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Event Arguments: Foundations and Applications

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Introduction

Since entering the linguistic stage in the late sixties, Davidsonian event arguments have taken on an important role in linguistic theorizing. The central claim of Donald Davidson's seminal (1967) work "The logical form of action sentences" is that events are spatio-temporal *things*, i.e., concrete particulars with a location in space and time. This enrichment of the underlying ontology has proven to be of great benefit in explaining numerous combinatorial and inferential properties of natural language expressions. Among the many remarkable advances achieved within the Davidsonian paradigm since then figure most prominently the progress made in the theoretical description of verb semantics, including tense and aspect, and the break through in analyzing adverbial modification. Numerous monographs and collections attest to the extraordinary fertility of the Davidsonian program; see, e.g., Rothstein (1998), Tenny & Pustejovsky (2000), Higginbotham, Pianesi & Varzi (2000), Lang, Maienborn & Fabricius-Hansen (2003), Austin, Engelberg & Rauh (2004) to mention just a few more recent collections.

In the course of the evolution of the Davidsonian paradigm, two moves have turned out to be particularly influential in terms of expanding and giving new direction to this overall approach. These are, first, the "Neo-Davidsonian turn" introduced by Higginbotham (1985, 2000) and Parsons (1990, 2000), and, secondly, Kratzer's (1995) merger of event semantics with the stage-level/individual-level distinction.

The neo-Davidsonian approach has lately developed into kind of a standard for event semantics. It is basically characterized by two largely independent assumptions. The first assumption concerns the arity of verbal predicates. While Davidson introduced event arguments as an *additional* argument of (some) verbs, neo-Davidsonian accounts take the event argument of a verbal predicate to be its *only* argument. The relation between events and their participants is accounted for by the use of thematic roles. The second neo-Davidsonian assumption concerns the distribution of event arguments. They are considered to be much more widespread than originally envisaged by Davidson. Hence, neo-Davidsonian approaches typically assume that it is not only (action) verbs that introduce Davidsonian event arguments, but also adjectives, nouns, and prepositions. Thus, nowadays event arguments are widely seen as a trademark for predicates in general.[1]

The second milestone in the development of the Davidsonian program is Kratzer's (1995) event semantic treatment of the so-called stage-level/individual-level distinction, which goes back to Carlson (1977) and, as a precursor, Milsark (1974, 1977). Stage-level predicates (SLPs) express – roughly speaking – temporary or accidental properties, whereas

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[1] A note on terminology: Bach (1986) coined the term "eventuality" for the broader notion of events, which includes, besides events proper, i.e., accomplishments and achievements in Vendler's (1967) terms, also processes and states. Other labels for event arguments in the broad sense are, e.g., "spatiotemporal location" (Kratzer 1995), "Davidsonian argument" (Chierchia 1995), or "E-position" (Higginbotham 1985).

individual-level predicates (ILPs) express (more or less) permanent or inherent properties.[2] On Kratzer's (1995) account, the SLP/ILP-distinction basically boils down to the presence or absence of an extra event argument. Stage-level predicates are taken to have an additional event argument, while individual-level predicates lack such an extra argument. This difference in argument structure is then exploited syntactically by the assumption of different subject positions for SLPs and ILPs; see Diesing (1992). Since then interest has been directed towards the role of event arguments at the syntax/semantics interface and the impact they have on syntax proper in terms of, e.g., event phrases.

All in all, Davidsonian event arguments have become a very familiar "all-purpose" linguistic instrument over the past decades, and recent years have seen a continual extension of possible applications far beyond the initial focus on verb semantics and adverbials.

These developments are accompanied by a newly found interest in the linguistic and ontological foundation of events. To the extent that more attention is paid to less typical events than the classical 'Jones buttering a toast' or 'Brutus stabbing Caesar', which always come to the Davidsonian semanticist's mind first, there is a growing awareness of the vagueness and incongruities lurking behind the notion of events and its use in linguistic theorizing. A particularly controversial case in point is the status of *states*. The question of whether state expressions can be given a Davidsonian treatment analogous to process and event expressions (in the narrow sense) is still open for debate; see Maienborn (2005) and the commentaries to this target article for some of the pros and cons.

The present volume grew out of a workshop "Event arguments in syntax, semantics and discourse" that the editors organized in February 26-28, 2003, in Munich (as part of the annual meeting of the German association for linguistics, DGfS), and in which we invited contributions geared towards drawing an interim balance of the use of and motivation for event arguments in linguistic theory. The articles presented here offer proposals towards this end from different empirical and theoretical perspectives. The leading question shared by the majority of the articles could be phrased in the following way.

How do lexical semantics, syntax, and pragmatics conspire to project event structure?

Discussing a wide range of linguistic phenomena (mostly pertaining to English, German and Romance) the articles

(a) supply fresh evidence for the virtually ubiquitous presence of event arguments in linguistic structure;

(b) they provide new, event-based, solutions as superior alternatives to already existing analyses; and/or

(c) they shed new light on the nature of event arguments and the way these are handled by the linguistic machinery.

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[2] See, e.g., Higginbotham & Ramchand (1997), Jäger (2001) for overviews of the linguistic phenomena that have been associated with the stage-level/individual-level distinction.

The volume is organized into four sections: Events – states – causation; Event nominals; Events in composition; Measuring events.

Section I: *Events – states – causation* addresses mainly foundational issues concerning the nature of events and states, how they relate to causation, and how they show up in the linguistic structure.

Manfred Bierwisch discusses the anchoring and accessibility of event arguments in semantic structure. He compares the different ways in which event arguments are structurally anchored in Davidsonian, neo-Davidsonian, and Reichenbachian approaches and presents arguments in favor of the latter variant. Bierwisch then goes on to argue that, no matter how complex a verb's internal event structure might be, only the highest event argument is made accessible for reference, quantification, modification, etc. This means, in particular, that inchoative and causative verbs will never project a target state into their argument structure. Apparent counterevidence as provided by durational adverbials, which obviously serve to specify the duration of an inchoative's target state, is accounted for by assuming that the operator BECOME is of an elusive nature. That is, target state modification of inchoatives relies on the improper absence of BECOME.

Stefan Engelberg draws attention to one of the classes of verbs that do not fit easily into the Davidsonian picture, namely dispositional verbs such as German *helfen* (help), *gefährden* (endanger), *erleichtern* (facilitate). These verbs may have an eventive or a stative reading depending on whether the subject is nominal or sentential. Trying to account for their readings within the Davidsonian program turns out to be challenging in several respects and provides new insights into the different nature of events and states. Engelberg advocates the philosophical concept of *supervenience* as a useful device to account for the evaluative rather than causal dependency of the effect state expressed by these verbs.

The proper analysis of state expressions is taken up again by **Anita Mittwoch**. She examines the arguments raised by Katz (2000, 2003) and Maienborn against extending the Davidsonian approach to (all) state expressions and rejects most of them, thereby corroborating the general neo-Davidsonian approach. On this view, states, rather than being different things, are merely somewhat poor examples of event(ualitie)s.

Engelberg's and Mittwoch's considerations concerning the ontological nature of states are supplemented by an article on the syntax of copular state expressions. **Kay-Eduardo González-Vilbazo** and **Eva-Maria Remberger** present a minimalist account of the Spanish copula forms *ser* and *estar*, which figure as lexical exponents of the stage-level/individual-level distinction. *Ser* and *estar* are analyzed as syntactic default strategies (last resort) that are introduced into the derivation at different functional layers: tense (T^0) and predication (Pr^0). Motivation for this comes from current semantic analyses of the *ser/estar* alternation for which the authors strive for a more transparent syntactic correlation.

Finally, causality is taken up again by **Horst Lohnstein**, who proposes a uniform account of the semantics of clause-connectives (*while, if, when, because* etc.) in terms of an invariant quantificational structure whose components are subject to parametrization. Lohnstein shows how different interpretive effects as, e.g., the temporal vs. adversative reading of German *während* (while/whereas) can be derived in this framework.

Section II: ***Event nominals*** presents a syntactic and a lexicalist approach towards an analysis of the argument structure of deverbal nominalizations.

Artemis Alexiadou discusses nominal and verbal gerunds in English within the framework of Distributed Morphology suggesting that the different properties associated with these forms follow from different attachment sites of a nominal *-ing* affix. Whereas nominal gerunds result from attaching *-ing* directly to the verbal root, verbal gerunds result from combining *-ing* with AspectP. On Alexiadou's perspective, argument structure is derived syntactically via an event structure which in turn is introduced by a special type of functional layer in the syntax.

