Predicate Classes: A Study in Compositional Semantics

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Abstract: The aspectual interpretation of sentences is constrained by the truth conditions predicates impose on points of times or time intervals. Using data from English, Vendler (1967) established a classification of four verb types on these grounds, that has been widely accepted in linguistic theory. Various researchers, among them Dowty (1979) for English and Ehrich (1992) for German, have proposed finer grained classifications. This paper is very much in the spirit of these proposals. Our aim is a detailed model of the compositional lexical semantics of predicates that models the contrasts of verbal aspect by implicit temporal arguments in the logical characterisation, thereby yielding a concise classification. Punctual and durative predicates are distinct through having either points in time or intervals as implicit temporal arguments. Truth intervals of predicates can be closed or open resulting in the telicity or atelicity of a verb. It is argued that resultativity must, in addition, be introduced by a secondary predicate denoting a result. This predicate may also be implicit. If it is explicit, however, it has the status of a syntactic argument. Since the secondary predicate is subject to a truth interval of its own, the verbal aspect of resultatives must be more complex than that of non-resultatives. Moreover, transitive and intransitive resultatives combine diverse kinds of elementary predicates such as ACT, BECOME, CAUSE Predicating over elementary events, licensing different argument structures and yielding specific truth conditions on times. Finally, a classification of 15 kinds of predicates is established on the basis of compositional complexity.

1. Introduction

The aim of this paper is to design a concise model for the compositional lexical semantics of predicates. It is meant to offer the possibility of integrating verbal aspect and argument structure in their logical characterisation and thus also in their classification. As illustrated in an outlook

at the end of the paper, this may also provide the basis for a compositional explanation of phrasal and sentential aspect[1] and tense and of restrictions for the compatibility of verbs and adverbials. We use as our metalanguage a first-order predicate logic which we supplement with elements of generative syntax and semantics. It is obvious that the aspectual interpretation of sentences is constrained by conditions on truth intervals which are predetermined by verbal aspect. On this basis, Vendler (1967) proposed his well known classification consisting of four verb classes. This rather broad classification is mainly based on English data. However, Ehrich (1992: 75) has already argued on the basis of the German verbal lexicon that more than four classes can be found if predicates are differentiated by punctual and durative verbal aspect and further aspectual properties such as resultativity. In our view, verbal aspect reduces to the lexical restriction of the aspectual interpretation of sentences by means of implicit temporal arguments of predicates defining truth intervals. E.g., intervals can be closed or open, which results in perfectivity on the one hand and imperfectivity on the other.

Dowty (1979: 73ff) presented a model based on the predication over temporal arguments. In addition, he was able to show the significance of argument structure for the interpretation of the verbal aspect (ibd. 52f.), which he explained by operators borrowed from generative semantics, i.e., CAUSE and BECOME (ibd. 71ff.) which presuppose a specific argument structure. In this paper, we argue that such operators are in fact ***elementary*** predicates over ***elementary events***, combining with other elementary predicates to form semantically complex predicates. Moreover, we propose that ***resultativity*** is based on the presence of a secondary resultative predicate which may be either explicit or implicit. If this resultative predicate is explicit, is also has syntactic argument status.

Since the secondary predicate is assigned a truth interval of its own, the aspectual interpretation of resultative verbs is always complex. Moreover, the result predicates differ with respect to the argument they predicate over: with intransitives, in NOM-ACC-languages like English and German, it is always the subject — irrespective of its thematic role; with transitives, it is the direct object. Taking into consideration both results and elementary predicates like CAUSE and BECOME, amended by a predicate specific to actions that we call ACT, we end up with a classification of 15 predicate classes on the basis of the truth conditions they define for intervals.

2. Discussing the State of the Art

As mentioned above, Vendler (1967) distinguishes four types of predicates: cf. 1: ***states*** (a), ***activities*** (b), ***achievements*** (c) and ***accomplishments*** (d); cf. Tab. 1 on the next page.

Expressed in a simplified way, type (a) and type (b) differ by the nature of their truth intervals: states are valid for every point in time within a certain time period (we suggest calling this linear validity), whereas durative predicates define the truth conditions for the entire period (cf. Lohnstein 2011: 268ff). E.g., you cannot dance at a point in time but only within a period between two points in time, whereas you can be beautiful at every single point in time. Predicates of type (c) are durative whereas those of type (d) are punctual. Both differ aspectually from the

[1] In fact we suspect that instead of the classical distinction of aspect and aktionsart, a threefold division into verbal, phrasal and clausal/sentential aspect would be more appropriate. This view is not elaborated upon in this paper, however, we return to it at some points in this article.

Vendler's Verb Classes			
(a)	***States:***	*know*, *love*, *hope*, *wish*, *own*, . . .	(linear)
(b)	***Activities:***	*walk*, *dance*, *swim*, *hunt*, *drink*, . . .	(durative, non-resultative)
(c)	***Accomplishments:***	*hide*, *sink*, *build*, *climb*, . . .	(durative, resultative)
(d)	***Achievements:***	*discover*, *reach*, *explode*, *win*, *find*, *loose*, . . .	(punctual, resultative)

Table 1.: Vendler's Verb Classes

first two by defining a bounding point where they stop being true. This property is usually called telicity. Some researchers, however — and we will follow them in this, prefer the term "perfective" because of the parallel aspectual properties of phrases and clauses/sentences (cf. Sasse 2006: 536f). Sometimes telicity/perfectivity is regarded as co-occurring with resultativity and is thus not in fact differentiated from it (e.g., Vendler 1967,). This will also be a point of discussion further below.

Facing this broad typology, first of all, it is not quite clear whether Vendler's system covers all kinds of predicates. Second, the four groups seem heterogeneous. Therefore, taking into account also thematic properties of arguments, Dowty (1979: 183ff) searched for some more classification criteria, yielding a system of eight groups of predicates, partly consisting of subgroups; cf. Table 2 and (1) for the criteria applied by Dowty.

	Non-Agentive	***Agentive***
States	(1a) *be asleep*; *be in the garden* (stage level); *love*, *know* (object level)	(2a) possibly *be polite*, *be a hero* belong here
(interval statives)	(1b) *sit*, *stand*, *lie*	(2b) *sit*, *stand*, *lie* (Subject: +human)
Activities	(3) *make noise*, *rain*	*walk*, *laugh*, *dance*
Single change of state	(5) *notice*, *realize*; *ignite*	(6) *kill*, *point out* (*something to someone*)
Complex change of state	(7) *flow from x to y*; *dissolve*	(8) *build* (*a house*), *walk from x to y*, *walk a mile*

Table 2.: Dowty's Classificaiton of Predicates

(1) a. *momentary* (1a) vs. *durative* (1b, 2b, 3–8)
b. denoting a *change of state* (3–8)
c. denoting a *definite* change of state (5–8)

d. *simple* vs. *complex* change of state (5–6)
e. *agentive* (2, 4, 6, 8) vs. *non-agentive* (1, 3, 5, 7)

Dowty (1979: 185) himself qualifies his own classification as "fuzzy". Moreover, it has been shown that it is also incomplete. Ehrich (1992: 75) suggested defining semelfactives, i.e., punctual non-resultatives (cf. Comrie 1976: 42), which are not part of Dowty's system, as a class of their own.

(2) ***acts*** and ***incidents:*** *cough*, *sneeze*, *startle*, . . . (punctual, non-resultative)

Ehrich (1992) eventually develops an alternative model on the basis of aspectual primitives. First, she divides predicates into ***situations*** and ***properties***. Only situations can be further classified by the binary features [±DUR] (durative) and [±RES] (resultative) (cf. Ehrich 1992: 75):

(3) ***properties:*** (*to be*) *blonde*, *squint*, *know*, . . .

(4) ***Situations***
a. ***actions*** and ***processes***: *built*, *recover*, . . . [±DUR, +RES]
b. ***acts*** and ***incidents***: *enter*, *find*, . . . [–DUR, +RES]
c. ***activities*** and ***states***: *dance*, *sit*, . . . [+DUR, –RES]
d. ***acts*** and ***incidents***: *cough*, *startle*, . . . [–DUR, –RES]

However, this system is not complete either: the subgroups in (a)–(d) can be further differentiated. E.g., resultative predicates can be subdivided according to perfectivity and imperfectivity. Dowty (1979: 88) found that there are "degree achievements" that are imperfective, which means that they denote a change of state that does not terminate the (complex) event; we would like to call exactly this kind of predicate a ***process***.

(5) ***processes:*** *(to) age*, *grow*, *mature*, . . . (imperfective, resultative)

That these are to be distinguished from other predicates denoting resultative events is evidential taking into account the compatibility with aspect specific adverbials.

(6) a. * *The woman has eventually aged.* (imperfective)
b. *The Titanic has eventually sunk.* (perfective)

In our view it is also counter-intuitive that Ehrich (1992: 76) deliberately neglects the difference between event-denoting and state-denoting predicates, classifying states together with activities in one group defined be the features [+DUR, -RES]. States and properties share the characteristics that they do not refer to events but directly predicate over individuals. Moreover, as shown above, states are not even durative but linearly valid for points in time, exactly like properties. Thus, they form a proper subclass of predicates together, with the minimal difference that states are valid only temporarily and are therefore repeatable.

(7) a. *Gretchen was naive* (**again and again*) (property)
b. *Gretchen was disappointed* (*again and again*) (state)

In the following section, we present arguments for a fine grained classification on the base of both aspectual factors and implicit arguments, which will be our basis for a formal classification system.

3. What are the Criterial Features for Classification?

In order to find a classification that is concise and precise, we are now trying to find the relevant criteria, which we explicate in a predicate logical metalanguage.

3.1. States and properties

Dowty (1979: 85f, 183ff) made a distinction between ***stage-level-*** and ***individual-level-predicates*** (he borrowed this term from Carlson 1980, cf. Kratzer 1995: 125f); using the terms we introduced above, states (i.e., ***stage-level-predicates***) are valid ***within one single truth interval***.

(8) a. *As long as I knew him, Goethe loved Gretchen.* (→ valid for an interval)
b. *Goethe loved Gretchen, until* (. . .)

