Lexical aspect and natural philosophy: how to untie them

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0.1 Introduction

Let me begin with two quotations. The first one is from Jackendoff (1993):

> 1. . . . the learner of language isn't just a passive "soaking up" of information from the environment. Rather, language learners actively construct unconscious principles that permit them to make sense of the information coming from the environment. (1993:35)

This is one of the many statements made by Jackendoff on stressing the importance of the cognitive perspective on how to do linguistics. It says that he does not accept the physicalist idea of the mind being a mirror of what is "going on out there", raising the question of which unconscious principles come into play.

This question is also raised in the second quotation:

> 2. Language is the medium to think and to make one's thoughts known; the instrument with which everyone shapes his inner world and makes it known to others. It expresses what one thinks, not how reality is; the meaning of the words should therefore not be sought in this [reality] but in the world of thoughts. . . . The reader should consult his own representation of the things, not the things themselves.

For the author there is a clear distinction between an external world and an internal one. The external one is the world of reality, nature, life and what these bring about; the internal world is the mental world, the world of thoughts, giving shape to the external world in so far this is knowable to a human being, "language teaches this in the clearest way". Then he continues:

> 3. An action expressed by a verb is thought of as going on, as an *action in progress*, or as having been done, as a *completed action*. An action is really the ever-continuing transition from an *action in progress* to a *completed action*. A verb captures an action either in the middle of this transition or at the other end, when it has become a *totally completed action*.

Here clearly a linguist must be speaking about a well-known aspectual opposition. Quotations 1 and 2 invoke the question of how the active construction of unconscious principles permit us to make sense of our dealing with the external world. Quotation 3 raises two questions central to the present chapter: (a) what sort of property of a verb allows to say what is and what is not a completed action?; (b) what is the nature of this "ever-continuing transition" from action in progress to completed action?

There is a gap of nearly hundred and fifty years between Jackendoff's quotation and the other two: they are from Te Winkel (1866), a paper about the Dutch tense system.[1] By his choice of a binary system Te Winkel did not accept the tripartition Past–Present–Future as a principle making "sense of the information coming from the environment" but he organized the Dutch tense system in terms of three oppositions: (i) Past – Present, (ii) Synchronous – Posterior and (iii) Action in Progress – Completed Action.[2]

This is a clear example of modeling semantic competence by the active construction of a binary principle that enables speakers and hearers to use language as guiding the interpretation of the world "out there". To consider future a part of the non-actualized present is to give priority to modal rather than to temporal considerations in spite of the fact that we use temporal terms based of the conceptual tripartition past, present and future (cf. Broekhuis and Verkuyl (2014)). The third opposition—in terms of operators, an opposition between IMP and PERF—will be central to the present chapter. It is therefore important to see that the primary operators PRES and PAST of opposition (i) differ from the other four by connecting a tenseless predication to the real time of speaker and hearer, making the predication tensed. This means that the opposition IMP and PERF may be seen as belonging to the tenseless part of a tense system but also, as in Russian, as being complementary to tense. Their role in the cognitive organization of our dealing with tense and aspect will be argued to be crucial for providing structure necessary to rendering abstract verbal information into actualization in real time.

0.2   Lexical aspect vs. grammatical aspect

In the aspectual literature, often a distinction is made between *grammatical aspect* and what is called *lexical aspect*. Grammatical aspect is generally seen as a matter of viewpoint at the clausal level ever since Smith (1991:93ff.), who followed Com-

rie (1976:3f.) in distinguishing it from lexical aspect. Lexical aspect concerns the internal constituency of actions, also known under the name of the German term *Aktionsart*. In spite of its popularity, there are some problems with the distinction itself.

The difference between Russian imperfective and perfective aspect in so-called aspectual pairs such as *pisat'^{i} – napisat'^{p}* (write) , *vyigryvat'^{i} – vyigrat'^{p}* (win), *igrat'^{i} – sygrat'^{p}* (play) might be considered a lexical matter because the semantic difference between sentences like (1) is located in the verb morphology.

(1) a. Tibor igral^i sonaty Bethovena.
     'Tibor was playing Beethoven sonatas.'

   b. Tibor sygral^p sonaty Bethovena.
     'Tibor played the (= these/those, a certain number of) Beethoven sonatas.'

However, if the difference between the imperfective past tense form *igral'^{i}* and its perfective counterpart *sygral'^{p}* is to be understood as a matter of lexical semantics, one is bound to attribute the difference in meaning between (1a) and (1b) to the difference between the verbs *igrat'^{i}* and *sygrat'^{p}* without any appeal to their arguments, because these are the same in both sentences. One is also forced into saying that, on top of the meaning element PLAY, the verb in (1a) has an imperfective aspectual meaning element A^i requiring that (1a) be interpreted as pertaining to an action-in-progress whereas, apart from what is expressed by PLAY, the verb in (1b) has a perfective meaning element A^p which allows (1b) to pertain to a completed action. In both cases, the meaning element A should be seen as strictly independent from the arguments of PLAY, because otherwise one would do structural semantics where the analysis of the relation between a verb and its arguments belongs. In other words, on a strictly lexical analysis of the aspectual difference one is bound to distinguish between the verb PLAY+A^i(X,Y) and the verb PLAY+A^p(X,Y) before the values for the arguments X and Y enter the stage in (1a) and (1b). This is what Slavic linguists generally do and certainly what didactic grammars such as Kolni-Balozky (1960) and Beyer Jr. (1992) do: they speak of the *vidy glagolov* (the aspects of the verb) and do not worry about arguments.

Yet, those who advocate a separation between grammatical aspect and lexical aspect consider the aspectual difference between (1a) and (1b) structural, not lexical in the strict sense just described. This is understandable because the interpretation

of these sentences can be shown to be determined by information not restricted to the verb itself: (1b) pertains to a specific set of sonatas due to the presence of the perfective prefix *s-*. Likewise the negation element in (2) as well as the NP *nikto* (nobody) interact with the verb determining the resulting aspect.

(2) Nikto ne igral^i sonatu Bethovena.
'Nobody played a Beethoven sonata.'

The sentence does not say that nobody <u>was playing</u> a Beethoven sonata, rather (2) expresses a statement about a fact, about a complete non-action, so to say. And the same holds for (2) with *sygral'^{p}* instead of *igral'^{i}*. This can only be accounted for by structural considerations.

At this point, it is necessary to extend the scope by taking into account non-Slavic languages for which the opposition between grammatical aspect (also called viewpoint aspect) and lexical aspect (also called situational aspect) has become popular. The motivation for the opposition in non-Slavic languages like English and French is the feeling that one should (roughly) follow the Slavic way of dealing with what in English is expressed by the Progressive Form and in French by the Imparfait (the examples in (3) are taken from De Swart (2012)).