Ingrid Kaufmann, instead, pursues a lexicalist approach according to which argument structure is basically determined at the level of lexical-semantic structure. Kaufmann's analysis is based on a corpus study of German nominalized infinitives showing that nominalized infinitives display two different patterns of argument realization whose distribution is determined by genuine semantic and pragmatic conditions. In order to account for these findings Kaufmann proposes an "ontological" solution according to which the two different patterns of nominalized infinitives differ in the way how the verb's event argument is referentially anchored.

Section III: ***Events in composition*** focuses on the role of event arguments at the syntax/semantics interface. The studies aim at uncovering the combinatorial mechanisms that lead to the formation of complex event descriptions.

Angelika Kratzer develops a novel analysis of German and English adjectival resultatives along the lines of serial verb constructions. In expressions like *to drink my teapot dry* the adjective is taken to combine with an empty CAUSE-affix. The resulting causing event is identified with the event expressed by the verb via the combinatorial operation of *Event Identification*. Kratzer succeeds in showing (a) how several syntactic and semantic properties of resultative constructions can be derived from her analysis and (b) that the direct object in a resultative construction is not a true argument of the verb but always starts out from within the adjectival phrase.

Working within Kratzer's framework, **Daniel Hole** proposes an analysis of possessor and beneficiary datives in German that extends Kratzer's Event Identification into a more general combinatorial operation, called *Variable Identification*. This mechanism serves to augment an event description by an additional thematic argument that will be bound by an already existing argument. Thus, operations like Event Identification and Hole's dative-induced Variable Identification can be seen as a specific implementation of the neo-Davidsonian program of building up complex event descriptions from a maximally coherent conjunction of a set of smaller predications.

Werner Abraham is concerned with the deontic and epistemic readings of modal verbs in the Germanic languages. Putting special emphasis on their Aktionsart-sensitivity, Abraham suggests to account for the polyfunctionality of modal verbs by assuming a control analysis for the deontic reading and a raising analysis for the epistemic reading. This syntactic analysis is correlated with a semantic analysis according to which epistemic modal verbs inherit both the theta properties and the event characteristics of the embedded full verbs, whereas deontic modal verbs project event and thematic arguments of their own.

Finally, **Section IV: *Measuring events*** provides a particularly clear picture of the many ways in which event arguments can be involved in measuring expressions.

Patrick Caudal and **David Nicolas** explore the relationship between degree structure and event structure by an analysis of various degree adverbials. Differences in distribution and interpretation are accounted for by assuming different types of degree scales. Degree modifiers like *partially, completely* act as modifiers on quantity scales, whereas *extremely, perfectly* and the like act as modifiers on intensity scales. The proposal rests on the assumption that most verbal predicates, including stative predicates, can receive a degree argument, either for inherent lexical reasons, or by virtue of their structural context. On this basis, Caudal and Nicolas introduce a new – and broader – characterization of (a)telicity in terms of a mapping between degrees and events.

Regine Eckardt draws attention to negative polarity items such as *bat an eyelash*, *lift a finger*, which serve to single out events of a particularly insignificant size. Eckardt develops an event-based variant of the pragmatic approach to NPI licensing proposed by Krifka (1995), showing that her event-based variant has several advantages compared to Krifka's event-free original account. On Eckardt's analysis, the respective NPIs turn out to be a special kind of adverbial modifier denoting functions from event predicates to event predicates. Weak NPIs map event predicates to the minimal events in their extension whereas strong NPIs yield so-called *subminimal events*, i.e., events that are even below the extension of an event predicate. Besides accounting for the different licensing contexts for weak and strong negative polarity items, Eckardt's approach also offers new insights into the ontology of events in terms of mereological structure.

Finally, **Kimiko Nakanishi** examines measure phrases that are separated from their host NP in German split topicalizations as opposed to measure phrases that are adjacent to their host NP. Nakanishi proposes to account for their different semantic properties in terms of different domains of measurement. Whereas the non-split case involves the measurement of individuals in the nominal domain, measure phrases in split topicalizations are analyzed as a means of measuring events in the verbal domain. Several semantic restrictions on split measure phrases such as the incompatibility with single-occurrence events, the incompatibility with individual-level predicates, and the unavailability of collective readings follow from monotonicity constraints applying to the verbal domain.

In their entirety, the articles collected here offer a representative overview of the questions, assumptions and strategies that are presently being pursued in the further development of the Davidsonian program. Our aim is that they will offer further impulses to work in this area.

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Section I: Events – states – causation

Manfred Bierwisch

The event structure of CAUSE and BECOME

Adopting the widely held view that verbs are predicates of events or states and refer to situations or eventualities, the present paper explores consequences of this assumption for the structure of inchoative and causative verbs. Inchoatives like *aufwachen* (wake up) are supposed to be semantically characterized by the operator BECOME, causatives like *wecken* (wake up) by the operator CAUSE. While BECOME specifies the transition from a source state to a target state, CAUSE identifies the causal connection between a cause and its effect, the latter often specified by an event of the inchoative sort. The paper argues that, with respect to its syntactically based compositional interpretation, a verb refers to one and only one state or event, irrespective of the complex structure of causatives and inchoatives involving causation, cause, effect, transition, source-, and target-state.
Technically, the event-reference of a verb is based on the highest position in its argument structure. This position absorbs (or unifies with) the qualification represented by (extensional) modifiers, as in *I woke him up at nine by a phone call.* Comparing the status of the fact variable proposed by Reichenbach with the event variable introduced by Davidson, Reichenbach's referential operator is argued to provide the more appropriate analysis for compositionally complex verbs. Further problems created by the "Neo-Davidsonian" variant of argument structure are argued to provide additional motivation for the view adopted here.
The analysis proposed for verbs carries over to event nouns, as shown by the parallel structure of *the change of the schedule last week* and *the schedule changed last week.* Apparent counterexamples are related to durational adverbials like *for two weeks*, which are usually supposed to be incompatible with proper events. But they are compatible with inchoatives in cases like *the schedule changed for two weeks.* In these cases, however, the adverbial clearly specifies the duration of the target state, rather than the duration of the event. The paper shows how this effect derives from the proposed analysis, if independently motivated assumptions about the status of BECOME are added.

1. The problem

The fairly trivial observation that natural language expressions are about situations, or more specifically states, events, and processes, raises non-trivial questions concerning the reference to situations and its proper analysis. Current proposals for dealing with these questions derive in one way or the other from Reichenbach (1947) or Davidson (1967). Both accounts are based on the assumption that a proposition p is to be enriched by an additional variable e which establishes the reference to a situation which is characterized by p. The technical details of the two proposals are different, but for a wide range of problems their consequences are the same and their representations can be translated into each other, as we will see. Both approaches are primarily concerned with the logical form and semantic interpretation of linguistic expressions, paying only marginal attention to the question of how the relevant representations are built up syntactically, and which role in particular the situation

or event variables play within the morpho-syntactic structure of linguistic expressions. Against this background, I will be concerned in this paper with the following questions:

A Which of the semantic event variables are syntactically accessible, and how?
B Which effects of event variables can be assigned to their syntactic and semantic selection restrictions?

Question A presupposes that semantic variables are accessible for syntactic specification, assuming that this is in fact the function of theta roles a head assigns to its syntactic complements, and it queries which event variables may realize a function of that sort in which way. Question B presupposes that it is by means of theta roles that a head realizes its semantic restrictions and morpho-syntactic or categorial requirements, called s-selection and c-selection, respectively, and it raises the non-trivial question of whether event variables, which are not normally specified by syntactic complements, can be associated with selection restrictions, and what their effects may be. These relevant issues will be pursued with respect to the semantic predicates CAUSE and BECOME and their combinations appearing in lexical items like *close*, *kill*, *change* etc. I will adopt the basic assumptions about these elements developed in Dowty (1979), extended by proposals discussed a.o. in Bierwisch (2002, 2003). The problems to be faced are illustrated by cases like these:

(1) a. He woke up for a while, but then he slept quietly for hours.
b. Mach am Abend bitte ein paar Minuten das Fenster auf.
In the evening, please open the window for a few minutes.
c. Yesterday, he came quite a while to my office.

According to standard and in fact well motivated assumptions, events denoted by verbs like *open*, *come*, *wake up* etc. can be temporally located by adverbials such as *yesterday*, *then*, *in the evening*, etc, but they cannot be modified by durational adverbials like *for hours*, *(for) quite a wile*, *a few minutes*, which combine freely with processes and states like *sleep*, *rest*, or *wait*. In (1a) however, durational adverbials combine with the event *wake up* as well as the state *sleep*. In (1b), moreover, the same event denoted by *aufmachen* (*open*) seems to be modified by the temporal adverbial *in the evening* and the durative adverbial *a few minutes*. In a similar vein, *come* is modified by both *yesterday* and *quite a while* in (1c). On closer inspection, one has to note, however, that the temporal adverbs locate the event in question, while the durational adverbs qualify the resulting state, rather than the event. Similarly, the durative adverbial *for a while* modifying *wake up* in (1a) specifies only the state of being awake. This illustrates the problem to be pursued here, viz. the question of how events and states and their properties are to be systematically accounted for. Some remarks about background assumptions needed to deal with these problems seem to be in point.

