

# Compositionality

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## 1. Introduction

The word *compositionality* is best known as a mathematical-philosophical term: it does not appear in most general dictionaries. It is often embedded in a larger term: *the principle of compositionality*. This principle is quite generally considered as important and hence it has received its own place in handbooks as a separate topic, such as Janssen (1997).<sup>1</sup> It has entered linguistics in proportion to how helpful logic is experienced as being for the semantic analysis of sentences of natural languages. Compositionality is usually understood by linguists as the principle that the meaning of a syntactic unit such as a phrase or sentence is a function both of the meanings of the immediate constituent parts comprising it and their mode of composition.

Compositionality concerns the computation of complex meanings at higher levels of structure on the basis of atomic meanings. If one has, in propositional logic, a proposition  $p$  and a negation sign  $\neg$ , then one is able to construct the complex proposition  $\neg p$ , the meaning of which is formed on the basis of the meanings of  $p$  and  $\neg$ , given an appropriate construction rule. More in general, Boolean algebra is founded on this idea of predicting the meaning of complex propositions on the basis of atomic ones thus warranting computability. The extension to predicate logic is generally attributed to the mathematical philosopher Gottlob Frege. Fregean compositionality turned out to be useful in the formalization of predicate logic by Bertrand Russell and later on by mathematical philosophers such as Willard Quine, Rudolf Carnap and Richard Montague.

One of the main ingredients of a compositional approach has been the insight that it is necessary to translate a sentence of natural language into predicate logic in order to disambiguate it and to escape from its “surface structure” by casting it into a so-called Logical Form so that the meaning of the resulting formal expression can be computed compositionally from bottom to top. For Bertrand Russell translation had a purifying function in the sense that it should remove the ambiguities, distortions and vagueness of natural language picking out the structure that makes a declarative sentence true or false. The price to be paid for this mathematical dream

is that essential features of natural language might turn out to be expressed in the parts that are left out. In the sixties, the mathematical logician Richard Montague opened the way for a more articulate point of view on the relation between natural and formal languages.

Essential for Montague's approach is his conviction that linguistic categories can be seen as logical types: count nouns can be interpreted as sets, adjectives as taking sets in order to yield sets, VPs as taking an external argument NP to yield a truth value, tense forms as pertaining to temporal elements and their configurations, etc. According to him, a natural language can be considered a formal logical language. In this perspective, the semantic value of a sentence can be seen as being compositionally determined along the lines sketched above for formal logic. The syntax of a natural language  $L$  can be seen as an algebra (roughly, a set of nodes corresponding to categories and operations between them). Montague required that the syntactic algebra be mapped directly or indirectly into a so-called model for  $L$ , a(n algebraic) structure containing semantic values for the different logical types, such as sets, individuals and truth-values and more complex values construed from them. Making use of this machinery requires to strive for compositionality.

Janssen (1997) provided a mathematical-logical technical analysis of the principle giving it a precise formal content and also clearly revealing the pitfalls for a formal-semantic application of the principle to empirical research domains. In his view, one of the merits of the principle is that it can serve as a methodological guide given the fact that the formal logic of natural language should be discovered as part of an empirical enterprise.

The present chapter is based on the conviction that complex meaning of phrase structure should be approached on the basis of the principle of compositionality. It will consider two temporal domains—tense and aspect—in which linguists have a choice between a compositional and non-compositional approach. Compositionality may be then seen as a regulating force that puts severe formal restrictions on proposing an analysis, restrictions that can be shown to render a compositional approach more fruitful than a competing non-compositional approach. One of these restrictions requires that the formal machinery obey the principle of compositionality by computing the meaning of complex structure on the basis of atomic meaning elements. In so doing one is able to make predictions due to the mathematical functions underlying complexity. In this way, one obtains the position of vulnerability required in empirical research. Section 2 shows that Reichenbach's tense system suffers from not being compositional and section 3 argues that a strictly compositional approach to Slavic aspectuality produces better results than competing non-compositional approaches advocated by a large majority of Slavic scholars, mostly on the basis of informal semantics.

