Aspectual Composition: Surveying the Ingredients

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Abstract: This paper discusses some of the ways in which the notion of compositionality is understood in the literature. It will argued that on a strict (Fregean) view a verb has a constant meaning to make in the aspectual composition independently from the information contributed by its arguments, that the VP (verb+ internal argument/complement) forms a substantive aspectual unit that should be recognizable as such complex aspectual information; and finally, that aspectual composition forces Discourse Representation Theory into revising the way states and events are taken.

Keywords: aspectuality, composition, terminativity, DRT, aspectual classes, collectivity, distributivity

1. INTRODUCTION

The notion of aspectual composition belongs in the wider perspective of developments in two domains of research. The first domain harbours the tradition of the so-called Fregean compositionality. This has been a very important compass in semantics and as the title of my 1971-dissertation *On the Compositionality of the Aspects* suggests, I was guided by it, although I did not have first-hand knowledge of Frege's work at the time. My first contact with Fregean compositionality was via the Katz/Fodor-semantics of the sixties which expressed Frege's ideas on building the complex meaning of phrases and sentences on the basis of their smaller parts. It was that insight of Frege's that—after the collapse of the markerese semantics provoked by Lewis 1972—turned out to be common ground for the philosophical-logical tradition that took over semantics in the seventies. I have always considered aspectual composition as part of this broader tradition whose major players are well-known: Frege, Russell, Carnap, Quine, Montague, among many others. It makes compositionality a guiding principle in the domain of aspectual phenomena, as it is in other semantic domains. Sometimes the fact that complex units are to be taken as more than the sum of their parts is used as an argument against Fregean

compositionality. This objection is wide off the mark. After all, the existence of molecules did not prevent chemistry from looking at atoms as building blocks.

The second domain is linguistic. The notion of aspectual composition hovered already over the literature of the twenties discussed in my dissertation. It grew on trees, as the English proverb says, but the tragedy for my aspectual heroes of the late twenties, Poutsma and Jacobsohn, who in Poutsma 1926 and Jacobsohn 1933 were well aware of the non-atomic nature of aspectual information, was that there were no (syntactic) trees at the time. At the end of the sixties, I could decide relatively easy that aspectuality should be treated on the basis of amalgamating the meanings of the verb and its arguments into larger units. This was due to the fact that since Chomsky 1957;1965 the notion of phrase structure had been fully available, whereas it was still absent or at best rudimentary in the twenties and thirties. The idea of aspectual composition started to grow on trees.[1] Phrase structure opens the way to a strict(-er) interpretation of Fregean compositionality.

The thesis that the meaning of a complex expression is computable on the basis of its constituent parts has been attacked in semantic "Gestalt-circles".[2] It seems to me that such attacks are too early. To continue the metaphor used above: a molecule is built from atoms by the way these are grouped together. So one cannot do away with Frege without taking into account constructional meanings, context information, or other ways of complementing the information that is present at first sight.

Let me explain this point in more detail with the help of Figure 1 in which the semantic information expressed by the features $[\pm\text{ADDTO}]$ and $[\pm\text{SQA}]$ may be taken as semantic atoms. The idea of the picture as a whole is that a Verb is specified for some semantic property, that
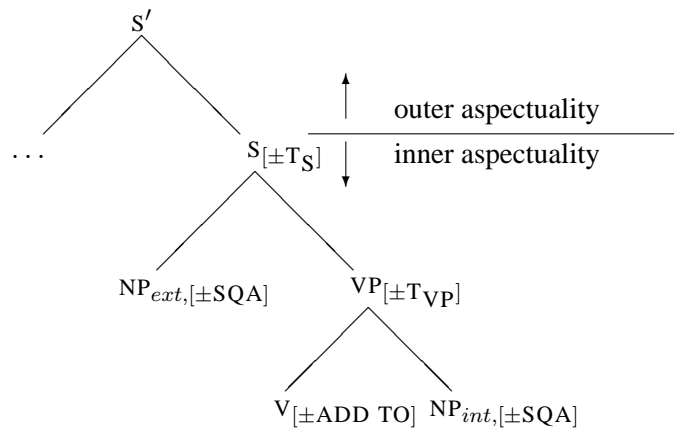

Figure 1: Aspectual composition

it takes NP_2 which is also specified for some semantic property, that it forms a VP at which

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[1] Chomsky's notion of recursivity comes from the same logical tradition that I mentioned earlier, so the idea of composing new complex structures on the basis of simpler ones had also a syntactic underpinning as clearly visible in the Katz/Fodor-semantics.

[2] Quite fiercely by Lakoff, e.g. in Margolis and Laurence 1999:413 and by some of the prototype theorists included in that collection. An interesting attempt to stick to compositionality in a cognitive approach in which gestalts are clearly recognized is Jackendoff 2002: 378–94.

level a complex semantic object is construed, here labeled as $[\pm T_{VP}]$, that the VP combines with NP_1 yielding a tenseless sentence S that carries the complex aspectual information labeled $[\pm T_S]$ and collected from the lower levels in the form of a complex semantic feature. Then this process comes to an end after which other principles are operative in a higher domain. To mark this transition a distinction is made between inner and outer aspectuality.

The [+ADDTO]-property of the verb expresses dynamic progress, change, nonstativity or whatever term is available to distinguish it from stative verbs, which have a minusvalue. The [+SQA]-feature expresses that the NP pertains to a specified quantity of things or mass denoted by its head noun as in (1a) or contains [-SQA]-NPs as in (1b):

(1) a. She played a sonata, three sonatas, some sonatas, a piece of music
         that sonata, Schumann's last sonata for piano
     b. She played music, sonatas, that (sort of) music, from that to the end

Contrary to what Dowty 1979:64 said about my position, this distinction has nothing to do with definiteness or indefiniteness. A [+SQA]-NP pertains to something discernible that can be separated from other things and as soon as you can do that, one may count or measure (cf. Verkuyl 1972:59ff.).[3] This semantic information is located in the determiner part of an NP.

