, interestingly enough, but rather in the more syntax-oriented frameworks of case theory and decompositional generative semantics, out of which emerged the lexical decompositional approaches of the MIT Lexicon Project (**T5**, e.g., Levin, 1985), Conceptual Semantics (**T6**, Jackendoff, 1995), Lexical Decomposition Grammar (**T9**, e.g., Wunderlich, 1997), and others. In some of these frameworks, only linking phenomena are considered. Sometimes it has even been explicitly denied that problems in the domain of lexical inferences and relations on the one hand, and problems in the domain of linking on the other, should be tackled within the same theoretical frameworks (Rappaport, 1985: 137). Having two theories for the explanation of a fairly coherent body of phenomena seems to me an unnecessarily generous approach to verb semantics, which runs the danger of developing meaning representations that suit one of the aims of lexical semantics while being incompatible with others.

Surprisingly, there have been only very few attempts to characterize the domain of data lexical verb semantics should account for. One of them can be found in Carter (1988), who formulated a program for lexical semantics in which he assumed that a semantic theory (as far as the meaning of words is concerned) should aim to achieve the following goals: i) it should express logical relations between words such as synonymy, ii) it should answer the question what a possible word is, iii) it should solve the linking problem, and iv) it should account for such phenomena as the order of acquisition of lexical items and the distribution of lexicalized meanings across languages. A similar breadth in the approach to lexical semantics also characterizes event structure theories like Pustejovsky's (1991b; 1995) and the theory I will develop in the remainder of this paper. In the following, I will give an overview of the types of phenomena I think a lexical semantic theory should account for. This catalogue of requirements can be taken as a guideline according to which the adequacy of the verb meaning representations presented in section 2.2 is to be evaluated. It is not meant to be some sort of final answer to the question of what lexical semantics is about. On the one hand, each particular theory creates its own domain of phenomena out of its specific explanatory potential, and on the other hand, it can not be said once and for all which part of a linguistic

theory has to account for which phenomena; phenomena that seem to require a lexical explanation might turn out to be easier to explain within the syntactic or pragmatic component of a linguistic theory. But still, having in mind which phenomena are likely to be relevant for a theory of verb meaning might help to avoid wrong theoretical decisions in the first place.

These are the five types of phenomena I consider critical for a theory on verb semantics; examples for each of these types will be discussed in sections 4 and 5:

- (i) Semantics-syntax mapping: Semantic properties of verbs determine to a large degree the syntactic realization of arguments and the ability to take part in valence alternations, resultative constructions, etc.
- (ii) Grammatical-categorial restrictions: Verbs are semantically classified with respect to their ability to occur in certain grammatical categories like progressive, imperative, or particular voices.
- (iii) Interlexematic relations: Verbs stand in semantic relations to each other, such as antonymy, hyponymy or synonymy.
- (iv) Inference behavior: Semantic properties of verbs influence the inference behaviour of lexical items in complex expressions. In particular, there are lexically-based inference peculiarities that show up in regular alternations of sentence patterns such as in diatheses, or when the tense or grammatical aspect of the sentence is changed. E.g., inferences about the internal temporal structure of an event expressed by the simple form of a verb might carry over to the progressive form of the verb or not, depending on particular lexical verb semantic properties.
- (v) Selectional restrictions: The combination of a verb with other lexemes is subject to certain semantic restrictions. This concerns the co-occurrence of particular adverbials or derivational morphemes with certain classes of verbs on the one hand and verb-dependent restrictions on the NPs filling argument positions on the other.

Arguments in favor of or against Lexical Event Structure Theory might arise from any of these domains.

4 Subevents and their participants

4.1 Modification of subevents

The motivation for the claim that the events verbs refer to have a linguistically relevant structure comes partly from the assumption that in many cases we get a more precise account of the meaning of event adverbials if we conceive of them as related to subevents.¹² In (11), each of the two adverbial PPs headed by *mit* 'with' is related to a different part of the event, as the respective implications show.

- (11) a. *Otto fuhr den Wagen mit großem Vergnügen*
 'Otto drove the car with great pleasure'
 implies: Otto was doing something with great pleasure
 does not imply: the car was moving with great pleasure
 b. *Otto fuhr den Wagen mit Höchstgeschwindigkeit*
 'Otto drove the car at highest speed'
 does not imply: Otto was doing something at highest speed
 implies: the car was moving at highest speed

If we assume that there are two subevents involved here (cf. Lex 2, section 3.1), namely a causing subevent e^1 (Otto operating the car) and a caused subevent e^2 (the car moving), the difference between (11a) and (11b) finds an explanation. The first adverbial, *mit großem Vergnügen* 'with great pleasure', modifies e^1 , and the second one, *mit Höchstgeschwindigkeit* 'at highest speed', modifies e^2 . Only the first subevent can serve as an anchor for the adverbial *mit großem Vergnügen*. There are two reasons for this. First, *mit großem Vergnügen* is clearly an event adverbial in (12a) and thus modifies neither states (12b) nor noun phrases, as (12c) shows. (12c) illustrates that the PP is ungrammatical as an adjunct to the NP *die Frau*. Second, *mit großem Vergnügen* is restricted to agentive events (12d):¹³

- (12) a. *sie bemerkte das mit großem Vergnügen*
 'she noticed that with great pleasure'
 b. *sie wußte das (*mit großem Vergnügen)*
 'she knew that (with great pleasure)'
 c. *die Frau (*mit großem Vergnügen) fuhr den Wagen*
 'the woman (with great pleasure) drove the car'
 d. *der Wagen fuhr (*mit großem Vergnügen)*
 'the car "drove" / moved (with great pleasure)'

These examples show that in order to explain the different behavior of the two adverbials, the event structure has to be more detailed than the one suggested by Pustejovsky (1991b) which does not distinguish causing and caused subevents.

These observations about subevent modification can be generalized as follows: an event adverbial can modify any subevent whose occurrence is implied by the verb and which satisfies the selectional restrictions of the adverbial.¹⁴ The first condition excludes subevents whose occurrence is presupposed by the verb from being modified by event adverbials. With the verb *to win*, which presupposes a preceding subevent in which the agent participates in a race, fight, game, etc. (see Lex 9 below), the adverbial *with great pleasure* cannot be understood as predicating over this presupposed subevent. The second condition explains why

only one subevent in (11a) can be modified by the adverbial *mit großem Vergnügen* 'with great pleasure' because only the agentive subevent corresponds to the selectional restrictions of the adverbial. If more than one subevent satisfies the conditions, ambiguities arise, as we will see in a moment.

This variability in the attachment to one or the other subevent is characteristic for modifiers (i.e., non-arguments), and contrasts with the behavior of a verb's arguments, whose kind of involvement in the event is determined by the verb. This corresponds to a general idea about the distinction between arguments and modifiers, namely that the semantic contribution of arguments is dependent on the verb's meaning and therefore has to be stated in the semantic representation of the verb, while the contribution of modifiers is independent of the particular verb's meaning. A comparison of the subtle differences between two German benefactive constructions shows this nicely. Benefactives in German can either be expressed by a dative NP or by a prepositional phrase headed by *für* 'for':

- (13) a. *Rebecca öffnete ihm die Tür*
'Rebecca opened him-DAT the door'
b. *Rebecca öffnete die Tür für ihn*
'Rebecca opened the door for him-ACC'

Like many other causative verbs, *öffnen* 'to open' consists of two subevents e^1 (the acting of Rebecca on the door) and e^2 (the door opening) and a result state s (the door being open):

<i>öffnen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{ÖFFN}(x, y, e)]$
	LES: $(\rightarrow_1 e^1: x^{\text{AGENT}}, y^{\text{PATIENT}}) \circ (\rightarrow_1 e^2: y^{\text{PATIENT}}) < (\rightarrow_1 s: y^{\text{PATIENT}})$

Lex 5: *öffnen* 'open'.

A benefactive *für*-PP can modify each of these three subevents in the sense that this subevent occurs for the benefit of the PP-internal referent. In (14), the subordinate final sentence makes clear in which sense it is a particular subevent that occurs for the benefit of this participant:

- (14) a. Pred. over e^1 : *soll ich die Tür für ihn öffnen (... damit er sieht, dass ich das schon allein kann)?*
'shall I open the door for him (... so that he will see that I can do that by myself)?'
b. Pred. over e^2 : *soll ich die Tür für ihn öffnen (... damit er hört, dass sie nicht mehr quietscht)?*
'shall I open the door for him (... so that he will hear that it doesn't squeak anymore)?'
c. Pred. over e^3 : *soll ich die Tür für ihn öffnen (... damit er hereinkommen kann)?*

'shall I open the door for him (... so that he can come in)?'

In contrast, we can see in (15a, b) that the interpretation of the benefactive dative is much more restricted. This is in accordance with what we would expect if it constitutes an argument.¹⁵ The dative is clearly related to the result state, as can be seen from (15c), i.e., the dative referent has to benefit from this state, e.g., in the sense that he wants to enter the room or to look inside the room. Interpretations like the ones in (15a) and (15b) are not available, in which the dative marked participant benefits from either of the other two subevents:

- (15) a. Pred. over e^1 : *soll ich ihm die Tür öffnen (?... damit er sieht, dass ich das schon allein kann)?*
'shall I open him the door (... so that he will see that I can do that by myself)?'
b. Pred. over e^2 : *soll ich ihm die Tür öffnen (?... damit er hört, dass sie nicht mehr quietscht)?*
'shall I open him the door (... so that he will hear that it doesn't squeak anymore)?'
c. Pred. over e^3 : *soll ich ihm die Tür öffnen (... damit er hereinkommen kann)?*
'shall I open him the door (... so that he can come in)?'

4.2 Subevents and interlexematic relations

Further support for the assumption that structured events are linguistically relevant comes from interlexical relations like hyponymy or antonymy. These are rarely discussed in verb semantics, probably because they cannot be easily accounted for in decompositional approaches,¹⁶ which have dominated verb semantics for quite a while.