(3) a. She was writing her thesis in 2009.
Elle écrivait sa thèse en 2009.

b. She wrote her thesis in 2009.
Elle écrivit sa thèse en 2009.

(4) a. She wrote papers with him.

b. She wrote three papers with him.

Those who distinguish viewpoint aspect from lexical aspect mostly restrict the former term to the sentences in (3) and talk about the opposition as a difference between the eventuality from the inside (in (3a)) and from the outside of it (in (3b)) as parallel to the Russian opposition discussed in (1). For this it is necessary to assume that the two sentences have the same eventuality in common, say W. The inside viewpoint in (3a) presumes $[a < p < b]$ where p is taken as the point of perspective from which one can observe what is going on (somewhere in the middle)

of the W-interval $[a, b]$. For the outside point of view, one would have $[a < b] < p$, with the point p located outside $[a < b]$. [3]

The next step is to assume that the opposition between the durative sentence (3c) and the terminative sentence (3d) is situational due to our knowledge that writing papers is different from writing three papers, again independent of the language under analysis. This knowledge about the world is then located in the lexicon, so a large majority of linguists tends to consider situational aspect (in the German literature: Aktionsart) identical to lexical aspect and by this they allow the terms *lexical* and *structural* to be blurred although they continue to speak about lexical aspect (e.g. Gvozdanovic (2012:782); De Swart (2012), Dowty (1979) among many others). Thus many scholars consider the Russian opposition in (1) and the opposition between (3a) and (3b) a matter of viewpoint aspect as opposed to the lexical aspectual opposition between (4a) and (4b).

However, this picture is disturbed in view of Russian sentences such as (5).

(5) Vchera Tibor igral^i sonaty Bethovena.
    'Yesterday Tibor played Beethoven sonatas.'

In this case, the translational equivalent of (5) is more correct than a translation with the Progressive Form would be: (5) expresses—or at least may express—a fact without focusing on action in progress. This might have to do with the fact that *yesterday* provides a closed domain and so (5) may convey that Tibor practiced the whole day without claiming that each sonata was played completely and without excluding that he played some of them completely. Here it is quite hard to understand why the difference between *igrat'^{i}* and *sygrat'^{p}* should be a matter of grammatical aspect, because one cannot maintain that the factual interpretation of (5) is from the inside and its perfective counterpart *Vchera Tibor sygral^p sonaty Bethovena* from the outside.

The difference between (6a) and (6b) goes into the other direction.

(6) a. Tibor sygral^p sonaty Bethovena.
        lit: Tibor played Beethoven sonatas.

     b. Tibor sygral^p obe sonaty Bethovena.
        'Tibor played both Beethoven sonatas.'

In Russian, the difference between (6a) and (6b) cannot be explained in terms of viewpoint aspect because both sentences express completed action. It can only be

explained in terms of overt absence of quantificational information in the NP *sonaty Bethovena* and overt presence of it in *obe sonaty Bethovena*. This explanation is based on the idea that playing Beethoven sonatas is crucially different from playing both Beethoven sonatas. This language-independent ontological difference is inherent to these eventualities and leaves no room for a viewpoint of the speaker or hearer. What matters linguistically is that the Russian perfective prefix *s-* is not very welcome in sentences describing an open situation, so what it does in (6a) is to assign to its internal argument a quantificational restriction, called [+SQA] in Verkuyl (1972), imposing an interpretation 'some sonatas but not unboundedly many'.[4] The [+SQA]-information in (6b) is compatible with the presence of *sygral^p*, so that (6b) is about a completed action.

The discussion so far amounts to the following conclusions:

- The term *situational aspect* as opposed to *grammatical aspect* is, strictly speaking, a terminological misnomer: situations are in the world "out there" and so an ontological notion is opposed to a linguistic one.

- *Lexical aspect* is also a terminological misnomer. The terminativity of (4b) *She wrote three papers with him* is a matter of predication. Aspect is always a matter of structure and so lexical aspect ceases to be lexical as soon as compositionality is allowed to do its work.

- There is no need for a distinction between grammatical/viewpoint aspect and lexical/situational aspect because both are structural.

- Lexical semantics is a proper part of aspectual analysis only in so far it focusses on a lexical item in order to get at an 'atomic' aspectual element expressed by it which participates in aspectual composition.

It is impossible to untie something that does not exist, so in the remainder of the present chapter the term *lexical aspect* will be used as corresponding to those aspectual phenomena that are generally discussed under this label.

0.3   Natural philosophy

The reason for combining the notion of lexical aspect with the notion of natural philosophy in the title of the present chapter is for me the observation in Filip

(2012b:721;2012a:1186) that "the origins of our understanding of lexical aspect lie in Aristotle's distinction of *kinesis* and *energeia*". Both Filip and Rothstein (2004)—"this book is about lexical aspect"—give credit for this insight to Dowty (1979), a work that indeed can be seen as linguistically completing the foundations for seeing aspectual classes as organizing our ontological view on the world, foundations laid around the fifties by natural language philosophers like Ryle (1949), Vendler (1957) and Kenny (1963).

In a section called *The Development of Verb Classification*, Dowty observes that Aristotle distinguishes between "*kineseis* (translated "movements") and *energiai* ("actualities"), a distinction which corresponds roughly to the distinction we shall be making between accomplishments and activities/states" (1979:52f.).[5] By this, Dowty opens the door for an external justification of his linguistic classification by the authority of philosophers, with Vendler in the lead. Many linguists have gone through this door.

Let me first give the crucial quotation for understanding the Aristotelian distinction mentioned by Dowty:

(7) Now of these processes we should call the one type motions (kinêseis), and the other actualizations (energeias). Every motion is incomplete—the processes of thinning (ischnasia), learning (mathêsis), walking (badisis), building (oikodomêsis)—these are motions (kinêseis), and incomplete (ateleis) at that. For it is not the same thing which at the same time is walking and has walked, or is building and has built, or is becoming and has become, or is being moved and has been moved, but two different things; and that which is causing motion is different from that which has caused motion. But the same thing at the same time is seeing and has seen, is thinking and has thought. The latter kind of process, then, is what I mean by actualization, and the former what I mean by motion. *Metaphysics* 1048b, 28–34 (transl. H. Tredennick (1961); Greek key words as they occur in the text are added to the translation.)

As pointed out in Ackrill (1965;1978) and Charles (1985), the distinction between a process aimed at a goal (kinêsis) and actualization, the situation in which the goal has been achieved (energeia) makes them mutually exclusive. Each process is incomplete as long as the telos has not been reached, whereas each actualization is in itself complete. Each completed process is an actuality (energeia), which has no goal in itself. Aristotle made motion dependent on a force (a mover) as a precondition of change to keep her going, all motion ultimately being reduced to the

(Unmoved) Prime Mover described in *Physics*, Book 8. As a consequence of this idea —totally absent in the Galilean perspective—change had to be seen as always related to a *telos*, a goal.

