

HIDDEN QUANTIFICATION IN PREFIX- AND PARTICLE VERBS*

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1 Introduction

This paper is about particle verbs that predicate endpoints to the events described by the complex verb. An example is the German particle-verb *ausspielen* that is built from the particle *aus-* and the verb *spielen*, s. (1) from an internet-forum of a radio station.

- (1) Songs ausspielen! Neuerdings breitet sich die Unsitte Songs abzuschneiden immer mehr aus!
(Play songs to their ends, please! We have had to experience the bad habit of cutting songs short!)(<http://www.mysnip.de/forum-archiv/thema/8773/34067/Songs+ausspielen.html>.)

The semantic commitment of the event not ending before its full temporal extension is also contributed by other German particles, e.g. with *auf-*, *ab-*, *ein-*, and is familiar from corresponding engl. *up*, dutch *op-* and from particles in other Germanic languages. Moreover, verb-formation of particle verbs with this semantic commitment is semi-productive. One aim of this paper is to demonstrate that the semantics of these particle verbs can be reconstructed compositionally from the semantic contribution of the particle and the contribution of the verbal kernel. In this respect this paper is one out of a series.¹ For ease of representation I will confine myself to German *aus-*particle verbs with this one of the many readings of *aus-*particle verbs on the one hand and out of *auf-* *ab-*, etc. particle verbs that follow the same composition pattern on the other hand. The working examples of *aus-*verbs of the main four verb-formation-patterns in German are listed in (2). A handful of further instances of the respective types are listed in Table 1. (The open list is not exactly representative, but a longer list does not require any conceptual or formal adjustments.)

- (2) a. *ausschlafen* (sleep until you have slept enough),
b. *ausreifen* (become fully ripe)
c. *ein Fahrzeug auslasten* (to load a vehicle to its capacity)

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¹s. (Roßdeutscher, 2011) and references therein.

d. *ein Buch auslesen* (to read a book to the end)

Although the semantics construction is different for each of the four types, the contribution of *aus-* to the verbal kernel and the verbal arguments is the same and follows variants of the same interpretation mechanism for inferring endpoints. These rule-based interpretations will be demonstrated in the next subsection by way of contrasting *aus-*verbs with their corresponding 'simple' verbs. Then I will sketch the strategy to account for them.

ausschlafen (from <i>schlafen</i> , 'sleep'), (to sleep until you have slept enough); <i>ausreden</i> (from <i>reden</i> , 'talk'), (to talk until you have made a point); <i>ausweinen</i> (from <i>weinen</i> , 'weep'), (to weep until you cannot weep anymore); <i>auslernen</i> (from <i>lernen</i> , 'learn'), (to finish your education); ...	ausreifen , (from <i>reifen</i> , 'ripe') (become fully ripe); (<i>eine Wunde</i>) <i>ausheilen</i> (from <i>heilen</i> , 'heal'), ((the wound) heal completely); (<i>die Haare</i>) <i>ausdünnen</i> (from <i>dünn</i> , 'thin'), ((your hairs) becoming thinner, getting bald); ...
ein Fahrzeug auslasten (from <i>Last</i> , 'load'), (to load a vehicle to capacity); <i>etwas / jemanden ausbeuten</i> (from <i>Beute</i> , 'loot'), (to exploit sth. or so.); <i>etwas / jemanden ausplündern</i> (from <i>plündern</i> , 'loot'), (to completely plunder sth. or so.); <i>etwas ausdeuten</i> (from <i>deuten</i> , 'interpret'), (to provide every possible interpretation); ...	(ein Buch) auslesen (from <i>lesen</i> , 'read'), (to read a book to its end); <i>einen Song ausspielen</i> (from <i>spielen</i> , 'play'), (to play a song to its end); (<i>ein Thema</i>) <i>ausdiskutieren</i> (from <i>diskutieren</i> , 'discuss'), (to fully discuss a topic); (<i>ein Programm</i>) <i>austesten</i> (from <i>testen</i> 'test'), (to do sufficient debugging of a program); <i>jede Blödelei ausreizen</i> (from <i>reizen</i> 'provoke'), (to max out every silly joke); ...

Table 1.

1.1 The difference that *aus-* makes. Some contrasts

Importantly, *aus-*verbs cannot combine with the adverbial-like element *weiter* (to continue to). Their corresponding 'simple' verbs can, and *weiter* directly combines with the verbal kernel, then. According to (Kratzer, 2004) this clearly indicates that *aus-*verbs are achievements, whereas the corresponding simple verbs are accomplishments. (Kratzer mentions the ungrammatical **wir wollten weitergewinnen* (we wanted to continue winning) as a witness. Table 2 displays this behaviour of *aus-*verbs for the four verb formation patterns.

a.	er will [weiter]schlafen, (he wants to sleep on)	* er will weiter aus schlafen
b.	sie ließen die Banane [weiter]reifen, (they let the banana become riper)	* sie ließen die Banane weiter aus reifen
c.	sie wollen das Fahrzeug [weiter]belasten, (they want to charge the vehicle with more load)	* sie wollen das Fahrzeug weiter aus lasten
d.	er will das Buch [weiter]lesen (reading the book, he wants to read on)	* er will das Buch weiter aus lesen

Table 2.

However, *aus*-verbs are not like *gewinnen* (to win) or *den Gipfel erreichen* (to reach the summit). The way they differ from ordinary achievements makes itself felt when we negate the sentences, as displayed in Table 3. The right column displays paraphrases of the negated sentences. The paraphrases demonstrate that all *aus*-verb descriptions of an event presuppose that a sequence of sub-events is already in progress and they assert a further sequence of sub-events culminating in some final point. For this reason, I will refer to the *aus*-verb descriptions as **sequential achievements**.

a.	er hatte nicht ausgeschlafen	(‘he had a sleep, but less sleep than he needed’)
b.	die Banane war nicht ausgereift	(‘the banana had ripened to some degree, but was not ripe enough’)
c.	sie hatten das Fahrzeug nicht ausgelastet	(‘they had loaded the vehicle, but not up to its maximal load’)
d.	sie hatten den Song nicht ausgespielt	(‘they had played parts of the song, but hadn’t played it to its end’)
e.	er hatte das Buch nicht ausgelesen	(‘he had read parts the book, but had not read it to its end’)

Table 3.