2. Background assumptions

Linguistic expressions relate a Phonetic Form PF to the representation of its meaning, the linguistic aspect of which is called Logical Form or Semantic Form SF.[1] Hence a linguistic expression is a pair <PF, SF>, where PF determines its pronunciation and SF its conceptual interpretation. Each expression is furthermore categorized by syntactic and morphological features Cat, classifying e.g. *dreams* as alternatively verb, present, and third person singular, or as noun and plural. Finally, a linguistic expression is characterized by its Argument Structure AS, which consists of a hierarchically structured sequence of argument positions or theta roles, determining the properties of constituents the expression may or must combine with. In particular, the theta roles in AS impose conditions called s-selection and c-selection, determining the semantic and morpho-syntactic properties of expressions saturating the theta role in question.[2] Thus the theta role to be saturated by the subject of the Verb *dreams* requires semantically a human (or personal) entity and syntactically a nominative singular DP. These two types of constraints are naturally determined by the semantic aspect of the argument position and by morpho-syntactic features associated with it. More technically, a theta role Θ_i is a pair $< \lambda x_i, F_i >$, where λx_i abstracts over a variable in SF, and F_i is a (possibly empty) set of features to be matched by the features in Cat of a constituent saturating Θ_i. The s-selection of Θ_i can now be understood as an effect of the predicates applying to x_i in SF, while the c-selection is due to features that follow from grammatical rules or principles, or are specified by lexical idiosyncrasy. A preliminary illustration of the assumptions sketched so far is given in (2), the lexical entry for the German temporal preposition *nach* (after), which differs grammatically from the directional preposition *nach* (towards) by the categorization [- Directional] :

(2)

/ nach /	[-V,-N,-Dir]	λx λy [+Obl]	[T y > T x]
PF	Cat	AS	SF
	GF		

As indicated in (2), Cat and AS constitute jointly what one might call the Grammatical Form GF of a linguistic expression, because Cat and AS together determine essentially its grammatically controlled combinatorial potential. On the other hand, AS and SF together

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[1] I need not go here into details related to the terminological decision. While LF, as used in Chomsky (1981) and subsequent work, is primarily concerned with syntactically determined aspects of meaning, SF is concerned also with the (grammatically relevant) internal structure of lexical items determining their contribution to the meaning (or conceptual interpretation) of linguistic expressions. For some discussion of these matters and the overlap in orientation between LF and SF see Bierwisch (1997). As I am concerned here with issues that clearly relate to word-internal conditions of semantic representation, I will take SF to provide the relevant representational format.

[2] The terminology – semantic or s-selection and categorial or c-selection – is due to Chomsky (1986), where selectional restrictions were not formally associated with theta roles, however.

can be considered as the Extended Semantic Form ESF, according to which e.g. a preposition like *nach* is a two-place relation.[3] This will turn out to be crucial for the semantic combinations an expression may enter into.

Within the SF of (2), T is a functor that assigns a time interval to its argument, and the two place predicate > represents an ordering-relation over the set of time intervals. Hence x and y are variables over individuals susceptible to ordering in time. Hence the s-selection associated with both argument positions of *nach* requires entities to which a time interval can be assigned. The c-selection determined by the Object Position is expressed by the feature [+Oblique] requiring a Dative-DP.[4] The other argument of *nach* – and of prepositions in general –, sometimes called the external or designated argument, does not specify features of c-selection, a point to which we will return. The conditions of s- and c-selection just mentioned must be met e.g. by the object of *nach* in a phrase like *nach der Wahl* (after the election). Suppose for the sake of illustration that something like (3) abbreviates the representation of the object-DP in question, where [DEF e [ELECTION e]] identifies a definite individual:[5]

(3) /der Wahl / [+N, -V, +Obl] [DEF e[ELECTION e]]

Merging (2) and (3) yields a PP with the representation indicated in (4), where the SF of (3) replaces the variable x in (2) as an effect of lambda-conversion, triggered by the combination of (2) and (3) through functional application:

(4) / nach der Wahl / [-V, -N, -Dir] λy[T y > T [DEF e [ELECTION e]]]

(4) illustrates in a rather simplified form the result of combining a head with its complement. In addition to this type of combination called complementation, we need an account of the operation that merges a head with an adjunct, as e.g. in *Besuch nach der Wahl* (visit after the election), where *nach der Wahl* is a modifier, not a complement of the head *Besuch*. Abbreviating the representation of *Besuch* by (5), we get something like (6) as the result of merging a head with an adjunct:

(5) / Besuch / [+N, - V,...] λz [VISIT z]

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[3] Technically, ESF is an expression in a so-called lambda-categorial language. Assuming that for principled reasons the SF of major syntactic constituents is to be construed as an expression of type t, i.e. as a proposition, ESF becomes an n-place predicate with AS defining its arity, i.e. the number and type of its arguments. See Bierwisch (1997, 2003) for further discussion.

[4] The feature [+Obl] is in fact predictable, being the default case for objects of prepositions in German. Hence it would not have to be specified in the entry (2). The principles and conditions controlling such regularities will largely be ignored in the present context, except where event positions are involved.

[5] This is, of course, an oversimplification in various respects. First, e must be construed as referring to a definite eventuality of the sort discussed in Bach (1986), a point to which we will return. Second, the definiteness operator DEF is actually a short-hand for a number of assumptions that cannot be discussed here. It must, however, provide a referential binding for the argument position of the Noun *Wahl*, turning it into a definite description, as will be discussed shortly.

(6) / Besuch nach der Wahl / [+N, - V,...]
λz [[VISIT z] & [T z > T [DEF e [ELECTION e]]]]

What (6) is supposed to account for is the observation that head and modifier are semantically combined by logical conjunction, and more specifically that the condition abbreviated by VISIT specifies an event that is additionally subject to the temporal location expressed by *nach der Wahl*. To this effect, the argument position λy of the adjunct (4) is absorbed by (or unified with) the argument position λz of the head (5). As both operators abstract over the same sort of variables, the absorbing theta role does not violate the s-selection of the absorbed Role, which furthermore does not impose c-selectional constraints that could be violated. Absorption of a theta role must furthermore be assumed to have two consequences: First, the SF of the adjunct is added to that of the head by logical conjunction &.[6] Second, the variable bound by the absorbed operator is substituted by the variable of the absorbing operator. In the present case, λy is absorbed by λz and y is substituted by z.

This account of (extensional) modification follows essentially the proposal made in Higginbotham (1985). It must be generalized in non-trivial ways if e.g. intensional modification as in *der angebliche Besuch* (the alleged visit) is to be included, since an alleged visit is not something that is a visit and an alleged event. In Bierwisch (2003), I have argued that in head-adjunct-combinations the head characteristically absorbs a theta role, as opposed to head-complement-combinations, where the head discharges a theta role. We will return to these matters below.

To sum up the framework sketched so far, we have lexical entries as sketched in (2), the argument structure of which specifies their s- and c-selectional properties as illustrated above. On the basis of these entries, syntactically complex expressions are created by the operation Merge as illustrated in (4) and (6) for complementation and adjunction, respectively. Merge combines two (basic or complex) expressions X and Y into a complex expression Z. One of Z's constituents is its head, determining its categorization. A provisional formulation of the properties of Merge is given in (7), presupposing that complex expressions have the same basic organization as lexical items.

(7) Merge (X, Y) ==> Z, where
  a. PF of Z is the linear combination of PF of X and Y,[7]
  b. Cat of Z is projected from Cat of X iff X is the head of Z, and either
  c. X discharges the lowest (i.e. next available) position of its AS to Y by functional application with subsequent lambda-conversion within SF, or
  d. Y discharges the lowest position in its AS to X by lambda-absorption, followed by logical conjunction of the SF of X and Y.

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[6] For principled reasons, discussed e.g. in Wunderlich (2000) and Bierwisch (2002), the conjunction & is asymmetrical, at least in the sense that one conjunct is closer to the functor than the other. Whether and which semantic consequences are connected to this asymmetry need not concern us at the moment.

[7] Two qualifications are to be made at this point. First, I will ignore here morphological processes with non-linear aspects of combination. Second, the linear ordering of head and complement or adjunct is subject to complex conditions of various sorts that must be left aside here.