In the seventeenth century, Aristotelian natural philosophy came to its end in the domain which today is called *natural science*. Physicists took a supreme step-by-step effort by saying farewell to what nowadays is considered at best a form of naïve physics. The Galilean vision on motion (Dialogue, Second day) is quite different from the Aristotelian one in that in the former, motion is in principle eternal (unbounded in aspectual terminology) unless there is some force bringing the moving object to a stop. It should be added that Aristotle was only interested in motion as carrier of change.

Many linguists working on aspect are attracted to the Aristotelian kinetics, the key term for them being *telicity*.[6] After Aristotle was put aside as a guide in physics it took the Catholic Church about nearly four hundred years before Galilei's work finally was declared compatible with the papal doctrine. This might explain why Aristotle remained an *ipse dixit*-guide in logic and philosophy, under the label *natural philosophy*, until far into the 20th century. In many European countries, the humaniora were imbued with natural philosophy.[7]

One could, of course, argue that Aristotle's ontology has nothing to do with the notion of motion in modern physics and that it perfectly addresses the problem of how to account for the cognitive organization of our dealing with the world "out there". In other words, his *Metaphysics* could be taken as providing a serious model for the semantics of expressions in natural language in spite of severe criticisms from outside linguistics, appropriately or not. I am on the side of those who hold that one cannot exclude that the construction of unconscious principles determining our cognitive organization could turn out to be compatible with the Aristotelian view after all. Yet the best attitude for those who take Aristotle as an aspectual guide seems to me to remain skeptical or at least to be prepared to follow a different track. The appeal to Aristotle's theoretical terms such as *telos*, *change*, and *motion* in the aspectual literature is not only amazing in view of the fact that his analysis of motion has been shown to be insufficient but also that nowadays there is still a lot of uncertainty among philosophers about the correct interpretation of the distinctions in *Metaphysics* 1048.[8]

Aristotle uses the Greek verb *badidzein* which is translated as *walk* even in the case of authoritative translations, such as Hugh Tredennick's and W.D. Ross' translations of *Metaphysics* and Ross' translation of *Nicomachean Ethics* in Barnes (1984). The English *walk* has as its most natural translation the verb *peripatein* where *peri-*, of course, already indicates that there is no telos, hence no kinêsis, as in *choreuein* (dance) and *aulein* (play the flute). *Badidzein* most generally implies or is connected to an explicit goal and Aristotle used this verb because in his analysis of motion, he was interested in change not in activity. In other words, in (7) walking must be seen as an incomplete motion.

The same inaccuracy holds for the translation of the Greek verb *oikodomein* which means 'to build a house'. In the Bywater edition of *Nic. Ethics* 1174a,21 used on the website Perseus, the adjectival form *oikodomikê*—which modifies the noun *kinêsis*—is translated as 'building a house'(-movement), whereas the Ross/Urmson-translation in Barnes (1984) translates it as 'building'(-movement). That translations are insensitive to important aspectual differences such as between *building* and *building a house* and between *walk* and *walk to the beach* might justify skepsis against the Aristotelian ontology as a beacon for research into aspectual information expressed in natural language.

One of the key problems is that Aristotle did not distinguish between talking about situations and talking about the meaning of verbs. Still his *Metaphysics* is to be seen as an exercise in ontology in the first place. So the problem boils down to the question of whether an ontological analysis can be equated with a lexical semantic analysis. In this respect, there is something interesting in the role of Vendler as an auxiliary guide. Vendler (1957) is an essay called *Verbs and Times* which also appeared in Vendler (1966), a collection of essays with the title *Linguistics in Philosophy*. Linguists fond of the Vendler-classes seem to have forgotten that Vendler did not write for linguists but for philosophers interested in ontology. The title *Verbs and Times* suggests that Vendler analyzes the meaning of English verbs as to how they express temporal information. But for the philosopher Vendler there is no objection to calling *push a cart* or *run a mile* or *draw a circle* a verb while taking each of them as a (complex) predicate (e.g. 1966:102). As a philosopher interested in metaphysics Vendler was justified in seeing meaning analysis of verbs ($\approx$ predicates) as instrumental for discovering different ontological classes corresponding

with them. After all, Vendler follows Aristotle in the art of blurring the difference between object language and metalanguage.

What really counts against using Aristotle's work as the foundation for aspectual analysis seems to me that he is not interested at all in aspectuality. If one interprets his analysis of the Greek equivalent of *build* as a lexical aspectual analysis—which it is certainly not— then one should at least see that he treats the meaning of *build* as prototypical (in the Wittgenstein/Rosch sense of prototypicality): it is about one house or temple, whereas a linguistic analysis should at least raise the question: what is the telos of *building houses*? And what is the telos of *building on talents*? And of *building data bases*? Does the presence of a bare plural in the VP has the effect of ruling out the telos so that we are back at the incomplete motion? If so, what then is the telos of this incomplete motion? Aristotle's ontological bias about the natural end of a motion prevailed by prototyping. And we see this back in the current aspectual literature. At the cost of compositionality.

From a linguistic point of view, the examples given by Aristotle in (7) concern at best the semantics of the Greek counterparts of verbs like *walk*, *build*, *see*, *think*, etc.[9] This would bring many of those who deal with Accomplishments and Achievements in terms of completion into trouble. Moreover, Aristotle explicitly used the Perfect tense form *bebadiken* for expressing that a walking process is completed (i.e. actualized) and the Perfect form *oikodomêken* for the completion of a building process. Is Perfect tense necessary in order for a telos to become actualized? What sort of completion is expressed by the Perfect and what sort of completion is expressed at a telos? Questions like these should be raised before accepting telicity as an aspectual notion. Without an appeal to tense, the interpretation of *energeia* as 'actuality' and 'actualization' in Aristotle's *Metaphysics* remains mysterious, in particular when *energeia* is also taken as expressing a 'state'. With tense, the Present tense form or the Present Perfect introduces real time in which motions are of have been <u>actualized</u> with respect to the present of the speaker/hearer.[10]

Summarizing, there is no reason for taking Aristotle as an *a priori* guide to revealing the principles by which we organize our temporal experience in language. This implies that there is no need to accept his ontology as soon as we can analyze the contribution of a verb apart from the content of its arguments. Aspect can be studied without natural philosophy.