Properties (individual-level-predicates) do not depend on truth intervals but are proper predicates over individuals.

(9) *Goethe squinted / was blind* (*, *as long as I knew him.*[2]).

Thus, the data suggest a simple way of noting the difference in predicate logic: whereas states predicate not only over an individual but also over (points in) time and thus have an implicit temporal argument, properties do not.[3] They predicate over individuals independent of time: the truth interval is limited only by the time of existence of the individual and is not a logical argument of the predicate (lifetime-effect; cf. Musan 2002: 78, Ehrich 1992: 74).[4] We suggest the following preliminary lexical entries:[5]

(10) a. LOVE: $\lambda y \lambda x \lambda t$ [**love′**(t, x, y)] (state)
b. SQUINT: λx [**squint′**(x)] (property)

[2]Of course this does not mean that they outlast the individuals they predicate over (cf. Ehrich 1992: 74). Also, many predicates denoting properties may still be temporary, e.g., given medical means against squinting or blindness. This poses no problem for our generalisations, however: in fact, restricting the truth interval of properties just changes them into states.

[3]The semantics of individual-level-predicates have been much discussed (cf. Kratzer 1995). Chierchia (1997: 198ff) suggests analysing them as ***inherently generic predicates***. This offers the possibility of treating them like ***stage-level-predicates*** with the only difference being that the implicit tense (or situation) argument is bound by a generic operator.

(i) *John is intelligent* ⇒ $\text{Gen}_s[C(j, s)][\text{intelligent}(j, s)]$ (Chierchia 1997: 198)

Here, the context variable *C* represents the conditions correlating John and the situation *s*, such that the predicate *intelligent* is generally valid for *John*_in_*s*. As long as John exists in the state limited by *s*, he is intelligent. In fact, properties can have limitations. A sentence like

(ii) *Goethe was a poet.*

obviously does not mean that he was already writing poems when he was a baby. Thus, assuming an operator like *C* might in fact be logically correct. However, *poet* is still a general property of Goethe and the fact that he started writing at a certain age may just be a matter of presupposition. Thus we do not think that, at least for our purposes, we need such an operator for classification. Note also the awkwardness of the following sentences:

(iii) ?*Goethe was born in 1749. He was a poet between 1765 and 1831. He died in 1832.*

[4]Note that not even this restriction is absolutely necessary:

(i) *Goethe is still Germany's greatest poet.* (vgl. Ehrich 1992: 74)

[5]Note that ***possible worlds*** could be included in these entries, too. Since they do not contribute to the account of the variation, we neglect them for the sake of presentation.

By means of λ-reduction, formulae as in (10a) above can easily be used for the description of propositions defined by states (t° refers to the ***time of the utterance***; : cf.Reichenbach1947).[6]

(11) a. *Goethe loved Gretchen.*
b. $\exists t\,[t < t^\circ \wedge \mathbf{love'}(t, \mathbf{Goethe'}, \mathbf{Gretchen'})]$
c. In words: There is at least one point in time before the utterance time, and at this time, Goethe loved Gretchen.

If the reference time is restricted by the existence of an individual as in the case of properties, one might apply formulae corresponding to the "definite-tense-reading' proposed by Partee (1973: 602) in order to describe them in propositions.

(12) a. *Goethe squinted.*
b. $\exists t\,[t < t^\circ \wedge t = \max_t[\mathrm{AT}(\mathbf{Goethe'}, t) \wedge \mathbf{squint'}(\mathbf{Goethe'})]]$
c. In words: There is at least one point in time before the utterance time, and that is the maximal time where Goethe exists and Goethe squints.

That properties can very often have an optional reading as a state does in our view not contradict but confirm our assumption. Note that this is also possible with nominals that normally express properties but not states:

(13) a. *Rome was a village, once upon a time.*
b. $\exists t\,[t < t^\circ \wedge \mathbf{village'}(t, \mathbf{Rome'})]$

In this case, we think the temporal argument is added by derivation. Some individual-level-predicates can even have an event-reading:

(14) *Goethe squinted at her wedding ring* (*for a while*).

We think in principle there are two possibilities to explain this variation: first, there may be lexical polysemy. Second, and this is the view we favour, there is interaction between the lexicon and the grammar (cf. Pustejovsky 1995: 105ff), leading to both composition and decomposition of semantic primitives in the syntax (cf. Stechow 1995, 1997). Even though this point is not essential for our account of classifying predicates, but rather follows from such kind of model, we will return to the question of decomposition at the end of the paper, thus providing some evidence for our compositional account of lexical entries. Before that, we continue by giving an account of the lexical composition of event predicates.

3.2. Events

In principle, we follow Davidson (1967) in assuming that event predicates have implicit event arguments, that is to say in addition to implicit temporal arguments. The plausibility of this assumption may be demonstrated through ambiguities given rise to by temporal adverbials used with events.

[6] We basically follow Reichenbach's (1947) terminology: Expressions are uttered at definite points in time and they refer to points in time. Putting these points in relation provides means of describing the temporal logic that has become standard in the literature, sometimes in an amended way.

(15) *Francis always sneezed loudly.*

(16) a. $\forall t \exists e\,[t < t^{\circ} \rightarrow \textbf{sneeze}'(t, e, \textbf{Francis}') \wedge \textbf{loud}'(e)]$
('It was always the case, that he sneezed loudly.')
b. $\forall e \forall t\,[\textbf{sneeze}'(t, e, \textbf{Francis}') \wedge t < t^{\circ} \rightarrow \textbf{loud}'(e)]$
('Whenever he sneezed, he did it loudly.')

This contrast is not there with state predicates: the following sentence could only get a second reading if it was read as an event.

(17) a. *Goethe always loved Gretchen passionately.*
b. $\forall t\,[t < t^{\circ} \wedge [\textbf{passionately}'(\textbf{love}')](t, \textbf{Go}, \textbf{Gr})]$ (event)

(18) a. $\forall t \exists e\,[t < t^{\circ} \rightarrow \textbf{love}'(t, e, \textbf{Go}', \textbf{Gr}') \wedge \textbf{passionately}'(e)]$ (event)
b. * $\exists e \forall t\,[\textbf{love}'(t, e, \textbf{Go}, \textbf{Gr}) \wedge t < t^{\circ} \rightarrow \textbf{passionately}'(e)]$ (event)

As addressed above, several predicates seem to be ambiguous between properties, states and events. In most cases, this can be attributed to compositional extension in the syntax. In the case of idiomatisation and lexicalisation, this extension may lead to polysemous lexical entries. In languages like German, the verb *lieben* ('to love') is ambiguous between 'be in love with' and 'make love to'. However, the event reading gives this sentence the character of an obscene joke, which indicates that the state reading is the primary one.

(19) a. Goethe liebte Gretchen leidenschaftlich.
Goethe loved Gretchen passionately
b. Goethe liebte Gretchen täglich. *(obscene)*
Goethe loved Gretchen daily

Thus, the assumption of an event argument can be an essential means to systematically distinguish event predicates from those denoting properties and states.

(20) a. SQUINT: $\lambda x\,[\textbf{squint}'(x)]$ (property)
b. CHESTY: $\lambda x \lambda t\,[\textbf{chesty}'(t, x)]$ (state)
c. SNEEZE: $\lambda x \lambda e \lambda t\,[\textbf{sneeze}'(t, e, x)]$ (event)

The corresponding sentences are:

(21) a. *Francis squints.*
b. $[\textbf{squint}'(\textbf{Francis}')]$

(22) a. *Francis is chesty.*
b. $\exists t\,[\textbf{chesty}'(t, \textbf{Francis}')]$ (→ t is an implicit argument)

(23) a. *Francis sneezes.*
b. $\exists t \exists e\,[\textbf{sneeze}'(t, e, \textbf{Francis}')]$ (→ t und e are implicit arguments)

We now turn to the further distinction of events by aspectual properties.

3.3. Durativity

We follow the convention, that ***intervals*** (*i*, *j*) are notationally distinguished from ***points in time*** (*t*). Intervals are ***ordered sets of points in time***.

(24) ***Time Interval*** (adapted from Cann 1993: 235)
A set of points in time *j* is called an interval iff for two points t_i and t_k all points *t* between t_i and t_k are part of *i*: $t_i, t_k \in j \Rightarrow \forall t\,[t_i < t < t_k \rightarrow t \in j]$

If predicates and operators contained in an expression are truth conditional for an interval, we speak of truth intervals (cf. Cann 1993: 238f.), which we will notate as starred (i^*, j^*) for the sake of illustration. Durative predicates are always valid (or true) for a whole interval. Thus, simple durative verbs like *burn*[7] (*sit mihi venia verbi* — we suggest calling them ***affairs***) are then characterised by a corresponding implicit argument i^*.

(25) BURN: $\lambda x \lambda e \lambda i^*[\mathbf{burn'}(i^*, e, x)]$ (imperfective durative predicate: affair)

(26) a. *The forest burned.*
b. $\exists j^* \exists e\,[i^* > t^\circ \wedge \mathbf{burn'}(i^*, e, \imath_x[\mathbf{forest'}(x)])]$

Before turning to a more detailed account of verbal aspect, we have to introduce our notion of resultativity, a feature that strongly interacts with both the clausal and the verbal aspect.

3.4. Resultativity

Non-resultative durative verbs like *burn* (the group we call ***affairs***) are always imperfective. Now we would like to argue that this is not true in reverse. In the first place, resultativity is the transition into a result state (or the movement to a result place, if one wants to differentiate them). A specific kind of predicates, those we suggest calling processes, are characterised by the circumstance that the event they denote is not terminated by the result, but that it proceeds beyond the transition to further result states (cf. also Engerer & Nicolay 1999: 338). Thus, a process is both resultative and imperfective. E.g.:

(27) a. *Francis was aging during this piece of work (more than usual).* (process)
b. *Francis is still growing.* (process)

Following Engelberg (2000: 108ff) we now proceed by distinguishing arguments of the ***lexeme function*** (in this case i^*, *e*, *x*) from those of the predicate constant. A result state is always an argument of the predicate constant. The predicate constant is then defined by a relational semantic feature like [+transition] (vaguely 'change from *P* to *Q*'), where *P* and *Q* can predicate over times and/or individuals. This feature roughly corresponds to the function of

[7] We have to concede that *burn* in English has at least three readings: besides the simple durative one we refer to at this point there is a perfective and a causative one. However, in languages like German, all these readings have separate lexical entries: *brennen* (imperfective), *verbrennen* (perfective), *anzünden* (causative). Due to many polysemous words, English is in fact not the most grateful language for an attempt to describe its inventory of predicates. However, since this article is about classes of predicates and not about names for predicates, we still use English examples, presupposing that the reader may follow us in understanding them with the reading we specify.