(7c) and (7d) determine the argument structure and the Semantic Form of Z (i.e. the ESF as noted above) under complementation and adjunction, respectively, where (7d) covers only extensional modification and is thus in need of further elaboration. As a consequence, conditions of s- and c-selection are imposed either according to (7c) by the head on the complement, or according to (7d) by the adjunct on the head.[8]

3. Some aspects of event arguments

Within this framework, the status of argument positions providing event reference is to be made explicit in two steps. First, as noted initially, an event variable, originally proposed as "fact variable" in Reichenbach (1947) and reinvented, in a somewhat different guise, in Davidson (1967), is assumed to explicitly represent states and events as entities in SF. The formal ontology of the values to be assigned to this variable is developed in Bach (1986).[9] The second step takes up the notion of a referential theta role, proposed in Williams (1981) and elaborated in Higginbotham (1985), and others. Originally, Williams considered this type of role as characteristic for nouns, creating the basis for reference and quantification as in *this man*, *every book*, *some problems* etc.[10] In Higginbotham (1985) and Bierwisch (1988) it was also taken as the basis for extensional modification, as sketched in (6) and (7d). With these prerequisites, it is a natural move to assume that verbs refer to events in roughly the same way in which nouns are assumed to refer to individuals to be assumed for nouns. The point is illustrated by the parallel between (8) and (9) compared to (10):

(8) a. Sie ändern den Fahrplan.
They change the schedule.
b. Sie ändern häufig/oft den Fahrplan.
They often change the schedule.
c. Sie ändern am Montag den Fahrplan.
On Monday, they change the schedule.

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[8] It might be added that Merge is deliberately based on the operation Merge as introduced e.g. in Chomsky (1995), with the following amendments: (i) Merge as defined in (7) does not project the full set of features of the head, but only those in Cat, (ii) it does not only merge the phonetic and syntactic information but also the information in ESF, thereby realizing the selection restrictions.

[9] For the time being, I will ignore the much debated difference between events and states, both covered by what Bach called "eventualities".

[10] It must be noted that the notion of Referential Role is crucially different from that of agent, theme, goal etc., although Williams (1981) is not quite clear in this respect. While agent, theme, etc. are supposed to relate somehow to the conceptual content of an argument position, referentiality has to do exclusively with the way in which variables relate to the domain of interpretation. In fact, agent, theme, patient, etc. all can become referential roles, as e.g. in *murderer*, *proposal*, *employee*, which are referential by means of the agent, theme, and patient role, respectively.

(9) a. Der Fahrplan ändert sich.
The schedule changes.
b. Der Fahrplan ändert sich häufig/oft.
The schedule changes often/frequently.
c. Der Fahrplan ändert sich am Montag.
On Monday, the schedule changes.

(10) a. Die Änderung des Fahrplans
The change of the schedule
b. Die häufige/*oft Änderung des Fahrplans
The frequent change of the schedule
c. Die Änderung des Fahrplans am Montag
The change of the schedule on Monday

Besides the specification of reference by means of tense and complementizer or determiner, the event-reference is parallel for the causative verb, the inchoative verb, and the noun, both in German *ändern*, *sich ändern*, and *Änderung* and in English verb and noun *change*. Also, frequency and temporal modifiers apply to verbal and nominal heads in the same way. The fact that *oft* and *often* are restricted to verbal heads, while *häufig* can modify verbs as well as nouns, is due to c-selection by the adjunct, with *oft* imposing something like [+V].[11]

Furthermore, the event reference of verbs can enter standard anaphoric relations and may be picked up by appropriate pronouns, as shown by the italicized elements in (11):

(11) a. Sie ändern häufig den Fahrplan. *Das* macht viel Ärger.
b. Sie ändern häufig den Fahrplan, *was* viel Ärger macht.
c. They change the schedule frequently, *that/which* is very irritating.

Again, this is essentially parallel to the referential character of nouns, with the anaphoric relations based on their referential argument, as shown in (12):

(12) a. Er kritisiert die häufige Änderung des Fahrplans. *Sie* macht viel Ärger.
b. Er kritisiert die häufige Änderung des Fahrplans, *die* viel Ärger macht.
c. He criticizes the frequent change of the schedule, *which/it* is disappointing.

As already noted, c-selection imposed by morpho-syntactic features of adjuncts can restrict them to verbal heads – as in *oft* (often), *heute* (today), *jetzt* (now) – or to nominal heads – as in *häufig* (frequently), *heutig* (today's), or *jetzig* (present). The familiar semantic restrictions, on the other hand, based on s-selection and depending on the content of SF, carry over from verbs to nouns, preventing (proper) events from durational modifiers like *for*

[11] A different, but comparable condition on c-selection restricts *heute* (today), *gestern* (yesterday), *damals* (then), *bald* (soon) and others to verbal heads, as opposed to *heutig*, *gestrig*, *damalig*, *baldig* modifying nominal heads. A closely related distinction is realized more systematically (but not without exceptions) by the English suffix *-ly* . For further discussion of this point see Bierwisch (2003).

hours, and states from delimitations like *quickly*, or *within a few minutes*, as indicated in (13) and (14).[12]

(13) a. Das Haus wurde {wiederholt/*stundenlang/ziemlich rasch} zerstört.
The house was {repeatedly/*for hours/rather quickly} destroyed.
b. Die {wiederholte/*stundenlange/ziemlich rasche} Zerstörung des Hauses.
The {repeated/rather quick} destruction of the house {*for hours}.

(14) a. Das Haus wurde {gestern/stundenlang/*ziemlich rasch} beobachtet.
The house was observed {yesterday/for hours/*rather quickly}.
b. Die {gestrige/stundenlange/*ziemlich rasche} Beobachtung des Hauses.
The {*rather quick} observation of the house {yesterday/for hours}.

Event variables cannot only enter anaphoric relations, they are also subject to quantification, with frequency adverbials like *always, often, occasionally, seldom*, etc. acting as quantifiers over eventualities. Thus the Logical or Semantic Form of (15a) should be something like (15b), or slightly more formally (15c):

(15) a. The schedule changes frequently.
b. There are many e such that e is a change of schedule.
c. For many e [the schedule changes (e)]

Quantification applies not only to events but just as well to states, if instances are separable, as in (16), where states are individuated by relevant occasions:

(16) a. Die Leitung ist immer besetzt.
The line is always busy.
b. Peter wiegt selten zu viel.
Peter seldom weighs too much.

Participating in quantification, event variables can furthermore be involved in scope relations. Thus the preferred reading of (17) assures that mail delivery occurrs regularly on Monday, not on other days. In other words, *on Monday* qualifies the regular delivery, i.e. it has scope over *regularly*. The preferred reading of (18), on the other hand, claims that on Monday the delivery of mail is regular, i.e. *regular* qualifies the delivery on Monday, and has, in this sense, scope over *on Monday.*

(17) Die Post wird regelmäßig am Montag zugestellt.
Mail is delivered regularly on Monday.

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[12] It should be noted that acceptability judgements can be obscured by a coerced, event-like interpretation of *observe*, such that e.g. *they will observe the house in three hours* is construed as *they will start the observation of the house in three hours.* But coercion of this sort confirms, rather than spoils the tenet that s-selection is based on semantic conditions. I will return to these matters in detail in section 7 and 8.

(18) Die Post wird am Montag regelmäßig zugestellt.
On Monday, mail is delivered regularly.

Whether and under which conditions the preferred interpretation can be replaced by other options need not concern us here. In part it is a matter of stress and focus-assignment, which must be left aside. The point to be made is merely that event variables cannot only be quantified – as in (15) and (16) –, but participate in standard relations of regular variables.[13]

4. Implementing event reference

As already noted, event reference has been introduced into standard semantic (or logical) representations in different ways. The most direct proposal is due to Davidson (1967), who suggested that the main predicate of an action sentence is to be extended by an additional argument, which refers to the event characterized by the sentence in question. More technically, a proposition of the general form (19) should in fact be analyzed as (20), where P' is an n+1 place predicate that relates P and its arguments to the event e.

(19) $P(x_1, \ldots, x_n)$

(20) $\exists e [P'(e, x_1, \ldots, x_n)]$

This proposal is illustrated in (21b), where the transitive verb *butter* of (21a) is analyzed as a three-place relation between e and the arguments of the verb. Past tense, provisionally indicated by $T(e) < T(u)$, ordering e temporally before the utterance time T(u), and adverbials like *in the kitchen* are now treated as predications of e, conjoined to the main proposition.[14]

(21) a. Fred buttered the toast in the kitchen
b. $\exists e$ [buttering (e, Fred, the toast) & $T(e) < T(u)$ & in the kitchen (e)]

Twenty years earlier, Reichenbach (1947) had already proposed a more general way to introduce event variables. Instead of adding an argument to the major predicate, Reichenbach defined an event function [p]* which turns a proposition p into a property of events. Substituting in this function the proposition (19) for p, one gets (22), which corresponds to (19) very much like Davidson's (20) corresponds to the initial (19).