0.4 Verbs and time

Linguists often look down on lexicography and indeed it is quite easy to say a lot of negative things about the consistency, correctness and completeness of dictionaries, but it is also comforting to see that the Oxford English Dictionary defines a verb as "a **word** used to describe an action, state, or occurrence, and forming the main part of the predicate of a sentence" and to observe that this definition is far more strict than most of the linguists writing about aspect in the "Aristotelian tradition" feel themselves obliged to. The OED seems to make a clear distinction between a verb and a verb phrase, staying close to what is (or should be) the linguistic norm: to consider a verb the kernel (head) of a predicate and not a VP, let alone a predication at the S-level. In this respect OED does not pay lip service, because (leaving the irrelevant things out) the verb *walk* is described as in (8) and *play* as in (9).[11]

(8) **walk** [no obj., usu. with adverbial] move at a regular pace by lifting and setting down each foot in turn, never having both feet off the ground at once: *I walked across the lawn | she turned and walked a few paces.*

(9) **play** [with obj.] produce (notes) from a musical instrument; perform (a piece of music): *they played a violin sonata.*

This is exactly what is to be expected from a dictionary. In the definition of *walk* there is no room for information about complements that *walk* may take except in terms of some examples. This allows *walk* to be the same semantic unit in occurring in *Mary walked in the park*, *Mary walked a few paces*, *Mary walked to the station* and in *Nobody walked*. Thus it makes no sense to take *walk* as pertaining to an incomplete action with a fixed goal. Also, we find our experiences with moving, lifting and setting down foots and staying with one foot on the ground back in definition (8), but the definition abstracts from temporality in the sense of unique actualization in real time. Verbs are atemporal as long as they are in the lexicon and it is only in the use of a sentence in a particular discourse situation that actualization can play a role. Note that in spite of the prototyping example in (9), the definition leaves room for all sorts of complements, due to the use of *produce* and *perform*.

Given that temporality is to be blocked from the lexicon and given the need to evade prototypicality when it comes to analyzing aspectual information, it is time

to discard terms like *telicity*, *culmination*, *homogeneity*, *cumulativity* and other popular terms such as DO and CAUSE in the Aristotle-Vendler-Dowty-tradition, as explanatory terms. This gives room for starting with the verb alone abstracting from the content of its arguments, directed by the question: what property must a verb have to provide abstract structure necessary for obtaining actualization in real time in a spoken utterance? Referring back to the separation between PLAY and the aspectual information A in the paragraph after (1), it seems appropriate from the methodological point of view to locate this structure in the A-part of a verb. That is, in all verbs. So, the next question is: what sort of structure is it that verbs have in common and that is involved in aspectual composition?

0.5   Sobering down ontology

Verkuyl (1993:ch.13) argues that the interaction between the number systems $\mathbb{R}$ and $\mathbb{N}$ is essential for aspectual information, where $\mathbb{R}$ models our experience with continuity and density and $\mathbb{N}$ our experience with discreteness, repetition and habituality but in both cases outside real time. In the present section, I will follow that line but the outcome will be different in important respects. Given the task to analyze verbs without taking into account the content of their arguments, the following list of assumptions announces itself:

a. each verb represents type structure in the sense that the time axis T—modeling actualization in real time at the moment of speech—is never part of the lexicon itself. Therefore the denotation of each verb in the lexicon contributes atemporal $\mathbb{R}$-structure because $\mathbb{R}$ can be seen as isomorphic to T;

b. certain verbs require lexically a mapping from $\mathbb{R}^+$ into $\mathbb{N}$;

c. certain verbs require an additional mapping from $\mathbb{N}$ into $\mathbb{N}$ in order to be able to lexically express repetition, habituality, plurality, etc.;

d. verbs not falling under (b) and (c) can occur with complements that cause a structural shift from $\mathbb{R}^+$ to $\mathbb{N}$;

e. the Progressive Form requires the presence of $\mathbb{R}^+$.

It is not possible to work this out in detail within the space allowed here. What follows is therefore a programmatic description of the architecture necessary for the

construction of a coherent account of how a verb contributes to complex aspectual information.[12]

The basic idea underlying the present analysis is that the tense operators PRES and PAST map from numerical systems like $\mathbb{R}$ and $\mathbb{N}$ into the time axis T. This idea is based on the assumption that the (mental) lexicon has no timeline, because its essence is to abstract from actual situations and to store our knowledge of them independently of tensed time. A verb does not provide a token in real time, it provides type structure and the idea is that number systems are more appropriate for expressing type structure and that the time axis is more suitable for actualizing a type in real time as a unique token. This means that a tenseless verb is to be interpreted as expressing structure in $\mathbb{R}$, here modeled in terms of the function $f_{co} : \mathbb{R}^+ \longrightarrow \mathbb{R}^+$ defined as:

(10) $f_{co}(x) = x$

This is a function which in an elementary way provides the basic atemporal properties necessary to experience time as linearly ordered, dense, continuous, directional and so on.[13] The subscript *co* stands for 'continuity in $\mathbb{R}^+$'. On the assumption that the function in (10) belongs to the denotation of every verb in the lexicon, it provides the sense that each verb is founded in $\mathbb{R}^+$ and that its meaning can be expressed in terms of intervals mapped into the time axis T by tense.[14]

0.5.1   *Modeling aspectual information of intransitive verbs lexically*

At this point it is necessary to separate the intransitive verbs from the other verbs, because we want to consider them in their capacity of having just one (external) argument and taking no complement. This means that we have to consider the question of how to integrate (10) as part of our lexical knowledge. The function f_{co} provides a stretch in $\mathbb{R}^+$ for verbs like *hang*, *sit*, *stumble*, *laugh*, *lie*, *sleep*, *purr*, *escape*, *die*, etc. by delivering an unrestricted range of images: Wagner's Brünnhilde might have slept forever, had Siegfried not awakened her. However, for a subset of them—*ignite*, *knock*, *resign*, *die*—f_{co} should be restricted because these verbs demand a discrete output.

In order to distinguish the restricted verbs from the unrestricted ones, one can make use of two functions in (11): the ceiling function $f_{ce} : \mathbb{R} \longrightarrow \mathbb{N}$ defined as (11a) and the floor (or, entier) function $f_{en} : \mathbb{R} \longrightarrow \mathbb{N}$ defined as (11b).

(11) a. $f_{ce}(x) = \lceil x \rceil$, where $\lceil x \rceil$ is the smallest integer not smaller than x.

    b. $f_{en}(x) = \lfloor x \rfloor$, where $\lfloor x \rfloor$ is the highest integer smaller or equal to x.