Expressions like *run somewhere* vs. *jog somewhere* (16) and *dye something* vs. *blacken something* (17) stand in a relation of hyponymy. Every *jogging to somewhere* is a *running to somewhere* (but not the other way around) and every *blackening something* is (at least at first sight) a *dying something*, but not the other way around.

- (16) a. *Rebecca jogged to the lake*
b. *Rebecca ran to the lake*
(17) a. *Jamaal blackened his shoes*
b. *Jamaal dyed his shoes*

There is a crucial difference between these two pairs, though, which becomes obvious when we look at the event structures of the respective verbs:

<i>jog</i>	SYN: /Ø/nom
	SEM: $\lambda P^{[+direction]}\lambda x\lambda e[JOG(x,P(x),e)]$
	LES: $(\rightarrow_I e^1: x^{AGENT}) < (\rightarrow_I s: x^{AGENT})$

Lex 6: *jog*.¹⁷

<i>blacken</i>	SYN: /obl/nom
	SEM: $\lambda y\lambda x\lambda e[BLACKEN(x,y,e)]$
	LES: $(\rightarrow_I e^1: x^{AGENT}, y^{PATIENT}) \circ (\rightarrow_I e^2: y^{PATIENT}) < (\rightarrow_I s: y^{PATIENT})$

Lex 7: *blacken*.

For the blackening-dying pair the hyponymy relation is related to the result state (the result state of *blackening* is a specific case of the result state of *dying*), while for the jogging-running pair it is related to the agentive subevent (the activity of *jogging* is a special form of *running*) but not to the result state of being somewhere. By referring to structured events, we can refine and relativize the idea of hyponymy as follows:

- (i) The verb *to run* (in its directional variant) is a hyponym of *to jog* with respect to the agentive subevent e^1 because all properties of e^1 which can be inferred from *to run* can also be inferred from *to jog* with respect to its agentive subevent e^1 . It follows from *to run* that the agent moves his legs in e^1 . The same follows from *to jog* with respect to e^1 , but where *to jog* also implies that e^1 is a kind of a sports activity and relatively slow.
- (ii) The verb *to dye* is a hyponym of *to blacken* with respect to the result state s because all the properties of s which can be inferred from *to dye* can also be inferred from *to blacken* with respect to its result state s' . It follows from *to dye* that the dyed object has a different color than before. The same follows from *to blacken* with respect to s' , but with the difference that *to blacken* also implies that the new color of the object is black.

This relativized notion of interlexematic relations is more than a mere refinement, because a closer look reveals that there is no unrelativized hyponymy relation between *to blacken* and *to dye*. Not every blackening is a dying:

- (18) a. *he blackened his face*
b. *?he dyed his face*

Yet, the hyponymy relation still holds with respect to the result states: 'y being black which it was not immediately before the event' is a particular case of 'y having a color which it did not have immediately before the event'.¹⁸

4.3 Result states

Result states play a role not only for a refined notion of interlexematic relations, but also for a number of other phenomena. The choice of the auxiliary for the perfect tenses of German intransitive verbs depends on whether the verb denotes an event that leads to a result state or not. In the former case, the auxiliary *sein* 'be' is chosen (19a), in the latter *haben* 'have' occurs (19b).

- (19) a. *sie ist gefallen / gestorben / zerbrochen / verblüht*
she is fallen / died / broken / withered
'she (it) fell / died / broke / withered'
b. *sie hat getanzt / gearbeitet / gegessen / geblüht*
she has danced / worked / eaten / withered
'she (it) danced / worked / ate / blossomed'

Kaufmann (1995: 407f) shows that it is not a mere change but a final state that triggers the choice of *sein*. The verbs *aufhören* 'stop' and *anfangen* 'begin' select *haben* because - although they refer to a change - they do not introduce a result state. The verb *bleiben* 'remain', on the other hand, which specifies the following state as similar to the preceding state instead of referring to a change, takes *sein* as perfect auxiliary.

Similarly, with verbs of motion *sein* occurs with the directional variant of the verb, *haben* usually with the non-directional and therefore non-resultative variant:¹⁹

- (20) a. *wir sind ins Zimmer getanzt*
we are into-the room danced
'we danced into the room'
b. *wir haben den ganzen Tag getanzt*
we have the whole day danced
'we danced the whole day'

The same criterion holds for the attributive use of the past participle of intransitive verbs which is only possible with verbs referring to events that lead to a result state; for auxiliary selection and restrictions of attributive use of the past participle cf. Hemmer (1780: 57), Blatz (1896: 561, 609), Paul (1902), Curme (1915: 270f), Abraham (1990), Kaufmann (1995: 407), Zaenen (1993: 141f):

- (21) a. *die geschmolzene Butter / der eingetroffene Zug / der verstorbene Künstler*
'the melted butter / the "arrived" train / the ("died") dead artist'
b. **der getanzte Mann / *die gelaufene Frau / *der geblutete Hund*
'the danced man / the run woman / the bled dog'

In some cases, where the verb itself does not introduce a result state, a contextually reconstructed result state can license the attributive use of the participle: *das gelesene Buch* 'the read book / the book having been read'. We probably conceive of reading a book as following a path which consists of the content of the book and whose end is reached when the last part of that content has been taken in by the reader. Furthermore, there are verbs like *bewachen* 'to guard', which do not involve a result state but nevertheless occur as attributive past participles: *die gut bewachte Bank* 'the well guarded bank'. Although not resultative, these verbs involve a state in the sense that they express that a certain state is kept up by the agent (cf. the discussion and representation in section 5.1).

Other phenomena whose explanation depends on the representation of result states are the admissibility of a stative passive, the embedability of verbs in complement sentences of aspectual verbs like *stop* and *finish* (cf. Engelberg, 2000b), the occurrence of certain types of valence alternations, the interpretation of attributive participles (cf. section 5.2), and the occurrence of verbs with particular types of aspectual adverbials (cf. section 4.5).

4.4 Presupposed and implied subevents

The distinction between subevents whose occurrence is presupposed by the verb's meaning and those whose occurrence is entailed has proven relevant for the explanation of several phenomena in the domain of aspectual defectivity, aspectual adverbials and adverbial modification.

The reason why some verbs cannot occur in the progressive aspect has been a long-standing puzzle. Leaving aside restrictions on stative verbs for the moment, an approximate solution that makes use of both the distinction between durative and punctual verbs and between presupposed and entailed subevents is the following: while all resultative and non-resultative durative verbs allow the progressive form, for punctual verbs there are occurrence and interpretation restrictions. Firstly, punctual verbs can occur in the progressive if they are non-resultative; in this case they are interpreted iteratively (22). Secondly, punctual verbs that presuppose a preceding event occur in the progressive, as in (23), where it is presupposed that Rebecca participated in the race or was nearing the completion of her journey, respectively. In this case, the progressive sentence is related to the time of this preceding event. Finally,

punctual verbs that do not belong to these two types - especially those that lead to cognitive states - do not allow the progressive (24) (Engelberg, 1999b). Verbs of this last type are resultative in the sense that once somebody has noticed something, he is aware of it, and once something has astonished somebody, he is in a state of surprise.

(22) a. *Rebecca was pinching Jamaal* (→ repeatedly)

b. *Rebecca was hopping* (→ repeatedly)

(23) a. *Rebecca was winning the race*

b. *Rebecca was arriving*

(24) a. *??Rebecca was noticing that*

b. *??that was astonishing Rebecca*

The Lexical Event Structures of the three types of verbs include these properties, which license (Lex 8, 9) or do not license (Lex 10) the progressive:²⁰

<i>pinch</i>	SYN: /obl/nom
	SEM: $\lambda y \lambda x \lambda e [\text{PINCH}(x, y, e)]$
	LES: $(\rightarrow_I e^1 [+PCT]: x^{\text{AGENT}}, y^{\text{PATIENT}})$

Lex 8: *pinch*.

<i>win</i>	SYN: /obl/nom
	SEM: $\lambda y \lambda x \lambda e [\text{WIN}(x, y, e)]$
	LES: $(\rightarrow_P e^1 [+DUR]: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_I e^2 [+PCT]: y^{\text{AGENT}}, y^{\text{PATIENT}})$

Lex 9: *win*.

<i>notice</i>	SYN: /obl/nom
	SEM: $\lambda y \lambda x \lambda e [\text{NOTICE}(x, y, e)]$
	LES: $(\rightarrow_I e^1 [PCT]: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_I s: x^{\text{AGENT}}, y^{\text{PATIENT}})$

Lex 10: *notice*.

A similar restriction holds for the co-occurrence of punctual verbs and adverbials of the type *in two hours*, as has already been noticed by Romberg (1899). These adverbials usually combine with verbs denoting durative events with a result state (25a)²¹. If combined with punctual change-of-state verbs, the sentences often sound odd (25b), unless one of two conditions holds. The first condition is that there is a preceding event that can be anchored in the context as a reference point for the beginning of the interval, as in (25c). In this case we do not get an event-exhaustive interpretation for the adverbial, though. That is to say, the interval of two minutes can not be identified with the length of the event referred to. The second condition is that a preceding event is lexically presupposed, as in (25d), where it is presupposed that Rebecca had been moving towards the summit and the *in*-adverbial

comprises the event time of the presupposed subevent. The event structure of *reach* is given in Lex 11.

- (25) a. *Rebecca wrote the paper in six weeks*
 b. ??*Rebecca's vase broke in two minutes* (unacceptable in the event-exhaustive sense)
 c. *Rebecca pressed the button and the bomb exploded in two minutes*
 d. *Rebecca reached the summit in two hours*

<i>reach</i>	SYN: /obl/nom
	SEM: $\lambda y \lambda x \lambda e [\text{REACH}(x, y, e)]$
	LES: $(\rightarrow_P e^1[\text{DUR}]: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_I e^2[+\text{PCT}]: y^{\text{AGENT}}, y^{\text{PATIENT}})$ $< (\rightarrow_I s: y^{\text{AGENT}}, y^{\text{PATIENT}})$

Lex 11: *reach*.