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[13] Scope variation of the sort illustrated in (17) and (18) does not carry over to nominalization, as shown by (i) as opposed to (ii). This is due to conditions of DP-syntax that are not to be pursued here.
(i) the regular delivery of mail on Monday
(ii) * the delivery of mail on Monday regular(ly)

[14] The treatment of tense as a conjunct on a par with adjuncts must be modified for reasons to which we return. For the time being it simply indicates the specification imposed on e.

(22) $\exists e [P(x_1, \ldots, x_n)]^* (e)$

In these terms, the analysis of (21a) comes out as (23), with tense and adverbial modification represented again by conjoined propositions:

(23) $\exists e [[$ buttering (Fred, the toast) $]^*(e) \& T(e) < T(u) \&$ in the kitchen (e) $]$

Reichenbach's proposal is more general than Davidson's, as it introduces an event variable by a general event function[15], rather than by extending the arity of particular (classes of) predicates.[16] It could thus apply to any proposition, including those specifying e.g. locative or temporal properties. This requires an empirically restricted occurrence of the event-function, ultimately converging with the specification needed for event arguments of the Davidsonian style. With this proviso, and ignoring certain consequences of the different theoretical contexts of the two proposals, Davidson's and Reichenbach's event variables are intended to account for roughly the same range of phenomena.[17] In particular, both Reichenbach and Davidson represent adverbial modification by conjoined predications of the event argument, such that e.g. *Fred buttered the toast* follows from (21a) by the rules of standard logic.

A rather different way to treat the event variable has been proposed a. o. by Parsons (1990). This so-called neo-Davidsonian theory replaces (19) by (24), turning P into a one-place predicate P" of events to which the arguments of P are then related by thematic relations R_i:,

(24) $\exists e [P''(e) \& R_1(e, x_1) \& \ldots \& R_n(e, x_n)]$

Thematic relations are taken from the usual set of theta roles like agent, theme, source, goal, etc. Under this proposal, the analysis of (21a) would come out as something like (25):

(25) $\exists e [$ buttering (e) & Agent(e, Fred) & Patient (e, the toast) & $T(e) < T(u)$ & Location (e, the kitchen) $]$

The move from (19) to (24) is – in spite of the deceptive terminology – a radical defection from Davidson's original intention. Separating the core predicate from its original arguments has far-reaching and fatal consequences. I will briefly sketch three of them.

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[15] Reichenbach explicitly uses fact function and event function synonymously. The distinction between facts on the one hand and events and states on the other made in Vendler (1967) and subsequent discussions corresponds more (but not exactly) to the distinction Reichenbach makes between objective or situational fact functions and propositional fact functions.

[16] Davidson originally assumed event arguments for verbs of change and action. Later on, various extensions have been discussed by various authors, including e-arguments not only for state verbs but also for certain types of adjectives and heads of locative PPs. I will return to this matter below.

[17] A hint to different notational variants appearing in the literature might be useful. In essentially the sense of Reichenbach's event function, Kamp & Reyle (1993) use the colon to associate a proposition p with an event e, Wunderlich (2000) uses curly brackets, and Bierwisch (1988) an operator INST. Thus $[p]^*(e)$, e:p, {p}e, and e INST p all specify an event e instantiating a proposition p.

First, as shown by (25), arguments and adjuncts of a verb cannot differ with respect to their semantic effect: Both are conjuncts added in the same way to the event predication.[18] Now, a major point in Davidson's treatment of events and adverbials was to provide a systematic account for the inference from e.g. (26a) to (26b) by standard conjunction reduction:

(26) a. Fred met Eve in Paris.
b. Fred met Eve.
c. * Fred met in Paris.
d. * Fred met.

According to the neo-Davidsonian analysis, (26c) and even (26d) should be derivable by conjunction reduction in the same way, obviously a wrong conclusion without any empirical justification. Notice that the deviance of (26c) and (26d) is not merely a matter of the syntactic surface, violating conditions of c-selection, but indicates rather a semantic deficiency.[19]

The second point, directly related to this problem, concerns the fact that the number and type of arguments a predicate requires belong to its essential, intrinsic properties. The event expressed by the verb *give*, for instance, requires necessarily what is usually called an agent, a theme, and a recipient; it cannot get along with, say, an experiencer and a goal or just a theme. Similarly *think* needs an experiencer and a theme, while *sleep* requires an experiencer, but excludes a theme. This is not a matter of arbitrary incidences, but systematically determined by the respective event predicates. That requires highly intricate sets of postulates, determining not only the required, but also the excluded thematic relations. Such postulates, which have never been considered by neo-Davidsonians in an even remotely adequate way, do nothing but supply information that has artificially been stripped away from the core predicates – an arbitrariness that becomes particularly obvious if one takes into account the internal structure of complex predicates of the sort to be looked at below.

Third, representations of the neo-Davidsonian style are in conflict with requirements of standard logic in a much wider range of the cases than those illustrated in (26). They yield inappropriate results also in lots of other cases, notably with respect to negation. Thus according to (24), the representation of (27a) – ignoring tense – would be (27b), which is equivalent to (27c).

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[18] The basic distinction between arguments and adjuncts is not obviated by the fact that there are similarities or even borderline cases. Thus *in Paris* is a locative argument selected by *stay* in (i), it is a free locative adjunct in (ii), and something in between, often called argument-adjunct, optionally selected by the noun *stay* in (iii).

(i) He stayed in Paris
(ii) He visited me in Paris
(iii) his stay in Paris

For some discussion of these similarities and borderline cases see Bierwisch (1988, 2003). The present problem is in no way affected by these phenomena.

[19] It might be noted that these considerations apply also to the condition T(e) < T(u) indicating past tense in (25). This is one of the reasons requiring a different treatment of tense, as mentioned in fn.13.

(27) a. He doesn't sell it.
b. $\neg\exists$ e [sell (e) & Agent (e, he) & Theme (e, it)]
c. $\forall$e [$\neg$ sell (e) $\vee$ $\neg$ Agent (e, he) $\vee$ $\neg$ Theme (e, it)]

According to normal understanding, (27a) is true if and only if there is no instance of his selling it, whatever *he* and *it* are apt to refer to. The three options by which (27a) could be falsified according to (27b) or (27c) are simply besides the point: There is no way to understand what it would mean that someone referred to by *he* is not the agent of the selling event e or something referred to by *it* is not the theme of that event, even if one ignores problems related to quantification over events.[20] Notice that this is different for something like *he doesn't sell it today*, where the negation – in line with the original Davidsonian approach – can appropriately apply to the event of his selling it and to the temporal location of that event.

These and a number of further points concerning the controversial nature of separated thematic roles strongly argue against the neo-Davidsonian approach. This leaves us with two possibilities to incorporate event reference into the notational system sketched in section 2. (28a) illustrates the Reichenbach-version of the verb *sleep* (using Kamp's ":" rather than Reichenbach's "[ ]*"), while (28b) follows Davidson's proposal, extending the property SLEEP into a relation between an individual and an event:

(28) a. / sleep / [+V, -N] λx λe [e : [SLEEP x]]
b. / sleep / [+V, -N] λx λe [[SLEEP' x] e]

Assuming that eventualities like individuals are elements of type e, the one-place predicate SLEEP in (28a) is of type $\langle$e, t$\rangle$, taking x to build up a proposition of type t, and the colon : is formally an operator of type $\langle$t,$\langle$e, t$\rangle\rangle$, turning a proposition into a predicate of events. The two-place predicate SLEEP' in (28b), on the other hand, is of type $\langle$e,$\langle$e, t$\rangle\rangle$, turning two individuals into a proposition. In both versions, both variables are bound by argument positions, providing the subject position and the event reference, respectively. The difference between (28a) and (28b) is in one respect more than merely a notational variant, however. As the domain of eventualities includes events, processes, and states, the variable e is subject to a sortal choice, depending in one way or the other on the predicate that takes e as its argument. In (28b) this choice is directly determined by the predicate SLEEP', while in (28a), it must somehow be proliferated from the property SLEEP to the argument of the event operator ":". I will return to this issue below.

It is worth noting that corresponding to the verb *sleep*, we have the entry (29) for the event noun *sleep*, which differs merely by its categorization:

(29) / sleep / [-V, +N] λx λe [e : [SLEEP x]]

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[20] It must be emphasized that what is at issue are the propositions that *he* and *it* are agent and theme of e, not the identity of the individuals referred to. The identity of the individuals could be focused and negated, as in *HE doesn't sell it* (*but his BROTHER*). – This is barely possible for the object NP in (27), however, for independent reasons, preventing contrastive stress on *it*.