In an interval (0,1) f_{ce} maps all real numbers x such that $0 < x < 1$ to 1, whereas f_{en} maps them to 0.[15]

Given f_{ce}, verbs like *die*, *ignite* and *knock* can be separated from verbs like *walk* and *hang* in terms of a composition of the functions (10) and (11a), that is, as $f_{ce} \circ f_{co} : \mathbb{R}^{+} \longrightarrow \mathbb{N}$ defined as:

(12) $(f_{ce} \circ f_{co})(x) = f_{ce}(f_{co}(x)) = \lceil x \rceil.$

In this way, the verb *die* is to be interpreted as pertaining to discretization on the basis of a mapping from $\mathbb{R}^{+}$ into $\mathbb{N}$. This makes it possible to interpret *John died on the evening of August 25* as a discrete event leaving in the dark how many images of the function f_{co} were involved in the mapping into $\mathbb{N}$. The Past tense locates the (unique) actualization of the discrete event in real time without requiring that the range of f_{ce} be taken as a point in time at which he died (if that is possible anyhow). In this way, the truth conditions are clearly relieved.

The most natural way of looking at a verb meaning is that the functions associated with it, start with the origin 0 and that the ceiling function maps to 1 in order to provide discreteness (in Te Winkel's terms: completed action).[16] However, such an assumption would not suffice because verbs like *stutter*, *knock*, *hit* lexically allow for repetition, albeit not necessarily. This repetition is not expressed by f_{co} in $\mathbb{R}^{+}$, it belongs clearly to $\mathbb{N}$. In other words, for the correct lexical characterization of these verbs, the output of f_{co} is to be taken by f_{ce} so as to provide a unit that may be repeated.

To account for this sort of "higher level" repetition, there is a well-known function available: the successor function $s : \mathbb{N} \longrightarrow \mathbb{N}$ standardly defined as:

(13) $s(n) = n + 1.$

Suppose that this function is also part and parcel of the information lexically expressed by a verb on top of the shift from $\mathbb{R}$ into $\mathbb{N}$. Then it accounts for the unbounded repetition that may be expressed by the verbs *tick*, *knock* and *hit*. But it does not account for verbs like *die* and *melt* and, as we shall discuss later, for sentences like *The bullet hit the target* on the interpretation that the sentence is

about one hit as opposed to *The bullets hit the target*. This implies that if one decides to attribute the successor function to a verb (whether lexically or structurally), there should always be a way to block it by information outside the verb itself to stop the function s from being applied. Thus one may think of defining a function $f_s : \mathbb{N} \longrightarrow \mathbb{N}$ as:

$$(14) \quad f_s(x) = \begin{cases} m & \text{if } x \geq m \\ x + 1 & \text{otherwise.} \end{cases}$$

Applying this to sentences like *Bill belched his way out of the restaurant* and *Harry moaned his way down the road* discussed in Jackendoff (1990:211ff.), this requires that the value of m be context-dependent. In the restaurant-case, the size of the restaurant as well as information about the amount of beer drunk by Bill could bring the hearer to estimate m as lying between 4 and 8. In the moaning-case, it clearly depends on the length of the road. In both cases m can be taken as a contextually determined natural number higher than or equal to 2. In speech situations people mostly are not forced to be very precise: what counts is finiteness in $\mathbb{N}$.

Restricting ourselves to the expression of the (optional or obligatory) built-in repetition in verbs like *knock* and *stutter*, one may think of the composition of three functions. To intransitive verbs like *knock*, *hit*, *blink*, *stutter*, etc.—but not to *die*, *melt* and *stop*—one may assign in their role of one-place predicate the function $(f_s \circ f_{ce} \circ f_{co}) : \mathbb{R}^+ \longrightarrow \mathbb{N}$ defined as:

$$(15) \quad (f_s \circ f_{ce} \circ f_{co})(x) = f_s(f_{ce}(f_{co}(x))) = \begin{cases} m & \text{if } \lceil x \rceil \geq m \\ \lceil x \rceil + 1 & \text{otherwise.} \end{cases}$$

If the value of m is taken as 2 or more, Table 1 gives the three resulting classes in its three columns based on what has been discussed above. Note that all verbs share the f_{co}-information, that $f_{ce} \circ f_{co}$-verbs are a proper subset of them and that the verbs in the third column is a proper subset thereof. The arrangement into three classes follows from properties of the functions involved: f_{co} operates inside an interval, f_{ce} maps the interval into $\mathbb{N}$ and f_s operates on the whole interval taken as a discrete unit.[17]

The first row of Table 1 contains purely intransitive verbs, the second row pseudo-intransitive verbs: they may occur without a complement but in many situations they allow for them: (*rotate pictures*, *walk to school*). They will be discussed

15

Table 1: Verbs occurring with one (external) argument

Continuous	Discrete	
f_{co}	$f_{ce} \circ f_{co}$	$f_s \circ f_{ce} \circ f_{co}$
exist, sunbathe, laugh	die, arrive, thin, resign, ignite	jump
rotate, walk, swim, burn, sit, lie, hang	melt, start, stop, freeze, win, hang up	knock, hit, belch

below in the analysis of verbs taking a complement because these require structural information. The verbs in the left column express only unbounded linear monotone increase along the number line in $\mathbb{R}$: one can hang, walk, smile, rotate, exist, age linearly and eternally (given the right conditions such as being allowed to eternal life). Verbs like *arrive* and *die* in the second column belong to the same class as the verbs *thin*, *melt* and *freeze* irrespective of the length of the interval in which values of f_{co} are mapped to a value in $\mathbb{N}$.

The advantage of sobering down on ontology is that from the aspectual point of view it is now possible to remove animacy and activity from the aspectual domain by treating a verb like *hang* in the same way as *walk*: they both presume a stretch in $\mathbb{R}^+$ brought about by f_{co}. Of course, except for robots, *walk* is mostly taken as an activity of [+animate]-beings, whereas *hang* is generally used with an [-animate]-subject. This allows for two interpretations of *John hang in the tree*: in one he was alive and in control so that the sentence is to be interpreted as expressing an activity of John and in the other he was dead or without control, in which case it is impossible to associate the sentence with activity. In the first case John may even have interrupted the hanging in the same way in which walkers take a rest or stop for a shopwindow. But what the verbs *walk* and *hang* have in common lies outside the domain of animacy and activity: they require f_{co}.

By sobering down we need not distinguish between two verbs *hang*. The information [±animate] is located in the HANG-part, not in the A-part of the verbal meaning of *hang*. Thus, the much-discussed issue of homogeneity expressed by verbs ceases to be of interest. Our knowledge about the need to interrupt a walk

will fall under knowledge of WALK not under A: we know that people involved in physical action sometimes interrupt their action. Interruption and stops are not aspectually relevant properties of *walk* itself, but follow from our knowledge about its external argument. A walking robot need not have a rest, John will need one if he is hanging alive and kicking. A pleasant consequence of sobering down is that it allows for explaining why meaning extensions, figurative expressions and metaphors retain the aspectual properties of their non-figurative counterparts.