This special presupposition/assertion structure of the verbal predicates involving a sequence of sub-events and the culmination condition indicates that *aus*- induces an operation to the following effects: (i) a partition of the event described by the simple verb, (ii) quantifying over things and thereby determining the endpoints. What things are quantified over is different for the four types of word-formation. But for every type the two aspects of the operation can be given formal substance within a root-based account of word-formation.

1.2 Background theory: verb formation from their roots

The analysis I will present builds on earlier works of word formation in a framework that combines methods from *Distributive Morphology* (DM) (Marantz, 2005), and *Discourse Representation Theory* (DRT). The general idea of combining the methods is the conviction that verbs are constructed from their roots. (cf. (Roßdeutscher and Kamp, 2010), (Roßdeutscher, 2011) and references therein). According to DM, there is one syntactic engine for forming words and forming constituents. The basic elements of word formation are roots bearing lexical or encyclopedic information and functional heads that undergo MERGE and MOVE-operations. (Examples of syntactic and semantic structural descriptions are displayed in the Figures in section 4.)

As shown in detail in those papers there are two disjoint types of verbal constructions, called bi-eventive and mono-eventive, which correspond more or less to Levin’s dichotomy of Result vs. Manner verbs cf. (Levin, 1999). Bi-eventively constructed verbs involve a causal connection between the referential argument of the verb and a brought about state that is contributed by the semantics of a sub-lexical projection merging from a root. Typical instances are (i) de-adjectival verbs like *reifen* (to ripe) from the adjective *reif* (ripe) and (ii) de-nominal verbs like *belasten* from *Last* (load).

Mono-eventively constructed verbs are built from event-types, or ‘manner’-denoting verbal kernels. Typical instances are *schlafen* (to sleep), *lesen* (to read). Transitive instances of the

latter example, such as *ein Buch lesen* (to read a book) or *einen Song spielen* (to play a song) are known as 'non-core-transitive verbs' (cf. (Levin, 1999)) or "verbs that enter syntactic structure as activities" (cf. (Kratzer, 2004)); we follow the particular syntactic DM-implementation of this widely accepted notions by (Marantz, 2005) (N.B. In German, bi-eventively constructed verbs have *ung*-nominalisations, mono-eventively constructed don't.) Particle verbs in general and *aus*-particle verbs in particular, usually share the constructive type with their corresponding simple verbs.

1.3 Hidden quantification in the root-based account

Let me sketch how the semantics of the 'simple' verbs come about and how the particle *aus*-operates on the simpler structures to make sequential achievements out of them. The formal implementation of the syntactic and semantic sub-lexical analyses in a DM/DRT-based architecture will be provided in semantic construction algorithms, cf. section 4.

1.3.1 De-nominal *aus*-verbs

The verb phrase *ein Fahrzeug belasten* (to load a vehicle) = '*ein Fahrzeug* $\sqrt{\text{be}}$ + $\sqrt{\text{last}}$ + *v(eralizer)*' means to apply load to a vehicle. An agent brings about that the vehicle has load on it, where the relation 'have sth. on' is contributed by the prefix *be-*. The event described by *ein Fahrzeug auslasten* also describes an event with these conditions but with stricter entailments: the described event is the sum of sub-events such that every sub-event results in a state where the vehicle has more load; the final sub-event results in a state where the vehicle has the sum of all loads on it which is at the same time the *maximal* load that this vehicle can be charged with. As a consequence the hidden quantification contributed by *aus-* is a quantification over loads, that is quantification over the denotation of the root $\sqrt{\text{load}}$, which is an entity. The sequence of sub-events that sums up to the whole event corresponds to the sum of entities. This correspondence between the temporal partition of the event resulting in the final state and the partition on the side of the things quantified over is decisive for *aus-* in general.

1.3.2 De-adjectival *aus*-verbs

The sentence *eine Banane reifte* (the banana became ripe) = '*eine Banane* $\sqrt{\text{reif}}$ (ripe)+*v(eralizer)*' describes an event that brings about the state of the banana bearing the property of being ripe. Similar to the de-nominal *auslasten* the de-adjectival *ausreifen* describes an event of the banana becoming ripe, but on top of that it describes the riping as the sequence and the sum of sub-events such that each sub-event results in a state where the banana has a higher degree of ripeness than before. The final sub-event results into a state where the banana has the maximal degree of ripeness. Here and in all de-adjectival *aus*-verbs quantification involves degrees of properties.

The verbal constructions in 1.3.1 and 1.3.2 are bi-eventive. In these patterns the culmination condition of the simple event description and the respective culmination conditions of the sub-events are transparently constructed from the contribution of the roots. The roots provide what is quantified over: entities, or sets of entities with de-nominal verbs — degrees of properties with de-adjectival *aus*-verbs. Note that the culmination conditions are dependent of the arguments of

the verb, of how ripe the banana may get and how much load the vehicle can bear. I will take this dependency as decisive for the sub-lexical syntactic analyses.

With mono-eventively constructed *aus*-verbs cf. 1.3.3 and 1.3.4 the analyses are less straightforward.

1.3.3 Non-core transitive verbs

ein Buch lesen = '*ein Buch* $\sqrt{\text{les}}$ + v(eralizer)' describes a reading process which is contributed by the root $\sqrt{\text{les}}$, denoting an event type of some agent's activity with the book as its incremental theme. Culmination of the described event, i.e. telicity, is inferred wrt. the quantized accusative NP functioning as the internal argument of the transitive verb *lesen*. The event-description culminates wrt. the theme. (cf. (Kratzer, 2004) building on algebraic accounts of Aktionsart composition as in (Krifka, 1998)).