The process of amalgamating the information contributed by V and its internal argument NP_{int} should be different from the process of amalgamating the information expressed by the VP and the external argument NP_{ext}, there being two different levels of phrase structure involved. Part of the difficulty of taking the sum S as more than the sum of its parts is that we know so little yet about the type of information that is collected at the S-level. As I will show below, the relation between NP_{ext} and VP can be taken in terms of a multiplication relation in which each of the members of the NP-denotation obtains its own VP. Where do we store this particular information? Is it made explicit by the algebraic machinery that computes meanings? Does the fact that there are two ways of multiplication that seem to govern the NP_{ext} VP-relation, follow from a general cognitive principle? At the present stage we do not yet have answers to these questions, but what we do know is that they are raised by stubbornly following the hard road of Fregean compositionality. It pays off to take this road by trying to compute the meaning of S on the basis of semantic information expressed at lower levels.

Figure 1 provides a simplified scheme for showing how compositionality based on phrase structure operates. The simplification concerns the fact that Figure 1 covers only two-place predicate verbs and one-place predicates with complements. In spite of the drastic reduction, it enables us to ask some relevant questions about how to shape the idea of aspectual composition. I will organize these questions into three main topics.

1. What is the contribution of the Verb to aspectual information?

2. Is the VP an aspectual unit on its own due to aspectual asymmetry?

3. How does aspectual asymmetry relate to the notion of event as the S-level?

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[3]On pages 79ff. discernibility expressed by mass nouns was analyzed in terms of the notion of partitivity: one insulates a part of a larger whole. Krifka's notion 'quantized' can be considered as the mereological explicitation of the [+SQA]-notion, although there are some remarkable differences having to do with NPs like *more than three sonatas*, *something*, etc. which I consider [+SQA] and Krifka as cumulative and not quantized.

The first topic will be discussed in section 2. It focusses on the question of how constant the meaning contribution of a verb should be kept. The second topic, discussed in section 3, concerns the question of how the VP is formed and how it behaves as an aspectual unit in the interaction with the external argument. In section 4, I will discuss the question of how aspectual information formed by compositional rules is (to be) given a place in the Kamp boxes of DRT. I will point out that some work is necessary to bridge the gap that now exists due to some decisions that may be disputed on compositional grounds.

2.   THE VERB AND ITS ROLE IN ASPECTUAL COMPOSITION

2.1   The constancy of verb meaning

What happens in the composition of the sentences in (2)?

(2)   a.   Mary walked three miles
       b.   Mary walked miles

In terms of the feature system above, the difference between the VPs *walk three miles* and *walk miles* is accounted for as in (3):

(3)   a. $V_{[+\text{ADDTO}]} + NP_{2,[+\text{SQA}]} \Rightarrow [+T_{\text{VP}}]$
       b. $V_{[+\text{ADDTO}]} + NP_{2,[-\text{SQA}]} \Rightarrow [-T_{\text{VP}}]$

It should be underscored that the features abbreviate information has received a precise (= formal) second order type-logical characterization in Verkuyl 1993.[4] In spite of the abbreviatory nature of the features, they help to show that the value of the verb is kept constant in the two cases of (3): it is the complement of the verb that should be held responsible for the different aspectual values of the two VPs that are compared, $[+T_{\text{VP}}]$ in the case of the terminative VP *walk three miles*, $[-T_{\text{VP}}]$ in the case of the durative VP *walked miles*. The semantic information at the level of the VP differs crucially from the lower-level information.

The features also yield a helpful feature algebra part of which is visible in (4).

(4)   a. $[_S$ Mary $[_{VP}$walk   three miles$]]$
              $[_{+T_S}[+\text{SQA}]$ $[_{+T_{VP}}[+\text{ADDTO}]$ $[+\text{SQA}]]]$ $\Rightarrow$ terminative
       b. $[_S$ Mary $[_{VP}$walk   miles$]]$
              $[_{-T_S}[+\text{SQA}]$ $[_{-T_{VP}}[+\text{ADDTO}]$ $[-\text{SQA}]]]$ $\Rightarrow$ durative
       c. $[_S$ Children $[_{VP}$walk   three miles$]]$
              $[_{-T_S}[-\text{SQA}]$ $[_{+T_{VP}}[+\text{ADDTO}]$ $[+\text{SQA}]]]$ $\Rightarrow$ durative
       d. $[_S$ Mary $[_{VP}$save   three miles$]]$
              $[_{-T_S}[+\text{SQA}]$ $[_{-T_{VP}}[-\text{ADDTO}]$ $[+\text{SQA}]]]$ $\Rightarrow$ durative

This algebra leads to the formulation of the Plus-Principle, which says that one minus-value below is sufficient to yield a [–T] at the top of Figure 1, the natural domain of the Principle appearing to be the domain of inner aspectuality.

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[4]In Dowty 1979 they are wrongly taken as *syntactic* in spite of the fact that they have always stood for the semantic information explained in section 1.

Being skeptical about the use of aspectual classes—they lure linguists into doing ontology rather than linguistics—, and being skeptical about Vendlers quadripartition, I adopted the tripartition State-Process-Event in the eighties. The tripartition emanated on a line followed by Comrie 1976, Mourelatos 1978 and Bach 1981, among others. It took a while before I realized that the tripartition simply results from encoding the feature-information in (4). The feature algebra construes the three aspectual classes that are relevant in aspectual composition as shown in Figure 2. It follows that verbs do not express states, processes and events (accomplishment
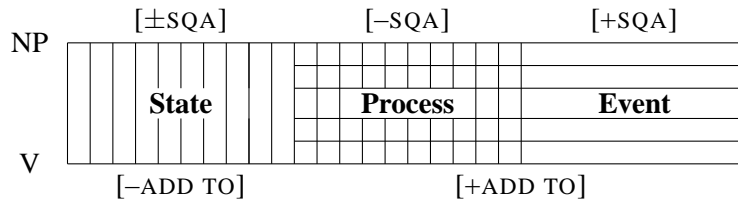

Figure 2: Construal of three aspectual classes

and achievements), but that the tripartition is a higher level classification, which means that it cannot be ontological in the strict sense.[5] Neither can it be in a wider sense. In saying that Mary walked miles rather than saying that Mary walked three miles we are simply less precise. With the choice about how to say it, we (as language users) but we select a certain way of informing on what happened. That, after that and only from a meta-point of view, we may be able to construe processes and events explicitly is because we want to have some easy way to distinguish between something that is experienced as not discernible as a separate unit and something that can be discerned as a countable or measurable unit. So, Figure 2 is a nice way to reduce the factor ontology in linguistic analyses.