Some remark about the floor function is in place here. As far as I can see, there are four options: (i) one may use the mapping to 0 by f_{en} in the composite function $f_{en} \circ f_{co}$ as characteristic for states. In that case, one would obtain the tripartition State (f_{en}) – Process (f_{co}) – Event (f_{ce}), which would run counter to the wish to exclude activity as an aspectual factor in view of verbs like *hang* and *walk*; (ii) one may use f_{en} as a way to account for negation: f_{en} takes what did not happen out of time, so to say; (iii) one may use the floor function for dealing with the so-called ingressive aspect which could be said to focus on the beginning of the interval yielded by the f_{co}-function; and (iv) one may not use it at all. I will not make a choice here but take (ii) as the most promising one.

0.5.2 *Modeling aspectual information of transitive verbs*

At this point it is helpful to take into account transitive verbs as presented in Table 2. Its first row contains verbs that are necessarily transitive in requiring an overt argu-

Table 2: Verbs with an external argument and an internal argument/complement

Continuous	Discrete	
f_{co}	$f_{ce} \circ f_{co}$	$f_s \circ f_{ce} \circ f_{co}$
cover, contain, possess	reach, discover, realize	
draw, hide, rotate, walk, play, pay, sing, see, swim, burn	melt, start, stop, freeze, win, cross,	knock, hit, belch

ment. The verbs in the second row are the pseudo-(in)transitive verbs of Table 1. As

to the columns, the general idea is that verbs in the leftmost one express continuity lexically so that it depends entirely on the arguments whether or not the resulting sentence is terminative. For example, in *The devil possessed me* has a terminative interpretation 'The devil took possession of me', whereas *She possessed a sense of humour* is durative. *I saw him for hours* makes *I saw him* durative (although I need not have seen him permanently), but #*For hours, I saw on TV that the plane had crashed* expresses the well-known forced repetition.

At this point, it should be observed that the floor function might be necessary for explaining why some verbs do not allow for function composition, so that state-verbs are to be distinguished from process-verbs, but the pros of this option should be weighed against the contras of distinguishing two verbs *possess*, *cover* and *contain* (hold vs. restrain). For the verbs of the leftmost column we assume that the ceiling function f_{ce} is to be contributed from outside the verb itself in the course of the compositional process making phrases. For example, the complement of *walk* in a sentence like *She walked to school* contains information that makes *walk to school* discrete in $\mathbb{N}$ and this information operates on the f_{co}-information of *walk* in a structural way.

The second column contains verbs which are lexically marked as expressing the composite $f_{ce} \circ f_{co}$-function. An argument for allowing lexical $f_{ce} \circ f_{co}$-composition in verbs such as *win* or *discover* is derived from observing the sentences in (16).

(16) a. She won medals. - - - - - - . . .

     b. She won the three medals here on the wall - - -

     c. # For hours she won the three medals here on the wall. - - - - - - . . .

Suppose that one may win only one medal per occasion and that (16a) with the [-SQA]-NP *medals* reports about a series of successes. The quantification over these occasions is in $\mathbb{N}$: the successor function f_s operates unboundedly on the output of the lexical $f_{ce} \circ f_{co}$. Sentence (16b) is terminative due to the [+SQA]-NP. Note that the forced repetition in (16c) displays the same pattern as in (16a). As said before, there is no reason to subdivide the discrete verbs in Table 2 into verbs pertaining to a longer or shorter interval. The mapping from $\mathbb{R}^+$ into $\mathbb{N}$ can be understood as offering certainty about the eventuality being engrained in the Reals. Aspectually, it makes no sense to compare *belch*, *knock* and *win* in terms of length even though a belch mostly takes a couple of milliseconds longer than a knock on the door.

The problem raised by the verbs in the second and third columns, is to <u>match</u> their f_{ce}-information with the [+SQA]-information contributed by their internal argument or complement. The plausible way of bringing the lexical application of f_{ce} together with the [+SQA]-information of an arguments or complement is to position it such that it serves its duty at the edge between the verb and its complement. One may think here in terms of a thematic role assigned by the verb to its argument, as proposed by Verkuyl (1993:300f.) and pictured in Figure 1.[18] This also works
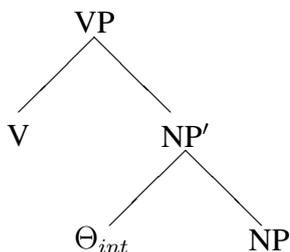
Figure 1: The ceiling function positioned at Θ.

for pseudo-(in)transitive verbs in the leftmost column, but differently: they are only marked as f_{co}-verbs so in the case of *She walked to school* the f_{ce}-information is contributed by the PP-complement. In many sentences in which f_{co}-verbs occur, the need for the application of f_{ce} comes from outside the lexicon and so the Θ-position qualifies as a place where f_{ce} can be triggered. In *She played her card* the quantificational information in the internal argument *her card* forces f_{co} into $\mathbb{N}$ by f_{ce}. In other words, the function f_{ce}—crucial for making an action discrete—is structurally available for receiving the complement-NP so as to yield the VP-meaning. The place where this happens can be argued to be at Θ. This makes it unnecessary to "go into" the Noun-information itself as in Krifka's work, so that it is not necessary to follow the process of eating an apple in *Mary ate an apple* by mapping events to objects and reversely. It suffices to have the determiner-information expressed by *an* available plus the information that *apple* is a Count Noun.[19]

An argument in favour of Figure 1 are VPs like *to play matches*. The verb *play* itself is marked as a f_{co}-verb and in its intransitive use it may pertain to something going on eternally (think of mythological gods playing on the Olympus). But in playing matches one ends up in the same category as winning medals: one needs a

way to discretize 'locally', i.e. per match. Due to the plural, one needs the successor function to get a (n unbounded) sequence of playing situations. This is only an option in the case of *She played her cards*. Here it should remain underdetermined wether f_{ce} is stopped after one application or may continue unboundedly, but the difference between *She played her cards* and *She played matches* is not aspectual at all. That is a matter of PLAY, not of A.

0.5.3 *Particles in phrasal verbs*

The Θ-position in Figure 1 is clearly the place where phrasal particles belong too. Historically they come from prepositions, adverbs, separable prefixes, etc. Claridge (2000:50) observes that they "should either have the feature 'motion' in general (not location and not direction in the sense of *-ward(s)* adverbials) or the feature result or both — with the last perhaps being the prototypical cases." (cf. also Bolinger (1971)). This is a description that fits perfectly in the present analysis, if one is prepared to stay away from the physical connotation of the terms *motion* and *result*, trading them in for f_{co} and f_{ce}, respectively.