Following our strategy in 1.3.1 and 1.3.2 of defining the surplus of *aus*- as quantification over sub-events that result in states of the theme bearing a property that changes by and by, we are led to the following condition: "*ein Buch aus-lesen* denotes the sum of sub-events such that every sub-event has its part of the theme getting read", that is to say "more and more of the book becomes read". But this condition, though correct, is not at all satisfactory, because the semantics of *ein Buch lesen* and the semantics of *ein Buch auslesen* come out the same. What we are led to is merely the condition of telic event descriptions with incremental themes, well-known since Krifka's work from the early nineties: telic descriptions induce a homomorphism between sub-events in the event domain (e.g. reading activities) and mereological parts in the domain of the denotation (e.g. pages or chapters of a book). As a consequence, Krifka's notion of an incremental theme cannot tell apart the difference between simple transitive verbs with 'manner'-roots and their corresponding *aus*-verbs. How can we define the difference on top of Krifka's notion? At this point, I can only say this much: I will solve this puzzle by strengthening Krifka's homomorphism between event-part-structures and mereological part-structures of the theme's denotation in *aus-lesen*. This will be done in section 2.

1.3.4 Unergative *aus*-verbs

Things become even more involved with unergative *aus*-verbs like *ausschlafen*. The sentence *der Mann schlief* (the man slept) = '*der Mann* + $\sqrt{\text{schlaf}}$ + v(eralizer)' describes an activity or process of sleeping as atelic; *der Mann schlief aus* describes a (sequential) achievement. Trying to follow our strategy of explicating the culmination conditions we get already stuck with the plain idea that "culmination means culmination wrt. an argument" (cf. (Kratzer, 2004)). There is no internal argument with unergative verbs. The subject is external, which according to widely accepted assumptions isn't a true semantic argument and is introduced in a Voice-projection above vP (or above VP in (Kratzer, 1996)). As the subject is no option for measuring out the event (or the sub-events the sequence of which makes the whole event) the event type itself must provide measuring conditions somehow. Indeed, there have been proposals in the literature to connect termination conditions to the event variable directly. (Filip, 2000) and subsequent work proposes to define the contribution of Russian prefixes such as *na-*, that form perfective verbs out of atelic unergatives, via with the help of such measures.

This solution, however, as will be argued in section 3, cannot be applied to verbs like *ausschlafen*. Instead, I will tackle the puzzle of gaining measures for culmination condition

directly from the event types as follows: Performing actions characterised by agentive event types like reading, playing, weeping, talking, require the following: desire, power, enthusiasm, and capability. I subsume these four requirements under the notion of **stamina**. In the onset of an action stamina is high, decreasing and fading away as the action is pursued. With these characteristics, stamina is a thing that can be assigned **degrees**. Degrees in turn can be assigned measures, i.e. numbers, decreasing sub-event by sub-event. We can characterise the result state conditions of the sub-events in terms of decreasing degrees (just as we did with degrees of properties for the adjectival type) and the final sub-event of *ausschaffen* as resulting in a state where degree of stamina is zero: the agent either doesn't want to perform the action any longer or has no longer the capability of doing so. I will go into this matter in section 3.

As already mentioned section 4 will be devoted to construction algorithms.

2 The algebraic puzzle of *ein Buch auslesen*

Decisive for the explication of telicity in (Krifka, 1998) is that the verb — by thematic role assignment Θ to the denotation of its argument — induces a 'one-to-one'-mapping between parts of the theme and parts of the described event. The former is a relation in a mereological part-structure \mathbf{P} and the latter in an event-structure \mathbf{E} . The description, i.e. the thematic assignment function Θ , fulfils the condition that (a) any proper part y of x stands in the theme-relation to some unique proper part of e' of e ; and (b) (reversely) a given temporal proper part e' of e stands in the theme-relation to some proper part y of x . The formal requirements are usually referred to as Θ shows *mapping of sub-events* (MSE) and *uniqueness of sub-events* (UE) on the one hand and Θ shows *mapping of sub-objects* (MSO) and *uniqueness of sub-objects* (UO) on the other hand. The conditions from (Krifka, 1998), sec. 3.2, are displayed in Table 4.

MSE. $\forall x, y \in U_P \forall e \in U_E [\Theta(x, e) \wedge y <_P x \rightarrow \exists e' [e' <_E e \wedge \Theta(y, e')]]$	MSO. $\forall x \in U_P \forall e, e' \in U_E [\Theta(x, e) \wedge e' <_E e \rightarrow \exists y [y <_P x \wedge \Theta(y, e')]]$
UE. $\forall x, y \in U_P \forall e \in U_E [\Theta(x, e) \wedge y \leq_P x \rightarrow \exists! e' [e' \leq_E e \wedge \Theta(y, e')]]$	UO. $\forall x \in U_P \forall e, e' \in U_E [\Theta(x, e) \wedge e' \leq_E e \rightarrow \exists! y [y \leq_P x \wedge \Theta(y, e')]]$

Table 4

The reader is referred to the model-theoretic axioms for the algebraic event structure \mathbf{E} with its universe U_E and 'proper part' $<_E e$ and 'improper part' \leq_E , defined within \mathbf{E} (and for the mereological part-structures \mathbf{P} as well) in (Krifka, 1998):206,199.