This difference has important consequences beyond the categorization as such, because argument positions differ systematically for nouns and verbs with respect to their syntactic properties. Thus, argument positions of nouns are generally optional, except for the referential role, which happens to be the event position in (29). Hence λx must be saturated by the subject in (28), but can be left unspecified in (29), as in *the sleep last night*, etc.

In (29), as in lexical entries in general, the c-selectional properties associated with the argument positions (such as case requirements) are largely predictable by the categorization. Thus λx requires nominative for the verb in (28), but (possessive) genitive for the noun in (29). See e.g. Bierwisch (1997) and Wunderlich (2000) for further discussion.

Given the assumptions about SF sketched in section 2, the entry (28a) would now support representations like (30b) and (31b), again with obvious simplifications in various respects:

(30) a. Fred slept in the kitchen
b. ∃e [[Te < Tu] [e : [SLEEP FRED] & [e IN [DEF y [KITCHEN y]]]]]

(31) a. Fred slept for an hour in the kitchen
b. ∃e [[Te < Tu] [e : [SLEEP FRED] & [EXTENT e ⊇ 1 HOUR] &
[LOC e IN [DEF y [KITCHEN y]]]]]

It must be added that (31b) is at best a first approximation, as it does not account for the relative scope of temporal and locative adverbials in relation to their syntactic position.

5. The event structure of inchoativity and causativity

The verb *sleep* refers to a particular sort of state. The same type of state provides the source of the change referred to by the verb *awake* (and *wake up*) and also the target state of the inverse change referred to by *fall asleep*. The transitive variant of *wake up* furthermore exemplifies the possibility to add an agent identifying the source of the change denoted by the intransitive verb, a pattern characteristic for so-called ergative verbs like *break*, *close*, *change*, etc. Following familiar assumptions, deriving from McCawley (1973), Dowty (1979) and related work, grammatically relevant semantic relations within and between causative and inchoative verbs based on the state characterized by SLEEP can be represented as follows, with [ACT y] specifying the event which brings about the relevant change of state:[21]

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[21] Actually, the proposition [ACT y] used here and in the sequel is a shorthand in various respects. First, ACT must be construed as a predicate subsuming all sorts of appropriate activities by which the effect in question can be brought about. Thus ACT comes close to a variable ranging over activity predicates. For a more detailed discussion of cause, effect, and causation see section 7 below. Second, ACT is treated as a predicate applying to an individual that provides the argument position of the agent, as exemplified in (i):

(32) a. / sleep / [+V] λx λe [e : [SLEEP x]]
b. / awake / [+V] λx λe [e : [BECOME ¬ [SLEEP x]]]
c. / awake / [+V] λx λy λe [e : [[ACT y] [CAUSE [BECOME ¬ [SLEEP x]]]]]

The transitive verb *awake* and its intransitive variant should, of course, be based on (roughly) the same lexical item. (32a) and (32b) can in fact be collapsed into one entry as shown in (33), where heavy parentheses include optional parts, the subscripts indicating that they must simultaneously be present or absent:

(33) / awake / [+V] λx (α λy) λe [e : (α [[ACT y] [CAUSE) [BECOME ¬ [SLEEP x]]]]]

Thus, according to (33), if an agent is present, it is realized as the grammatical subject, otherwise the argument of SLEEP becomes the subject. In German, the items integrated in (33) require separate entries shown in (34c) and (34d), which cannot be collapsed, even though they are etymologically related. German furthermore provides a lexical entry denoting the inverse event of (33), as shown in (34b).[22]

(34) a. / schlaf- / [+V] λx λe [e: [SLEEP x]]
b. / ein + schlaf- / [+V] λx λe [e: [BECOME [SLEEP x]]]
c. / auf + wach- / [+V] λx λe [e: [BECOME ¬ [SLEEP x]]]
d. / (auf+) weck- / [+V] λx λy λe [e: [[ACT y] [CAUSE [BECOME ¬ [SLEEP x]]]]]

It might be added, that ergative verbs like (33) are represented in German by cases like *brechen*(break), *heilen*(heal), *schmelzen*(melt) and others. However, the dominating pattern relating inchoative and causative constructions of the same verb in German is reflexivization of the type (*sich*) *öffnen* (open), (*sich*) *drehen* (turn), (*sich*) *biegen* (bend), (*sich*) *ändern* (change) etc. (Cf. *sie ändern den Fahrplan* vs. *der Fahrplan ändert sich* in (8) and (9) above). A lexical entry of *ändern* (change) that would account for this aspect is sketched in (35), where heavy parentheses again indicate optionality:[23]

(i) Paul woke me up
(ii) A sudden noise woke me up

As shown by (ii), however, the subject position of a causative verb can also be assigned to an expression referring to an event rather than the relevant actor. Now, mutual substitution of actor and event is a rather general phenomenon. It therefore needs a systematic account, which cannot be pursued here any further.

[22] The differences between (33) and (34) are in fact typical phenomena of lexicalization, exploiting general principles of lexical representation in idiosyncratic ways. This includes the incidental "overload" by the almost synonymous entries *awake* and *wake up*. A similar overload appears in German with *aufwachen* and *erwachen* being largely synonymous. It is worth noting on this background that the lack of a straight causative counterpart for *einschlafen* (fall asleep) is not a mere idiosyncrasy: the verb *einschläfern* (lull asleep), which would fill this position morphologically, has the highly specialized interpretation of narcotize, obviously due to the fact that falling asleep is internally triggered and cannot directly be caused by an external agent.

[23] As a side-remark it might be mentioned that the predicate DIFFERENT is an abbreviation, to be defined provisionally as follows, where { p } indicates that p is presupposed, as discussed below:

(35) / änder- / [+V] λx λy λe [e : [([ACT y] [CAUSE)[BECOME [DIFFERENT x]]]]]

In contrast to ergative verbs like (33), de-causativization is simpler in (35): No position from the argument structure is deleted, optionality applies only to the causative component in SF, leaving a spurious position λy, as a consequence of which the object position is realized by a reflexive pronoun.[24] Thus although the reflexive construction looks superficially more complex than the un-ergative use of a causative verb, the lexical information it requires is surprisingly simple.

Turning now to the event structure based on lexical items with the internal make up illustrated in (32) – (35), we notice first that inchoative verbs referring to an event e_i involve at least three eventualities: a source state s_j and a target state s_k, such that the event e_i is to be defined as the transition from s_j to s_k. Thus for *einschlafen*, s_j and s_k are the states of being awake and being asleep, respectively. Generally, the properties of the source state are defined by those of the target state simply by negation. Hence if e_i is just the transition from s_j to s_k, the information needed for the SF of an inchoative verb is only the specification of BECOME and the proposition p specifying the target state.[25]

Second, causative verbs referring to an eventuality e_n involve at least a cause e_m and an effect e_l, such that e_n consists in the causation of e_l by e_m. The effect e_l might be a process, as in *the truck moved the trailer steadily*, or a state as in *the squad kept the rope straight*, but in the majority of cases it is an event, as in *Max opened the bottle*, *Eve woke the kids up*, *Macy's changed the schedule*, etc. In case of an event causation, the event's source and target state are to be distinguished. Hence causation of an event involves (at least) five eventualities:

(36) a. the causing event e_m
b. the effect e_l, identified as the change e_i
c. the causation e_n of e_i by the cause e_m
d. the source state s_j of e_i
e. the target state s_k of e_i

(i) [DIFFERENT x] $=_{def}$ ∃ (P, s) [{ s : [P x] } ¬ [P x]]
In other words, for something to be different with respect to some property P, a state meeting this condition is presupposed. It is only this presupposed condition with respect to which a difference can be identified in the first place.

[24] This analysis implies (i) specific assumptions about improper positions in AS, i.e. operators that do not bind a variable in SF, and (ii) a natural, but non-trivial assumption about reflexive anaphors, according to which the antecedent of a reflexive pronoun provides the value for its argument position. See Bierwisch (1997) for some discussion of both assumptions.

[25] For inchoatives like *close*, *open*, *wake up*, *redden*, etc. this fact manifests itself even in their morphological make-up. But also inchoatives like *come* and *receive*, where the target state is not marked morphologically, derive the initial from the final state by negation. There are, however, at least two types of lexical amendments that can be added to this basic pattern. First, for very few cases the source state may impose additional conditions. A case in point is *melt*, which requires its theme to start out as solid, rather than merely not liquid. Second, in cases like *ersticken* (choke), *ertrinken* (drown), *erfrieren* (freeze to death), all with the target state *not alive*, the transition is to be qualified by the mode of dying. Again the morphological make-up is relevant in many cases, an issue that must be left aside here.