Jackendoff (2002) divides phrasal particles into several subclasses among which the set of aspectual particles, from which I take some examples. Sentences like *Elena drank the milk up* roughly mean 'V NP completely', "i.e. *up* is not directional as it is in *toss the ball up*". Other features of aspectual particles are: (i) some of them are redundant (*close up the suitcase*); (ii) they are not idiomatic: their meaning is fully predictable; (iii) they are independent, free to combine with verbs (2002:76). These are exactly conditions compatible with the functions f_{co} and f_{ce}. For sentences like *Bill slept away* and *Bill wrote on* Jackendoff observes: "These mean roughly 'Bill kept on V-ing', i.e. *away* is not directional as in *run away* and *on* is definitely not locational" (2002:76). In the present framework these cases are dealt with automatically in terms of the presence or absence of the ceiling function in the Θ-position. This also holds for cases as discussed in Toivonen (2006). A sentence like *The children jumped on* is to be analyzed as a case in which the particle *on* feeds the $f_s \circ f_{ce} \circ f_{co}$-function expressed by verbs like *knock*, *hit* and *jump* with the instruction to take the second option in definition (15): the repetition in $\mathbb{N}$ is unbounded.

0.6 Testing the interplay between the aspectual functions

The above reduction of A-information in verbs looks promising for the cases we have dealt with in explaining how the function composition with the functions f_{co}, f_{en}, f_{ce} and f_s may be accounted for. In the present section, I will inspect some of the sentences (1) - (6) discussed above in order to see whether or not the reduction yields the correct picture.

The perfective prefix *s-* in (1b) *Tibor sygral^p sonaty Bethovena.* ('Tibor played a certain number of Beethoven sonatas') can be seen as enforcing the transition from $\mathbb{R}^+$ into $\mathbb{N}$. There are two ways of dealing with the verb *sygrat'^{p}*. The first is to assign the $f_{ce} \circ f_{co}$-structure to the verb as a whole (as in the case of verbs like *win*, *realize*, *reach*, etc.); the second is to break down the verb in a *s-* and a *-grat'*-part and to locate f_{ce} in *s-*. In both cases, the right result is obtained along the lines sketched above. With regard to (1a) *Tibor igral^i sonaty Bethovena* ('Tibor was playing Beethoven sonatas') there are two possibilities if one also takes into account (5) *Vchera Tibor igral^i sonaty Bethovena* ('Yesterday Tibor played Beethoven sonatas'). One can characterize the (covert) IMP-prefix in *igral^i* as preventing f_{ce} from being applied, so that the remaining tenseless predication is forced to stay in $\mathbb{R}$, yielding the progressive reading. In (5), the factual interpretation of the imperfective aspect is to be understood in terms of an inference: the adverbial *Vchera* ('yesterday') provides a closed domain and an appropriate context may imply the application of f_{ce} in spite of the absence of information in the internal argument itself triggering f_{ce}.

For the English equivalent of (1a) and the non-Slavic sentences in (3) and (4) the analysis appears to work properly. Many analyses of the Progressive Form assume an operator PROG outside a tenseless predication. For (3a) *She was writing her thesis in 2009* the only assumption to be made is to make BE + -ING part of the tenseless predication. I do not see obstacles for an analysis PAST(She BE writing her thesis in 2009).[20] Assuming a bottom-to-top interpretation, the suffix -ING should then be seen as the instruction to block or overrule the application of f_{ce}, which brings about the unbounded continuity expressed by the Progressive Form. It prevents the shift from $\mathbb{R}^+$ to $\mathbb{N}$ by its focus on the going on-part of the predication.

Such an analysis might also apply to the French data in (3a) *Elle écrivait sa thèse en 2009* ('She was writing her thesis in 2009') and (3b) *Elle écrivit sa thèse*

Table 3: Continuity, IMP and the Present Particiciple

Infinitive	Present Participle	Imparfait (3rd sing)	gloss
écrire	écriv-ant	écriv-ait	to write
traire	tray-ant	tray-ait	to milk
plaire	plais-ant	plais-ait	to please
connaître	connaiss-ant	connaiss-ait	to know

en 2009 ('She wrote her thesis in 2009'). Consider Table 3. The general situation is this: if one deprives the French Imparfait of its tense suffixes one obtains the stem *écriv-* which also occurs in the Present Participle, the present subjunctive forms and the plural present tense forms. This is a striking correlation.[21] It opens the way for assuming that in (tenseless predication) the verb stem expresses only f_{co}, allowing the present tense forms, the Imparfait and the present participle to express unbounded progress. Admittedly, the Passé Simple also makes use of this stem but in a considerable number of cases this is not the case. Note that this can be understood in terms of an option in definition (15): the Passé Simple requires the first option in (15) with $m = 1$. This corresponds to the use of the Greek Aorist. The other forms in Table 3 do not have this requirement because they are defined as expressing f_{co}. One may think of a morphological marking for the ceiling function of French verbs in a tenseless predicate. This would result in an interesting parallel with the Russian situation: if the present participle stem is not marked perfectively as requiring $f_{ce} \circ f_{co}$, then the resulting tense will be the Imparfait, otherwise the resulting tense will be the Passé Simple.[22]

0.7 Summary

In the present chapter, I have argued that in the literature about aspectual classes there is an annoying unbalance in allowing too much *a priori* ontology. This is due to considering the lexicon as the place to be for having a free ride to the secrets of ontological structure. As a consequence the main aspectual difference visible in

the sentences in (1) and in the first two sentences of (3) is put aside in the domain of grammatical aspect, so that one can focus on lexical aspect, hence on aspectual classes, hence on ontological classes. As long as one takes the position that aspect is a complex of different semantic factors contributed by different meaning elements in a phrase or sentence, one is bound to work more soberly on the question of how to account for aspectual phenomena such as continuation, compulsory repetition, unboundedness, etc. apart from what we know about verbs. One way to sober up is to look for abstract mathematical principles that guide our construction of complex information. The first step is then to remove tense from the analysis and to restrict the focus on tenseless predication. The second step is to abstract from the content of the arguments verbs may have and to see verbs as carrying type structure expressed by elementary functions operating on number systems that can be assumed to underlie our temporal organization. The combined action of the functions discussed above seems to be sufficient for doing away with the distinction between grammatical and lexical aspect. I am aware that the present sketch is not the whole story, so I refer to Verkuyl (to appear) for a more detailed account.

Acknowledgment

Notes

[1]Translations of the quotes are mine. L.A. te Winkel (1810 –1868) was a prominent nineteenth century Dutch grammarian. Levelt's brilliant *A History of Psycholinguistics* (2013) makes clear that the so-called 'Cognitive Revolution' by many scholars located in the United States of the fifties and sixties of the past century, has a flourishing European pre-history going back to the 18th century. Te Winkel participated in the mid-nineteenth century linguistic discussion being part of that history.