Dowty's (1979: 261) "one-placed atomic" (ibd. 141) operator BECOME. Alternatively, we suggest analysing BECOME as a multi-placed ***elementary predicate***, relating an interval, an event, an individual and also a result state by means of shared arguments.

(28) BECOME (≈ transition): $\lambda P \lambda x \lambda e \lambda i^* \exists t\,[\text{BECOME}(i^*, e, x) \rightarrow t \in i^* \wedge P(x, t)]$

It denotes exactly the event of transition of an individual x into a state $P(x, t)$ during an interval i. Since the event e is a precondition for the result, resultativity can be defined as a conditional relation. That the point in time where a result state is attained does not necessarily correspond to a boundary point of the truth interval is shown by the class of predicates we call processes, 'degree-achievements' in Dowty's (1979: 88ff) terminology. He explains predicates like AGE or GROW by comparing them to comparative adjectives. We think the specific character of these predicates is made up by the fact that there is always a comparison between ***states***, i.e., predicates over temporal arguments. That is why they can rather easily be accounted for in predicate logic.

(29) a. AGE: $\lambda x \lambda e \lambda i^* \forall t_a \forall t_b[\text{BECOME}(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \mathbf{age'}(t_b, x) > \mathbf{age'}(t_a, x)]$[8]

b. GROW: $\lambda x \lambda e \lambda i^* \forall t_a \forall t_b[\text{BECOME}(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \mathbf{size'}(t_b, x) > \mathbf{size'}(t_a, x)]$

3.5. Perfectivity and imperfectivity

In our view, a predicate should only be called perfective if it simultaneously denotes a result state and the ending point of an event. Thus, the distinction ***perfective/imperfective*** is an independent condition for truth intervals. Expressions can provide truth conditions on initial or final points of truth intervals. In the least marked case they do not. In this case we speak of ***imperfective verbal aspect***: the ***reference time*** of the expression is ***included*** by the ***truth interval of the predicate*** (cf. Stechow 1997: 279). In predicate logic this can be analysed as a set relation $j \subseteq i^*$ which is often notated as an aspectual operator IMPERF (cf. Cann 1993: 252), with its perfective counterpart PERF.

(30) ***Aspectual Operators*** (adapted from Cann 1993: 252ff)

a. $[\![\text{IMPERF}\,\varphi]\!]^{M,g,i} = 1 \leftrightarrow [\![\varphi]\!]^{M,g,i^*} = 1 \wedge \exists j[j \subseteq i^*]$
(⇒ Reference time is included in the truth interval.)

b. $[\![\text{PERF}\,\varphi]\!]^{M,g,i} = 1 \leftrightarrow [\![\varphi]\!]^{M,g,i^*=1} \wedge [\exists t\,[t \leq i^*] \vee \exists t'\,[i^* \leq t']]$
(⇒ Reference time is limited by a bounding point of the truth interval)

Given that verbal aspect constrains the truth conditions of the sentence, one might suggest that a set relation between implicit temporal argument may also be part of the lexical entry.

(31) GROW1: $\lambda x \lambda e \lambda i^* \lambda j \forall t_a \forall t_b[j \subseteq i^* \wedge \text{BECOME}(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \mathbf{size'}(t_b, x) > \mathbf{size'}(t_a, x)]$

[8] Here, we notate the function COMPARATIVE in a simplified way, as a comparison of two predicate functions. We presuppose their dimensional interpretation. Explicating it would lead to somewhat more complex formulae like those proposed by Bierwisch & Lang (1989):

(i) BIGGER: $\lambda y \lambda x\,[\text{quant}[\max(x) = \text{quant}[\max(y)] + a]]$ (a is the variable difference)
≈ the quantified maximum of y differs from that of x by the value of a.

However, imperfectivity might simply be the default interpretation implied by the absence of a perfective operator: perfectivity is the ***marked case***. Thus, imperfective durative verbs are simply characterised by a non-terminated truth interval i^*, as proposed above.

(32) MOVE$^{-\text{trans}}$: $\lambda P \lambda e \lambda x \lambda i \forall t_a \forall t_b [\text{BECOME}(i^*, e) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow P^{+\text{loc}}(t_b, x) > P^{+\text{loc}}(t_a, x)]$

Note that using the functor '>' with a $P^{+\text{loc}}$ implies that this secondary predicate must belong to the dimensional ones, like *far* or *close*.

The ***progressive form*** in sentences like the following is then based on the introduction of an interval j representing reference time by a syntactic operation (e.g., an operator located in a functional head like T^0 in generative syntax).

(33) a. *Francis was moving across the soccer field.*

b. $\exists j \exists i^* \exists e \forall t_a \forall t_b [j \subseteq i^* \wedge i^* \subseteq t^\circ \wedge \text{BECOME}(i^*, e_k, \textbf{Francis}') \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \textbf{across-the-soccer-field}'(t_b, \textbf{Francis}') > \textbf{across-the-soccer-field}'(t_a, \textbf{Francis}')]$

In contrast, ***perfective resultative*** predicates are marked by a point of termination on the lexical level:

(34) a. BLOSSOM: $\textbf{bloom}'(x) = 1$ for $t \geq i^*$

b. WITHER: $\textbf{bloom}'(x) = 0$ for $t \geq i^*$

We suggest calling these kinds of predicates ***developments***. The truth interval of BLOSSSOM is terminated by the state of blooming, that of WITHER by the state of non-blooming. Thus, a lexical entry can also be formalised by means of an implicit secondary predicate:

(35) BLOSSOM: $\lambda x \lambda e \lambda i^* \exists t [\text{BECOME}(i^*, e, x) \rightarrow i^* \leq t \wedge \textbf{bloom}'(t, x)]$ (development))

The fact that the state BLOOM is a predicate over a pair of an individual and a point in time does not contradict the circumstance that this point in time is part of the following interval where $\textbf{bloom}'(t, x)$ is true for all t. The logic of BLOSSOM denotes only a predicate over the end point of its own truth interval. The same is true for its antonym WITHER:

(36) WITHER: $\lambda x \lambda e \lambda i^* \exists t [\text{BECOME}(i^*, e, x) \rightarrow i^* \leq t \wedge \neg \textbf{bloom}'(t, x)]$ (development)

Developments can be further subdivided into those with implicit and those with explicit results. Explicit results are syntactic arguments. As in other cases, these arguments may be obligatory or facultative.

(37) *The ship sank* (*to the bottom of the sea*).

In the case of verbs of movement, one might want to suggest that they contain an elementary predicate MOVE instead of BECOME (i.e., BECOME with an additional feature [+movement]). However, this predicate would not be a primitive anymore. Moreover, movement is nothing more than a transition with the specification that the result denotes a local relation:

(38) MOVE: $\lambda P \lambda x \lambda e \lambda i^* \exists t [\text{BECOME}(i^*, e, x) \rightarrow t \in i^* \wedge P^{+\text{loc}}(x, t)]$

In the case of SINK, the result predicate opens an argument position that can be filled by a local secondary predicate. Directionality in our view follows directly from the conditional that is part of the predicate constant. Given that the semantics of the verb *sink* is defined not only by movement, but also by additional features (specifying this kind of movement), additional components of predication over the event must be there. These we notate — admittedly in a simplifying way — by means of the word *sink* itself.

(39) SINK: $\lambda P \lambda x \lambda e \lambda i^* \exists t\,[\text{BECOME}(i^*, e, x) \wedge \textbf{sink}'(e) \rightarrow i^* \leq t \wedge P^{+\text{loc}}(t, x)]$

3.6. A short note on ambiguity and underspecification

We suppose that result predicates (or directional predicates) can be derived from all state or location predicates if one of the following rules of transition is observed:

(40) a. $\lambda P \lambda x \lambda e \lambda i^* \exists t\,[\text{BECOME}(i^*, e, x) \rightarrow t \in i* \wedge P(x, t)]$
b. $\lambda P \lambda x \lambda e \lambda i^* \exists t\,[\text{BECOME}(i^*, e, x) \rightarrow t \in i^* \wedge \neg P(x, t)]$

If this rule is not made explicit in the sentence, the result predicate belongs to the definition of the primary predicate constant, i.e., it is inherent. If it is not inherent, it is also a syntactic argument. Thus again the question arises whether facultativity makes differentiated lexical entries necessary. Dowty (1979: 88) regards verbs like *sink* as degree-achievements, because they can be modified by durative adverbials. This certainly does not work with *sink* in the sense of 'sink to the ground'.

(41) *The ship sank* (**to the bottom of the sea*) *for an hour.*

We suppose that perfective resultatives are incompatible with durative adverbials, because the truth interval of the latter exceeds the limit of the argument interval. This is confirmed by clearly perfective verbs like *wither*.

(42) **The flower withered for a week.*

The phenomenon of switches between predicate classes after the addition of adverbials lead authors to the conclusion that it is VPs rather than Vs that need to be classified (cf. Dowty 1979: 61). After all, other syntactic phenomena such as auxiliary selection in languages like German are influenced by adverbials as well (cf. Musan 2002: 1, Fn. 2):

(43) a. Sie haben die ganze Nacht getanzt.
They have the whole night danced
b. Sie sind durch den Ballsaal getanzt.
They are through the ballroom danced

This contrast occurs with all verbs that are potentially resultative, especially with movement verbs.