A final argument for the relevance of the distinction between presupposed and implied events has already been mentioned in section 4.1. The attachment of manner adverbials to subevents is restricted to entailed subevents. Presupposed subevents cannot be modified.

4.5 Semantic relations and subevents

In section 3.1 I argued that event participants are related to some subevents but not necessarily to all of them. In the following, I will give two examples which show that it is the relation of the agent to the result state in particular that plays a role in licensing certain constructions.

It has occasionally been noticed (e.g., Morgan, 1969: 61; Pustejovsky, 1991b: 74) that phrases of the type *for one hour* show a certain ambiguity. In (26a) the *for*-phrase is related to the activity of jogging, in (26b) to the result state of being out of the house:

- (26) a. *he jogged for twenty minutes*
er joggte zwanzig Minuten lang
 he jogged twenty minutes long
 b. *he left the house for twenty minutes*
er verließ das Haus für zwanzig Minuten

As the translations in (26) show, these two readings are expressed by two different phrases in German. The restrictions for the German *für*-PP, as in (26b), are particularly interesting. The *für*-PP in its temporal meaning can only apply to a result state of an event if this result state is controlled by the agent, as in (27a) and (27b).²² If demonstrators block a street (27a), the

result state of the street being blocked will hold as long as the demonstrators maintain this state. Similarly, the result state of the factory being occupied is under the control of the workers (27b), while the state that results from loosing a key (27c) and the state of an apple having been eaten (27d) are not controlled by the agent.

- (27) a. *die Demonstranten blockierten die Straße für eine Stunde*
 'the demonstrators blocked the street for one hour'
 b. *die Arbeiter besetzten die Fabrik für drei Tage*
 'the workers occupied the factory for three days'
 c. *??sie verlor den Schlüssel für einige Minuten*
 'she lost the key for five minutes'
 d. *??sie aß den Apfel für eine Stunde*
 'she ate the apple for one hour'

There is an additional phenomenon for which a similar restriction holds, namely the occurrence of a PP expressing the agent with the so called *bleiben*-passive. Stative passives in German can be formed with the auxiliary *sein* 'be' or with *bleiben* 'remain'. As with other passives, it is possible to express the agent in a prepositional phrase. Yet, with the *bleiben*-passive the occurrence of this PP is heavily restricted:

- (28) a. *die Fabrik blieb (von den Arbeitern) besetzt*
 'the factory remained occupied (by the workers)'
 b. *die beiden blieben (*vom Standesbeamten) verheiratet*
 'they remained married (by the registrar)'
 c. *der Tänzer blieb (*vom Garderobier) angezogen*
 'the dancer remained dressed (by the dresser)'
 d. *??der Junge blieb (*von seinem Vater) gekämmt*
 'the boy remained combed (by his father)'
 e. *??das Hemd blieb (*von Klaus) gebügelt*
 'the shirt remained ironed (by Klaus)'
- (29) a. Agent-PP with *bleiben*-passive possible: *besetzen*, 'occupy'; *sperrern*, 'close (e.g. a street)'; *bedrohen*, 'threaten'; *blockieren*, 'block'; *bewachen*, 'guard'.
 b. Agent-PP with *bleiben*-passive not possible: *bügeln*, 'iron'; *essen*, 'eat'; *kämmen*, 'comb'; *herstellen*, 'produce'; *sortieren*, 'sort'.

Like with co-occurrence restrictions between verbs and *for*-PPs, the control of the stative subevent by the agent is the crucial licensing property (29).²³ This is reflected in the Lexical Event Structure for verbs like *besetzen* 'occupy':

<i>besetzen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{BESETZ}(x, y, e)]$
	LES: $(\rightarrow_1 e^1: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_1 s: x^{\text{AGENT}(\text{CONTROL})}, y^{\text{PATIENT}})$

Lex 12: *besetzen* 'occupy'.

5 Temporal properties and relations

5.1 Temporal relations

Two kinds of temporal information about subevents are encoded in Lexical Event Structures, namely the length of subevents and temporal relations between subevents. In the following, I will give an overview of the phenomena whose explanation depends on the encoding of these (partly) lexical properties.

The relevance of temporal relations between subevents shows up in the inference behavior of sentences with causative verbs. As has often been observed, a sentence containing a causative verb entails the sentence containing the corresponding inchoative verb, as in (30). What has not been noticed, though, is that the entailment relation between causative and inchoative variant does not always hold if the verbs are put in the progressive form (31). For example, it doesn't hold for (31b) because Rebecca might have been interrupted while felling the tree, in which case the tree might never have been falling.

- (30) a. *Rebecca dried her hair* \rightarrow *her hair dried*
 b. *Rebecca felled the tree* \rightarrow *the tree fell*
- (31) a. *Rebecca was drying her hair* \rightarrow *her hair was drying*
 b. \neg [*Rebecca was felling the tree* \rightarrow *the tree was falling*]

The different inference behaviour in (31) can be put down to semantic peculiarities of the verb *dry* on the one hand and *fell* on the other. With *dry* the temporal relation between the causing event (Rebecca acting upon her hair) and the caused event (her hair drying) can be conceived of as temporally parallel or overlapping as with *abtrocknen* 'dry off' in Lex 1 (section 2.2). This temporal relation does not hold with *fell*; the causing event (Rebecca acting upon the tree) necessarily precedes the caused event (the tree falling):

<i>fell</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{FELL}(x, y, e)]$
	LES: $(\rightarrow_1 e^1 [+DUR]: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_1 e^2 [+PCT]: y^{\text{PATIENT}}) < (\rightarrow_1 s: y^{\text{PATIENT}})$

Lex 13: *fell*.

Typically, durative, resultative verbs, i.e., verbs that occur in accomplishment expressions, can be modified by *in*-PPs, as in (32a). But some of these verbs, even if they allow *in*-PPs in their inchoative variant (32b), are clearly less acceptable with these adverbials in their causative variant (32c):²⁴

- (32) a. *Tom strich den Zaun in zwei Stunden an*
 'Tow painted the fence in two hours'
 b. *das Haus brannte in zwei Stunden nieder*
 'the house burnt down in two hours'
 c. *??Rebecca brannte das Haus in zwei Stunden nieder*
 'Rebecca burnt down the house in two hours'
 d. *Rebecca fällte den Baum in fünf Minuten*
 'Rebecca felled the tree in five minutes'

The temporal structure of transitive *niederbrennen* 'burn down' is similar to that of *fell* in that the causing event (Rebecca setting fire to the house) precedes the caused event (the house burning down). But mere precedence does not exclude *in*-adverbials, as can be seen in (32d). The restriction is that the end of the first, causing subevent must not be separated from the result state by a considerably long (i.e., durative) caused subevent. The lexical entries of *fällen* 'fell' (as in Lex 13), *anstreichen* 'paint' (Lex 14) and *niederbrennen* 'burn down' (Lex 15) show the differences in temporal structure among the three causative verbs discussed. Note that verbs can be underspecified with respect to the duration of the subevent. The verb *niederbrennen* does not imply anything particular about the length of the causing subevent:

<i>anstreichen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{ANSTREICH}(x, y, e)]$
	LES: $(\rightarrow_1 e^1 [+DUR]: x^{\text{AGENT}}, y^{\text{PATIENT}}) \circ (\rightarrow_1 e^2 [+DUR]: y^{\text{PATIENT}}) < (\rightarrow_1 s: y^{\text{PATIENT}})$

Lex 14: *anstreichen* 'paint'.

<i>niederbrennen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{NIEDERBRENN}(x, y, e)]$
	LES: $(\rightarrow_1 e^1: x^{\text{AGENT}}, y^{\text{PATIENT}}) < (\rightarrow_1 e^2 [+DUR]: y^{\text{PATIENT}}) < (\rightarrow_1 s: y^{\text{PATIENT}})$

Lex 15: *niederbrennen* 'burn down'.

Other phenomena depend on how a state as part of an LES is temporally related to the other subevents. While states usually show up as result states, i.e., states which follow the event

referred to by the verb, there are some verbs which express actions whose purpose it is to maintain a certain kind of state. Somebody who guards something keeps it in a state of security, where the activity of guarding is temporally parallel to the state of being secure:

<i>bewachen</i>	SYN: /acc/nom
	SEM: $\lambda y \lambda x \lambda e [\text{BEWACH}(x,y,e)]$
	LES: $(\rightarrow_I e^{1[+DUR]}: x^{\text{AGENT}}, y^{\text{PATIENT}}) \circ (\rightarrow_I s: y^{\text{PATIENT}})$

Lex 16: *bewachen* 'guard'.

This difference between transitive verbs like *bewachen* 'guard' (Lex 16) and *anstreichen* 'paint' (Lex 14) has a well-known effect on the interpretation of attributively used past participles of these verbs (Wustmann, 1891: 189). In (33a) the event denoted by the participle is contemporaneous with the event denoted by the finite verb (the army base is guarded while being watched) while in (33b) it precedes it (the fence had been painted before being watched):

- (33) a. *Rebecca betrachtete die gut bewachte Kaserne*
 'Rebecca observed the well guarded army base'
 b. *Rebecca betrachtete den frisch gestrichenen Zaun*
 'Rebecca observed (looked at) the freshly painted fence'

5.2 Punctual vs. durative events

Besides temporal relations between subevents, the punctual-durative distinction constitutes the second type of temporal information in Lexical Event Structures. This distinction has been employed in research on aspect and aktionsarten ever since (e.g., in Streitberg, 1891: 71f; Romberg, 1899: 4f). Although the early attempts to explain the difference between imperfective and perfective aspect (e.g., Schleicher, 1855; Pott, 1859) in terms of a distinction between durativity and punctuality have proven unsuccessful, it is still a matter of dispute whether phenomena in the domain of aktionsarten and Vendler-classes have to do with this distinction. Some semanticists have argued in favor of it (Vendler, 1957: 156; Moens & Steedman, 1988: 42; Ehrich, 1991: 452; Mittwoch, 1991) and some against it (Mourelatos, 1978: 417; Dowty, 1979: 181ff; Tenny, 1987a: 25ff; Verkuyl, 1989: 55ff; Klein, 1994: 88). The discussion can not be reviewed here,²⁵ but the following examples will show that the distinction between durative and punctual events is relevant for the explanation of a wide variety of phenomena.