[2]Taking (i) - (iii) as oppositions between tense operators this means that *Mary will leave* is to be analyzed as PRES(POST(IMP(Mary leave))) and *Mary will have left* as textscpres(POST(PERF(Mary leave))). It should be underscored that PRES and PAST are in fact the only operators expressing real time, whereas SYN, POST, IMP and PERF operate on and yield a tenseless predication. This excludes posteriority from being identified with future because it lacks the sense of being directly related to the point of speech. See for a formalized account of the binary system Verkuyl (2008).

[3]Nowadays both the term *aspect* and its Russian equivalent *vid* cannot escape from a visual interpretation. However, there are other ways for dealing with the opposition between (3a) and (3b). In a historical analysis of the heteroclite origin of the term *aspect*, De Voguë et al. (2004:118) shows that its visual connotation may be simply due to a dubious interpretation of the word *vid*. Apart from its visual meaning connected to the Latin verb *videre*, the Russian *vid* also may mean 'sort' or '(conceptual) subdivision', in the sense of 'branch'. This simply means that originally aspect was simply seen as a form opposition, not a semantic one. In the early use of the term *vid* in the 18th and 19th century linguistic literature, this non-visual meaning was predominant. The visual metaphor crept in by translation. For a perspicuous sketch of the history of the study of aspect and Aktionsart, see Młynarczyk (2004:33-67).

[4]Informally, the feature [+SQA] assigned to an NP stands for 'Specified Quantity of A', where A is the denotation of the Noun and where 'Specified Quantity' stand for information expressed by the Determiner (cf. Verkuyl (1993); Krifka (1989;1998) uses the term *quantized* for this restriction but the two terms have a totally different content because the notion 'quantized' presumes notions such as cumulativity, part structure, etc.; cf. Krifka (1998:200).

[5]Albert Rijksbaron (pers. comm.) points out that it is in Aristotle's non-physical (rhetorical) writings that the activity side of *energeia* is activated; cf. Rijksbaron (1989:49f.).

[6]Te Winkel's distinction between Action in Progress and Completed Action does not appeal (overtly) to Aristotle's ontology. This holds for virtually all linguists who wrote about aspect before the second half of the last century, such as Poutsma (1926) in his chapter on aspect and the German grammarians that I mentioned in the first chapter of Verkuyl (1972) among which Streitberg (1889), Herbig (1896) and Jacobsohn (1933).

[7]In the early sixties, there was a huge clash in Holland between the leading mathematical logician Evert Beth and one of the leading linguists at the time, Anton Reichling, who was in his earlier days trained as a Jesuit priest, Elffers (2006) describes in detail how Beth decided to discontinue the discussion about Chomsky's *Syntactic Structures* with the frustrated feeling that Reichling approached science as a Aristotelian natural philosopher. Is it accidental that Zeno Vendler in his earlier life also was thoroughly trained as a Jesuit priest, that Anthony Kenny was trained as a Roman Catholic priest and that Gilbert Ryle was a philosopher feeling himself at home in the tradition of phenomenology (like Meinong and Heidegger)? It might explain their intimacy with Aristotle's mental legacy and with their natural philosophical approach to the role of language in ontological issues. A highly interesting picture of the role of the Church in scientific research is given in Jaspers and Seuren (2014).

[8]A clear account of the long-standing difficulties in interpreting Aristotle's notion of motion is Sachs (2005).

[9]It should be said that Vendler had a keen eye for translational problems (1966:10ff.).

[10]Albert Rijksbaron (pers. comm.) pointed out to me that Aristotle's analysis of the difference between motions and actualities is restricted to the indicative. He explains this in terms of the dominant role of truth in Aristotle's *Metaphysics*.

[11]Of course, this is not the only information provided about the two verbs, but (8) and (9) suffice to make the point at issue.

[12]A more detailed account of the sketch following in § 0.5.1 is given in Verkuyl (pear).

[13]In other terms, $f_{co} = \{\langle x, y \rangle | y = x \wedge x \geq 0\}$ What (10) does, is also inherent to the notion of continuity as used in Jackendoff (1996:351).

[14]For languages without the Pres/Past-distinction, e.g. Chinese, see Verkuyl (2008:162-179).

[15]Applied to π, $\lfloor \pi \rfloor = 3$, applied to 0.658, $\lfloor 0.658 \rfloor = 0$. Applied to π, $\lceil \pi \rceil = 4$, applied to 0.658, $\lceil 0.658 \rceil = 1$. The floor and ceiling functions are generally defined as functions from $\mathbb{R}$ or $\mathbb{Q}$ to the set of integers $\mathbb{Z}$, but in the present analysis we restrict ourselves to positive integers including 0. I will continue with the ceiling function returning to the floor function later on.

[16]This would have as a consequence that if the ceiling function f_{ce} maps, say the image 3.6789 of the function f_{co} to 4 as the first discrete number in its range, the number 4 will be replaced by 1. Technically, this would require an adaptation in the definition of f_{ce}, but more importantly, conceptually it would mean that the length of the interval created by f_{co} is not reflected in the $\mathbb{N}$-structure: the 'holes' between the natural numbers are made independent of the intervals between them if they occur in $\mathbb{R}$. This independence is exactly what is necessary to account for repetition and habituality.

[17]In Verkuyl (to appear), I explore a different route from the one sketched here on the basis of skipping the successor function f_s. The ceiling function f_{ce} is a so-called step function which allows to account for the repetition possibly expressed by verbs like *belch* and *jump* in terms of a continued mapping from $\mathbb{R}^+$ to $\mathbb{N}$ providing a sequence of similar steps. In terms of the present chapter this amounts to allowing m to be set as $m \geq 1$. This alternative would lead to blurring the difference between the two discrete classes in Table (1).

[18]Such a structure would even allow intransitive $f_{ce} \circ f_{co}$-verbs to have the f_{ce}-function located at the Θ-location where the place for the NP is blocked. I will not go into the technicalities here given the restriction on the number of pages.

[19]Cf. Verkuyl (1993:168–187) for a formal account (in the framework of the theory of Generalized Quantification) of how to deal with quantificational information in NPs with a Count or Mass Noun.

[20]In a binary tense system as sketched in Verkuyl (2008) this would be a normal procedure. It runs counter to the proposal made in Verkuyl (1993: 318ff.) where PROG is considered an operator external to the tenseless predicate p: TENSE(PROG(p))).

[21]Exceptions are *avoir* and *être*. In a number of cases singular present tense forms back out of the regularity.

[22]The same appears to apply to Italian. Lenci and Bertinetto (2000) discusses the impossibility for sentences like *Gianni andava al mare con Maria* ('Gianni went-IMP to the beach with Mary') to occur with adverbials like *due volte* (twice) or *molte volte* (many times) as opposed to these sentences occurring with the Present Perfect.

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