I will confine myself here to circumscribe the mapping between the respective structures, compare Table 5, second row, below. Think of an event e of the type 'reading a book'. This event e is assumed to contain two non-overlapping, but abutting sub-events e' and e'' , such that e is the sum of the two (written as the condition $e = e' \oplus e''$). For the denotation of the book y undergoing reading there exist parts of the book y' and y'' such that y' undergoes reading in e' and y'' undergoes reading in e'' . The definition of telicity in (Krifka, 1998) and in earlier works relies much on the intuition that a description of an event is telic, if there are no initial or final parts of the events that qualify for the description to be true yet. It is only the entire event that makes the description true.² Applying the concepts to *ein Buch lesen* and to *ein Buch auslesen* both predicates qualify as telic. (The complication that *ein Buch auslesen* has the presupposition

²"It is obvious that quantized predicates are telic: If a quantized predicate X applies to some event e , then it does not apply to any proper part of e , hence the only e' such that $X(e')$ and $e \leq_E e'$ is e itself" (Krifka, 1998):207

that a book-reading event must be underway to apply the predicate to the event as a whole has no impact on this).

The additional condition that makes an event to qualify for a true *ein Buch auslesen*-description rather than for a true *ein Buch lesen* description concerns temporal order-relations that the denotation of the theme must fulfil. To put it briefly, the parts of the theme are not only mereological parts, but **temporally ordered** mereological parts.

ein Buch lesen		y is (strictly) incremental theme
E: event structure $e = e' \oplus_E e''$	$E \stackrel{\Theta}{\Leftrightarrow} P$	P: mereological part structure $y = y' \oplus_P y''$
	\mapsto	
	$\Updownarrow \tau$	
T: time structure	$T \Leftrightarrow P$	P: mereological part structure
$e' <_E e \xrightarrow{\tau} \tau(e') <_T \tau(e \setminus e')$	\mapsto	$y' <_{t,P} y''$
ein Buch auslesen		y is sequential theme

Table 5. Strengthening the algebraic structure for sequential achievements.

This additional requirement doesn't make itself felt very often. But it does so in *ein Buch auslesen* as opposed to *ein Buch lesen* and *einen Song ausspielen* as opposed to *einen Song spielen*: books and songs come with a pre-determined temporal order of their parts, i.e. the order in which the parts participate in an action. That order must be respected in the *aus*-verb-description.

As for the former think of a scenario of reading a dissertation of five chapters. Chapter 3 is the most substantial, so you read it first. As you do not understand it, you read the first two chapters, and then, in order not to miss anything, you read chapter 4 and 5. This scenario makes (3.a) and (3.b) true, but (3.c) is not true in this scenario. This is because the predetermined order of the parts of the dissertation is not respected. As for the latter playing a song backwards (= *rückwärts*) doesn't respect the order of the parts either. This is why (4.b) is uninterpretable.

- | | |
|--|--|
| <p>(3) a. Ich habe die Dissertation gelesen.
 b. Ich habe die ganze Dissertation (the whole dissertation) gelesen.
 c. Ich habe die Dissertation ausgelesen.</p> | <p>(4) a. Sie hatten den Song rückwärts gespielt
 b. # Sie hatten den Song rückwärts ausgespielt</p> |
|--|--|

Naturally there are not many verb- direct object- pairs where the theme involves such temporal ordering of its parts to undergo the action. But where this is not so, such a temporal ordering on parts of the incremental theme will be accommodated; the temporal ordering will be induced by the temporal ordering of the sub-events that make up the sequential achievement.

Let's explicate these intuitions in formal terms. The strengthening of the Krifkanian homomorphism is as follows:

Θ induces a one-to-one-mapping between **temporally ordered** parts of the event and **temporally ordered** mereological sub-parts of the theme

The notion of a 'temporally ordered mereological sub-part' is defined recurring to the temporal order $<_t$ of time-structure **T**. **T** is set of run times of the events of event-structure **E**. The part-whole relation $<_P$ in the mereological structure respects in addition a temporal precedence relation $<_t$:

Definition of $\prec_{t,P}$. Let y' be a mereological proper part of y'' , i.e. $y' <_P y''$.
 $y' \prec_{t,P} y''$ iff y' and y'' are naturally determined to be theme in e in the temporal order
 \prec_t of run-time $\tau(e)$

Table 5 displays the one-to-one-homomorphisms that define these algebraic structures of an 'incremental theme' as defined in (Krifka, 1998), i.e. the mapping $\overset{\Theta}{\rightleftharpoons}$ on the top (respecting the conditions in Table 4) and the strengthened condition in the bottom.

The ordering $\prec_{t,P}$ is induced via the one-on-mapping \Downarrow , known as the trace function τ between the event structure \mathbf{E} and the time-structure \mathbf{T} . τ maps an event onto its run-time $t = \tau(e)$. For an event e which is the \oplus -sum of e' and e'' (and therefore e' is a proper part of e wrt. event structure (cf. $<_E$)), e' is mapped (by the one-one homomorphism \Downarrow) onto its run-time $\tau(e')$ which temporally precedes (cf. \prec_t) the run-time of the rest of e , i.e. $\tau(e \setminus e')$. The run-times of the proper parts of e are then mapped onto the temporally ordered proper parts of y . This is how the semantic requirement of *aus-* comes out as strengthening the algebraic structures of incremental themes.

2.1 Semantic representation for the type *ein Buch auslesen*

With those homomorphisms at hand, we are now in the position to present a vP-representation for the non-core transitive *aus-*verbs, exemplified in *ein Buch auslesen*. A vP-representation is presented in Table 6.