2.2   Lower level coercion

Neither Dowty 1972 nor Dowty 1979 did follow the above line of thought of giving the verb a stable, constant meaning in the sentences in (2). Dowty clearly took a different option by using Vendler classes in order to characterize the lexical differences between verbs. His 1979-representation of them is given in Table 1. States do not have an operator of the sort present in

State	$V(x_1, \ldots, x_n)$
Activity	$\mathrm{DO}(x_1, V(x_1, \ldots, x_n))$
Accomplishment	$\mathrm{DO}(x_1, V(x_1, \ldots, x_n))$ CAUSE (BECOME $V(x_1, \ldots, x_n)$)
Achievement	BECOME $V(x_1, \ldots, x_n)$

Table 1: Dowty's four aspectual classes

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[5]That is, if the lexicon stores our knowledge of the world, one could say that lexical categories reflects ontological categories. However, as soon as phrase structure comes in, the relation between language and ontology is far too complex to assume that aspectual classes are ontological categories of (temporal) individuals.

the other three classes: states merely express timeless predication. Activities are constructed from States, Agentive Accomplishments are built up from Activities and Achievements.

For Dowty there are two verbs *walk* in (2), one of which pertains to an Activity, in (2b) *Mary walked miles*, and one in which CAUSE and BECOME appear as operators, so as to obtain the Accomplishment verb *walk* in (2a) *Mary walked three miles* (1979: 66 – 71). Now, at this point there are two options: (a) to postulate two verbs *walk*; and (b) to choose one of the verbs as basic and to introduce rules operating on this basic meaning. The first option is traditionally considered very unattractive, so in the wake of Dowty, the second option is abundantly present in the literature of the eighties and early nineties. This is how it proceeds. Lexically one characterizes the basic meaning of the verb *walk* as V_{Act}, which says that the verb is to be considered an Activity verb.

(5)   a.   Mary walked three miles $V_{Acc} (= \Uparrow V_{Act})$
       b.   Mary walked miles V_{Act}

To make the Activity verb *walk* compatible with bounded information *three miles* in (5a), some operator say $\Uparrow$ changes V_{Act} into V_{Acc} which can take the [+SQA]-NP *three miles*. In (5b) the verb simply takes its complement because the [–SQA]-NP *miles* may co-occur with a V_{Act}. Adapting the kernel meaning of a verb to the context in which it appears is by no means considered an unnatural thing to do. In fact, Poutsma 1926:291 did so, by saying that "the normal aspect of the [English] verb is often modified or even utterly changed by the context". In the sixties, the idea of tuning a constituent to the context in which it appears, became visible again outside the aspectual domain in Weinreich 1966, who made use of so-called transfer rules. In a sense, transfer rules are precursors of the type-logical instruments developed in Partee and Rooth 1983 under the name of coercion rules. One difference is that transfer rules are "low-level coercion rules" in the sense that they operate on the relation between a verb and its possible complements.

The idea of transfer rules differs from the view in which the verb provides a constant contribution to the making of the VP. The issue involved is this: suppose that a certain verb V has a basic meaning X selecting a meaning Y of its complement while not being able to select meaning Y'. Transfer adherents let an operation O apply to X changing the meaning X of V into a verb meaning O(X) that may take Y' into the VP-meaning [O(X)](Y'). In this way one ends up with X(Y), exemplified in (5b) and [O(X)](Y') exemplified in (5a). The alternative way is to say, as I do, that X may take both meanings Y and Y' so that at the level of VP one obtains X(Y) and X(Y'). In that case, the difference at the VP-level is explained in terms of the difference of the verbal complement.

The question arises of whether it is possible for Moens 1987 and Moens and Steedman 1987 to have Vendler's quadripartition at the S-level without an appeal to lower level coercion. Recall that the tripartition into states, processes and events of Figure 2 is derived from the presence or absence of linguistic material. It would be a compositional miracle to be able to derive the Vendler quadripartition from the same information. Consider the following sentences where

the Vendlerian aspectual class labels are assigned to the S-level:

(6) a. John discovered nothing State
b. John discovered treasures Process
c. John discovered three treasures Accomplishment
d. John discovered a treasure Achievement

The suggestion made by Mark Steedman (pers. communication at the conference) that the four classes can be compositionally derived along the lines of Figure 1 assuming a stable verb meaning cannot be made true: *a treasure* does not contribute a (culmination) point to obtain an Achievement as opposed to *three treasures* which on that line of thought should contribute a closed interval so as to obtain an Accomplishment. Given the fact that the NP *a treasure* may occur in a sentence expressing a state (*John hoped for a treasure*), the differences between the four classes must be found in verbal differences. The conclusion should be that what I call the Edinburgh approach is forced into low level coercion, this being the only way to obtain four Vendler classes at the S-level. Along this line, Vendler's four classes can only be derived on the basis of the differences between the complement meanings Ya, Yb, Yc and Yd requiring four types of verb meanings Oa(X), Ob(X), Oc(X) and Xd, if the basic meaning of *discover* is to express achievement. In this way, one may relate the four resulting meanings at the sentential level, [Oa(X)](Ya), [Ob(X)](Yb), [Oc(X)](Yc) and Xd(Yd), to four aspectual classes. It is hard to escape from the impression that a low coercion analysis is a complex way of saying that there are four verbs *discover*. Why having three meaning operators Oa, Ob, O... on X in (6), if one can do with one stable X in all four cases?[6] I fail to see why the simple solution of keeping the verb meaning constant in aspectual composition is so difficult to accept.