## 2. Tense and Compositionality

### 2.1. Reichenbach's Ternary System

The standard tense system in linguistics and formal semantics is unmistakably that of Reichenbach (1947). It describes the tense forms of English in the form of a matrix based on two tripartitions:

1. Past - Present - Future
2. Anterior - Synchronous - Posterior

In order to connect the two tripartitions the system does not relate the point of speech S directly to an eventuality E. As shown in Table 1, the first tripartition relates the point of speech S to a point of reference R in three different ways. Analogously, the second tripartition relates R to the event E. In this way R fulfills an intermediating role between the two divisions. In spite of its popularity,

Table 1

*Reichenbach's matrix for English tense forms*

	<b>past</b> R – S	<b>present</b> R,S	<b>future</b> S – R
<b>anterior</b> E – R	1. <b>anterior past</b> E – R – S <i>had walked</i>	2. <b>anterior present</b> E – R,S <i>has walked</i>	3. <b>anterior future</b> E – S – R, E, S – R, S – E – R <i>will have walked</i>
<b>simple</b> E,R	4. <b>simple past</b> E,R – S <i>walked</i>	5. <b>simple present</b> E,R,S <i>walks</i>	6. <b>simple future</b> S – R,E <i>will walk</i>
<b>posterior</b> R – E	7. <b>posterior past</b> R – E – S, R – S – E, R – S,E <i>would walk</i>	8. <b>posterior present</b> S,R – E <i>will walk</i>	9. <b>posterior future</b> S – R – E <i>will walk</i>

there are severe problems with Reichenbach's proposal. For example, cells 6, 8 and 9 contain the same tense form and cell 3 and 7 cover three different configurations. Moreover, the form *would have walked* does not appear in the matrix.

The two tripartitions make the system in Table 1 ternary. It can be shown to be non-compositional. This does not say that ternary systems are non-compositional by definition. Montague's tense rules in his PTQ-fragment are clearly based on a tripartition and they are compositional, in principle.<sup>2</sup> It is the particular choice made by Reichenbach in crossing two tripartitions that makes his tense system non-compositional. This can be proven by assuming that it is compositional and by showing that this assumption leads to unsolvable problems. In order to let it be compositional the first step is to ensure that each member of the two tripartitions is uniquely interpreted as the fixed value of an operator.

For the second tripartition in the rows of Table 1 and Figure 1 this means:

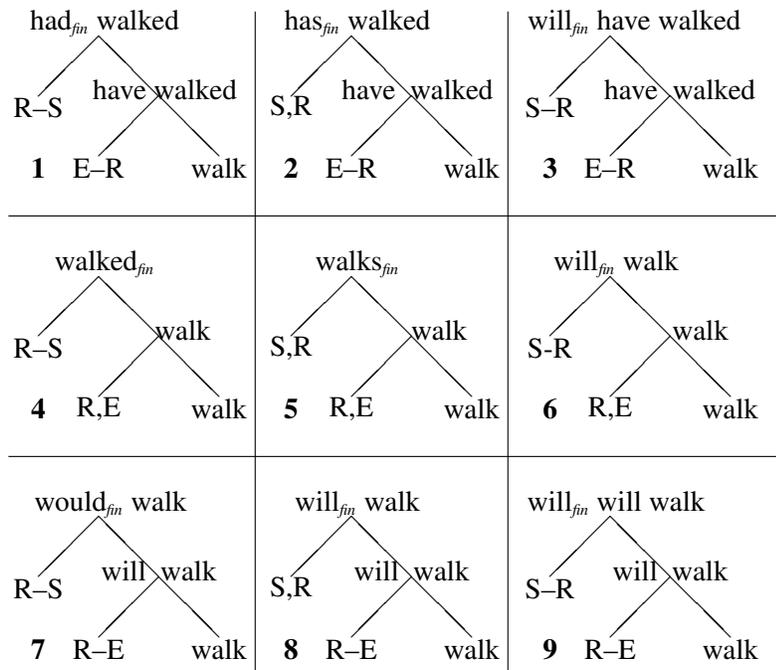


Figure 1. Reichenbach's problem with compositionality

- **anterior:**  $\text{HAVE}_{inf} \mapsto \text{E} - \text{R}$   
 1, 2, 3:  $\text{HAVE}_{inf}(\text{walk}_{inf}) = \text{have walked}$
- **simultaneous:**  $\text{id}_L \mapsto \text{R,E}$   
 4, 5, 6:  $\text{id}_L(\text{walk}_{inf}) = \text{walk}_{inf}$