One of the phenomena sensitive to this distinction has been discussed in section 2.2. The alternation between an accusative NP (34a) and a PP headed by the preposition *an* (34b) is restricted to verbs which express durative resultative events.

- (34) a. *sie schrieb einen Roman*
'she wrote a novel'
b. *sie schrieb an einem Roman*
she wrote at a novel
'she was writing a novel'

Co-occurrence restrictions between verbs or VPs and temporal-aspectual adverbials have been the main motivation for establishing Vendler-style aspectual verb classes. Some of these phenomena require a punctual-durative distinction. Not surprisingly, punctual verbs occur with punctual adverbials like *at that moment* (35a). Although durative verbs can also be modified by punctual adverbials, the interpretation they receive in this case is of a particular kind. While in (35a) the event time is conceived of as identical with the time denoted by the adverbial, in (35b) the time of the adverbial is interpreted as either coinciding with the begin of the event time or as within the event time. It should be kept in mind here that the German simple past in (35b) covers the progressive and the non-progressive reading.

- (35) a. *die Bombe explodierte in genau dem Augenblick*
'the bomb exploded right at that moment'
b. *um fünf Uhr backte er einen Kuchen*
'at five he baked / was baking a cake'

Punctual verbs can also be modified by durative adverbials. In contrast to durative verbs (36a), they get an iterative interpretation in this case (36b).²⁶

- (36) a. *Rebecca joggte eine Zeitlang*
'Rebecca jogged / was jogging for a while'
b. *Rebecca klopfte eine Zeitlang*
'Rebecca knocked / was knocking for a while'

It has also been noticed that punctual verbs do not occur as complements of aspectual verbs like *beginnen* 'start' or *aufhören* 'stop', as in (37a) (e.g., Streitberg, 1900: 61f; Dowty, 1979: 59). Again, this is possible if they can get an iterative interpretation, as in (37b), which is usually available for non-resultative punctual verbs:

- (37) a. **die Vase fing an / hörte auf zu zerbrechen*
 'the vase started / stopped breaking'
 b. *Rebecca fing an / hörte auf zu rülpsen*
 'Rebecca started / stopped belching' (→ belched repeatedly)

The Lexical Event Structures of the two types of punctual verbs in (36) are the following:

<i>zerbrechen</i>	SYN: /nom
	SEM: $\lambda x \lambda e [ZERBRECH(x,e)]$
	LES: $(\rightarrow_I e^{1[+PCT]}; x^{PATIENT}) < (\rightarrow_I s; x^{PATIENT})$

Lex 17: *zerbrechen* 'break'.

<i>rülpsen</i>	SYN: /nom
	SEM: $\lambda x \lambda e [RÜLPS(x,e)]$
	LES: $(\rightarrow_I e^{1[+PCT]}; x^{AGENT})$

Lex 18: *rülpsen* 'belch'.

Finally, according to Oya (1996), punctuality is among the conditions that determine the occurrence of the expletive reflexive pronoun *sich* with those intransitive verbs that take part in the causative-inchoative alternation in German. Verbs that do not occur with the reflexive pronoun are those that refer to punctual events (*zersplittern* 'shatter', *zerbrechen* 'break', *abreißen* 'tear off'), events that originate naturally (*reifen* 'ripen', *schmelzen* 'melt', *gären* 'ferment'), or to events that constitute movements like *rollen* 'roll', *segeln* 'sail', or *fliegen* 'fly':

- (38) *der Zweig biegt sich / *der Zweig biegt* (durative)
 the twig bends itself / the twig bends
 'the twig bends'
 (39) **der Zweig bricht sich / der Zweig bricht* (punctual)
 the twig breaks itself / the twig breaks
 'the twig breaks'

The occurrence restrictions for the progressive and the interpretation and co-occurrence of *in-*adverbials with punctual verbs, which were described in section 4.4, are two other phenomena involving the punctual-durative distinction.

6 The semantics of event-internal temporality

6.1 The semantics of temporal relations

Although many theories in lexical semantics are more or less successful in mapping distinctions in the semantic and syntactic behavior of verbs onto distinct structures in lexical representations, these theories often do not put much effort into clarifying the semantics of these structures. The meaning representations are often vague, with the result that the syntactic and semantic phenomena to be explained tend to shape the representations in a circular way, thereby yielding empirically weak theories.²⁷

If we look at theories **T1** through **T9** we see that semantic information usually comes in the form of propositions containing a number of predicates, which can be one-place or multi-place, first order or higher order. Thus, in order to make the content of these propositions precise, we have to answer the following three questions:

- (i) What is the logical type of the predicates involved, i.e., is 'AGENT' a function or a relation between thing and event individuals, or between predicates and argument positions, is 'PUNCTUAL' a first-order property of events or a second-order property of verbal predicates, etc.?
- (ii) What are the truth conditions for these predicates and how can we determine the meaning of 'AGENT' or 'PUNCTUAL' as independently as possible from the phenomena to be explained?
- (iii) What do the variables of the basic ontological sorts like x and e stand for, i.e. what are the identity criteria for things and events?²⁸

In this section, I will show how questions (i) and (ii) can be answered for some of the properties and relations employed in the Lexical Event Structures. Question (i) is given an especially detailed treatment in Engelberg (2000b), in particular with respect to the logical type of thematic roles and similar semantic relations. Question (iii) with respect to the ontology of events is dealt with extensively in Engelberg (2000b; 2001).

Two strategies can be employed to achieve a precise characterization of the truth conditions of the predicates employed in the lexical-semantic representations in order to ensure the interpretability of these representations. We can explore the properties of the predicates in our representations within formal logic and / or we can link these predicates to cognitive structures whose existence and properties have been determined by cognitive research. I will exemplify these strategies for the temporal domain of Lexical Event Structures.

So far, only two temporal relations have been employed in Lexical Event Structures: precedence ($<$) and overlap (\circ). A closer look at different verbs shows that things are a little

bit more complicated. Firstly, we have to distinguish between precedence ($<$) and immediate precedence ($\mid<$). In (40a) the first subevent (Rebecca's throwing motion) has to precede the second subevent immediately (the flying of the spear). Likewise in (40b), the drying event immediately precedes the result state of the hair being dry. In (40c), on the other hand, the temporal relation between the causing and the caused event is partly determined by the context. If Rebecca has killed Jamaal by poisoning him it could be the case that a considerable amount of time passed between the causing and the caused subevent. Thus, the lexical specification only requires a mere precedence relation between the two subevents.

- (40) a. *Rebecca threw the spear*
 b. *Rebecca's hair dried*
 c. *Rebecca killed Jamaal*

Secondly, the relation of temporal overlap can be split into three different relations: overlapping precedence ($<_{\circ}$), temporal identity ($=_t$), and earlier begin ($<_s$). In (41a), Rebecca's motion and the movement of the cart do not completely overlap. We can assume that Rebecca's motion begins a little bit earlier. In (41b), both the translatory movement of the wheel down the hill and its rotation occupy the same stretch of time. The event times of the two subevents are identical.²⁹ In (41c), the temporal relation is more unspecific. Rebecca might have turned on the oven such that a minute later the butter began to melt. Or she might have supported the melting process by constantly stirring the butter. The only thing that needs to be specified in the LES is that the causing subevent begins earlier than the caused subevent, where both subevents can overlap but need not do so.

- (41) a. *Rebecca pushed the cart*
 b. *the wheel rolled down the hill*
 c. *Rebecca melted the butter*

Thus, it is necessary to distinguish the following five temporal relations between subevents in Lexical Event Structures:

- | | | |
|--|---------------------------------------|--|
| (i) precedence ($<$) | e.g., <i>kill / töten</i> (x,y,e) | LES:.. ($\rightarrow_1 e^1$) $<$ ($\rightarrow_1 e^2$) ... |
| (ii) immediate precedence ($\mid<$) | e.g., <i>throw / werfen</i> (x,y,e) | LES:.. ($\rightarrow_1 e^1$) $\mid<$ ($\rightarrow_1 e^2$) ... |
| (iii) temporal identity ($=_t$) | e.g., <i>roll / rollen</i> (x,e) | LES:.. ($\rightarrow_1 e^1$) $=_t$ ($\rightarrow_1 e^2$) ... |
| (iv) earlier begin ($<_s$) | e.g., <i>melt / schmelzen</i> (x,y,e) | LES:.. ($\rightarrow_1 e^1$) $<_s$ ($\rightarrow_1 e^2$) ... |
| (v) overlapping precedence ($<_{\circ}$) | e.g., <i>push / schieben</i> (x,y,e) | LES:.. ($\rightarrow_1 e^1$) $<_{\circ}$ ($\rightarrow_1 e^2$) ... |

Temporal relations can be made explicit fairly easily within temporal logic. I will assume that a temporal event structure TES is a tuple $\langle E, <, \circ \rangle$ where E is a set of events and " $<$ " and " \circ " are the two basic temporal relations 'precedence' and 'overlap'. Kamp & Reyle (1993: 667f) give a set of axioms for this structure.³⁰ They furthermore assume that times can be constructed out of events by a homomorphic mapping from event structures to interval structures. Within this structure, it is now possible to define the temporal relations employed in Lexical Event Structures:

Temporal relations

The basic relations are precedence ($<$) and overlap (\circ); for any events e^1 , e^2 , and e^3 we can derive immediate precedence ($\mid<$), temporal identity ($=_t$), overlapping precedence ($<\circ$) and earlier begin ($<_s$) as follows:

- (i) $\Box \forall e^1 \forall e^2 [(e^1 \mid< e^2) \leftrightarrow_{\text{def}} ((e^1 < e^2) \& \neg \exists e^3 [(e^1 < e^3) \& (e^3 < e^2)])]$
- (ii) $\Box \forall e^1 \forall e^2 [(e^1 =_t e^2) \leftrightarrow_{\text{def}} ((e^1 \circ e^2) \& \forall e^3 [(e^1 < e^3) \leftrightarrow (e^2 < e^3)]) \& ((e^3 < e^1) \leftrightarrow (e^3 < e^2)))]]$
- (iii) $\Box \forall e^1 \forall e^2 [(e^1 <\circ e^2) \leftrightarrow_{\text{def}} ((e^1 \circ e^2) \& \exists e^3 [(e^3 < e^2) \& \neg (e^3 < e^1)])]$
- (iv) $\Box \forall e^1 \forall e^2 [(e^1 <_s e^2) \leftrightarrow_{\text{def}} \exists e^3 [(e^3 < e^2) \& \neg (e^3 < e^1)]]]$

According to (i), an event e^1 immediately precedes an event e^2 , iff it precedes it and there is no event e^3 between e^1 and e^2 . According to (ii), two events are temporally identical iff all events that follow e^1 also follow e^2 and the other way around, and iff all events that precede e^1 also precede e^2 and the other way around. According to (iii), an event e^1 precedes and overlaps an event e^2 iff e^1 and e^2 overlap and there is an event e^3 that precedes e^2 but not e^1 . Finally, according to (iv), e^1 begins earlier than e^2 iff there is an event e^3 that precedes e^2 but not e^1 .

We can now formulate the following hypothesis about temporal relations within Lexical Event Structures:

Temporal relations in Lexical Event Structures

- (i) $\text{TR} = \{<, \mid<, <\circ, =_t, <_s\}$, where TR is the set of admissible temporal relations in an LES; no other temporal relations occur between subevents in an LES.
- (ii) For all subevents e^n and e^m within an LES, there is a relation R in TR such that:
LES: $(e^m \text{ R } e^n)$.³¹

Condition (i) restricts the possible relations in Lexical Event Structures. Strikingly, simple overlap does not play a role. There seem to be no verbs which require that two subevents

overlap without determining the order of the begin of the subevents. Condition (ii) determines that verbs always put restrictions on the temporal relations between subevents, i.e., there are no verbs that allow the temporal relations between subevents to be entirely determined by the context. These hypotheses show how an exact account of temporal relations within Lexical Event Structures leads to interesting generalizations about possible words.

One remark about underspecification: the temporal relations which occur in Lexical Event Structures are defined in such a way that they underspecify the possible temporal relations which hold between the actual subevents. The underspecification is reflected in the fact that the relations in TR stand in implication relations to each other. For example, 'immediate precedence' (as in the LES of *throw*) implies 'precedence' (as in *kill*). Thus, *kill* is less specified for temporal relations between subevents than *throw*. Similarly, 'overlapping precedence' (as with *push*) implies 'earlier begin' (as with *melt*) such that *melt* is less specified than *push*.

Some of the rules which make use of the restrictions that have been mentioned in this section require more information about temporal relations than are actually specified in the Lexical Event Structures. For example, the incompatibility of transitive *niederbrennen* 'burn down' with *in*-adverbials has been traced back to the restriction that the end of the causing subevent should not be separated from the result state by a durative caused subevent. The LES for *niederbrennen* in Lex 15 (section 5.1) specifies that the first subevent precedes the second one. But this is probably too strict. It is possible to construe the involvement of the agent during the whole event time in an appropriate context, such as *by constantly fanning the fire she burnt down the shack in two hours*. The LES must therefore underspecify the relation between e^1 and e^2 as one of earlier begin:

<i>niederbrennen</i>	SYN:	/acc/nom
	SEM:	$\lambda y \lambda x \lambda e [NIEDERBRENN(x,y,e)]$
	LES:	$(\rightarrow_1 e^1: x^{AGENT}, y^{PATIENT}) <_s (\rightarrow_1 e^{2[+DUR]}: y^{PATIENT}) < (\rightarrow_1 s: y^{PATIENT})$

Lex 15': *niederbrennen* 'burn down'.

The first version, in Lex 15, merely constitutes the default, i.e., Lex 15 has specified how sentences containing *niederbrennen* are interpreted unless contextual information is available which contradicts the statement about the temporal relations between e^1 and e^2 .

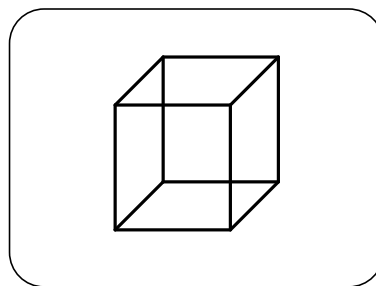
6.2 The semantics of punctuality

Besides temporal relations, the specification of events as durative vs. punctual determines the temporal structure within an LES. At first sight, employing temporal logic yet again to define these notions seems to be the straightforward thing to do. But a simple distinction between temporal points and intervals will not do the trick here, since most verbs marked as punctual are not entirely lacking duration. Events as referred to by *break*, *jump*, *belch* or *knock* take up some amount of time, miniscule though it may be. In other words, these events do not occur at temporal points, a fact which has been observed before.³² In an early account, Pott (1859: 178) assumes that for aspectual verb pairs in Slavic and pairs in German like *sitzen* 'to sit' / *sich setzen* 'to sit down' one can discover "[...] that in these pairs reference to the same kind of temporal property is made, which involves - to illustrate the matter briefly and aptly by borrowing a spatial metaphor - whether they are thought of as being p u n c t u a l in their duration (which, of course, is impossible in the strongest mathematical sense and therefore only relatively true) or as being l i n e a r".³³ More recently Platzack (1979: 93) remarks that punctual events are those, "that do not last in time (or rather, are not conceived of as lasting in time)", and Moens (1987: 102) claims that "[...] processes and culminated processes can be »compressed« into points. This [...] does not mean that they cease to have a temporal duration, but rather that their internal structure is no longer of importance."

These explanations do not have much of an explanatory bite to them. In particular, it leaves us with two questions. Firstly, why should we conceive of extremely short events as events without duration, or, in other words, why should we deceive ourselves about the true duration of events? Secondly, why do languages rely so heavily on a distinction between events that do not last more than a couple of seconds and those which last longer?

Most of the predicates employed in lexical semantics can be tied to central cognitive concepts, such as agentivity or causation. In this context, it seems quite reasonable to expect that a cognitive basis for the distinction between short and long events can be identified, too. Indeed, research on cognitive time concepts reveals that a short interval of 2 to 3 seconds plays a crucial role for perception, behavior, and speech production. The following phenomena involve this three-second interval which I will refer to as the 'cognitive moment'³⁴:

- (i) Errors in the estimation of the length of intervals: Experiments show that the length of short acoustic or visual stimuli is overestimated while the length of long stimuli is underestimated; the threshold between over- and underestimation lies between 2 and 2.5 seconds (Pöppel, 1978: 723f).
- (ii) Oscillation of extremely faint sounds: Faint, barely audible acoustic stimuli like the ticking of a watch held some distance from the ear are only perceived periodically; the rhythmic appearance and disappearance of the sound perception occurs every couple of seconds (Urbantschitsch, 1875).
- (iii) Rhythm of metronome beats: Regular metronome beats of equal acoustic quality are perceived as units of two (or more); this "tick-tock" effect disappears if the distance between two beats exceeds about 2.5 seconds (Wundt, 1911: 6).
- (iv) Oscillation of ambivalent patterns: The perception of ambivalent patterns like the Necker cube below oscillates between the two readings of the pattern at least every three seconds or so; to a large degree this occurs independently of the will of the observer (Pöppel, 1985: 56ff).



- (v) Distance between pauses in speech production: Crosslinguistic investigations of spoken lyrics show a tendency towards rhythms with short pauses about every 3 seconds (Turner & Pöppel, 1983). Comparable rhythms can be found in normal speech (Pöppel, 1985: 71ff). An independent observation is that rhythmic pauses in speech cannot be explained by the demands of breathing rhythms (Handel, 1989: 426).
- (vi) Rhythm of actions: Intercultural investigations show that simple actions like scratching, hand-shaking, knocking, chopping a tree, waving, or hammering tend to be bundled into rhythmic groups with a length of two to three seconds, interrupted by short breaks (Feldhütter, Schleidt & Eibl-Eibesfeldt, 1990).

The cognitive moment or "subjective present", as this interval has also been called, is determined by a neural mechanism that integrates successive events into a perceptual gestalt whose duration is restricted to an upper limit of about three seconds (Pöppel, 1985: 53). This gestalt creates something like a "window of consciousness" that induces a "feeling of nowness". Since the perception of events and the structure of our own actions is determined by the cognitive moment, it can be assumed that our general cognitive concept of events involves a classification of events that is mirrored in the way we use verbs to talk about events: punctual events are events that do not take longer than the duration of the cognitive moment, while durative events exceed this three-second interval.

Since this concept of punctuality is by and large based on the perception of events, its relevance for concrete, perceptible events is obvious. But, many verbs referring to perceptible events in their basic reading (42a) have also metaphorical readings (42b). Interestingly, the behavior with respect to the *an*-construction, which is sensitive to the punctual-durative distinction (section 5.2), is the same as with the basic reading. Yet, the claim that the denoted event in (42b) is punctual may be hard to defend in light of the fact that it doesn't preserve the temporal structure of the basic reading completely. Splitting a party can take more time than just a couple of seconds.