2.3 The Notion of Culmination

The promotion of the four Vendler classes to the S-level as given in Moens 1987 has been formalized in Lascarides 1988. In sentences like (7),

(7) a. Mary walked [$_{Pr}$Mary walk]
b. Mary walked three miles [$_{Cp}$Mary walk three miles]
c. Mary walked miles [$_{Pr}$Mary walk miles]

the label Pr stands for propositions expressing a process such as (7a) and (7c) and the label Cp for propositions expressing a culmination point. The two notions are tied up to the scheme in Figure 3. To obtain the interpretation of sentences like *Mary ran in four minutes* expressing that today Mary accomplished her daily run in four minutes, Moens/Lascarides put Cp as an operator in front of [$_{Pr}$Mary run], the result [Cp[$_{Pr}$Mary run]] leading to an interpretation expressing a culmination point. Pr can also be taken as an operator. It may coerce the Cp-proposition

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[6]The notion of coercion was developed in order to deal with the type-logical clash problem: only when two constituents do not match as in *She began a book*, is it necessary to put a sort of lubricant between the two non-matching types. But why should *walk* in (2) be incompatible with *three miles* and compatible with *miles*? Isn't it the task for verbs to be able to take their complements without making too specific restrictions?
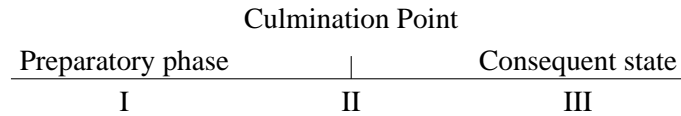
Culmination Point

Preparatory phase		Consequent state
I	II	III

Figure 3: Phasal structure

Mary walk three miles into a proposition expressing the preparatory phase as in *Mary was walking three miles*: PROG(Pr)([$_{Cp}$Mary walk three miles]). So, the Pr-operator brings one in the Preparatory phase, the Cp-operator at the culmination point. It is clear that the notion of culmination is quite crucial, both in the form in which it is expressed by (7b) and in the form of an operator Cp coercing a sentence into expressing a culmination point.

Figure 3 is used by many scholars in the domain of aspectuality. In Kamp and Reyle 1993, for example, it plays a crucial role in their analysis of aspectuality and tense. However, Figure 3 raises the question (not often raised in the literature) of whether or not the notion of culmination point is something that has an explanatory force in aspectual composition. For the analysis of (7b) the question boils down to asking which element contributes the culmination point allegedly expressed by the sentence directly and straightforwardly? Can one tell this information from the predication itself?

In my view, the answers to these questions are negative. The notion of culmination turns out to be not really compatible with the idea of compositionality. This is because culmination is crucially a phasal (ontological) concept rooted in the idea that a closed interval has marked bounds and given the direction of change the final point is even more marked. It is the final bound that is given a prominent place in Moensian analyses, but one fails to find any argument for it on the basis of the presence of linguistic material expressing specifically a culmination point. It is revealing to compare here. The information expressing culmination cannot be detected in the same way in which quantificational information can be found in a sentence, as in the compositional approaches along the lines of Verkuyl 1972 and Krifka 1989a. On those approaches, the [+SQA]- or quantized information is contributed by the determiner of the internal argument-NP. It is given a place in the complex information at the VP-level as a whole expressing a Path.[7] Relating the NP$_{int}$ to a V so as to form a VP is "going through (= computing) the way in which quantificational information contributed by the internal argument is integrated in a temporal structure". The relation itself can be accounted for in terms of a Path-function ℓ_x picking its input values from the successor function s contributed by the verb and providing the sense of additivity connected with progress. The NP *five letters* in (8) provides

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[7]In the localistic tradition the process of accommodating an NP to its functioning in the temporal structure of a sentence is associated with the notion of Path where the development of the change can be followed. This Path-notion dates back to the sixties, in particular to the work of Gruber. I followed him in the analysis of Source-Goal-structures and in Verkuyl 1978 the notion of Path was formalized in the cognitive setting of Herb Clark's work on spatial orientation. The framework of generalized quantification made it possible to formalize the localistic heritage in set-theoretical terms: [+ADDTO] can be taken as the moving from a zero point by adding. It also makes it possible to escape from impressionistic notions like Goal, Source and Theme and Path as part of the theory itself. At best they are handy metaphoric labels.

the co-domain of this function. It is taken as a set with a certain cardinality.

(8)   Mary mailed five letters while still in France

A simplified picture of a possible application of this function is given in Figure 4, where the

$\llbracket NP \rrbracket$: p_0 p_1 p_2 p_3

ℓ_x :

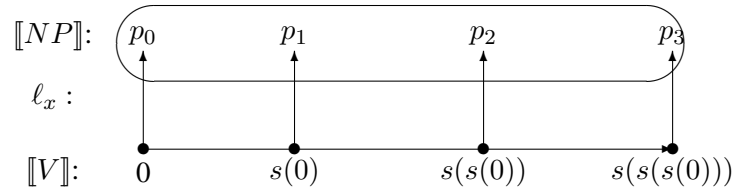$\llbracket V \rrbracket$: 0 $s(0)$ $s(s(0))$ $s(s(s(0)))$

Figure 4: A Path

progress expressed by (8), say as further comment on sentence (10) below, may count three mailing (sub-) events (say, 2 letters in Jaujac, 1 in Vienne and 2 in Plomion), although we do not know what really happened, unless more specific information is given. So, this is just one of many combinatorial possibilities in (8). The final point of a Path has no specific value on its own and certainly there is no single linguistic element in the sentences discussed so far that on its own provides it. What is provided by an internal argument is its quantificational information and this makes the Path bounded or unbounded. [+SQA]-internal arguments do not contribute a culmination point, neither do verbs. In other words, from a strictly compositional view the notion of culmination point is highly suspect.[8]

The source of the problem with the notion of culmination seems to me to be a (mis-)leading metaphor. I am afraid that culmination is a suggestive holistic term dating from the (Aristotelian) time that some verbs were seen as expressing a specific inherent goal (a telos) as if there are "goal movements". Now, the notion of an inherent goal is quite suspect if connected with changes, because it pertains to human considerations. Why should the verb *fall* express an inherent goal whereas celestial bodies may fall eternally? Why should *die* express an inherent goal rather than expressing something like 'cease to live'? Why should *explode* express an inherent goal rather than something like 'cause to scatter'? Why should (7b) *Mary walked three miles* have an inherent goal? One might equally well maintain that the walking event came to an end because the [+SQA]-NP *three miles* restricts the otherwise unrestricted walking process. The appropriate metaphor for looking at the relation between the internal argument and the verb *walk* seems to me to come closer to the internal argument preventing that the unbounded verbal additivity should continue: [+SQA]-NPs like *three miles* and *the letter* restrict the progress expressed by the verbs *walk* and *write* rather than providing culmination or telos:

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[8]Note that a Path harbours both continuous information (the verb contributes a structured interval which can be described in the Reals) and discrete information (the verb also provides indices, counting points indicating structured parts of the Path necessary to distinguish sub-events (cf. Verkuyl 1993 for the details.). Here is an important difference between Krifka and myself: Krifka's mereological approach really reduces all temporal information to information described in the system of real numbers (the physics line), whereas my system tries to focus on the interaction between two numbers systems: the naturals (indices, partition structure, etc.) and the reals (at the ground level). In my opinion, it is necessary to have them both because natural language and our cognitive system uses both independently. We count minutes, hours, days, weeks, etc. by indexing them with the help of natural numbers knowing that these stand for intervals (the symbolic species line, so to say).

the internal argument leaves no room for further walking or writing, so to say.[9] We need no apotheosis at the end of an event: the notion of a bounded Path as discussed shortly does not require that its final point be given a specific place. The Path-notion simply requires that the trajectory as a whole be taken as a complex unit consisting of verbal and nominal ingredients. That a bounded Path has a final point simply follows but is closer to being an epiphenomenon than being a central element in the meaning: it is simply not encoded.

3   ASPECTUAL ASYMMETRY: THE VP AS A UNIT

In memorizing the meaning of verbs, language learners tend to learn VPs rather than Vs. Learning verbs often happens in a larger context of providing schemes which are easy to memorize: *to write a letter*, *drink a glass of milk*, *answer the phone*, *see a bird*, etc. Prototypically these V(y)-schemes are terminative (telic, accomplishment) VPs. There is nothing strange about that: terminativity is marked, prototypes are marked too. This is another way of saying that the VP is an important unit in learning to capture temporal structure: it is a way to learn about event structure. But learning verbs is something different from learning VPs. Therefore it is necessary to have a closer look at the difference.

3.1   Separating verbal information from VP-information

Vendler is a philosopher: he tried to connect ontological categories to linguistic clues in order to be able to distinguish between them. In metaphysical issues, linguists seem to agree on an important point: knowledge of the world is to be stored in our lexicon. That is, the question of what a bike is amounts to asking 'What is the meaning of the word *bike*?' So, quite standardly, the notion of an ontological category is on the same footing as the notion of a lexical category (verb, noun, adjective). It follows that as soon as one gets into phrase structure, it is quite hard to maintain the notion of ontological category as a stable notion (to walk three miles is in different category from to walk miles or to walk six miles). For exactly this reason, Vendler has to call his paper *Verbs and Times*, not *Verb Phrases and Times*, because his ontological investigation could or should not bring him at the level of phrase structure. At phrase level there is no or hardly any room for fixed ontological entities due to variable parts in the complex meanings.[10] In this sense, one cannot escape from observing that Vendler's contribution has caused a lot of opaqueness rather than transparency, for his linguistic readership, that is to say.

As far as I can see, two steps are to be taken to get rid of the effects of mixing linguistic and ontological reasoning. The first step is to see what logicians do if they characterize a predicate.

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[9]The second metaphor is closely related to the Keplerian astronomic definition of movement of a celestial body as unrestricted until some force operates on it in order to stop it. So, it helps to put some eternal beings or robots in our examples: *The flying Dutchman was doomed to sail eternally* as opposed to the *The flying Dutchman was doomed to sail three miles eternally.*. This helps to remove human fragility as a hidden factor in the analysis of verbal meaning.

[10]The attempts in Jackendoff 2002 to extend the notion of lexical item with phrasal information support the skepticism one may have against matching language directly with ontological categories, certainly if these categories are taken realistically.

If it is right to represent (9a) as (9b), then the meaning of the two-place predicate W is to look at the set W of pairs $\langle x, y \rangle$.[11] In other words, the meaning is found in the arguments, but note that W also should contain a pair $\langle m, ls \rangle$ because Mary also wrote letters.

(9)   a.   Mary wrote the letter
        b.   W(m,l)
        c.   W(x,y)

A lot of linguists have followed a logical course, so they leave the task of characterizing the real meaning of a verb like *write* to lexicographers mostly ignoring the results in that domain. The common linguistic practice is to smuggle information about the arguments, especially the internal argument preferably in a singular form. That is, *write* is treated as if it means *to write a letter*, *to write a book*, etc. This makes the verb *write* an accomplishment verb. Unfortunately, Kamp and Reyle 1993 follow this linguistic bad practice. Since Vendler's paper, many linguists see the verb *discover* and *win* as achievement verbs because they discuss sentences like *John discovered a treasure* and *Ellen won the race*, both with a singular NP, the leading thought being that in both cases the sentences express a point event. The tendency is certainly to ignore sentences like *John discovered many treasures* or *John discovered much more than he expected*. As soon as one includes these sentences in the analysis, the question arises of whether it makes really sense to say that these verbs express a point event. The sentence *John discovered three treasures* may after all pertain to a situation in which John discovered them one by one in such a way that after taking away the soil above the first treasure a tiny part of the second treasure became visible and after digging up the second one, he continued to dig and after some while the third treasure became discernible. Replace *treasure* by *dino bone* and it will be clear that the prototypical picture of a discovery situation might be one of careful digging. Maybe it is also good to break away from *Ellen won the race* in favour of *Ellen won the competition* or *Last year Gary won three matches with a 85% score*. The idea of a point event becomes highly absurd here.

It would indeed be wise for linguists to have a closer look at the lexicographic tradition in which the verbs discussed so far are defined. Looking at the meaning of *write* in dictionaries we find in the beginning of the list of senses something like 'produce written signs' where the signs in questions should be taken as the alphabetic letters making up the letter written by Mary in (9a). In other words, the kernel meaning of *write* includes a lower level activity as part of the way to bring about a structured written object such as posted letters are. Likewise, we find *discover* defined as 'take away a barrier or barriers from' or 'find what is covered'. Looking at *find*, we see there 'come across something by going or doing' and *win* as 'to appear as a winner in a struggle'. To do this exercise is quite fascinating and it demonstrates exactly what is fully suppressed by a straightforward Vendlerian treatment: the meaning of a verb can be described in terms of other meanings on the basis of (the ideal of) translational equivalence, i.e. (near-)synonymy without being forced to stay in the same aspectual Vendler class. It is possible (as standard lexicographic practice shows) to define *discover*, *find* and *win* without any sense of achievement: *take away*, *come across* and *to appear as winner* can be taken to be

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[11]In the representations in (9) I follow Kamp and Reyle 1993 leaving out the quantifier, because a full representation would not add anything relevant in the present context.

indifferent as to the length of the process involved. They do not express any need to restrict oneself to an unanalysable point. The exercise is based on the idea of trying to get rid of as much information about the content of a specific argument y in (9c) as possible.