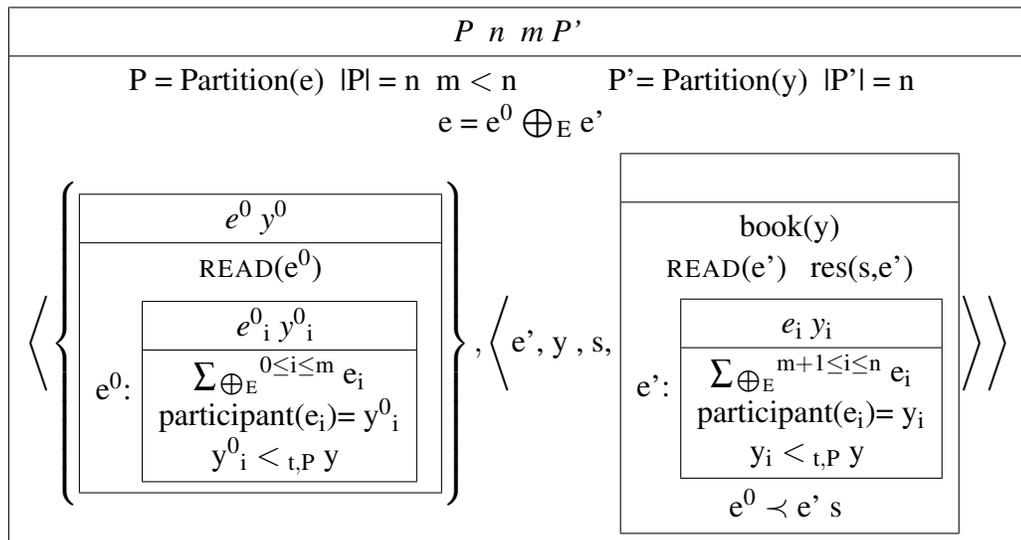


Table 6. Semantic representation of the vP (= Kratzers's VP) *ein Buch auslesen*

The event e described by the verb phrase is the sum of the presupposed event e^0 (cf. structure in curly brackets) and the asserted event e' , which is listed in a binding store to the left of the assertion, together with the discourse referent y for the book and the resultant state s of e , see 'res(s,e)'.³ As the event culminates, we can apply the notion of a partition P of e (of cardinality n), i.e. a set of non-overlapping $e_{i \leq n}$ that sum up to e . The sequence e_0 to e_m sums up to e^0 and the sequence e_{m+1} to e_n sums up to e' . Moreover, there is a structure identical partition $P(y)$ of the

³The notation with the binding store is due to the background theory. All discourse referents in the store will be existentially quantified on some DRS-level in a sentence representation, though not all at top-level, because not all can be referred to by pronouns.

same cardinality for the theme's representation y . The partition is a set of disjoint parts $y_{i \leq n}$ that sum up to y . Moreover the proper parts y_i are temporally ordered sub-part of y , see the condition ' $y_i <_{t,P} y$ ' that formulates the additional requirement for the thematic relation 'participant(e_i) = y_i ' on the sub-events e_i that are quantified over.

3 Semantics for the *ausschlafen*-type

When I sketched my solution of the representation puzzle for agentive intransitive *aus*-verbs, I eluded to the fact that I was influenced by (Filip, 2000) to overcome representation puzzles for the semantics of Russian prefixes such as *na*- in perfective descriptions (cf. ^P on the verb) (5)(cf. (Filip, 2000):22)

- (5) Ivan **na**guljál'sja^P po górodu
 Ivan ACM.ACC-walk.past.refl. around town.
 'Ivan walked a lot / enough / to his heart's content around the town'

The theoretic turn in (Filip, 2000) and subsequent work is to yield quantized predicates by imposing a **measure** over the event-variable introduced by some of the arguments of the predicate. E.g. in (5) the event is measured by its associated path argument; the path is *long* wrt. some standard of comparison. This representation strategy, however, doesn't apply to the German predicates *ausschlafen* or *ausweinen*. Different from motion predicates, where a hidden or overtly expressed path argument can be measured, no such argument is conceptually given in those verbal predicates.

As indicated in the introduction, inducing a measure of decreasing **stamina** that drives the agent's action doesn't commit us to represent arguments for measuring the event. The eventuality structure involving summation of a sub-events e_i is analogous to the representation in Table 6. (Compare also the vP-node representation in Figure 1, below). The characterisation of the sub-events e_i that sum up to the whole event is formulated in terms of degree. As a background assumption we have to assume that for at least a set of event-predicates introduced by a 'manner'-root an abstract event predicate **stamina** can be applied to the action specified by the root. In addition, though less delicate, some function DEGREE must map sub-events of this action to decreasing natural numbers, where zero determines the final resultant state. The reader must be put up with my conjecture that according to my experience my analysis fits enough examples to indicate semi-productivity⁴.

4 Semantics Construction Algorithms

4.1 *Aus*-in unergative verbs

With these considerations semantics constructions in the DM/DRT architecture is presented in Figure 1 with the syntactic analysis to the left and semantic interpretation of the nodes to the right

⁴As is common with particle verbs, novel instances, — sometimes surprising ones — are also found. Here is an example from a narrative, speaking of a woman that had lost all power for living, a conceptualisation that justifies forming an *aus*-verb of the reading we are focusing on, although *leben* (to live) wouldn't come into our mind as involving stamina.

- (i) Für sie war keine Quelle mehr, die den müden, abgetragenen Wanderer am schwülen Tag ergötzt. Kein Trunk mehr kühlte sie! **Sie hatte ausgelebt!** Den letzten Lebenstropfen kostete ihr dieser Vorfall.'

(up to vP-level). A sentence like *ein Mann schlief aus* has a syntactic representation where the particle *aus-* is adjoined to vP. The root $\sqrt{\text{aus}}$ in this syntactic context contributes an event-property of a sequential achievement (which becomes predicated over the referential argument e'). Please read ‘ $\text{DEG}(\text{STAMINA})(e_i) = d_i$ ’ as ‘‘degree of stamina of the action e_i is the natural number d_i ’’. (The order ‘ $>_N$ ’ is the order of natural numbers). Lack of space doesn’t allow me to represent the presupposition/assertion-structure.