(44) a. Die Mannschaft hat eine Stunde lang gerudert.
The team has one hour long rowed
b. Die Mannschaft ist nach Buxtehude gerudert.
The team is to Buxtehude rowed

There are two possibilities leading to a central question: is it the adverbial determining the semantics of the complex expression, or do polysemous verbs license different types of adverbials (cf. Dowty 1979: 62)? Note that this kind of variation is not at all possible with all resultatives; if we take *drown* and *sink* as a minimal pair, why should it be that durative modification is possible only with the latter?

(45) a. * *He drowned for an hour* (*before suffocating*).
b. *The ship sank for an hour* (*before going under completely*).

Many predicate terms are vague. The generative lexicon creates complex meanings (i.e., meanings composed of semantic features and elementary predicates) both diachronically and synchronically that are not always associated with differentiated expressions (cf. Pustejovsky 1995: 27ff). Both morphology and syntax provide means of specifying these predicates. E.g., in languages like German, specific prefixation serves for the precision of verbal aspect.

(46) a. Das Schiff versank *(*eine Stunde lang.*)*
The ship PREF.sank one our long
b. Er erkletterte *(*einen Tag lang*)* den Mount Everest.
He PREF.climbed one day long the Mount Everest

A similar function is fulfilled by explicit resultative secondary predicate or added arguments.

(47) a. *The ship sank to the bottom of the sea* (**for an hour*).
b. *He climbed Mount Everest* (***one day long*).

Only when adding or omitting such elements does not result in changing the verbal aspect, we would like to speak of facultativite arguments. Polysemous verbs like *sink* or *climb*, however, we assume to have more than one lexical entry, each licensing different kinds of adverbials on the basis of compatibility of the implied truth intervals.

(48) *sinken* and *versinken* in languages like German
a. SINK_1: $\lambda P \lambda x \lambda e \lambda i^* \forall t_a \forall t_b$ [BECOME$(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow P^{+\text{loc}}(t_b, x) > P^{+\text{loc}}(t_a, x)$]
b. SINK_2: $\lambda x \lambda e \lambda i^* \exists P \exists t$ [BECOME$(i^*, e, x) \wedge$ **sink′**$(e) \rightarrow i^* \leq t \wedge P^{+\text{loc}}(t, x)$]

3.7. Punctuality

Durative and ***punctual*** verbs differ mainly in the denotation of truth conditions for either intervals or points in time. Punctual verbs, too, occur both as resultative and non-resultative predicates. However, they cannot be perfective or imperfective, since they do not cover intervals. We call these predicates ***incidents*** and ***effects***.

(49) a. $\text{FIRE}^{-\text{trans}}$: $\lambda y \lambda x \lambda e \lambda t^*$[**fire′**$(t^*, e, x, y)$]
b. *The gun fired.* (***incident***, non-resultative)

(50) a. BURST: $\lambda x \lambda e \lambda t^* \exists P \exists t$ [BECOME$(t^*, e, x) \wedge$ **burst′**$(e) \rightarrow t^* < t \wedge P(t, x)$]
b. *The balloon burst.* (***effect***, resultative)

Punctual resultatives, too, can have an explicit secondary result predicate as an argument:

(51) a. $\lambda P \lambda x \lambda e \lambda t^{*}[\text{BECOME}(t^{*}, e, x) \wedge \mathbf{burst'}(e) \rightarrow P(t^{*}, x)]$
b. *The balloon burst into pieces.* (***effect***)

3.8. Summary

The account of verbal aspect developed above leads into a binary system as shown in the following diagram. It can be regarded as a derivative of the one proposed earlier by Ehrich (1992: 75).

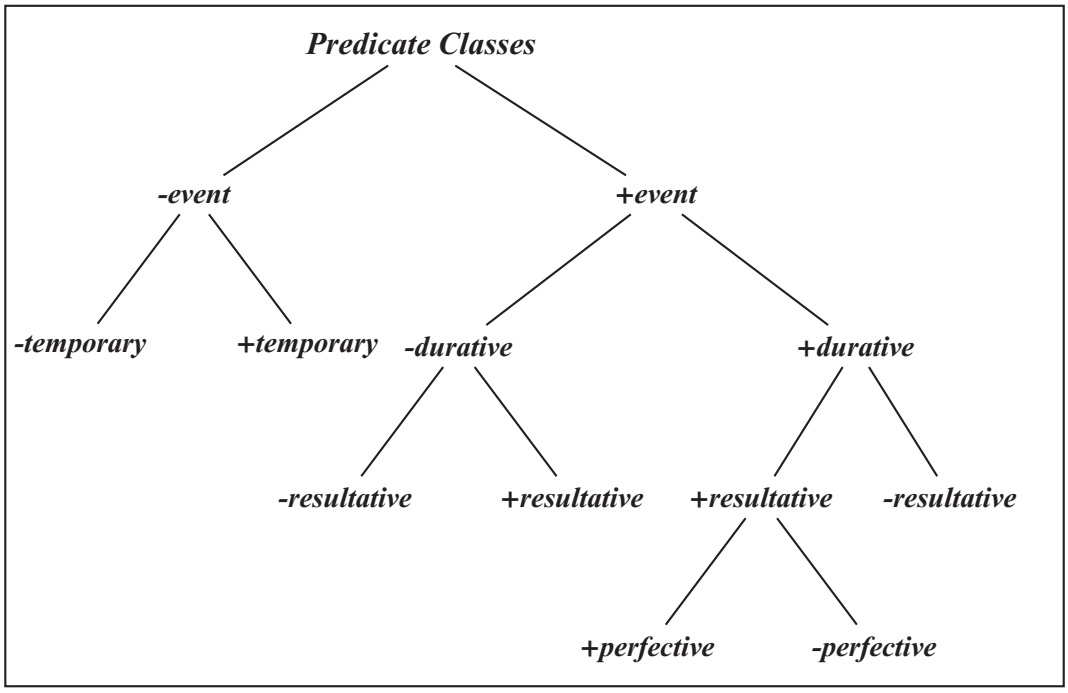

Figure 1.: Binary Classification of Predicates

As shown above, ***states*** have the features [–event,+temporary], whereas properties have [–event,–temporary]. All of the other predicates denote different kinds of events. Properties, states and events can be denoted by verbs and nouns. Adjectives denote only properties and states. In the next section, we develop the intended finer grained classification of predicates. This we do on the basis of the concept of verbal aspect developed so far, and, in addition, by looking more closely at what we call ***elementary predicates***.

4. Classification According to Verbal Aspect and Elementary Predicates

Dowty (1979) already showed that considering argument structure may offer a number of ex-

planations for the behaviour of predicates in the context of truth intervals and thus also verbal aspect. Since both Vendler (1967) and Ehrich (1992) remain silent about it, we now intend to examine the lexical conditions of argument structure. However, we ought first to make clear that we do not consider the assignment of thematic roles a primitive of verbal semantics. On the contrary, we have found that it results from the types of elementary predicates of which the predicate constant of a verb (or noun or adjective) is composed (for a similar view see Pustejovsky 1995: 99). We have already seen that secondary predicates with argument status (basically resultatives) can be licensed by the elementary predicate BECOME. After further considerations leading to the addition of two further elementary predicates, i.e., CAUSE and ACT, we will end up with 15 classes of verbs that can be logically distinguished.

4.1. Descriptive classification based on verbal aspect and argument structure

It has been often observed in the research on argument structure that it is not only the quantitative valency of predicates which is criterial. E.g., it is also quite relevant whether the subject of predication has the features of an ***agent*** or of an ***undergoer***. There are even verbs assigning no semantic role to a subject at all. And trivalent verbs differ as to whether they have two objects[9] or one object and a resultative argument.

(52) a. *Francis danced.* (agent subject)
b. *Francis slipped on the dance floor.* (undergoer subject)
c. *It is raining.* (subject without semantic role)
d. *Francis offered Frederick a cup of tea.* (double object construction)
e. *Francis carried the cup to the kitchen.* (object & resultative construction)

These observations seem relevant for the classification of verbs especially if they are related to their conceptual features (often called ***lexical conceptual structure***, LCS; cf. Jackendoff 1990) expressed in terms of a hierarchy of thematic roles, or, alternatively, as proposed by Dowty (1991), in terms of finer grained prototypical conceptual features. This LCS seems to have significant effects also on syntactic structures. Two prominent examples are ***auxiliary selection*** in languages like German or Italian (cf. Burzio 1981, Haider 1984, Haider & Rindler-Schjerve (1987)) and the ***serialisation of arguments*** (cf. Jackendoff 1990, Dowty 1991).

(53) a. Franz hat getanzt. *(agent subject → aux* = have*)*
Francis AUX danced
b. Franz ist auf der Tanzfläche ausgerutscht. *(undergoer subject → aux* = be*)*
Francis AUX on the dance floor slipped

(54) a. *Francis threw Frederick a ball.* (RECIPIENT > THEME)[10]
b. *Francis threw a ball into a basket.* (THEME > GOAL)

[9] We ignore the fact here that there are also different kinds of objects, namely objects marked by case, PP-objects and object sentences.

We do not think, however, that thematic properties can be a primitive explanation for either of these two phenomena. Consider the following minimal pairs: what could be the difference of the semantic roles of the subjects causing the auxiliary variation, especially if accounted for in terms of proto-features?

(55) a. Ich habe in Stuttgart gewohnt.
I AUX in Stuttgart dwelled

b. Ich bin in Stuttgart umhergezogen.
I AUX in Stuttgart wandered-around

(56) a. Stundenlang hat das Licht gebrannt.
For-hours AUX the light burned

b. Stundenlang ist das Wasser gelaufen/geflossen.
For-hours AUX the water ran/flew

If the semantic properties of the subject are criterial, why do verbs not assign any to a subject specified for the AUX *have*?

(57) a. Es hat geregnet.
it AUX rained

b. Es hat an der Tür geklopft.
it AUX on the door knocked

The answer could be as simple as: *sein* is chosen as an auxiliary if and only if the subject is an undergoer. But why should the subject of *burn* above be less of an undergoer than that of *flow*? Why should that of *wander around* be less of an agent than that of *dwell?* We will argue below that *sein* is chosen if and only if the subject is the individual argument of the elementary predicate BECOME. This offers a purely structural means of explaining the syntactic variation without referring to fuzzy conceptual features like patienthood (cf. also Engerer & Nicolay 1999: 338f).