The second step to be taken is to acknowledge that there is a difference between Write(x,y) and Discover(x,y) in terms of the way in which the temporal structure at the level of VP is built up and that Walk(x,y) is in some way closer to Drink(x,y) than to Discover(x,y) or to Find(x,y). It is also clear that when we compare *Mary walked three miles* to *Mary drank three litres of water*, Walk(x,y) comes closer to Drink(x,y) than in the case of a comparison between *Mary walked three miles* and *Mary drank three bottles of water*. However, the step involves the rejection of the equipollence between the members of the pairs in (9c). This sort of comparison shows that the VP tends to act as a substantive level of information on its own, so that one can better think of a predicational scheme of the form $W(y)(x)$ where $W(y)$ forms an aspectual unit on its own: it is at that level that the full interaction between the verb and its complement can be made visible. The Path-construction demonstrated above accounts exactly for this: the function amalgating the verb information and the complement-information makes the semantic atoms into a semantic molecule.

3.2   The VP as a factor in a non-commutative multiplication

An important argument for taking the verb + its internal argument as a semantic aspectual unit on its own, is to see that, in the distributive interpretation of sentences like (10),

(10)   The three girls mailed five letters

each of the girls may have had her own set of configurations in which she mailed the letters (all at one, 1+4, 2+3, etc.) In the collective interpretation we know that we are speaking about one VP-denotation to which the three girls relate without any further information about their individual contribution. Note in passing that the terminativity itself is distributed, for example, in a durative sentence like *Girls used to mail five letters in those days*, which expresses that each girl of an unbounded series of girls was involved in a terminative event of mailing five letters each realizing one of the combinationarial possibilities given the cardinality of the internal argument NP.[12]

An adequate way of representing the choice between distributive and collective is in terms of the law given in (11) that appears to govern it: the interpretation is constrained either by (11a) or by (11b).[13]

(11)   a. 3×5 (distributive)   b. 1×5 (collective)

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[12] It has turned out to be necessary to underscore here that [+SQA] does not mean the same as 'quantity with identified cardinality or measure'. In (10) we happen to know the exact quantity providing a set of combinatorial possibilities, but in most cases we are given the information that there is a specified quantity involved but we simply are not informed about the exact cardinality or measure, as in *She mailed many letters*, *She mailed at most five letters* or in *She drank some wine*.

[13] The multiplication sign in (11) is, of course, to be understood as being closely related to the regular operation of intersection that determines the nature of predication in the framework of generalized quantification (cf. Verkuyl 1999a, chapter 7).

On the distributive interpretation, we have to deal with a multiplication sorted out as $(1 \times 5) + (1 \times 5) + (1 \times 5)$, which amounts to saying that each of the three individuals receives the value of a terminative VP. As each VP harbours the information that a set of five letters was mailed, the sum total of mailed letters in (10) is fifteen. On the collective interpretation, each of the girls is mapped to the same VP-information, so that their individual contribution is blurred. In short (and as argued for extensively in Verkuyl 1993 and Verkuyl 1999a), each of the three girls "gets her own VP", but on the distributive interpretation there is a constraint differing from the constraint on the collective interpretation.

There are several ways to characterize the function amalgamating the information expressed by the external argument and its VP. One way to understand the essence of this procedure is to take the VP-factor in the multiplication in terms of a λ-function operating on the elements of the external argument denotation g_1, g_2 and g_3, so that we have: VP : NP $\longrightarrow$ $\{1,0\}$, spelled out as:

$$\lambda x[M(l)(x)](g_1) = M(l)(g_1)$$
$$\lambda x[M(l)(x)](g_2) = M(l)(g_2)$$
$$\lambda x[M(l)(x)](g_3) = M(l)(g_3)$$

To meet the law expressed in (11) the function is constrained either as a constant function for the collective interpretation or as an injective function for the distributive interpretation. It is important to see that the VP is taken as a factor in a non-commutative multiplication. The difference between the status of the two factors means that the external argument and the internal argument have an essentially different role to play: the internal argument information is part of the Path, the external argument denotation forms a domain checked by the λ-function in order to make sure that all its elements are given an individual VP. This underlines the importance of the VP as an aspectual unit.

At this point it is necessary to signal a problem for those who use the first order conjunctive normal form for representing the information expressed by sentences like (9a) *Mary wrote the letter*: they need to have a proper syntax from which these forms are derived.

(12)   a. $\exists e \exists x \exists y \exists t [\mathrm{Write}(e, x, y) \wedge \mathrm{Mary}(x) \wedge \mathrm{the\text{-}letter}(y)]$
       b. $\exists e \exists x \exists y \exists t [\mathrm{Write}(e) \wedge \mathrm{Agent}(x, \mathrm{m}) \wedge \mathrm{Patient}(y, l)]$

It is the problem of how to account for the asymmetry of the two arguments. In the logical representation it cannot be made visible. The problem cannot be resolved without assuming a syntax from which (12a) or (12b) are derived as one of its logical forms. But this means that the interpretation should make use of information provided by the syntax and to give this a place in some way in one of the two forms in (12). One thing is clear, interpretation of (12) does not provide a closer tie between the verb and its internal argument.