Corresponding to the target state, by which inchoatives are determined, the effect of the causation tends to be characteristic for causatives. This is in fact the essence of the pattern illustrated in (33), which captures the crucial property of so-called ergative verbs. It furthermore turns in many cases the resulting state into the defining condition of the causation as a whole. Obvious examples are the causative variants of *open*, *close*, *wake up*, *dry*, *clean* or German *schwärzen* (blacken), *kühlen* (cool), *töten* (kill) etc.[26] Differing from the source state of inchoatives, the cause of causatives can be and often is lexically specified: *erschlagen* (slay) *erstechen* (stab (to death)), *erschießen* (shoot), *erdolchen* (stab (with a dagger)) differ from *töten* (kill) by specifying the action, left open in *kill*. As already mentioned, ACT in (33) is a kind of dummy, in causatives like *stab*, *shoot*, or *hang* it is replaced by a lexical specification of the pertinent action.[27]

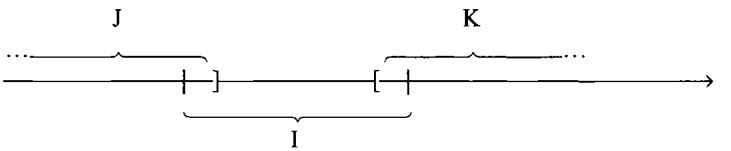
Besides these differences in lexical specification, the eventualities listed in (36) differ with respect to their temporal structure, their logical status, and their referential accessibility, as shown in sections 6 and 7.

6. The eventualities involved in BECOME

Taking BECOME as the core component of inchoatives, I will characterize its basic temporal structure by means of conditions proposed e.g. in Dowty (1979), taking BECOME as an operator of type ⟨t, t⟩ with the properties indicated in (37), where p specifies the target-state, and I, J, K are time intervals as schematized in (38):

(37) [BECOME p] is true at I if and only if
  (i) there is an interval J containing the initial bound of I such that ¬p is true at J, and
  (ii) there is an interval K containing the final bound of I such that p is true at K.

(38)



Two problems must be clarified here. First, as it stands, the interval I can extend over arbitrary parts of the source as well as the target state, such that *Fred woke up* would hold for a situation that includes arbitrary parts of Fred's sleep and of his being awake. Second, if one relies on strictly two-valued logic, no interval I' between J and K is possible, as at any time

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[26] Again, the defining target state may, but need not be morphologically realized. Thus while German *töten* is related to *tot* (dead), the resulting state has no overt reflex in *kill*. Similarly *give*, *show*, or *convince* are characterized by the resulting state, viz. *have*, *see*, and *believe*, respectively, without morphological relationship.

[27] The basic causative pattern can be enriched by further conditions, as in *assassinate*, *murder*, *donate*, etc. Amendments of this sort don't change the event reference and can thus be ignored here.

either p or ¬p must hold, with no transition. Hence any change would have to be strictly momentary. Dowty suggests to avoid these problems first by means of some sort of Gricean maxim, which picks out the shortest non-empty interval appropriate under conditions of encyclopedic or common sense knowledge, and second by acknowledging intervening time-intervals with undecided (or not two-valued) truth conditions. This ambivalent time structure of the event e_i, which overlaps with both s_j and s_k, is reflected by the fact that normally e_i is not available for durational adverbials, as shown in (39a), but might still be qualified for extension in time in (39b):

(39) a. * The cat died for three hours.
b. The cat died very slowly.

The next point to be noted is the different status to be assigned to the event, its initial and its final state. According to standard criteria, they instantiate what is usually called assertion, presupposition and implication, respectively. Consider (40) for illustration:

(40) a. The cat died.
b. The cat didn't die.
c. Did the cat die?
d. Didn't the cat die?

Asserting and denying the cat's dying equally requires the initial state of the event, viz. the cat's being alive, to hold before. It must also hold for both types of question (40c) and (40d) to be appropriate. The negation of the initial state, i.e. the cat's being dead before the event, is compatible with the negation (40b) only as a correction of the presupposition. The target state on the other hand, viz. the cat being dead afterwards, follows from the truth of the assertion (40a), while its negation, that the cat is still alive, follows from the denial (40b). These observations are expressed more formally in (41) for the target state and in (42) for the source state, where t ○ t' represents (temporal) overlap of t and t', and { φ } ψ indicates that φ is presupposed by ψ :[28]

(41) $\forall e$ [$\exists s'$ [e: [BECOME p] implies s' : [p]]]
where T e = t, T s' = t', t' ○ t , t' ○ t'' , t < t'' .

(42) $\forall e$ [$\exists s$ [e : [BECOME [p]]] $\Rightarrow$ [{ s: ¬[p] } [e : [BECOME [p]]]]]
where T s $\supset\subset$ T e (i.e. s precedes e immediately)

(41) requires the target state s' to share its time in part with e and in part with the subsequent interval t''. Because of (41), the source state s can overlap only with the initial part of the event e. One might construe (42) as an operation that expands the expression to the left of the arrow into that to the right of it, supplying automatically the presupposed source state

[28] This notation is adopted from Kamp (2001), where properties of presuppositions are explored more generally.

of an inchoative event. In any case, (41) and (42) spell out the properties of BECOME and the predictable aspects of inchoatives based on it.

I will now turn to the intriguing question to what extent the eventualities involved in a change of state are accessible for reference and modification. The analysis proposed for *wake up*, *einschlafen*, or *aufwachen* (in (32b) and (34)) suggests that it is just the main event, which the referential position λe makes available to this effect. This seems to be born out by cases like (43), where apparently tense, temporal and modal adverbials all apply to the main event:

(43) Dann schlief sie innerhalb von drei Minuten ganz sanft ein.
Then she fell asleep very softly within three minutes

Similarly, adverbial quantification by *frequently, usually, mostly, occasionally* etc. as in (44a) must rely on the same variable, given that adverbial quantifiers range over events, as proposed e.g. by von Fintel (1994). Simplifying with respect to irrelevant details, (44a) is thus to be analyzed as (44b), where [MOST e] must be construed as a quantifier with the restrictor given by the SF of *Eva schläft ein* and the nucleus *in zehn Minuten*:

(44) a. Eva schläft meistens in zehn Minuten ein.
Eva usually falls asleep within ten minutes
b. MOST e [e : [BECOME [SLEEP EVA]]] [T e ⊆ 10 MINUTES]]

As noted right in the beginning, this is not the whole story, though. A crucial problem, already illustrated in (1) above, is shown by the minimal pair in (45):

(45) a. Er ist in kurzer Zeit eingeschlafen.
(He fell asleep within a moment)
b. Er ist für kurze Zeit eingeschlafen.
(He fell asleep for a moment)

The temporal delimitation *within a moment* in (45a) characterizes the change, while the durational adverbial *for a moment* in (45b) can only concern its resulting state. In other words, different aspects of the complex eventuality must be available for modification.

One way to account for this observation has been proposed by McCawley (1973) within the framework of Generative Semantics. According to this proposal, the system of pre-lexical syntax provides two syntactic positions for an adverbial in cases like (45): *within a moment* commands [BECOME [SLEEP x]], while *for a moment* commands just the predication [SLEEP x].[29] The pros and cons of pre-lexical syntax need not be repeated here, as the observation illustrated by (1) and (45) has various ramifications not naturally accounted for on the basis of pre-lexical syntax. Notice first, that the alternative interpretation illustrated in (45) carries over to adnominal modification, as shown by the parallel properties of the (a)- and (b)-cases in (46) and (47):

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[29] This approach has been pursued in a number of ways, especially with respect to elements like *almost* and *again* e.g. in von Stechow (1996). Alternative accounts of these facts, which do not rely on pre-lexical syntax, are discussed e.g. in Kamp & Roßdeutscher (1994).