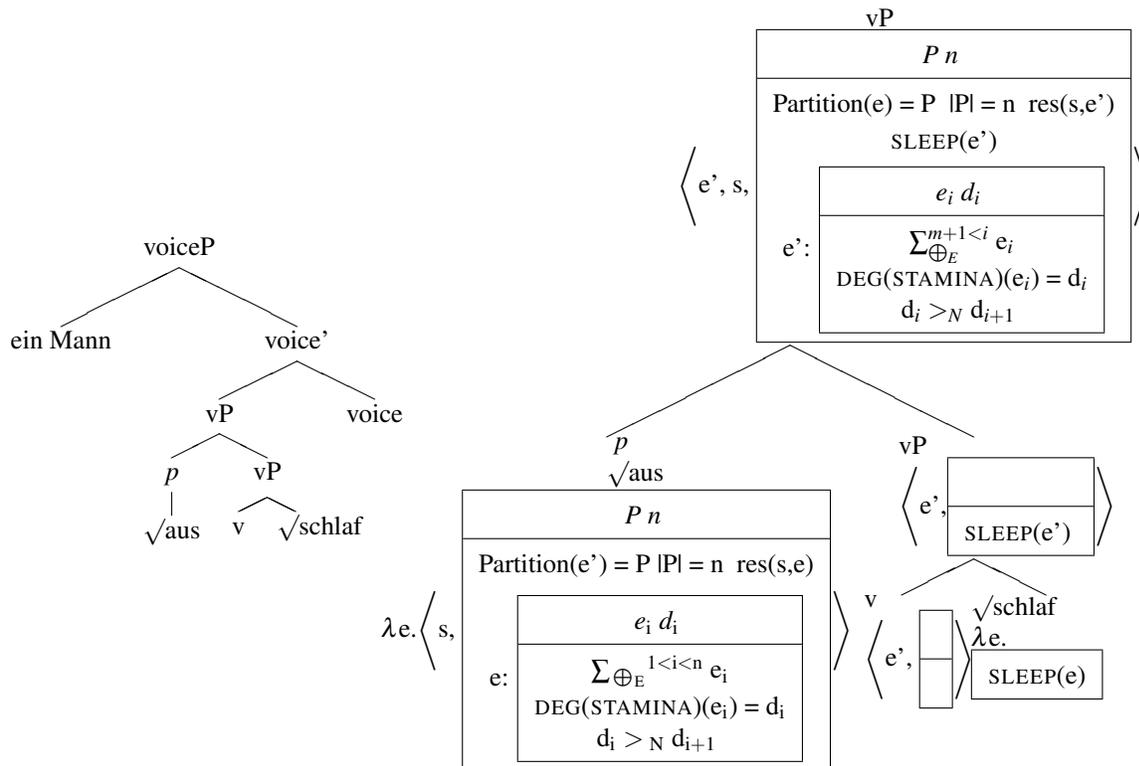


Figure 1. Semantic composition of *ausschlafen*.

4.2 Transitive *aus*-verbs vs. non-core-transitive verbs with plain accusative arguments

In non-core transitive *aus*-verbs as in *ein Buch auslesen* the theme is thematically marked by the particle. For it is the particle that requires the temporally ordered mereological part-relation on the theme’s denotation and introduces the partition on the event and theme discourse referents. For this reason the particle, being a two-place-relation, is the head of a projection where the direct object is introduced as a slot-filler, see the lambda abstract at the *aus*-root node in Figure 2. (The summation condition is as displayed in Table 6.)

In transitive *aus*-verbs the culmination is predicated overtly by the particle. This is not so with the corresponding simple verbs with plain accusative NPs. Interpreting the latter wrt. culmination is a matter of world-knowledge inference. Moreover, as (Kratzer, 2004):418 mentions in a footnote, there is also some contextual flexibility about the coarseness of the underlying mereological part structure. This allows for, say, ‘to read a book’, to be true if the book was

not really read to its end. With *aus-* particle verb there is no flexibility of this sort. Neither is there a way to coerce the transitive description to an interpretation according to termination without the natural endpoint being reached, as in *drei Stunden lang ein Buch lesen* (to read a book for three hours) or *drei Minuten lang einen Song spielen* (to play a song for three minutes). The respective predicates with *aus-*verbs are all infelicitous.

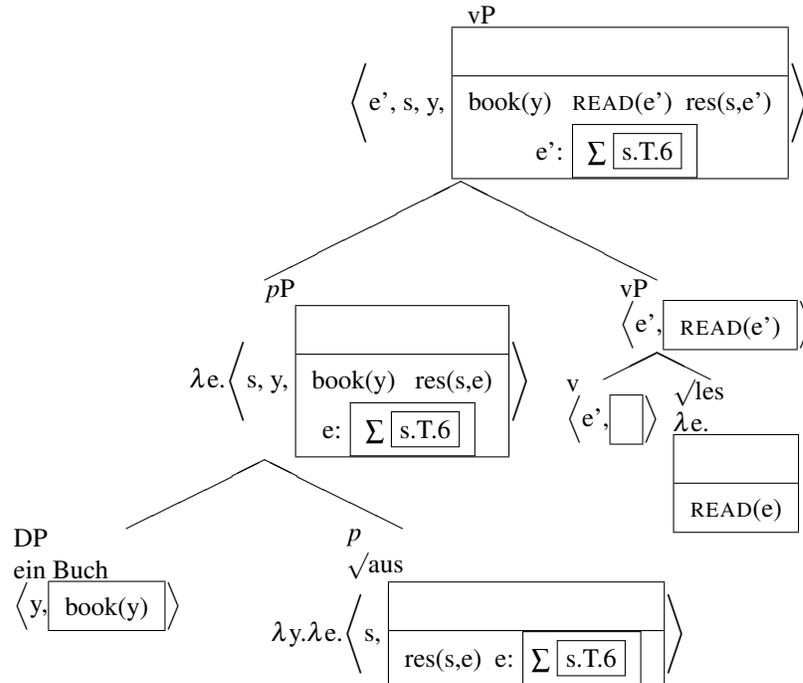


Figure 2. Semantic composition of *ein Buch auslesen*.