In Kamp and Reyle 1993 there is a connection between syntax and semantic representation in the sense that a structure containing a NP [$_{VP}$ V NP]-configuration is translated into the box language of which (12a) can be made a part. But I fail to see how the closer ties between the verb and its internal argument have been given a place leading to the VP as a substantive aspectual unit in their work. On the contrary, as I will show shortly in more detail, Kamp & Reyle do not give a semantic implementation of the closer syntactic ties within the VP. They translate syntactic asymmetry into logical equipollence loosing the asymmetry information. The same

holds for the neo-Davidsonian Parsons 1990: Parsons recognizes the VP as a syntactic unit and assumes that the information presented by his predicates Culm (expressing a culmination point) and Hold (expressing a state) are expressed by the VP but he does not indicate how this proceeds on the basis of smaller elements.[14] The only Davidsonian offering a sufficiently precise account in which the closer relation between the internal argument and the verb is expressed is Krifka. In Krifka 1989b, the idea is to introduce the verb *write* as a verb stripped from its arguments: $\lambda e[\text{Write}(e)]$. The determiner of the internal argument NP is then defined as receiving the values of its Noun and of the verb: $\lambda Q \lambda P \lambda e \exists y[\text{P}(e) \wedge \text{Patient}(y, e) \wedge \text{Q}(y)]$, so that one obtains $\lambda e \exists y[\text{Write}(e) \wedge \text{Patient}(y, e) \wedge \text{the-letter}(y)]$. In this way, Krifka accounts for the VP as a semantically relevant unit which as such plays a role in the system of postulates that distinguishes between different aspectual properties. His approach is discussed in detail in Verkuyl 1993: 259–267, which criticizes the fact that Krifka harbours too much information in these postulates. For example, the information that an NP is quantized cannot be "read from" the presence of the information itself: it is formulated as a general constraint on predicates. One has to check one's own knowledge about the meaning of *the letter* to observe that a proper sub-part of its denotation cannot be called *the letter* rather than relating the specific place where the quantificational information is located to other parts of the complex information. The formal machinery proposed in Verkuyl 1999a: chapter 1 consists of a set of interacting mathematical functions that operate within the sentential domain. Looking for the strictest form of compositionality is a way to express the hope to be able to connect these functions with cognitive computations.

I would not like to suggest that Krifka's way of accounting for terminative aspectuality is not compositional but there are quite loose forms of it which all evade the hard way of finding out which elements in a complex structure do contribute and how they do it together.[15] In one sense, I can see the merits of mereology (for ontological purposes lattices are quite helpful), but I think a more restricted approach along the lines of strict compositionality trying to discover how information is encoded in the language, is to be preferred. It is certainly necessary to follow this line, because it triggers questions that otherwise would be put aside. The next section is a demonstration of what happens if some questions are not raised at all.

4   ASPECTUAL ASYMMETRY AND THE NOTION OF EVENT

4.1   The VP and eventhood

Arguments for aspectual asymmetry as discussed above were presented in two ways. Firstly, one can observe that in sentences of the simple sort, such as *Mary walked three miles* or *Mary mailed five letters* the VPs *walk three miles* and *mail five letter* are terminative without taking

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[14]For a detailed criticism of this approach, see Verkuyl 1999a: 40–43.

[15]In Krifka 1998, Krifka deals differently with the matter at issue. Rather than matching the verb with a thematic role, he derives the VP by putting the internal argument NP into a lambda-expression introducing a two place relation in which both the verb and the internal argument are put. This yields the same sort of expression as in the earlier approach. One could see the '98-version as a way to provide a machinery for the (old) Davidsonian approach of (12a).

into account the nature of the external argument NP. That is, in cases like (13a),

(13) a. Nobody walked three miles   [$_S$Nobody [$_{VP}$walk three miles]]
      b. Nobody walked   [$_S$Nobody [$_{VP}$walk]]

the VP retains its terminative property [+T$_{VP}$] but at the S-level it is neutralized by the [–
SQA]-property of the external argument resulting in [–T$_S$], along the (abbreviatory) line of the
feature algebra in (4). In the resulting phrase the [+T$_{VP}$] is given a subordinated place in a
larger durative structure but it remains visible as such. In other words, it should be possible to
distinguish between (13a) and (13b), the latter being analyzed in terms of [–T$_{VP}$] and [–T$_S$]. It
is important to see that it is quite natural to say that the sentences in (13) pertain to states as it
is natural to say that (2) *Mary walked three miles* pertains to an event, just in case the speaker
does not present a sum total of walking (sub-)events making up three miles (just replace *three*
by *hundred* to see the problem of using the term 'event' for the whole walk).
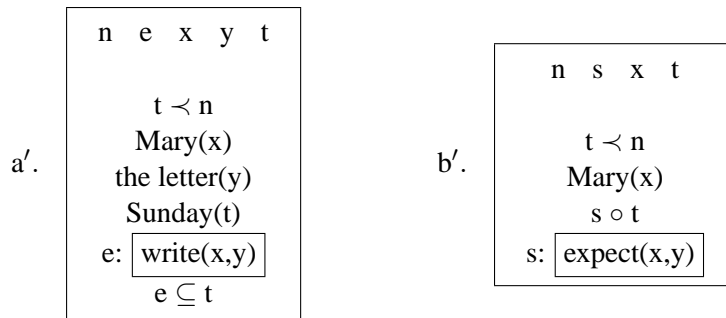
The second way in which aspectual asymmetry shows up quite convincingly is visible in
sentences with a plural external argument as discussed in the preceding section. But here some
interesting observations are to be made with respect to the notion of event. Firstly, in sentences
like (10) *The three girls mailed five letters* only the collective interpretation fits our intuition
about what an event should be: a sufficiently coherent spatio-temporal semantic object such
as the event on a sunny afternoon on which the three girls made a walk and put five letters
into the postbox in one of the streets they passed by. As soon as the distributive interpretation
comes in the notion of event is under tension. Locally, if one of the combinatorial possibilities
of the collective interpretation turns out to have been the case: the three girls used to walk
once a month and on each of these occasions they mailed a letter. On this interpretation it
becomes very hard to use the notion of event in a proper way. More globally this also holds
for the interpretation in which each of the girls mailed five letters. It is quite hard then to
select a combinatorial possibility which really comes close to our intuitive every-day notion
of what counts as an event (there should be sufficiently large temporal overlap between the
three mailing Paths). My skepticism against the use of events in the analysis of aspectuality
is based on problems like these, the more so because one could argue that on the distributive
interpretation the most natural way to use the term 'event' is to apply it at the level of VP. That
is, one could argue that each of the girls is involved in her own event because the essential
ingredient for eventhood is located in the Path-information. But this means that the e-argument
in Davidsonian analyses should be connected more closely to the internal argument than to
the external argument. The problems I have with Davidsonian event-semantics is that it is too
rough-grained for a proper view on the inner aspectual composition. Yet events are handy for
discourse, one could say and given their success in DRT, it seems quite impossible to convince
people that life is not that easy. I will demonstrate this with the help of a closer view on what
Kamp & Reyle say on e's and s's.