- **posterior:**  $\text{WILL}_{inf} \mapsto \text{R} - \text{E}$ .  
7, 8, 9:  $\text{WILL}_{inf}(\text{walk}_{inf}) = \text{will walk}$

where R,E is represented by the identity function  $\text{id}_L$ .<sup>3</sup> For the first tripartition in the columns in Table 1 and Figure 1 it means:

- **before:**  $\text{PAST} \mapsto \text{R} - \text{S}$ :  
1.  $\text{PAST}(\text{have}_{inf}) = \text{had}$ , 4.  $\text{PAST}(\text{walk}_{inf}) = \text{walked}$ , 7.  $\text{PAST}(\text{will}_{inf}) = \text{would}_{fin}$
- **simultaneous:**  $\text{PRES} \mapsto \text{S}, \text{R}$ :  
2.  $\text{PRES}(\text{have}_{inf}) = \text{has}$ , 5.  $\text{PRES}(\text{walk}_{inf}) = \text{walks}$ , 8.  $\text{PRES}(\text{will}_{inf}) = \text{will}_{fin}$
- **later:**  $\text{FUT} \mapsto \text{S} - \text{R}$ :  
3.  $\text{FUT}(\text{have}_{inf}) = \text{will}_{fin}(\text{have}_{inf})$ , 6.  $\text{FUT}(\text{id}_L)(\text{walk}_{inf}) = \text{will}_{fin}(\text{walk}_{inf})$ ,  
9.  $\text{FUT}(\text{will}_{inf})(\text{walk}_{inf}) = \text{will}_{fin}(\text{will}_{inf}(\text{walk}_{inf}))$

Figure 1 makes it easy to understand how the compositional interpretation proceeds. The cells 1, 2, 4 and 5 turn out to be unproblematic for a compositional procedure: both the PAST-operator and the PRES-operator take an infinitival verbal form (indicated by the subscript ‘inf’) to yield a finite tense form (indicated by the subscript ‘fin’). If one accepts that the FUT-operator introduces the finite auxiliary  $\text{will}_{fin}$  at once, then the cells 3 and 6 also qualify as unproblematic but anticipating an objection to be made right after the next paragraph, direct introduction of  $\text{will}_{fin}$  deviates from the general format  $\text{TENSE}(\text{V}_{inf}) = \text{V}_{fin}$  in cells 1, 2, 4, 5, 7 and 8.

The subscripts on the operators are important for seeing where the first problem arises. In each of the three cells of the bottom row the verb  $\text{walk}_{inf}$  is taken by the R – E-operator  $\text{will}_{inf}$  so as to form  $\text{will}_{inf}(\text{walk}_{inf})$  expressing posteriority. In 7 and 8 this does not lead to problems but in 9 there are now two *will*-forms: one finite (accounting for S – R), the other infinitival (accounting for R – E). The doubling in 9 cannot be analyzed as an innocent form of redundancy that can simply be undone by getting rid of one of the *will*-forms by “dedoubling”. The configuration S – R contains a different sort of information from the configuration R – E, so both types of information should be retained. Hence, it is entirely ad hoc to stipulate that an infinitival and a finite tense form be reduced to just one finite form as a sort of phonological reduction. It follows that 9 is the spot where compositionality cannot be maintained in terms of fixed values.

The advantage of having a general rule  $\text{TENSE}(\text{V}_{inf}) = \text{V}_{fin}$  is far more important than one may think at first sight. In Reichenbach’s matrix in Table 1, the rule clearly works for PAST and PRES but not for FUT. Why not? For an answer one should first observe that in cell 8 the finite tense form *will* is formed on the basis of the rule  $\text{PRES}(\text{V}_{inf}) = \text{V}_{fin}$ . So the question arises: why is it necessary to have

the third column in Table 1 at all if you have derived  $will_{fn}$ ? The answer to this is that this column is justified only by the wish to have *Olga will have walked* in the system. Strictly speaking the cells 6 and 9 are not necessary from the point of view of producing the tense form  $will_{fn}$ . The problem with cell 9 has been discussed above. The only argument for having both 6 and 8 seems to be that one may use the difference between S,R – E in 6 and S – R,E in 8 as the basis for claiming a difference in perspective, cell 6 being the reverse of the Present Perfect configuration E – R,S in cell 2 and cell 8 being the reverse of the Simple Past configuration E,R – S in cell 4.