Similarly, it is desirable to find a formal way of explaining the effect of lexical properties on the serialisation of arguments. Also, we would like to avoid the potentiation of verb classes by assuming that every possible argument hierarchy opens a verb class of its own and by relating them to the combination of a minimal number of elementary predicates that may potentially select a greater range of kinds of arguments but define a restricted set of classes of predicates. Before elaborating these claims formally, we shall give some examples for illustration. First we must make clear, however, that the mere quantitative valency does not play an essential role for a semantic classification. We see no sense in distinguishing classes of predicates denoting ***states*** according to the number of their arguments.

(58) a. *Francis is glad* (monovalent state predicate)

[10] In Dowty's (1991) terms, the recipient has more features of a proto agent and the theme more features of a proto undergoer. The least agentive features are attributed to semantic roles like GOAL and SOURCE. Note also, that in terms of the LCS, this should mean that the verb *throw* has two different conceptualisations and thus two lexical entries. This assumption is confirmed by the fact that, in languages like German, there are in fact two different verbs, one of them a particle verb that is derived from the other:
(i) *Franz hat Maria* (DAT) *einen Ball* (ACC) *zugeworfen.*
(ii) *Franz hat einen Ball* (ACC) *in einen Korb geworfen.*

b. *Francis loves Frederick.* (bivalent state predicate)

(59) a. *Francis is tall.* (monovalent state predicate)
b. *Francis learns Latin.* (bivalent process predicate)

Note, however, that in this case, it is not only the explicitness of the resultative which makes the difference, but also the fact that the result state of *learn* (i.e., *know sth.*) is not represented as a separate argument but incorporated in the sentence predicate; it is only its argument, i.e., *Latin*, that occurs as a syntactic argument of the predicate constant *learn*. We consider this a mere matter of lexical respectively morphosyntactic representation and not a case for the semantic classification of predicates. Whereas predicate classes are universal, their lexical entries are arbitrary. The representation of 'become tall' and 'become knowing sth.' as *grow* and *learn* is as arbitrary as the fact that there are no English verbs for 'become glad' or 'become loving sbd'. Similar things can be stated for causatives. E.g., 'cause *x* to have *y*' is lexicalised as give. However, if causatives are derived from two different kinds of predicates like

(60) a. *Francis has a good job.* (bivalent state predicate)
b. *Francis went to school.* (bivalent development predicate)

They will end up with different argument structures, even though they have the same number of arguments.

(61) a. *Frederick gave Francis a good job.* (trivalent resultative, implicit result)
b. *Frederick sent Francis to school.* (trivalent resultative, explicit result)

The different argument structures, however, result from the number of elementary predicates the semantically complex predicate constant is composed of. Only in (61b) above, BECOME is involved in addition to the elementary predicate CAUSE. We now proceed by looking more closely into the compositional semantics of causatives.

4.2. Resultativity and causativity

As shown above, if the resultative has the status of a syntactic argument, it is in fact an ***explicit secondary predicate***.

(62) a. *His body moved across the soccer field.* (process)
b. *The ship sank to the bottom of the sea.* (development)
c. *The balloon burst into pieces.* (effect)

If a resultative verb has a direct object, it will always also be the argument of this secondary predicate.

(63) a. *Francis moved his body across the soccer field.*
b. *Francis shot the ball into the goal.*
c. *Grandfather brought the good wine from the cellar.*

The reason is that these causatives imply a ***process***, a ***development*** or an ***effect*** involving a transition. That is why they can — in our model — be notated as decomposed into elementary events e_i and e_k. Complex conditions for the verbal aspect follow from this, since these events can have their own truth intervals. In the following paragraphs we illustrate this with verbs like *move* (transitive) that implies a process, *shoot* implying a development and *bring* implying a result. We use the elementary predicate CAUSE in addition to BECOME, both of them predicating over an elementary event.

(64) $\text{MOVE}^{+\text{trans}}$: $\lambda P \lambda y \lambda e_k \lambda x \lambda e_i \lambda i \forall t_a \forall t_b [\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, y) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow P^{+\text{loc}}(t_b, y) > P^{+\text{loc}}(t_a, y)]$

(65) a. *Francis was moving his body across the soccer field.*

b. $\exists j \exists i^* \exists e_i \exists e_k \forall t_a \forall t_b [j \subseteq i^* \wedge i^* < t^\circ \wedge \text{CAUSE}(i^*, e_i, \text{Francis}, e_k) \wedge \text{BECOME}(i^*, e_k, \textbf{his-body}') \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \textbf{across-the-soccer-field}'(t_b, \textbf{his-body}') > \textbf{across-the-soccer-field}'(t_a, \textbf{his-body}')]$

In contrast to imperfective *move*, perfective causatives contain a perfective transition, which can be either durative (***development***) or punctual (***effect***). However, whether the whole predicate is durative or punctual depends only on the aspectuality of the higher event. The verb *shoot* denotes a punctual causation of a durative perfective transition. It is defined by additional semantic features of the causing event e_i, which we notate by a coordinated lexical function $\text{SHOT}(e_i)$ that intuitively denotes this event to be a shot.

(66) SHOOT: $\lambda P \lambda y \lambda e_k \lambda x \lambda e_i \lambda i^* \lambda t^* \exists t [\text{CAUSE}(t^*, e_i, x, e_k) \wedge \text{SHOT}(e_i) \wedge \text{BECOME}(i^*, e_k, y) \wedge \text{GOAL}(P) \rightarrow i^* \leq t \wedge P^{+\text{loc}}(t, y)]$

Again we illustrate the λ-reduction in predicate logic:

(67) a. *Francis shot the ball into the goal.*

b. $\exists t^* \exists i^* \exists e_i \exists e_k \exists t [t^* < t^\circ \wedge \text{CAUSE}(t^*, e_i, \textbf{Francis'}, e_k) \wedge \text{SHOT}(e_i) \wedge \text{BECOME}(i^*, e_k, \textbf{the-ball}') \wedge i^* \leq t \rightarrow \textbf{in-the-goal}'(t, \text{the-ball}')]$

c. There is a (event) time t^* before t° and an event e_i that is a shot and by which Francis causes at t^* another event e_k taking place during i^*. This event is the transition of the ball to a result at the point in time t terminating the interval i^* that is defined as the locative relation in the goal.

Note that the shot and the movement of the ball take place at different times, which results in complex aspectual conditions.[11] Note also that the whole predicate is punctual if the causing

[11] The fact that the shot is the initial point of the movement of the ball does not, in our view, have to be separately notated as part of the lexical entry. Likewise, it need not be notated that the ball could move further if it were not stopped upon reaching the goal. Both circumstances are implied by our world knowledge. This assumption of logical underspecification can also explain apparent paradoxes of the decomposition of causatives, as discussed by Fodor (1970) and Koo (1997). The implied close relation of the two elementary events seems to exclude propositions like

(i) ? *John killed Bill on Sunday by stabbing him on Saturday.* (cf. Fodor 1970)

This sentence is, in our view, not illogical but has an interpretation contradicting our knowledge of the world. Thus, the objections by these authors do not really exclude a compositional analysis as it is proposed here, but just show that the interpretation of expressions involves presuppositions.

event is punctual. Nevertheless, the aspect of the caused event also has effects on the aspectual interpretation. In principle, both elementary events can be modified by adverbs, which often leads to ambiguity (cf. Dowty 1979: 241ff).

(68) *Francis almost killed Frederick.*
  a. *He almost caused his death.*
  b. *He caused his being nearly dead.*

This fact has as a result the often discussed contrast between repetitive and restitutive readings with the adverb again (cf. Dowty 1979: 252, Stechow 1995).

(69) *Francis opened the door again.*
  a. *He opened it another time.*
  b. *He restored the original state of being open.*

Whereas higher temporal adverbials modify the higher event only, lower temporal adverbials modify the lower event and thus must be compatible with it.

(70) a. *Francis has lent his bicycle to Frederick until tomorrow.* (e_2 is temporary)
  b. * *Francis has shown his bicycle to Frederick until tomorrow.* (e_2 is punctual)

In contrast to the punctual verb *shoot*, *bring* is a durative verb implying an ***effect***, i.e., a punctual transition into a result state.

(71) BRING: $\lambda P \lambda y \lambda t \lambda e_k \lambda x \lambda e_i \lambda i^* [\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(t, e_k, y) \rightarrow i^* \leq t \wedge P^{+\text{loc}}(t, y)]$

(72) a. *Grandfather brought the good wine from the cellar.*
  b. $\exists i^* \exists e_i \exists t \exists e_k [\text{CAUSE}(i^*, e_i, \text{grandfather}', e_k) \wedge \text{BECOME}(t, e_k, y) \rightarrow i^* \leq t \wedge \neg \textbf{in-the-cellar}'(t, y)]$

Note that the semantic role of the resultative (SOURCE in generative terms) is not a primitive of the lexical entry. SOURCE is just the negative of GOAL; what they have in common is their predetermined reference to a local relation and the directionality resulting from the conditional.

(73) a. *Grandfather brought the good wine to the kitchen.*
  b. $\exists i^* \exists e_i \exists t \exists e_k [\text{CAUSE}(i^*, e_i, \textbf{grandfather}', e_k) \wedge \text{BECOME}(t, e_k, y) \rightarrow i^* \leq t \wedge \textbf{in-the-kitchen}'(t, y)]$

Note also again that the dimension [±durative] is defined by the higher event (i.e., the causing predicate). This fact can be made very clear looking at the minimal pair FIND and DISCOVER which is distinguished only by the temporal argument of the elementary predicate CAUSE.