4.2   Events and states in Discourse Representation Theory

The transition from inner aspectual information to higher levels has not yet been given a precise
formal treatment. If the claim in DRT would be that such a treatment has been given, then we

have to focus on what what Kamp and Reyle say about two of the well-known boxes attributed to the sentences in (14), of which (14a$'$) is the box in K&R p. 511.

(14)   a.   Mary wrote the letter on Sunday   b.   Mary expected the letter on Sunday

a$'$.
$$\boxed{\begin{array}{c} \text{n} \quad \text{e} \quad \text{x} \quad \text{y} \quad \text{t} \\[4pt] t \prec n \\ \text{Mary}(x) \\ \text{the letter}(y) \\ \text{Sunday}(t) \\ \text{e: } \boxed{\text{write}(x,y)} \\ e \subseteq t \end{array}}$$

b$'$.
$$\boxed{\begin{array}{c} \text{n} \quad \text{s} \quad \text{x} \quad \text{t} \\[4pt] t \prec n \\ \text{Mary}(x) \\ s \circ t \\ \text{s: } \boxed{\text{expect}(x,y)} \end{array}}$$

The first line of the boxes contains two sorts of discourse referents: **x** and **y** are atemporal individuals, **n**, **e**, **s** and **t** are temporal. The **e** is introduced as Davidsonian which is to say that, according to Kamp and Reyle 1993, sentence (14a) would receive the representation in (15):

(15) $\exists e \exists x \exists y \exists t [\text{write}(e, x, y) \wedge \text{Mary}(x) \wedge \text{the-letter}(y) \wedge \text{Sunday}(t)$
        $\wedge \text{Time}(e, t)]$

Davidson does not work with states, but in the Kamp/Reyle framework of Davidsonian event semantics it has become standard to introduce states **s** as counterparts to the events **e**.

Against the background of the Davidsonian commitment in representations like (15) the following quotation is of importance

> First we must settle some matters of notation. In ([a box harbouring (15)]) we represented the statement that **e** is an event of **x** writing **y** as **write(e,x,y)**. From now on we will present such conditions in a slightly different form. Insofar as it is right to see such conditions as specifying the type of a given event, the discourse referent for that event has a status different from the other discourse referents in the condition. We make this special status of the event discourse referent explicit by putting it in front of the verb. Thus we will, for instance, write **e:** $\boxed{\textbf{write(x,y)}}$ instead of the condition **write(e,x,y)** of (15). (K&R, p. 511)

This is an important passage because it seems as if K&R just introduce a notational variant from the Davidsonian way of taking *write* as a three-place predicate, whereas what they do is to carry out a major conceptual operation rather than giving a "slightly different form". They are fully aware that they give the Davidsonian event argument a status different from the other arguments. What they do not say is that by this very change they introduce a compositional approach to the aspectuality of the predication. That is, in the notation **e:** $\boxed{\textbf{write(x,y)}}$ the **e** can no longer be taken as a primitive. It is an entity that is allowed only on the basis of conditions expressed by the information in the box itself. This point becomes immediately clear if we give the relevant counterpart in sentences like (14b) *Mary expected the letter on Sunday*.

Given their treatment of states later in their chapter on Tense and Aspect, Kamp and Reyle are bound to assume **s:** $\boxed{\textbf{expect(x,y)}}$. But this can only mean that the choice between **s** and **e** is dependent on the aspectual information in the box. In this case, it is the nature of the verb that differentiates between **s** and **e**. But why is there only a choice between **s** and **e**? Arguments of the predicate also decide on what sort of eventuality is yielded. Sentences like *Mary wrote letters* in *Mary wrote letters on Sunday* should neither be analyzed as **e:** $\boxed{\textbf{write(x,y)}}$ nor as **s:** $\boxed{\textbf{write(x,y)}}$. K&R's choice between states and events could be considered highly arbitrary given the fact there are good reasons to end up with states, processes and events. As shown in Figure 2, the three aspectual classes are the outcome of the compositional process of getting the aspectual information of elements in a sentence to the top of the predication.

The above discussion of Kamp & Reyle treatment of e and s shows that DRT-representations cannot escape from the principles of inner aspectual composition that yield State, Processes and Events. In spite of that Kamp and Reyle 1993 find it necessary to accept the Moens diagram in Figure 3 as basic for their analysis and to extend their machinery with Vendler classes. So, they end up with all the problems discussed in sections 2 and 3 above: the impossibility to encode the information associated with the ontological notion of culmination point and the impossibility of deriving the four Vendler classes compositionally.

5   CONCLUSIVE REMARKS

It is time to round up. I have tried to show that if one take aspectual composition seriously in the sense of trying to operate from the bottom to the top in an attempt to find the elements by which natural language encodes aspectual information in different parts of a complex phrasal structure. A strict form of compositionality takes the domain, i.e. the language side, of the model-theoretic (logical-semantic) interpretation function as the point of departure rather than its co-domain, the domain of discourse itself, apart from the question of whether there is such a domain as realists have it.[16] From this it follows that aspectual classes are not stable persistent ontological categories at the level of lexical categories: whatever contact is made with the domain of discourse, it is at the phrasal level, which amounts to saying that the ties between a language element α and its denotation I(α) existing at the bottom level at which the interpretation function I begins, are rather complex at the phrase levels at which α is a VP or an S. It has been the purpose of the present paper to contribute the insight that the analysis of aspectuality should be focussed on the ways in which aspectual information is really encoded in the elements and in the ways they relate to one another syntactically.

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[16]So, my point holds for realists by saying that one should respect the direction of the interpretation function as well as for nominalists saying that the co-domain of the interpretation function should be taken as a cognitive domain.

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