This triggers a skeptical question: why does English (and Dutch) distinguish between *has walked* (cell 2) and *walked* (cell 4) and aren't there separate forms for expressing the difference between 6 and 8? The first part of the answer is to observe that the difference between *has walked* and *walked* expresses a difference between Present and Past, because *has* is undeniably a present tense form. The other part of the answer is that the difference between S,R – E and S – R,E does not correspond with a difference in tense:  $will_{fn}$  in 6 is also undeniably a present tense form, so whatever future is expressed by it, it can only be expressed by an operation on an infinitival auxiliary  $will_{inf}$ . But this is clearly a matter of the cells 7, 8 and 9 at the bottom, not of cell 6 which is at issue now. Seen in this light the  $will_{fn}$  in cell 6 is at best felt to be idiosyncratic.<sup>4</sup>

The next steps in following this track of thought are: to skip the idea of defining Future in terms of  $will_{fn}$  in the right-hand column of Table 1, to be content with the existence of 8, to rule out cell 9 and also cell 6 and to live with a tense diagram as given in Table 2. Of course, this requires a proper solution for the bottom line in

Table 2

*Reichenbach on the way to compositionality*

	Past	Present
Anterior	1. had walked	2. has walked
Synchronous	4. walked	5. walks
Posterior	7. would <sub>fn</sub> walk	8. will <sub>fn</sub> walk
Posterior + Anterior	?? would <sub>fn</sub> have walked	3. will <sub>fn</sub> have walked

Table 2. One of the ways of finding such a solution is to go binary.

In fact it seems to be the only appropriate way to go because in Reichenbach's system there appears to be a deep-lying inconsistency which can be revealed only along the lines just drawn. As observed above, Reichenbach can only be made

compositional if one succeeds in defining the elements of his tripartitions in a unique way. But doing so in the case of *have* and *will*, one can see that *will* is to be defined as R – E and *have* as E – R. This looks like an inconsistency. More concretely it is impossible for *(Olga) would have walked* to be derived by  $\text{Past}_{in}(\text{will}_{inf})(\text{have}_{inf})$  (walk), if  $\text{will}_{inf}$  is interpreted as R – E and  $\text{have}_{inf}$  as E – R. The same applies to *Olga will have walked*. The reason for this inconsistency is easy to see: Reichenbach’s system lacks a point R’ mediating between  $\text{will}_{inf}$  and  $\text{have}_{inf}$ . Having to assume this point R’ for both *will have V* and *would have V* boils down to a strong argument for a binary system. There is no other way for Reichenbach to solve the problem of inconsistency except for defining two new operators: (i) PresFut working as in cell 3 and (ii) PastFut outside the matrix and working analogously to it. Compared with the binary approach discussed in section 2.2 this seems to be an idiosyncratic and unnecessary solution, especially in view of the problem with cell 9.

## 2.2. Te Winkel’s Binary System

Reichenbach was not familiar with the binary system presented in the nineteenth century by Te Winkel (1866) who proposes to describe the eight tense forms of the Dutch tense system with the help of three binary oppositions as given in Table 3. The (sort of) Reichenbachian notation at the right-hand side may help to understand

Table 3

*Three binary tense oppositions*

Te Winkel:	quasi-Reichenbach notation
1. Present vs. Past	S,R vs. R – S
2. Synchronous vs. Posterior	R,R’ vs. R – R’
3. Imperfect vs. Perfect	$E \subseteq R'$ vs. $E \subset R'$

some of the consequences. The explanation of the binary system below will also make use of Reichenbach’s notation in order to keep the explanation as succinct as possible.

The first consequence of going binary is that the Future tense is detached from S: it is introduced in the second opposition by assuming a point R’ posterior to R, where R is introduced already in the first opposition, either as connected to the Present (by S,R) or as connected to the Past (by R – S). The expression of posteriority in English is then to be taken as triggered by the presence of the auxiliary

*will<sub>inf</sub>* or *shall<sub>inf</sub>*. The third opposition accounts for the four forms with the auxiliary verb *have<sub>inf</sub>* as opposed to tense forms not having this auxiliary. The presence of *have<sub>inf</sub>* expresses that E has been completed within R', whereas its absence expresses indeterminacy with respect to whether or not E is completed in R'.