(74) a. FIND: $\lambda y \lambda e_k \lambda x \lambda e_i \lambda t^* \lambda i^* [\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(t^*, e_k, y) \rightarrow i^* \leq t^* \wedge \neg \textbf{hidden}'(t^*, y)]$
  b. DISCOVER: $\lambda y \lambda e_k \lambda x \lambda e_i \lambda t^* [\text{CAUSE}(t^*, e_i, x, e_k) \wedge \text{BECOME}(t^*, e_k, y) \rightarrow \neg \textbf{hidden}'(t*, y)]$

This is why only *find* but not *discover* is compatible with a durative temporal adverbial.

(75) a. *It took Francis an hour to find Frederick.*
b. *It took Francis an hour to discover Frederick.*

On the other hand, if the causing event is punctual, this is true for the whole predicate constant, independent of the durativity of the embedded event.

(76) * *Francis shot the ball into the goal for an hour.* (≠ *it took an hour till the ball reached the goal)*[12]

Following Vendler (1967), we suggest terming durative causations ***accomplishments***, whereas punctual ones can be termed ***achievements***. Only when the implied lower event is imperfective, i.e., when it is a ***process*** do we suggest using the term ***performance***.

4.3. Resultativity without BECOME

We now turn to the cases where the results do not follow from a logically defined transition. Above we mentioned the verb *give*. We would like to argue that it only involves the elementary predicate BECOME in its reading with a resultative.

(77) a. *Francis gave a book to Frederick.*
b. $\exists t^* \exists i^* \exists e_i \exists e_k \exists x \exists t[t^* < t^\circ \wedge \text{CAUSE}(t^*, e_i, \textbf{Francis}', e_k) \wedge \text{BECOME}(i^*, e_k, x) \wedge \textbf{book}'(x) \rightarrow i^* \leq t \wedge \textbf{with-Frederick}'(t, x)]$

In the other case, there is just a state resulting from an action by the subject *Francis*. Actions are characterised by another elementary predicate that we call ACT. They can be durative or punctual, and they do not necessarily have results. We suggest calling durative actions without a result ***activities***, whereas we will call it an ***act*** if it is punctual. Examples are:

(78) a. DANCE: $\lambda x \lambda e \lambda i^* \lambda j[\text{ACT}(i^*, e, x) \wedge \textbf{dance}'(e)]$ (activity)
b. SNEEZE: $\lambda x \lambda e \lambda t^*[\text{ACT}(t^*, e, x) \wedge \textbf{sneeze}'(e)]$ (act)

Durative actions can also have results. Looking at a verb like *train* (intransitive), we see that the result is a change of state of the subject. However, we do not think that it is causation of a ***transition*** like 'to train oneself', where there is a separate argument for a second elementary predicate like BECOME. It is a result following directly from an action performed by the subject. Since *train* is imperfective, it is in fact a state compared to a preceding state, as in the case of ***processes*** and ***performances***. Because of the semantic closeness to those resultatives containing the elementary predicates CAUSE and BECOME, we also term them as performances, achievements and accomplishments, using indices 1 and 2 to distinguish them.

(79) $\text{TRAIN}^{-\text{trans}}$: $\lambda x \lambda e \lambda i^* \forall t_a \forall t_b [\text{ACT}(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \textbf{trained}'(t_b, x) > \textbf{trained}'(t_a, x)]$ (performance_1)

As for the perfective resultative actions, there are again two classes, depending on whether the elementary event that is an argument of the elementary predicate ACT is durative or punctual.

[12] The sentence may be acceptable under a repetitive reading which seems to be an option with all punctual verbs.
(i) *Francis coughed/sneezed/threw a ball/took down wine from the shelf for an hour.*

(80) a. SLEEP-IN: $\lambda x \lambda e \lambda t^* \exists t\,[\mathrm{ACT}(t^*, e, x) \rightarrow t^* \leq t \wedge \mathbf{slept\text{-}in}(t, x)]$[13] (accomplishment$_1$)

b. DESPOND: $\lambda x \lambda e \lambda t^*\,[\mathrm{ACT}(t^*, e, x) \rightarrow \mathbf{desponded'}(t^*, x)]$ (achievement$_1$)

Turning back to the different lexical entries we assume for *give*, the variant taking two objects would be an achievement$_1$ in our terms, i.e., a punctual perfective action.

(81) a. *Francis gave Frederick a book.*

b. $\exists t^* \exists e \exists x\,[t^* > t^\circ \wedge \mathrm{ACT}(t^*, e, \mathbf{Francis'}) \wedge \mathbf{book'}(x) \rightarrow \mathbf{have'}(t^*, \mathbf{Frederick'}, x)]$

Again, our assumption of different lexical entries gets support from languages like German, where there are in fact two verbs, one derived from the other by prefixation.

(82) a. Franz gab Friedrich ein Buch.
Francis gave Frederick a book

b. Franz übergab ein Buch an Friedrich.
Francis PREF-gave a book to Frederick

4.4. Lexical entries for all classes

The assumption of a small number of types of elementary predicates thus offers the possibility to systematise the classification of predicates not only according to their verbal aspect, but also to the kind of arguments that are selected. Elementary predicates not only compose structures of complex events and result states but are also basic for the definition of the semantic roles of arguments and offer the option of a compositional variant of θ-theory. They imply the following generalisations:

1. The explicit argument of ACT corresponds to an AGENT.
2. The explicit argument of CAUSE corresponds to an INSTRUMENT.
3. The explicit argument of BECOME corresponds to a THEME.
4. The resultative in the scope of BECOME is a state predicate or a GOAL or SOURCE (where, as shown above, a SOURCE is nothing more than a result that is complementary to a GOAL).

One might propose that animate causers are AGENTs rather than INSTRUMENTs, but this difference is only significant in a feature based model of thematic roles. INSTRUMENTs can be animate as can THEMEs, which might then be called PATIENTs in a feature based model. In our structurally motivated account, the semantic roles of the explicit arguments are defined by the relations between themselves or between them and the implicit arguments which may be results or events or even temporals. Based on our assumptions about compositionality, we suggest the

[13] *slept-in* then means something like *slept enough*. The agentivity of the subject seems not very intuitive with some of these verbs. This problem is also discussed by Dowty (1979: 165) who uses the operator DO with these verbs which roughly corresponds to our elementary predicate ACT. He argues that there is an 'activity in the physical sense involving active movement or change' or similar.

following classes of predicates with rising logical complexity, each of them illustrated with an example.

(83) a. SQUINT: $\lambda x\,[\mathbf{squint'}(x)]$ (property)

b. LOVE: $\lambda y \lambda x \lambda t\,[\mathbf{love'}(t, x, y)]$ (state)

c. FIRE$^{-\text{trans}}$: $c)\lambda y \lambda x \lambda e \lambda t^*\,[\mathbf{fire'}(t^*, e, x, y)]$ (incident)

d. BURN: $\lambda x \lambda e \lambda i^*\,[\mathbf{burn'}(i^*, e, x)]$ (affair)

e. SNEEZE: $\lambda y \lambda x \lambda e \lambda t^*\,[\text{ACT}(t^*, e, x) \wedge \mathbf{sneeze'}(e)]$ (act)

f. DANCE: $\lambda x \lambda e \lambda i^*\,[\text{ACT}(i^*, e, x) \wedge \mathbf{dance'}(e)]$ (activity)

g. BURST: $\lambda x \lambda e \lambda t^* \exists P \exists t\,[\text{BECOME}(t^*, e, x) \wedge \mathbf{burst'}(e) \rightarrow t^* < t \wedge P(t, x)]$ (effect)

h. WITHER: $\lambda x \lambda e \lambda i^* \exists t\,[\text{BECOME}(i^*, e, x) \rightarrow i^* \leq t \wedge \neg\mathbf{bloom'}(t, x)]$ (development)

i. AGE: $\lambda x \lambda e \lambda i^* \forall t_a \forall t_b [\text{BECOME}(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \mathbf{age'}(t_b, x) > \mathbf{age'}(t_a, x)]$ (process)

j. DESPOND: $\lambda x \lambda e \lambda t^*\,[\text{ACT}(t^*, e, x) \rightarrow \mathbf{desponded'}(t*, x)]$ (achievement$_1$)

k. SLEEP-IN: $\lambda x \lambda e \lambda i^* \exists t\,[\text{ACT}(i^*, e, x) \rightarrow i^* \leq t \wedge \mathbf{slept\text{-}in'}(t, x)]$ (accomplishment$_1$)

l. TRAIN$^{-\text{trans}}$: $\lambda x \lambda e \lambda i^* \forall t_a \forall t_b\,[\text{ACT}(i^*, e, x) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \mathbf{trained'}(t_b, y) > \mathbf{trained'}(t_a, y)']$ (performance$_1$)

m. DISCOVER: $\lambda y \lambda e_k \lambda x \lambda e_i \lambda t^*\,[\text{CAUSE}(t^*, e_i, x, e_k) \wedge \text{BECOME}(t^*, e_k, y) \rightarrow \neg\mathbf{hidden'}(t^*, y)]$ (achievement$_2$)

n. FIND: $\lambda y \lambda e \lambda k \lambda x \lambda e_i \lambda t^* \lambda i^*\,[\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, y) \rightarrow i^* \leq t^* \wedge \neg\mathbf{hidden'}(t^*, y)]$ (accomplishment$_2$)

o. MOVE$^{+\text{trans}}$: $\lambda P \lambda y \lambda e_k \lambda x \lambda e_i \lambda i^* \forall t_a \forall t_b [\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, y) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow P^{\text{loc}}(t_b, y) > P^{\text{loc}}(t_a, y)]$ (performance$_2$)

Note again that only the predicates in (j), (k) and (l) above are necessarily actions, (m), (n) and (o) are just causations; this has two effects: first, the result state only applies to the subject of predication in (j), (k) and (l), whereas in (m), (n) and (o) it does not. Second, the predicates in (m), (n) and (o) call for an obligatory object which the result state can apply to. It can be related to the subject only by means of an anaphor, which in turn is ungrammatical with the predicates in (j), (k) and (l).

(84) a. *He discovered/found/moved himself.*

b. *He desponded/slept-in/trained*[14] (* *himself*).