- (42) a. *sie spaltete das Brett / *an dem Brett*
'she split the board / was splitting the board'
b. *sie spaltete die Partei / *an der Partei*
'she divided ("split") the (political) party / was dividing the party'

Thus, if we conceive of the basic reading of a verb as being the reading in which the verb refers to a concrete event that is immediately perceptible, we can call those verbs punctual or non-punctual which refer to punctual and non-punctual events respectively in this basic reading. More precisely, we call those verbs punctual which refer to events whose only (e.g., intransitive *break*) or whose caused (e.g., transitive *break*) subevent is punctual in the basic reading of the verb. The *an*-construction is not restricted to verbs referring to non-punctual events only, but to non-punctual verbs in the sense just defined. Coming back to one of the central questions posed at the beginning of section 6.1, namely the one of the logical type of the predicates involved, punctuality, "PCT₁", turns out to be a first-order predicate over events that don't last longer than a cognitive moment. On the basis of PCT₁, a second-order punctuality predicate over verbs, "PCT₂", can be defined as characterizing those verbs which refer to punctual verbs in their basic reading. PCT₂ can then be employed in the explanation of linguistic phenomena like the valence alternation between the accusative NP and the *an*-pp.³⁵

7 Conclusion

The paper at hand has offered a proposal for a lexical-semantic theory. Enterprises of this sort are confronted with questions such as the following:

- (i) What is the domain of linguistic phenomena whose explanation is intended to be supported by the meaning representations employed in the theory?
- (ii) Which entities and structures in the representations are needed to capture all the lexical distinctions that are necessary for the explanation of these phenomena?
- (iii) What is the 'meaning' of the lexical-semantic representations, i.e., how can the truth conditions for the propositions occurring in these representations be made explicit?
- (iv) What are the semantic, syntactic or morphological rules that operate on these meaning representations?
- (v) How are the lexical-semantic representations processed in the semantic derivation of the sentence?

In this paper I have put the emphasis on the first three questions and have provided the following answers:³⁶

A lexical-semantic theory on verb semantics should support explanations in five domains of phenomena, semantics-syntax mapping, grammatical-categorial restrictions, interlexematic relations, inference behavior, and selectional restrictions. Thematic role approaches and decompositional theories have been shown to be inadequate for the explanation of several phenomena within these domains. Instead, a theory based on the notion of structured events yields more satisfying results. A few assumptions guided the development of Lexical Event Structure Theory as outlined in this paper: events are internally structured in the sense that they consist of several subevents and states whose temporal duration and relations have to be specified. The occurrence of these subevents is either implied or presupposed and event participants are related to some, but not necessarily all subevents by semantic relations.

The discussion of several phenomena out of the five domains listed above has revealed that Lexical Event Structures provide the right semantic distinctions for the explanation of these phenomena. From the domain of semantics-syntax mapping there are the phenomena of the *an*-construction in German and the realization of the agent in a stative construction, from the domain of grammatical-categorial restrictions the restrictions on the occurrence of verbs in the progressive aspect and the occurrence of attributively used past participles, from the domain of interlexematic relations a refined concept of hyponymy relations between verbs, from the domain of inference behavior the implications of causative verbs in the progressive aspect and the interpretation of aspectual adverbials, and from the domain of selectional

restrictions the adverbial modification of subevents, the selection of perfect auxiliaries and the co-occurrence restrictions of aspectual adverbials.

Furthermore, it has been argued that the empirical value of lexical-semantic theories depends above all on the explicitness and precision with which the predicates employed in the representations are defined. Discussing the logical type and the truth conditions of temporal properties of subevents and temporal relations between subevents it has been shown that two strategies can be applied to yield interpretable lexical-semantic representations. The predicates employed can be defined within some logical-semantic framework and they can be linked to central cognitive concepts which have been revealed by empirical cognitive research.

About the Author

Dr. Stefan Engelberg teaches at the University of Wuppertal, Germany. His personal homepage is <http://www.uni-wuppertal.de/FB4/personen/engelberg/welcome.html>.

Email: engelb@uni-wuppertal.de

Acknowledgements

This research has been carried out in the project SFB 282 "Theory of the Lexicon", supported by the DFG (Deutsche Forschungsgemeinschaft, 'German Science Foundation'). For comments and discussion I would like to thank Jennifer R. Austin, Kerstin Blume, Joachim Jacobs, Ingrid Kaufmann.

Notes

¹ For more details, cf. Filip (1989) and Engelberg (1994b).

² There is also a morphological restriction, in that derived verbs do not take part in the alternation, i.e. verbs converted from adjectives (*trocknen*, 'to dry'), prefixed verbs (*ver|nähen*, 'to close by sewing') and verbs with separable particles (*her|stellen*, 'to produce').

³ For simplicity, I will not list the particular semantic relations in the following representations, but just speak of agents and patients in a very unspecific way. I assume that thematic relations are derived from more basic

relations like 'volition', 'change', etc. within a prototype theory of thematic roles (T4) (cf. Dowty, 1991; Engelberg, 2000b).

- ⁴ States are not marked for durativity / punctuality. Except for very few cases, which do not play a role in Lexical Event Structures, like *it is twelve o'clock*, states are always conceived of as durative.
- ⁵ This follows the multidimensional valence theory developed within the research project "Theory of the Lexicon" (SFB 282); cf. e.g. Jacobs (1993, 1994).
- ⁶ Cf. furthermore Engelberg (2000b) for a discussion of why directional phrases (in contrast to locative phrases) are arguments and why variants of verbs that differ in their valency frames, like *fahren* with and without a directional phrase, have to be represented as different variants of the verb with different lexical entries.
- ⁷ These relations are probably better conceived of as relations between propositions about these subevents. As with causation, I don't want to discuss their semantics here. Notice that non-causal c-relations, i.e., concessive and consecutive relations, only occur between a presupposed and an implied subevent, but not between two implied subevents.
- ⁸ Vendler (1957) distinguished four aspectual classes of expressions which can be determined by several operational tests like occurrence in the progressive aspect and co-occurrence with adverbials like *for five minutes*, *in five minutes*, *at five o'clock*: states like *love somebody* (no progressive, *for*-PP, no *at*-PP), activities like *push a cart* (progressive, *for*-PP, no *in*-PP), achievements like *reach the summit* (no progressive, no *for*-PP, *at*-PP), and accomplishments like *write a letter* (progressive, no *for*-PP, *in*-PP).
- ⁹ Dowty (1979: 88) takes note of these verbs, too, and suggests treating them as BECOME-verbs that embed a vague predicate.
- ¹⁰ The sentence *the balloon burst in one hour* (10a) is at least not acceptable in the intended event-exhaustive reading, i.e. in the sense that the event of bursting itself took an hour. The example *the temperature rose in one hour* (10b) becomes more acceptable if the temperature at the beginning of the one-hour interval and the temperature at the end can be construed from the context.
- ¹¹ Except for some references in Verkuyl (1972), the huge amount of work done on aktionsart phenomena in historical-comparative linguistics from the middle of the 19th century onwards has gone unnoticed in modern research on aspectuality.
- ¹² Pustejovsky (1988: 31ff, 1991b: 70) demonstrates that adverbials often expose an ambiguity that can be resolved by the assumption that in each of the readings, the adverbial predicates over a different part of the event structure. Cf. for related solutions Morgan (1969: 61), Fillmore (1972: 5), Parsons (1990: 110f).
- ¹³ The verb *fahren* 'to drive, to go by car / train' exhibits a causative alternation in German:
- (i) *der Wagen fuhr* 'the car "drove" / moved'
 - (ii) *sie fuhr den Wagen* 'she drove the car'.
- ¹⁴ There is one as yet unexplained counterexample to this generalization. With some causative verbs, whose causing and caused subevent can be spatially separated, a local adverbial can only modify the whole event, and cannot do so with just one of the subevents, i.e., the sentence in (i) can only be uttered with respect to the event in (ii) but not with respect to (iii) and (iv):
- (i) *Rebecca ermordete Jamaal in Chicago* 'Rebecca murdered Jamaal in Chicago'
 - (ii) *e*: Rebecca did something in Chicago (e.g., sent cookies containing arsenic), such that Jamaal died in Chicago (after having received the cookies and eaten them)

(iii) *e*: Rebecca did something in Chicago (e.g., sent cookies containing arsenic), such that Jamaal died in San Francisco (after having received the cookies and eaten them)

(iv) *e*: Rebecca did something in San Francisco (e.g., sent cookies containing arsenic), such that Jamaal died in Chicago (after having received the cookies and eaten them)

¹⁵ For a more thorough discussion why the dative NP is an argument of the verb, cf. Engelberg (2000b).

¹⁶ This has already been shown by Fodor (1977: 150), who argued that in order to decompose *red* in a way that one concept in the decomposition is the superordinate concept of 'being-colored', the other concept would have to express the idea of 'redness-but-not-necessarily-colored'. However, there is no such concept.

¹⁷ The SYN information for *jog* in Lex 6 expresses that *jog* in this reading requires a nominative NP and a second phrase that is not formally restricted, but which according to the selectional restrictions for the argument *P* in SEM must express a direction; cf. Jacobs (1993, 1994) for the notation conventions. As far as the /nom value is concerned, we have to assume that nominative is not a structural case in German while it is in English. There are a couple of verbs in German like *grauen* 'being terrified' or *frieren* 'being cold' which must or can have a dative or accusative NP realizing their only argument, while English verbs are exceptionless in selecting /nom. Thus, from the viewpoint of syntactically processing valence information /nom can be omitted from the SYN value list of English verbs.

¹⁸ An objection could be raised that *blacken* implies a more superficial application of paint / dye while *dye* refers to a color change of the whole substance the paint / dye is applied to, and that therefore this does not constitute an example of hyponymy in a strict sense. But this depends on the exact description of the result state. If the result state of *dye* is understood in the sense that every part of the object the paint / dye has been applied to has a different color afterwards and the result state of *blacken* by the fact that every part of the object the paint / dye has been applied to is black afterwards, we still get a strict hyponymy relation with respect to the result state. Apart from that, there are other, less controversial cases of hyponymy relative to result states like *I got my pants altered* vs. *I got my pants shortened*.

¹⁹ It has to be conceded that some motion verbs allow *sein* for the non-directional variant, too (e.g., *schwimmen* 'to swim', *joggen* 'to jog'). Some intransitive motion verbs, like *gehen* 'to go / walk' or *rennen* 'to run', only occur with *sein*.