In this way, the binary system defines for each of the oppositions a parallelism between four tense forms having a certain tense property and four tense forms not having it. Present and Past are seen as the most fundamental tenses in the sense that tensed forms may occur without posterior forms or perfect forms but not without Past or Present: they provide the point of attachment from which the tense configurations are construed. Another consequence is that the eight tense forms in Dutch are all covered by the system due to its  $2 \times 2 \times 2$ -structure.<sup>5</sup>

Formalization of Te Winkel's binary system shows that the system is fully compositional. It suffices here to give the bare outlines. Assume a tenseless predication such as (1a) which is the lowest S in Figure 2.<sup>6</sup>

- (1) a. Olga write the letter
- b.  $\lambda\alpha.$ Write( $\alpha$ )(b)(o)

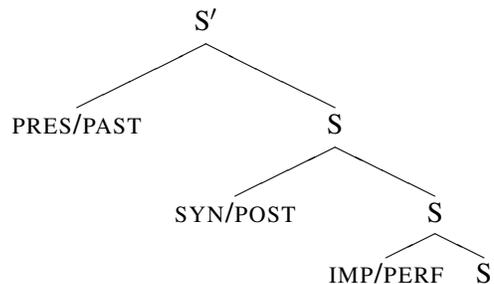


Figure 2. Tense structure

Then Te Winkel's tense oppositions can be described in terms of six operators. PRES vs. PAST cover the first opposition of Table 3, SYN vs. POST the second one and IMP vs. PERF the third one. Obviously, PERF and POST correspond with the presence of the auxiliaries *have* and *will*, respectively; IMP and SYN with their absence. The four operators below PRES and PAST take tenseless predications to form tenseless predications, whereas PAST and PRES take tenseless predications yielding a tensed sentence.

Compositionality is obtained because the operators are defined as functions. Each of them has a fixed value in the system and is therefore uniquely computable. For example, the past tense form *walked* is analyzed as a complex expression

PAST+walk<sub>inf</sub>, where PAST is interpreted as an operator: PAST(walk<sub>inf</sub>) = *walked*.<sup>7</sup> Likewise, *will have walked* is built up from PRES(WILL<sub>inf</sub>)(HAVE<sub>inf</sub>)(walk<sub>inf</sub>), where WILL<sub>inf</sub> stands for the operator POST and HAVE<sub>inf</sub> for the operator PERF.<sup>8</sup> In this way, the unsolvable problem in combining *will* (= R – E) with *have* (= E – R) that ended the subsection on Reichenbach is solved here without any difficulty.

With this system of tense operators one can also formally derive the tensed sentences in (2a) and (3a).<sup>9</sup>

- (2) a. Olga has written the letter  
 b.  $\exists!i\exists j\exists k[\text{Write}(k)(b)(o) \wedge k \prec j \wedge j \simeq i \wedge i \circ n]$   
 c. ... Write(E)(b)(o)  $\wedge E \subset R' \wedge R' \simeq R \wedge R, S]$
- (3) a. Olga wrote the letter.  
 b.  $\exists!i\exists j\exists k[\text{Write}(k)(b)(o) \wedge k \preceq j \wedge j \simeq i \wedge i < n]$   
 c. ... Write(E)(b)(o)  $\wedge E \subseteq R' \wedge R' \simeq R \wedge R < S]$

Due to the binary architecture of the tense system, compositionality is a quite natural asset. The present tense form of the Present Perfect has been done full justice by seeing it in terms of the relation between the point of speech  $n$  and what counts as the present  $i$  in which  $n$  is embedded. The perfect sense has been accounted for by the fact that the eventuality index  $k$  is properly included in its own present  $j$ , whereas  $j \simeq i$  asserts that this  $j$  is synchronous to  $i$ , which accounts for what has been called ‘current relevance’. Note that it is not necessary to burden the definition of Perfect with the notion of resultant state: current relevance simply follows from synchronizing  $j$  and  $i$ .