The non-causative verb *train* shows again that quantitative valency alone cannot be regarded as the relevant primitive, here:

(85) *He trained in linguistics. Now he is trained in linguistics.* (***** *Now linguistics is trained.*)

Transitivity and intransitivity, if related to the options of the object-to-subject diathesis and not solely to the number of arguments, obviously does not follow from the presence of what is called a ***direct object*** in traditional grammar, but indeed results from the interaction of the elementary predicates CAUSE and BECOME: passivised predicates are in fact reduced causatives.

(86) a. FIND: $\lambda y \lambda e_k \lambda x \lambda e_i \lambda t^* \lambda i^*$ [CAUSE$(i^*, e_i, x, e_k) \wedge$ BECOME(i^*, e_k, y) $\rightarrow i^* \leq t^* \wedge \neg$**hidden′**$(t^*, y)$]

b. BE-FOUND: $\lambda y \lambda e_k \lambda t^* \lambda i^*$ [BECOME$(i^*, e_k, y) \rightarrow i^* \leq t^* \wedge \neg$**hidden′**$(t^*, y)$]

Similarly, polysemy can, in our view, be explained in a simple way by derivation from a basic meaning, either by compositional addition or by subtraction of semantic primitives (features, relations, elementary predicates), which my occur diachronically or synchronically. Even though, in the following example, the predicate SMOKE_2 corresponds to the original meaning according to our intuition, it is most probably impossible to reconstruct the "first meaning" of polysemes without diachronic research.

(87) a. SMOKE_1: λx [**smoke′**(x)] (property)

b. SMOKE_2: $\lambda x \lambda t$ [**smoke′**(t, x)] (state)

c. SMOKE_3: $\lambda x \lambda e \lambda i^*$ [ACT$(i^*, e, x, y) \wedge$ **smoke′**(e, y)] (activity)

(88) a. *Goethe smoked.* (= *was a smoker*) (property)

b. *The pipe was smoking.* (state)

c. *Goethe was smoking a pipe.* (activity)

(89) a. $\exists t$ [$t < t^\circ \wedge t = \imath t$ (AT$(t,$ **Goethe′**$)$)] $\wedge$ [**smoke′**(**Goethe′**)] (property)

b. $\exists j \exists i^* \exists t$ [$j \subseteq i^* \wedge i^* < t^\circ \wedge t \in i^* \wedge$ **smoke′**$(t, e,$ **the-pipe′**$)$] (state)

c. $\exists t \exists e \exists i^* \exists j \exists x$ [$j \subseteq i^* \wedge$ ACT$(i^*, e,$ **Goethe′**$) \wedge$ **smoke′**$(e,$ **pipe′**$)$] (activity)

To conclude this section, we summarise our predicate classes in a less formal and maybe more intuitive form by putting them in natural language terms:

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(90) a. ***Properties*** do not denote events and are valid without temporal restriction. (e.g., SQUINT)

b. ***States*** do not denote events and have temporally restricted validity. (e.g., LOVE)

---

c. ***Incidents*** denote events but no results and are punctual. (e.g., $\text{FIRE}^{\text{trans}}$)

[14] Here, the fact that TRAIN also has a causative variant is perhaps a little misleading:
(i) *He trained his students in linguistics.*
(ii) ? *He trained himself* (*in linguistics*).
is thus an awkward though grammatical sentence.

d. ***Affairs*** denote events but no results and are durative (e.g., BURN)

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e. ***Acts*** denote events that are actions but no results and are punctual. (e.g., SNEEZE)

f. ***Activities*** denote events that are actions but no results and are durative. (e.g., DANCE)

---

g. ***Effects*** denote events as well as results and are punctual. (e.g., BURST)

h. ***Developments*** denote events as well as results and are durative and perfective. (e.g., WITHER)

i. ***Processes*** denote events as well as results and are durative and imperfective. (e.g., AGE)

---

j. ***Achievements*$_1$** denote events that are actions as well as results and are punctual. (e.g., DESPOND)

k. ***Accomplishments*$_1$** denote events that are actions as well as results and are durative and perfective. (e.g., SLEEP-IN)

l. ***Performances*$_1$** denote events that are actions as well as results and are durative and imperfective. (e.g., TRAIN−trans)

---

m. ***Achievements*$_2$** denote two events, the first one causing the second, as well as results, the higher event being punctual. (e.g., DISCOVER)

n. ***Accomplishments*$_2$** denote two events, the first one causing the second, as well as results, the higher event being durative and perfective. (e.g., FIND)

o. ***Performances*$_2$** denote two events, the first one causing the second, as well as results and are durative and imperfective. (e.g., MOVE)$^{+trans}$

4.5. Some more examples

(91) a. properties: *know*, (*smart*, *blind*, *man*, *tree*), . . .

b. states: *bloom*, *have*, *surround*, *(pregnant*, *geriatric*), . . .

c. incidents: *flash*, . . .

d. affairs: *rain*, *snow*, *bide*, . . .

e. acts: *cough*, *swear*, *kiss*, *beat*, . . .

f. activities: *sleep*, *eat*, *read*, *watch*, . . .

g. effects: *doze off*, *arrive*, *explode*, *fall*, . . .

h. developments: *blossom*, *sink*, *rot*, . . .

i. processes: *rot*, *grow*, . . .

j. achievements$_1$: *start*, *dock*, *escape*, . . .

k. accomplishments$_1$: *recover*, *recuperate*, . . .

l. performances$_1$: *gain*, *climb*, *regenerate*, ...
m. achievements$_2$: *frighten*, *shoot*, *throw*, *kill*, *spill*, *pick up*, ...
n. accomplishments$_2$: *build*, *bring*, *fetch*, ...
o. performances$_2$: *carry*, *inch*, ...

5. Prospectus: Predicate Classes, Tense and Aspect

What we expect from our classification as a basis for future research is its exhaustibility for the interpretation of syntactic structures in the generative model. Semantically complex predicates, if fully decomposable, can explain restrictions on the projection of tense features and their interpretation as well as the compatibility with temporally sensitive expressions like adverbials and, moreover, this can be modelled directly in one syntactic tree.

Following Stechow (1997), we assume that, in a generative model, the role of tense can be captured best if the contents of functional heads like T^0 are treated as logical functions operating over more deeply embedded elements. Thus, restrictions such as the blocking of a perfect interpretation of the past participle of certain verbs plus perfect auxiliary or the incompatibility of certain verbs with certain tenses can be regarded as a selectional restriction. The same is true for the blocking of temporal adverbials if one assumes that adjunction is in fact the composition of two formulae that must be compatible with respect to the implicit temporal arguments. — In the following paragraphs we first sketch the cooperation of lexical decomposition and syntactic selection by functional heads and then elucidate the restrictions of temporal and aspectual interpretation following from that.

5.1. "Tense" is a characteristic function[15]

We assume that functional heads like I^0 or T^0 host functions of the following kind which have both lexical entries and corresponding syntactic features like PRES or PRET representing them:

(92) a. PRES : $\lambda\varphi\lambda j\lambda i\exists e\,[t^\circ \subseteq j \wedge j \in i \wedge \varphi(i, e)]$
b. PRET : $\lambda\varphi\lambda j\lambda i\exists e\,[j < t^\circ \wedge j \in i \wedge \varphi(i, e)]$

The lexical composition of predicates is crucial for selectional constraints of these temporal functions. Tense and aspect follow from such functions over syntactically decomposed predicates that are represented by complex VPs. Consider the following sentence:

(93) *Francis moved his body across the soccer field.*

The lexical entry of $\text{MOVE}^{+\text{trans}}$ looks as follows (cf. (64), page 251):

(94) $\text{MOVE}^{+\text{trans}}$: $\lambda P\lambda y\lambda e_k\lambda x\lambda e_i\lambda i\forall t_a\forall t_b[\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, y) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow P^{+\text{loc}}(t_b, y) > P^{+\text{loc}}(t_a, y)]$

[15] In the sense that TENSE constrains the set of true predications; cf. Cann (cf. 1993: 96): "Functions that map all the elements in a domain onto one of two values, e.g. yes (kursiv) and no (kursiv), are called characteristic functions (fett) of sets of elements of the domain, because they characterise the sets they are associated with."

We assume that both elementary events contained in this predicate are projected as lexical heads into syntax, where the argument grid is saturated stepwise. Every step of saturation corresponds to one projectional tier in syntax, or to the reduction of one lambda in the formula. The tense variables are quantified over when the functional heads are added. These are the steps:

First of all, the implicit resultative is replaced by a lexical expression; cf. the graph in (100).

(95) $\lambda y \lambda e_k \lambda x \lambda e_i \lambda i^* \lambda j \forall t_a \forall t_b \, [j \subseteq i^* \wedge \text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, y) \wedge t_a \in i^* \wedge t_b \in i^* \wedge t_a < t_b \rightarrow \textbf{across-the-soccer-field}'(t_b, y) > \textbf{across-the-soccer-field}'(t_a, y)]$

Since the directional adverbial *across the soccer field* carries enough information by means of its own composition to replace the whole conditional, it should be legitimate to shorten this formula as follows, which, in fact, corresponds to the syntax of the expression in natural language:

(96) $\lambda y \lambda x \lambda e_k \lambda e_i \lambda i^* \lambda j \, [j \subseteq i^* \wedge \text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, y) \rightarrow \text{ACROSS}(i^*, y, \textbf{the-soccer-field}')]$

'move across the soccer field'

The next steps of saturation are:

(97) a. $\lambda x \lambda e_k \lambda e_i \lambda i^* \, [\text{CAUSE}(i^*, e_i, x, e_k) \wedge \text{BECOME}(i^*, e_k, \textbf{his-body}') \rightarrow \text{ACROSS}(i^*, \textbf{his-body}', \textbf{the-soccer-field}')]$

'move his body across the soccer field'

b. $\lambda e_i \lambda i^* \exists e_k \, [\text{CAUSE}(i^*, e_i, \textbf{Francis}', e_k) \wedge \text{BECOME}(i^*, e_k, \textbf{his-body}') \rightarrow \text{ACROSS}(i^*, \textbf{his-body}', \textbf{the-soccer-field}')]$

'Francis move his body across the soccer field'

Following Stechow (1995, 1997: 266ff), we assume that by means of lexical decomposition, the elementary predicate BECOME can be identified with the head V^0, whereas CAUSE triggers the projection of a further phrase vP, v^0 representing the second elementary predicate; see (100) below. Selection by v^0 also has the effect of existential binding of the event variable of BECOME.

vP is now selected by I^0, it becomes an argument of the characteristic function hosted by I^0, in this case PRET, cf. (92b) above. This has the effect that the event variable of the elementary predicate CAUSE gets bounded by an existential quantifier.