(46) a. Er kehrte nach kurzer Zeit/für kurze Zeit heim.
He returned home after/for a short time
b. Seine Heimkehr nach so kurzer Zeit/für so kurze Zeit
His return home after/for such a short time

(47) a. Das Wetter änderte sich plötzlich/dauerhaft.
The weather changed suddenly/permanently
b. Die plötzliche/dauerhafte Änderung des Wetters
The sudden/permanent change of the weather

The alternative furthermore persists under adverbial quantification as illustrated in (44). Thus, a generic sentence like (48a) clearly requires quantification and modification to apply to the event as a whole, while in (48b) only the temporally restricted sleeping period is quantified over:

(48) a. Ein normaler Patient schläft meistens in ungefähr einer Stunde ein.
An average patient usually falls asleep within roughly one hour
b. Ein normaler Patient schläft meistens für ungefähr eine Stunde ein.
An average patient usually falls asleep for roughly one hour

In principle, this type of interpretation again carries over from adverbial cases like (49) to the adnominal modification in (50), which might be considered as clumsy, but neither as ungrammatical nor unclear in interpretation:

(49) a. Gelegentlich ändert sich das Wetter in wenigen Minuten.
Occasionally the weather changes within a few minutes
b. Gelegentlich ändert sich das Wetter für mehrere Wochen.
Occasionally the weather changes for several weeks

(50) a. Gelegentliche Änderungen des Wetters in wenigen Minuten waren absehbar
Occasional changes of the weather for within a few minutes were to be expected
b. Gelegentliche Änderungen des Wetters für mehrere Wochen waren absehbar
Occasional changes of the weather for several weeks were to be expected

With respect to the background assumptions sketched in section 2, the question arises whether and how the state s', instantiating according to (41) the result of the change, should be available for reference and modification in the same way as the event e. Formally, two options can be adumbrated, if we assume that both the event e and its target state s' are actually available in SF for abstraction by argument positions, an assumption that requires the SF of an inchoative verb like *einschlafen* as illustrated in (34b) to be modified as shown in (51), with the obvious modification in (41) and (42). The two options to be considered can then be illustrated by (52).

(51) [e : [BECOME [s' : [SLEEP x]]]]

(52) a. / ein + schlaf- / [+V] λx λs' λe [e : [BECOME [s': [SLEEP x]]]]
b. / ein + schlaf- / [+V] λx λ⟨e,s'⟩ [e : [BECOME [s': [SLEEP x]]]]

Both of these possibilities raise non-trivial problems. In (52a) an additional, presumably optional, in any case rather specific position would have to be introduced into AS requiring various conditions determining its properties and behavior. Even if s-selection would guarantee that only an appropriate adverbial can get its argument position absorbed by either λs' or λe, there are still a fair number of unsolved problems raised by the additional, improper referential position. These problems would not arise in (52b), where no additional position is introduced, but merely λe, the regular event reference, is replaced by the position λ⟨e,s'⟩, supporting the complex variable ⟨e,s'⟩ instead of the original e. This would require, however, an intricate and completely ad hoc regime of lambda abstraction, dealing with complex variables and their effects. Hence instead of exploring artificial ways to adapt one of the solutions hinted at in (52), it seems reasonable to stick to already available means as far as possible, getting along without an additional eventuality-variable squeezed into AS.

Two observations seem to be relevant in this respect. First, adverbials that are neutral with respect to event or state apply by default to the overall event. Thus even though the time, the companionship, and the localization of Peter's change of place could just as well characterize the target state, it is interpreted as a specification of the event:

(53) a. Peter kam gestern abend.
Peter came last night
b. Peter kam unerwartet nach Hause.
Peter came home unexpectedly

Even though (53a) would be compatible with the truth of *Peter was here last night*, it clearly does not semantically represent that proposition. Corresponding comments apply to (53b). Second, tense and time adverbials seem to be forced to apply to the same eventuality. Thus, the durational modification in (54a) concerns the target state, which the past tense locates before the utterance time, while the manner adverbial in (54b) modifies the change, which the present tense locates (preferably) at utterance time.

(54) a. Das Tor öffnete sich für fünf Minuten.
The door opened for five minutes
b. Das Tor öffnet sich langsam.
The door opened slowly

These observations suggest that there is only one event reference available, which must support both the change or – under appropriate conditions – its result. This would be the natural effect if inchoative verbs with the operator BECOME have the representation illustrated in (55) for *sich öffnen* (intransitive *open*):

(55) / öffn- / [+V, -N] λx λy λe [e : [*BECOME* [OPEN x]]]

The crucial point here is the status of *BECOME* marked by italicization.[30] What this is intended to indicate is a special type of optionality, in the sense that it can be ignored for conceptual and truth-conditional interpretation, such that (54a) would have more or less the interpretation of (56a) with the SF as indicated in (56b):

(56) a. Das Tor war für fünf Minuten offen.
The door was open for five minutes
b. ∃e [Te < Tu [e : [OPEN [DEF x [DOOR x]]] & [Te ⊇ 5 MINUTES]]]

There is, however, a crucial difference in interpretation between (54a) and (56a): While (54a) explicitly claims the resulting state to be the effect of a change, (56b) simply states a past situation.[31] This difference would be an automatic effect of the condition (42), if we assume that the presupposed source state is introduced also if the "shadowy" operator does not participate in further interpretation, in other words, if (55) is expanded into (57) in any case,[32] while (42) would of course not apply in (56):

(57) / öffn- / [+V, -N] λx λy λe [{ s ⊃⊂ e & s: ¬[OPEN x] } [e: [*BECOME* [OPEN x]]]]

Notice that the presupposed state s immediately precedes e, whether e instantiates an event or a state. This fairly restricted stipulation associated with the status of *BECOME* yields exactly the two options for reference to eventualities illustrated before. It furthermore carries over to nouns as exemplified in (50). Thus *Änderung* (change) would have an entry like (58), which refers either to the change or its result, triggering again by means of (42) the presupposed source state:[33]

(58) / änder-ung / [+N] (λx) λe [e : [*BECOME* [DIFFERENT x]]]

On this background, it is interesting to note that reference and modification may oscillate between the event (as a whole) and its target state, but not between the event and its presupposed source state. Even adverbials that would conceptually fit the source state can only

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[30] For the improper argument position λy giving rise to the reflexive anaphor, see note 23

[31] There are, of course, implicatures arising from the delimitation *for five minutes*, but that is a different issue which I'll leave aside here.

[32] For the sake of completeness, it might be noted that the implication required by (41) holds trivially, even if *BECOME* is ignored.

[33] As *Änderung* is a regular derivation, it presumably does not require a separate lexical entry. (58) furthermore leaves aside the relation to the causative variant of *ändern* (included in (35) above), which would show up in cases like *seine überraschende Änderung der Liste* (his changing the list surprisingly). – It should be noted, though, that applying (42) to (58) to introduce the presupposed state would give (ii), if the definition (i) for DIFFERENT given in fn. 22 is taken into account:

(i) [DIFFERENT x] $=_{def}$ ∃ (P, s) [{ s : [P x] } ¬ [P x]]

(ii) / änder-ung / [+N] (λx) λe [{ s ⊃⊂ e & s : [P x] } [e : *BECOME* ¬ [P x]]]]

This correctly specifies the (result of the) change as cancellation of some property P that held of x before.

modify the event – as in (59a) – or the target state – as in (59b). Adverbials that would be appropriate only for the source state, as in (59c), are anomalous.

(59) a. Er ist qualvoll gestorben.
He died painfully
b. Er ist eine halbe Stunde weggegangen.
He left half an hour
c. ?? Er hat sich seit zwei Stunden hingesetzt.
He sat down since two hours

In cases like (60a) the adverbial clearly specifies the duration before the event to which the clause refers. Hence the time interval of the event differs from that specified by the adverbial, exactly as cases like (60b). Thus, the adverbial in (60a) and (60b) does not rely on reference to the target state.

(60) a. Er ist nach einer Stunde aufgestanden.
He got up after an hour
b. Er ist vor einer Stunde aufgestanden.
He got up an hour ago

In general, then, an inchoative verb (or noun, for that matter) refers to one and only one eventuality. This is primarily the event it describes, and secondarily – due to the peculiar, elusive status of *BECOME* – the target state, but never the source state. Although presupposed and necessary, the source state is not available for reference in SF. The particular, somehow diaphanous character of *BECOME* may also be supported from the opposite direction, so to speak. One of the criteria for the standard distinction between (a-telic) processes and states on the one hand and (telic) events on the other is their behavior with respect to durational and terminating adverbials. As discussed so far, proper events like *come*, *die*, *get sick* combine freely with temporal delimitations like *(with)in a week*, but allow durational adverbials only as a specification of the resulting state, such that *die for a week* is awkward:

(61) a. Hans schlief innerhalb einer Stunde ein.
Hans fell asleep within one hour
b. Hans schlief für eine Stunde ein.
Hans fell asleep for one hour
c. Anna starb innerhalb einer Woche.
Anna died within one week
d. ?? Anna starb für eine Woche
?? Anna died for one week

States and homogeneous processes on the other hand allow durational adverbials, but should resist temporal delimitations, such that *be sick within three days* would be out. That this is not the case is shown by the acceptability of (62a) and (62c). This does not mean, however, that states and homogeneous processes combine with time-limits, but rather that