²⁰ It would have to be shown that the arguments of *win* and *notice* in fact bear the roles indicated in their event structures. The *x*-argument of *win*, for example, has sometimes been treated as non-agentive (e.g., Pustejovsky, 1991b: 61). I will not argue for any particular solution here, since the precise roles and the underlying semantic entailments are not relevant for the phenomena discussed.

²¹ As is well known, this does not hold if a bare plural or a mass noun occurs in object position: *??she wrote papers / stuff in two weeks*. A more detailed approach to this phenomenon would also assume that a certain type of incremental relation between the object referent and the event must hold (cf. Krifka, 1989a)

²² A corpus-based investigation supports this conclusion. There were only very few examples among the roughly 350 sentences in the corpus containing a *für*-adverbial which contradict this generalization in that the adverbial was not related to a state but to a particular kind of activity (cf. Engelberg, 1994a). The corpora used are accessible online at the Institute for German Language in Mannheim: <http://corpora.ids-mannheim.de/cgi-bin/idsforms/cosmas-www-client>.

- ²³ For some slight differences between the restrictions for the *für*-PP and the agent-PP with *bleiben*, cf. Engelberg (2000a).
- ²⁴ Cf. also Kaufmann's (1993: 241ff) discussion of these examples.
- ²⁵ Cf. Engelberg (2000b: 34ff) for a more extended discussion of the literature and Engelberg (1999b) for an overview of the relevant phenomena.
- ²⁶ This does not hold for many resultative punctual verbs, in particular those which denote non-repeatable events like the exploding of a bomb.
- ²⁷ Cf. the criticism in Ravin (1990) and Engelberg (1999a; 2000b]).
- ²⁸ It is widely assumed that the introduction of a basic ontological sort should be accompanied by a criterion that tells us under which condition two entities of this sort are identical (cf. Quine, 1975).
- ²⁹ It has been argued in Engelberg (2000b) that the rotation and the translatory movement expressed in (41b) constitute different subevents. Firstly, the event conception developed in Engelberg (2000b) establishes the two movements as being non-identical. Strong evidence from psychology of perception supports the view that we conceive of moving events as consisting of two subevents and not just as an event performed in a certain manner. Secondly, linguistic phenomena like adverbial modification of subevents support this assumption. This holds for other verbs of movement, too. In *she elegantly swam to the other side of the lake*, the adverb *elegantly* modifies that subevent which is constituted by the body movements of the swimmer. In *she swam across the lake without a detour* the adverbial *without a detour* specifies the translatory movement of the swimmer beginning at one and ending at the other end of the lake.
- ³⁰ The axioms from Kamp & Reyle (1993: 667f):
- (i) $\Box \forall e^1 \forall e^2 [(e^1 < e^2) \rightarrow \neg(e^2 < e^1)]$
 - (ii) $\Box \forall e^1 \forall e^2 \forall e^3 [(e^1 < e^2) \& (e^2 < e^3) \rightarrow (e^1 < e^3)]$
 - (ii) $\Box \forall e^1 [e^1 \circ e^1]$
 - (iv) $\Box \forall e^1 \forall e^2 [(e^1 \circ e^2) \rightarrow (e^2 \circ e^1)]$
 - (v) $\Box \forall e^1 \forall e^2 [(e^1 < e^2) \rightarrow \neg(e^1 \circ e^2)]$
 - (vi) $\Box \forall e^1 \forall e^2 \forall e^3 \forall e^4 [(e^1 < e^2) \& (e^2 \circ e^3) \& (e^3 < e^4) \rightarrow (e^1 < e^4)]$
 - (vii) $\Box \forall e^1 \forall e^2 [(e^1 < e^2) \vee (e^1 \circ e^2) \vee (e^2 < e^1)]$
- ³¹ If there are two subevents e^1, e^2 , and a state s in an LES, only the temporal relations between e^1 and e^2 and between e^2 and s are explicitly given in the representation. The relation between e^1 and s can be derived, though, and will also be within TR.
- ³² For the history of the punctuality concept in verb semantics cf. Engelberg (1999b).
- ³³ My translation of: "[...] in beiden Rücksichtnahme auf eine gleiche Eigenschaft der Zeit, nämlich danach, ob sie - um die Sache durch ein vom Raume entlehntes Bild in Kürze und schlagend zu veranschaulichen - ihrer Dauer nach p u n k t u e l l gedacht wird (was freilich in strengster mathematischer Strenge unmöglich und demnach nur beziehungsweise wahr), oder l i n e a r ."
- ³⁴ For a more thorough presentation and discussion of the following cognitive phenomena, cf. Engelberg (1999a).
- ³⁵ Cf. Engelberg (1999a) for a more extensive discussion of the relation between basic and derived readings of verbs with respect to punctuality.

³⁶ The questions of what exactly the rules look like that operate on these representations and how these representations are to be processed semantically were not considered in much detail. Some answers to these questions are provided in Engelberg (2000b). There the focus was on the interaction of adverbials and event structures in compositional semantic processes.

References

- Abraham, W., 1990. A Note on the Aspect-Syntax Interface. In: J. Mascaró & M. Nespó (eds.), *Grammar in Progress. Glow Essays for Henk van Riemsdijk*, 1-12. Dordrecht: Foris.
- Blatz, F., 1896. *Neuhochdeutsche Grammatik mit Berücksichtigung der historischen Entwicklung der deutschen Sprache, Zweiter Band: Satzlehre, dritte völlig neu bearbeitete Auflage*. Karlsruhe: Lang. [Reprint Hildesheim, New York: Olms 1970.]
- Blume, K., 2000. *Markierte Valenzen im Sprachvergleich: Lizenzierungs- und Linkingbedingungen*. Tübingen: Niemeyer.
- Carter, R., 1988. Arguing for Semantic Representations. In: B. Levin & C. Tenny (eds.), *On Linking: Papers by Richard Carter*, *Lexicon Project Working Papers* 25, 139-166. Cambridge, MA: MIT.
- Chierchia, G. & S. McConnell-Ginet, 1990. *Meaning and Grammar. An Introduction to Semantics*. Cambridge, MA, London: MIT Press.
- Curme, G.O., 1915. *A Grammar of the German Language. Designed for a Thorough and Practical Study of the Language as Spoken and Written To-day*. Reprint. New York: Macmillan.
- Davidson, D., 1967. The Logical Form of Action Sentences. In: N. Rescher (ed.), *The Logic of Decision and Action*, 81-95. Pittsburgh: University of Pittsburgh.
- Dowty, D.R., 1979. *Word Meaning and Montague Grammar. The Semantics of Verbs and Times in Generative Semantics and in Montague's PTQ*. Dordrecht, London: Reidel.
- Dowty, D.R., 1989. On the Semantic Content of the Notion of 'Thematic Role'. In: G. Chierchia, B.H. Partee & R. Turner (eds.), *Properties, Types and Meaning, Vol. II*, 69-129. Dordrecht, Boston, London: Kluwer.
- Dowty, D.R., 1991. Thematic Proto-Roles and Argument Selection. *Language* 67, 547-619.
- Ehrich, V., 1991. Nominalisierungen. In: A. v. Stechow & D. Wunderlich (eds.), *Semantik, Semantics. Ein internationales Handbuch der zeitgenössischen Forschung*, 441-458. Berlin, New York: de Gruyter.
- Engelberg, S., 1994a. Ereignisstrukturen. Zur Syntax und Semantik von Verben, *Arbeiten des Sonderforschungsbereichs 282 "Theorie des Lexikons"*, Nr. 60. Wuppertal: Bergische Universität Wuppertal.
- Engelberg, S., 1994b. Valency and Aspectuality: Syntactic and Semantic Motivation for the Notion of "Change of State". In: D.W. Halwachs & I. Stütz (eds.), *Sprache - Sprechen - Handeln. Akten des 28. Linguistischen Kolloquiums, Graz 1993, Bd. 1*, 53-59. Tübingen: Niemeyer.
- Engelberg, S., 1999a. The Magic of the Moment - What it Means to be a Punctual Verb. In: S.S. Chang, L. Liaw & J. Ruppenhofer (eds.), *Proceedings of the Twenty-Fifth Annual Meeting of the Berkeley Linguistics Society, February 12-15, 1999*, 109-121. Berkeley: Berkeley Linguistics Society.