### 3. Aspect and Compositionality

Verkuyl (1972) credited both Poutsma (1926) and Jacobsohn (1933) for their important contribution to displaying the compositional nature of aspect by their implicit appeal to phrase structure. Poutsma observed that “the normal aspect of a verb is often modified or even utterly changed by the context” (1926, p. 291), where his notion of context clearly applies to constituents with which the verb occurs. Jacobsohn is even more explicit: for him the accusativus effectivus in sentences like *Ich schrieb einen Brief* (‘I wrote a letter’) makes the verb *schreiben* (‘write’) perfective (1933, p. 297). He stated that this is not the case in *Ich schrieb Briefe* (‘I wrote letters’). In the lack of a sufficiently developed notion of phrase structure, however, Poutsma and Jacobsohn were forced to call upon some sort of transfer rule: for them the internal argument *a letter* in *I wrote a letter* makes the imperfective verb *write* perfective. They belong to the first scholars who explicitly

express the idea that the verb cannot be considered the only factor in providing aspectual information, a view held quite generally by linguists studying Slavic languages.

Linguists had to wait until the fifties of the twentieth century before they could make use of sufficiently developed syntactic tools for building phrase structure. Zellig Harris and Noam Chomsky were among the first linguists who became acquainted with the technical tools of formal syntax and in particular Chomsky (1957) opened the way for a systematic and precise study of phrase structure. Katz and Fodor (1964) combined the linguistic lexical tradition of componential analysis with the logical tradition discussed earlier and visible in Chomsky's syntactic work: "It is clear, as Katz and Fodor have emphasized, that the meaning of a sentence is based on the meaning of its elementary parts and the manner of their combination" (Chomsky 1965, p.161f). At this point, linguists were finally in the position to use syntax as supplying the basic ingredient for compositionality: without syntactic structure there is no genuine compositionality. As soon as one is able to group building blocks of some sort, there is a need for dealing with what is expressed by combinations at a higher level of structure. In this way, the development of the notion of phrase structure in linguistics made it possible to work out the notion of compositionality along the line set out in formal syntax.

The informal "feature algebra" in (4) illustrates how the process of aspectual composition in English takes place with the help of phrase structure.<sup>10</sup>

- (4) a.  $\begin{matrix} [+T_S \text{ [NP Olga]} & [+T_{VP} \text{ wrote} & \text{[NP three letters]]]} \\ & [+SQN] & [+A] & [+SQN] \end{matrix}$   
 b.  $\begin{matrix} [-T_S \text{ [NP Olga]} & [-T_{VP} \text{ wrote} & \text{[NP } \emptyset \text{ letters]]]} \\ & [+SQN] & [+A] & [-SQN] \end{matrix}$   
 c.  $\begin{matrix} [-T_S \text{ [NP No one]} & [+T_{VP} \text{ wrote} & \text{[NP a letter]]]} \\ & [-SQN] & [+A] & [+SQN] \end{matrix}$   
 d.  $\begin{matrix} [-T_S \text{ [NP Olga]} & [-T_{VP} \text{ expected} & \text{[NP a letter]]]} \\ & [+SQN] & [-A] & [+SQN] \end{matrix}$

The basic idea underlying this informal algebra is that only if a VP can be marked as having the aspectual value  $[+T_{VP}]$  on the basis of the two plus-features  $[+A]$  and  $[+SQN]$ , the resulting (tenseless) predication S can have a plus-value  $[+T_S]$  but only if the external argument has a plus value, in this case  $[+SQN]$ . T abbreviates 'terminative', a notion that pertains to temporal boundedness of a sort discussed in section 3.1. In (4a), the  $[+A]$ -verb combines with a  $[+SQN]$ -NP to form a terminative VP,  $[+A]$  standing for 'nonstative', 'dynamic', or more technically 'additive'. It is opposed to  $[-A]$  which expresses stativity. Because *Olga* is also a  $[+SQN]$ -NP, the value of the resulting information at the S-level is  $[+T_S]$ .

The restriction on terminativity as requiring only plus-values is called the Plus-Principle. It implies that terminativity (boundedness, telicity) is a marked aspectual compositional property of a sentence. In (4b) – (4d) there are “leaks” (minus values), so the resulting value at the top is  $[-T_S]$ . Note that the durativity in (4c) is due to its external argument: *nobody* is a  $[-SQN]$ -NP, so the resulting information at the S-level is  $[-T_S]$ . In the other two durative cases, the VP already makes it impossible to obtain  $[+T_S]$  at the top. In (4d), the aspectual leak is caused by the stative nature of the verb. In all cases the procedure is strictly compositional.