4.3 Bi-eventive *aus-*verbs

4.3.1 De-nominal *aus-*verbs vs. simple de-nominal verb

Figure 3 displays the syntactic analyses of the respective verb phrases in the DM-framework of the de-nominal type. In *auslasten* the projection headed by *aus* is adjoined to a bi-eventive vP-structure, which is like the corresponding *be-*prefix-verb, except for a silent P-head and a trace t_1 for the theme in the projection of P. The word-syntactic analyses predict the *ung-*formation, i.e. *die Belastung des Fahrzeugs, Auslastung des Fahrzeugs*. We have an instance of multiple thematic marking: in the sub-lexical PP, headed by a silent P (which has the same semantics as the prefix *be-*) the theme is predicated to be in an application relation **have** with a load ($\sqrt{\text{last}}$); in the $\sqrt{\text{aus}}$ -projection the theme is predicated to deliver the information with respect to which entity the load is a maximal load.

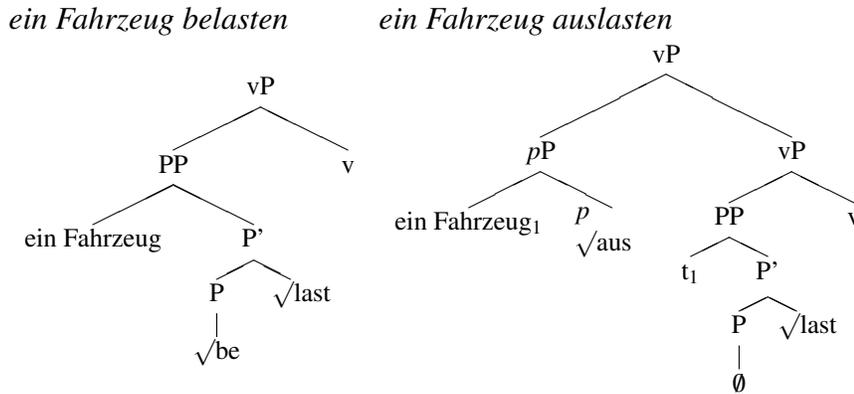


Figure 3.

The construction algorithm based on the syntactic representation to the right in Figure 3 is displayed in Figure 4.

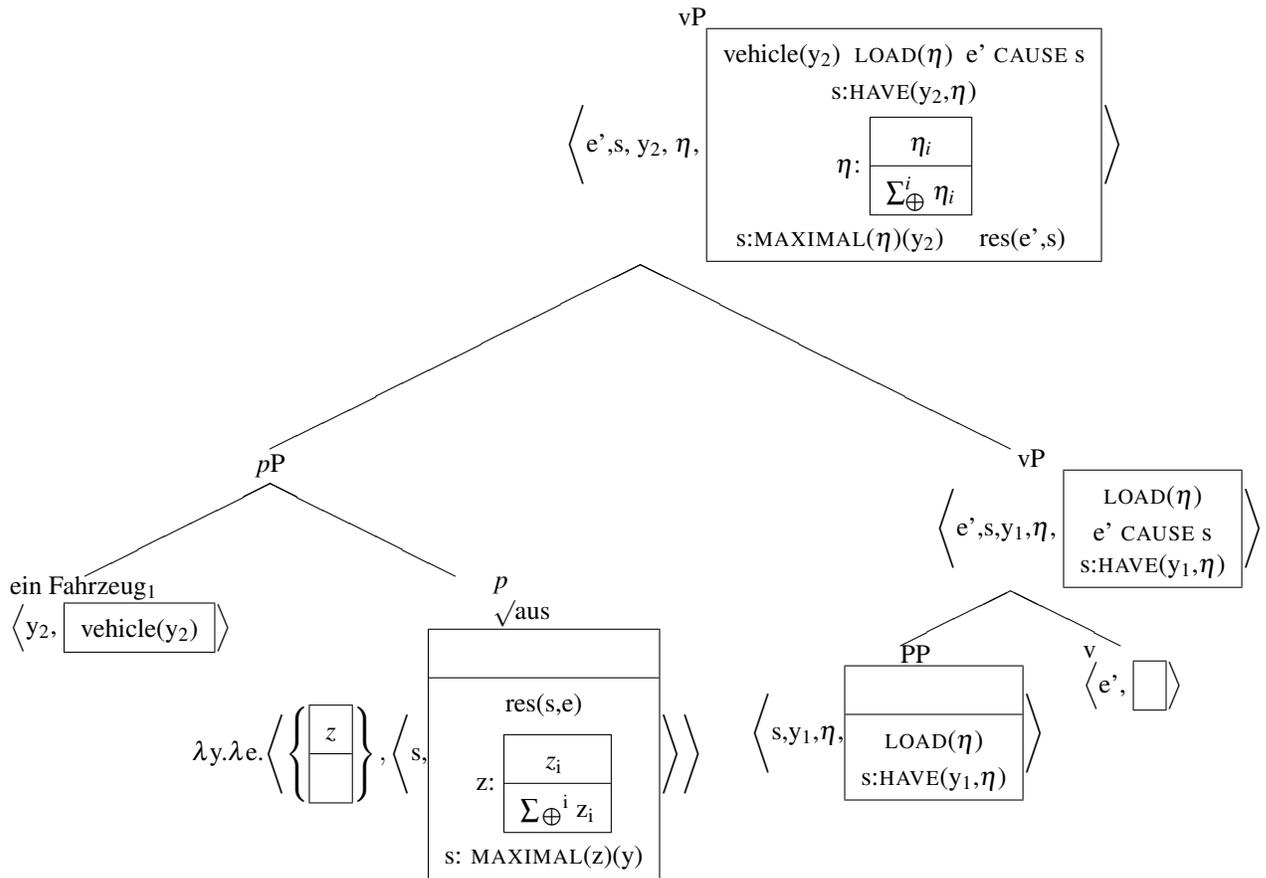


Figure 4

Lack of space forces me to forgo the semantics construction of the PP step by step. The reader is referred to (Roßdeutscher and Kamp, 2010) for a detailed description. The presentation starts with the semantic representation of the PP as a whole. I will confine myself to the refinements that come in from the particle. The trace t_1 in the PP introduces a discourse referent y_1 going into