- Engelberg, S., 1999b. "Punctuality" and Verb Semantics. In: J. Alexander, N.-R. Han & M. Minnick Fox (eds.), Proceedings of the 23rd Annual Penn Linguistics Colloquium., University of Pennsylvania Working Papers in Linguistics, Vol. 6.1, 127-140. Philadelphia: Penn Linguistics Club.
- Engelberg, S., 2000a. Verb Meaning as Event Structure. In: A.K. Melby & A.R. Lommel (eds.), LACUS Forum XXVI. The Lexicon, 257-268. Fullerton, CA: LACUS.
- Engelberg, S., 2000b. Verben, Ereignisse und das Lexikon. Tübingen: Niemeyer.
- Engelberg, S., 2001. Immunisierungsstrategien in der lexikalischen Ereignissemantik. In: J. Dölling & T. Zybatov (eds.), Ereignisstrukturen, 9-33. Leipzig: Institut für Linguistik der Universität Leipzig.
- Feldhütter, I., M. Schleidt & I. Eibl-Eibesfeldt, 1990. Moving in the Beat of Seconds. Analysis of the Time Structure of Human Action. Ethology and Sociobiology 11, 511-510.
- Filip, H., 1989. Aspectual Properties of the AN-Construction in German. In: W. Abraham & T. Janssen (eds.), Tempus - Aspekt - Modus, 259-292. Tübingen: Niemeyer.
- Fillmore, C., 1968. The Case for Case. In: E. Bach & R.T. Harms (eds.), Universals in Linguistic Theory, 1-88. New York: Holt, Rinehart and Winston.
- Fillmore, C.J., 1972. Subjects, Speakers, and Roles. In: D. Davidson & G. Harman (eds.), Semantics of Natural Language, 1-24. Boston, Dordrecht: Reidel.
- Fodor, J.D., 1977. Semantics: Theories of Meaning in Generative Grammar. New York: Crowell.
- Grimshaw, J., 1990. Argument Structure. Cambridge, MA, London: MIT.
- Gruber, J.S., 1976. Lexical Structures in Syntax and Semantics. Amsterdam, New York, Oxford: North-Holland.
- Handel, S., 1989. Listening. An Introduction to the Perception of Auditory Events. Cambridge, MA, London: MIT Press.
- Hemmer, J., 1780. kern der deutschen Sprachkunst und Rechtschreibung, aus des kurpfälzischen geistlichen rates, herrn Hemmer, grösern werken fon im selbst heraus gezogen. Mannheim: Schwan'en.
- Jackendoff, R., 1995. Semantics and Cognition, 7th edition. Cambridge, MA, London: MIT Press.
- Jacobs, J., 1993. The Lexical Basis of Optional Complements, Arbeiten des Sonderforschungsbereichs 282 "Theorie des Lexikons", Nr. 53. Wuppertal: Bergische Universität Wuppertal.
- Jacobs, J., 1994. Das lexikalische Fundament der Unterscheidung von fakultativen und obligatorischen Ergänzungen. Zeitschrift für germanistische Linguistik 22, 284-319.
- Kamp, H. & U. Reyle, 1993. From Discourse to Logic. Introduction to Modeltheoretic Semantics of Natural Language, Formal Logic and Discourse Representation Theory. Dordrecht, Boston, London: Kluwer.
- Kaufmann, I. (1993): Die Kombinatorik lokaler Verben und prädikativer Komplemente. Konzeptuelle Grundlagen semantischer Dekompositionsstrukturen, Diss. University of Düsseldorf. [Published in Tübingen: Niemeyer 1995.]
- Kaufmann, I., 1995. O- and D-Predicates: A Semantic Approach to the Unaccusative-Unergative Distinction. Journal of Semantics 12, 377-427.
- Klein, W., 1994. Time and Language. London, New York: Routledge.
- Krifka, M., 1989a. Nominal Reference, Temporal Constitution and Quantification in Event Semantics. In: R. Bartsch, J. v. Benthem & P. v. Emde Boas (eds.), Semantics and Contextual Expression, 75-115. Dordrecht, Providence: Foris.

- Krifka, M., 1989b. Nominalreferenz und Zeitkonstitution. Zur Semantik von Massentermen, Pluraltermen und Aspektklassen. München: Fink.
- Krifka, M., 1998. The Origins of Telicity. In: S. Rothstein (ed.), *Events and Grammar*, 197-235. Dordrecht: Kluwer.
- Levin, B., 1985. Lexical Semantics in Review: an Introduction. In: B. Levin (ed.), *Lexical Semantics in Review*, Lexical Project Working Papers 1, 1-62. Cambridge, MA: MIT.
- McCawley, J.D., 1976. Remarks on What Can Cause What. In: M. Shibatani (ed.), *The Grammar of Causative Constructions*, 117-129. New York, San Francisco, London: Academic Press.
- Mittwoch, A., 1991. In Defence of Vendler's Achievements. In: C. Vetters & W. Vandeweghe (eds.), *Perspectives on Aspect and Aktionsart* (= *Belgian Journal of Linguistics* 6), 71-85.
- Moens, M. (1987): *Tense, Aspect and Temporal Reference*. Diss. University of Edinburgh.
- Moens, M. & M. Steedman, 1988. Temporal Ontology and Temporal Reference. *Computational Linguistics* 14, 15-28.
- Morgan, J.L., 1969. On Arguing about Semantics. *Papers in Linguistics* 1, 49-70.
- Mourelatos, A.P.D., 1978. Events, Processes, and States. *Linguistics and Philosophy* 2, 415-434.
- Oya, T., 1996. Über die kausativ-inchoativen Alternationen im Deutschen. *Sprachtheorie und germanistische Linguistik* (= *Arbeitspapiere der Lajos-Kossuth-Universität Debrecen*, 3).
- Parsons, T., 1980. Modifiers and Quantifiers in Natural Language. In: F.J. Pelletier & C.G. Normore (eds.), *New Essays in Philosophy of Language* (= *Canadian Journal of Philosophy*, Supplementary Vol. VI), 29-60. Guelph: Canadian Association for Publishing in Philosophy.
- Parsons, T., 1990. *Events in the Semantics of English. A Study in Subatomic Semantics*. Cambridge, MA, London: MIT Press.
- Paul, H., 1902. Die Umschreibung des Perfekts mit **haben** und **sein**, *Abhandlungen der philosophisch-philologischen Classe der Königlich Bayerischen Akademie der Wissenschaften*, 22. Band, 1. Abteilung, 159-202.
- Platzack, C., 1979. *The Semantic Interpretation of Aspect and Aktionsarten. A Study of Internal Time Reference in Swedish*. Dordrecht: Foris.
- Pöppel, E., 1978. Time Perception. In: R. Held, H.W. Leibowitz & H.-L. Teuber (eds.), *Handbook of Sensory Physiology*, Vol. VIII: Perception, 713-729. Berlin, Heidelberg, New York: Springer.
- Pöppel, E., 1985. *Grenzen des Bewußtseins. Über Wirklichkeit und Welterfahrung*. Stuttgart: Deutsche Verlags-Anstalt.
- Pott, A.F., 1859. *Etymologische Forschungen auf dem Gebiete der Indo-Germanischen Sprachen*, 1. Teil, 2. umgearbeitete Auflage. Lemgo, Detmold: Meyer'sche Hofbuchhandlung.
- Pustejovsky, J., 1988. The Geometry of Events. In: C. Tenny (ed.), *Studies in Generative Approaches to Aspect*, Lexicon Project Working Papers 24, 19-39. Cambridge, MA: MIT.
- Pustejovsky, J., 1991a. The Generative Lexicon. *Computational Linguistics* 17, 409-441.
- Pustejovsky, J., 1991b. The Syntax of Event Structure. *Cognition* 41, 47-81.
- Pustejovsky, J., 1995. *The Generative Lexicon*. Cambridge, MA, London: MIT.
- Quine, W.V.O., 1975. On the Individuation of Attributes. In: A.R. Anderson, R.B. Marcus & R.M. Martin (eds.), *The Logical Enterprise: Essays for Frederick B. Fitch*. New Haven: Yale University Press.

- Rappaport, M., 1985. Review of Joshi's "Factorization of Verbs". In: B. Levin (ed.), *Lexical Semantics in Review*, Lexicon Project Working Papers 1, 137-148. Cambridge, MA: MIT.
- Rappaport, M., M. Laughren & B. Levin, 1987. *Levels of Lexical Representation*, Lexicon Project Working Papers 20. Cambridge, MA: MIT.
- Ravin, Y., 1990. *Lexical Semantics without Thematic Roles*. Oxford: Clarendon.
- Romberg, H.B., 1899. *L'idée de la durée par rapport aux verbes et aux substantifs verbaux en français moderne*. Göteborg: Zachrissons Boktryckeri.
- Schleicher, A., 1855. *Das futurum im deutschen und slawischen*. *Zeitschrift für vergleichende Sprachforschung auf dem Gebiete des Deutschen, Griechischen und Lateinischen* 4, 187-197.
- Streitberg, W., 1891. *Perfective und imperfective Actionsart im Germanischen*. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 15, 70-177.
- Streitberg, W., 1900. Rezension von "Delbrück, B.: *Vergleichende Syntax der indogermanischen Sprachen*. Zweiter Teil - Strassburg: Trübner 1897". *Indogermanische Forschungen* 11, 56-67.
- Tenny, C., 1987a. *The Aspectual Interface Hypothesis*. In: J. Blavins & J. Carter (eds.), *Proceedings of NELS 18*, Vol. 1, 490-508. Amherst.
- Tenny, C. 1987b. *Grammaticalizing Aspect and Affectedness*. Diss. MIT, Cambridge, MA.
- Turner, F. & E. Pöppel, 1983. *The Neural Lyre: Poetic Meter, the Brain, and Time*. *Poetry August*, 277-309.
- Urbantschitsch, V., 1875. *Ueber eine Eigenthümlichkeit der Schallempfindungen geringster Intensität*. *Centralblatt für die medizinischen Wissenschaften* 13, 625-628.
- Vendler, Z., 1957. *Verbs and Times*. *The Philosophical Review* LXVI, 143-160.
- Verkuyl, H.J., 1972. *On the Compositional Nature of the Aspects*. Dordrecht: Reidel.
- Verkuyl, H.J., 1989. *Aspectual Classes and Aspectual Composition*. *Linguistics and Philosophy* 12, 39-94.
- Voorst, J. v., 1988. *Event Structure*. Amsterdam, Philadelphia: Benjamins.
- Wunderlich, D., 1996. *Models of Lexical Decomposition*. In: E. Weigand & F. Hundsnurscher (eds.), *Lexical Structures and Language Use*. *Proceedings of the International Conference on Lexicology and Lexical Semantics*, Münster, September 13-15, 1994, Vol. 1: *Plenary Lectures and Session Papers*, 169-183. Tübingen: Niemeyer.
- Wunderlich, D., 1997. *Cause and the Structure of Verbs*. *Linguistic Inquiry* 28, 27-68.
- Wundt, W., 1911. *Einführung in die Psychologie*. Leipzig: Voigtländer.
- Wustmann, G., 1891. *Allerhand Sprachdummheiten*. *Kleine deutsche Grammatik des Zweifelhafte, des Falschen und des Häßlichen*. Leipzig: Grunow.
- Zaenen, A., 1993. *Unaccusativity in Dutch: Integrating syntax and Lexical Semantics*. In: J. Pustejovsky (ed.), *Semantics and the Lexicon*, 129-161. Dordrecht, Boston, London: Kluwer.