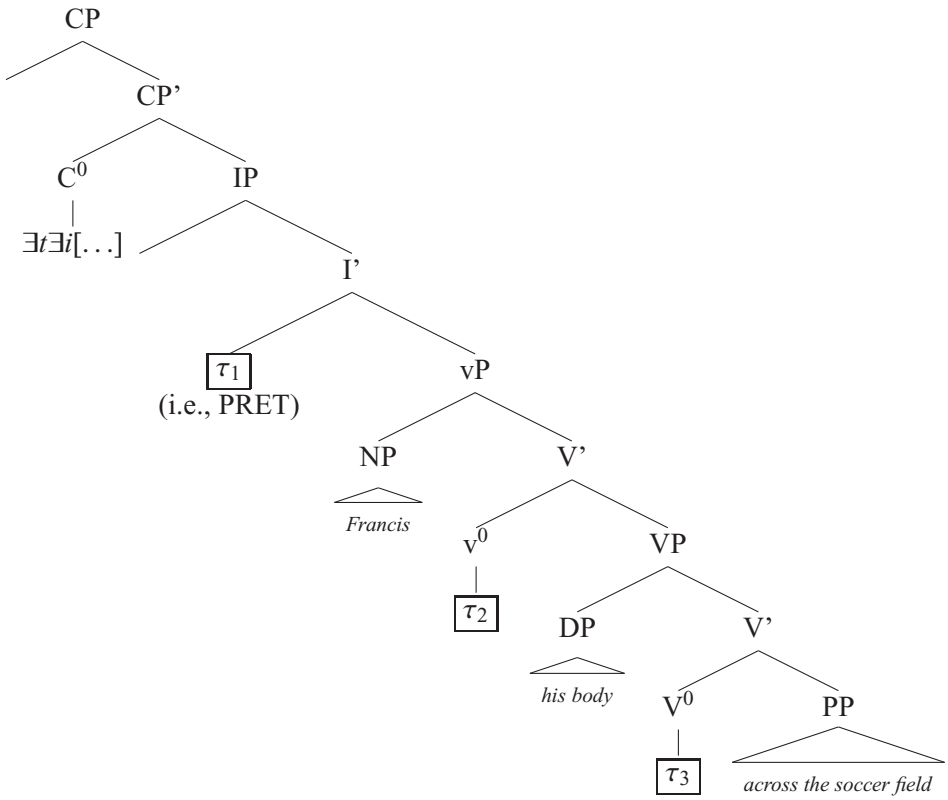
(98) $\lambda i^* \lambda j \exists e_i \exists e_k \, [j < t^\circ \wedge \text{CAUSE}(i^*, e_i, \textbf{Francis}', e_k) \wedge \text{BECOME}(i^*, e_k, \textbf{his-body}') \rightarrow \text{ACROSS}(i^*, \textbf{his-body}', \textbf{the-soccer-field}')]$

This expression contains a λ-bound temporal variable — which accounts for the intensional interpretation of propositions represented by IP (cf. Stechow 1992: 19). Like the event variables, the tense variables must also get bound by an existential quantifier in order to give the predication an extensional propositional interpretation — i.e., to make it a sentence.

(99) $\exists j \exists i^* \exists e_i \exists e_k \forall t_a \forall t_b \, [j < t^\circ \wedge \text{CAUSE}(i^*, e_i, \textbf{Francis}', e_k) \wedge \text{BECOME}(i^*, e_k, \textbf{his-body}') \rightarrow \text{ACROSS}(i^*, \textbf{his-body}', \textbf{the-soccer-field}')]$

In our view, this is done by a characteristic function hosted by C^0 corresponding to the syntactic finiteness features, which we do not discuss in detail. Thus, the whole sentence is structured as in (100); cf. page 260.

(100)



$\tau_1 := \lambda\varphi\lambda t\exists e[t < t^\circ \wedge \varphi(t, e)]$
$\tau_2 := \lambda x\lambda e_i\lambda t\exists e_k[\text{CAUSE}(t, e_i, x, e_k)]$
$\tau_3 := \lambda y\lambda e_k\lambda i[\text{BECOME}(i, e_k, y)]$

5.2. Form and interpretation of inflection

A detailed survey of the interpretation of the German perfect is provided by Musan (2002: 63ff), who takes the view that its semantics is uniform (ibid. 21ff) but contextually interpreted in different ways (ibid. 60ff). In contrast, we found that the syntactically and morphologically uniform construction auxiliary plus past participle (henceforth AUX+PII) does not have a uniform semantics. Consider:

(101) Franzl hat den Ball über das Tor hinaus geschossen.
Francis AUX the ball over the goal away shoot.PII
'Francis shot the ball over the goal.'

The lexical entry of *shoot* is (cf. 66, page 251):

(102) SHOOT: $\lambda P\lambda y\lambda e_k\lambda x\lambda e_i\lambda i^*\lambda t^*\exists t\,[\text{CAUSE}(t^*, e_i, x, e_k) \wedge \text{SHOT}(e_i) \wedge \text{BECOME}(i^*, e_k, y) \wedge \text{GOAL}(P) \rightarrow i^* \leq t \wedge P^{+\text{loc}}(t, y)]$

After λ-reduction we should find the following formula represented by vP:

(103) $\lambda i^*\lambda t^*\lambda e_i\exists e_k\exists t[\text{CAUSE}(t^*, e_i, \textbf{Francis}', e_k) \wedge \text{SHOT}(e_i) \wedge \text{BECOME}(i^*, e_k, \textbf{the-ball}') \rightarrow i^* \leq t \wedge \text{OVER}(t, \textbf{the-ball}', \textbf{the-goal}')]$

It should be clear now, that even though this predicate may form a PII selected by the AUX, it is incompatible with perfective clausal aspect. The reason is that the CAUSE-event is punctual, whereas PERF is a function containing a right-bounded interval.

(104) PERF: $\lambda\varphi\lambda j\lambda i^*\exists e\,[j \leq t^\circ \wedge j \in i^* \wedge \varphi(i^*, e)]$

The *shoot*-sentence does not, in fact, have the same perfective interpretation as the following one containing a durative predicate:

(105) a. *Francis has danced* (*for an our*).

b. $\exists j\exists i^*\exists e\,[j \leq t \wedge j \subseteq i \wedge \text{ACT}(i^*, e, \textbf{Francis}') \wedge \textbf{dance}'(e)]$

More arguments could be found to support the fact that the *shoot*-sentence does not express perfect tense. One of them is that, in languages like English, there is no perfect tense with verbs like *shoot*.

(106) * *Francis has shot the ball over the goal.*

The reason must be that, in German, the perfect construction is homomorphous with present tense constructions denoting the change to a result state, which implies the presence of the CAUSE event. Thus, the correct formula for our sentence is (107)

(107) $\exists t^*\exists i^*\exists e_i\exists e_k\exists t\,[t^* < t^\circ \wedge \text{CAUSE}(t^*, e_i, \textbf{Francis}', e_k) \wedge \text{SHOT}(e_i)$
$\wedge\ \text{BECOME}(i^*, e_k, \textbf{the-ball}') \wedge i^* \leq t \wedge \text{OVER}(t, \textbf{the-ball}', \textbf{the-goal}')]$

Thus it contains a function like the preterite, and, again, the corresponding English sentence is in the past but not in the perfect tense.

(108) PRET: $\lambda\varphi\lambda t\exists e\,[t < t^\circ \wedge \varphi(t, e)]$

(109) *Francis shot the ball over the goal.*

Similarly, our model makes restrictions on the use of progressive tense, which is incompatible both with punctual events and with properties, obvious (cf. Dowty 1979: 177ff).

(110) a. * *The bomb was exploding between six and seven.*

b. * *He is knowing Latin*

It can be assumed that progressive tense is a function subcategorised for pairs of events and intervals:

(111) PROGR: $\lambda\varphi\lambda i\lambda j\exists e\,[j \subseteq i \wedge \varphi(i, e)]$

Since the lexeme functions of neither punctual verbs nor properties contain an implicit argument *i*, their projection cannot be an argument of the function PROGR.

(112) a. EXPLODE: $\lambda x\lambda e\lambda t * \exists P\exists t\,[\text{BECOME}(t^*, e, x) \wedge \textbf{explode}'(e) \rightarrow t^* < t \wedge P(t, x)]$

b. KNOW: $\lambda y\lambda x\,[\textbf{know}'(y, x)]$

5.3. Sentential aspect, temporal adverbials and the German perfect tense

Much more could be said about the impact of implicit temporal arguments and the collaboration of elementary predicates on sentential aspect. Both temporal adverbials and the perfect tense are constrained by them. Alas, however, we do not have room for this now — in fact, a whole book could be filled with it. Thus, this might be the right place and the right time to use the familiar formula promising future research ...

6. Conclusion

In this essay, we have tried to find a distinction of predicate classes based on their compositional semantics. Here, the four classic categories proposed by Vendler (1967) have turned out to be insufficient. We also discussed models suggesting further differentiation but found these not to be differentiated enough. Instead, we proposed 15 classes which we explained on the basis of predicate logic, thereby proving their distinction in detail. We also showed that they can be decomposed in syntax and thus be shown to have different effects on the projection of the functional features of tense and aspect in the clause, and on the combination with temporal adverbials. This is on the grounds that both the verbal predicates, the functional phrases in the domains of IP and CP and the temporal adverbials are in fact characteristic functions over specific implicit temporal arguments. Overall, we hope to have contributed some useful insights into the understanding of verbal semantics.

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