the binding store, where y_1 is awaiting identification with the discourse referent y_2 , introduced by the accusative DP *ein Fahrzeug*. The sortal root $\sqrt{\text{last}}$ introduces the discourse referent of an entity sort, η (which is underspecified wrt. being individual or sum (cf. Greek letter)). As sketched in the introduction the vP has a semantics that a state s is brought about by e' where y_i is applied some load η . The semantics of *aus-* is two-place-relational wrt. entities (or three-place relational taking into account that the projection headed by *aus-* delivers an event predicate (cf. λ -abstracts λy and λe in front of semantic representation of $\sqrt{\text{aus}}$). The quantification is over some implicit discourse referent z , which is represented in a presupposition (s. curly brackets). As a rule such presuppositional discourse referents must be either resolved within some level of linguistic representation or represent discourse referents from the context. Here the presupposed discourse referent will be resolved word-internally by η , representing the entity contributed by the entity-root $\sqrt{\text{last}}$. Quantification is quantification over mereological parts of z and is dependent on the theme. *Aus* requires that the event that the *aus*-projection modifies culminates at the point when the implicit argument z is maximal wrt. (the λ -bound) y . At *pP* we have an event property (without node-representation) where y_2 satisfies the λ -abstract by conversion, thereby substituting the occurrence of y with y_2 (while the presupposition of z still obtains). Three things happen when, at the vP-level of adjunction, the event predicate $\lambda e.[\dots]$ applies to e' , where the latter is the referential argument of the verb. (i) The presuppositional argument z becomes resolved by η . This specifies η as the maximal sum of loads. (ii) The variable y_1 from the trace becomes unified with y_2 ; it is a vehicle y_2 that gets a maximal load, see condition 's:HAVE(y_2, η)'. (iii) The culmination condition 's:res(s, e)' and the brought about state s from the bi-eventive de-nominal verb are identified. It should be easy to verify that e' has the temporal structure of a sequential achievement. e' is the sum of sub-events e_i corresponding to a sub-part of the maximal load, which sums up as the event develops, where sub-event by sub-event (and run-time by run-time) the vehicle becomes charged with a heavier load.

4.4 De-adjectival *aus*-verbs

I can be brief here and I confine myself to the conjuncture that there are no particular additional challenges with de-adjectival *aus*-verbs. The semantics construction algorithm is much like the one for de-nominal *aus*-verbs. I end my analyses by presenting the vP-presentation in Table 7.

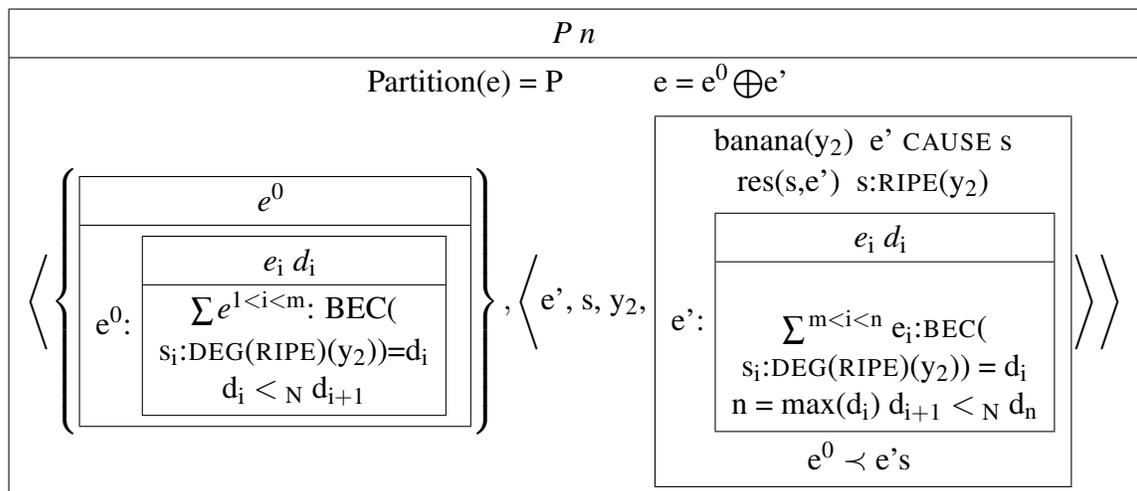


Table 7. Semantic representation of the vP *eine Banane ausreifen*

5 Conclusion and outlook

I presented a compositional semantics for sequential achievements built with the particle *aus-*. The compositional theory was developed for the four main verb-formation classes in German. For each class *aus-* induced a temporal partition of the described event in a one-to-one correspondence with a temporally ordered set of quantified values determining the endpoint.

There are still further challenges for *aus-*verbs the paper didn't touch, yet. Compare (6.a,b).

- (6) a. Jussi ließ Wein (aus dem Fass) auslaufen
 Jussi let wine (out of the barrel) [out]run
 'Jussi let wine run out of the barrel'
- b. Jussi ließ das Fass (* von Wein) auslaufen
 Jussi let the barrel (* of wine) [out]run
 'Jussi let the barrel empty'

The contributions of *aus-* in both sentences are the same in that they both contribute a topological relation. But in (6.b) we have hidden quantification in addition. For (6.b) but not (6.a) is a sequential achievement. Moreover, in (6.b) we have syntactic demotion of the figure argument and promotion of the ground-argument of the topological relation *aus* (\approx *out*), cf. (Svenonius, 2003). Instead of a syntactic description of the alternation, however, I advocate an analysis where hidden quantification plays its role in the syntax-semantics-interface.

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