The formal semantic machinery underlying the notation in (4) is not generative. Chomsky’s ban on interpretation as an obvious part of the linguistic toolkit governed and bound generative grammarians from the late sixties practically until the minimalist period began to emerge in the nineties. One could either become an autonomous syntactician and do away with semantics (compositionality included), find a new framework or simply extend the generative framework in the same sense in which renegade Catholics still call themselves Christian after having left the mother church. This is another way of saying that the study of aspect in those years was only possible outside the generative syntactic mainstream. For those who were attracted by the formal approach of the Frege/Russell-tradition, the extension to Montague’s framework offered itself as a reasonable option. The model-theoretic approach became popular with linguists who had been working in generative grammar but who had not found sufficient semantic tools in that framework in the seventies. In this way, compositionality turned out to be a natural ingredient of formal semantic approaches (cf. Partee 1987, 2007).

### 3.1. Sharing the Same Aspectual Tests

The claim of universal grammar put forward by generative grammarians and implicitly inherent to montagovian semantics did not hit fertile ground in the domain of Slavic linguistics. Historically, aspect had been considered as typical of Slavic languages making them unique and so the burden of the proof is mostly put in the hands of those who claim that Slavic aspect is on a par with, say, Germanic aspect. It will be argued in the remainder of the present section that the principle of compositionality in the sense employed so far turns out to be a proper tool for the study of Slavic aspect. If the Russian translation of the English sentence (4a) *Olga wrote three letters* has properties that lead to an aspectual value similar to the marked value  $[+T_S]$  of the English sentence and if translation of the other three sentences in (4) cannot be marked  $[+T_S]$ , then there are reasons to assume that the same semantic machinery might determine the interpretation of complex phrase structure. The common ground is that semantically predication in Russian and other Slavic languages at the sentential level is to be understood in the same

way as predication in Germanic and Romance languages. That is, a predication is taken as consisting of a predicate (generally expressed by a Verb) and its arguments (generally expressed by Noun Phrases). It is difficult to see why this should not work out properly for Slavic languages.

Sentence (5a) expresses that Olga wrote a specified quantity of letters in the sense that the NP *three letters* pertains to something discrete due to the quantificational information contributed by the determiner.

- (5) a. Olga wrote three letters.  
b. Olga wrote letters.

Sentence (5b) does not contain any determiner restriction on the quantity of letters and so the absence of quantificational information in the NP *letters* can be informally represented by the feature [-SQN], as in (4b). The nature of the difference between (5a) and (5b) can be shown to be temporal as illustrated by the sentences in (6).

- (6) a. #The whole night/for hours Olga wrote three letters.  
b. The whole night/for hours Olga wrote letters.

Sentence (6a) is not well-formed. There is an incompatibility between the durational adverbial and the presence of [+SQN]-information in the internal argument of the verb. At best, (6a) expresses a sort of forced repetition excluding a single-event interpretation, whereas (6b) with the bare plural complement of *write* is well-formed, presenting an eventuality in the past that took place continuously (for some time).

Now, strikingly parallel observations can be made with respect to Russian. The translations of the sentences in (5) are given in (7).

- (7) a. Ol'ga napisala tri pis'ma.  $\approx$  (5a)  
b. Ol'ga pisala pis'ma.  $\approx$  (5b)

The translations of (6a) and (6b) are given in (8).

- (8) a. #Ves' vecher/chasami Ol'ga napisala tri pis'ma.  $\approx$  (6a)  
b. Ves' vecher/chasami Ol'ga pisala pis'ma.  $\approx$  (6b)

The English (5a) and its Russian counterpart (7a) behave the same in their refusal to take durational adverbials. In (7a), the NP *tri pis'ma* expresses [+SQN]-information, but it is obvious that the verb form in (7a) differs from the English verb form in (5a): English does not require a prefix in front of the verb in order to

secure the clash in (6a).<sup>11</sup> Moreover, it is possible in Russian to have a sentence like (9a) that would not clash with a durational adverbial.

- (9) a. Ol'ga pisala tri pis'ma.  
       'Olga was writing/wrote three letters.'  
       b. Ves' vecher/chasami Ol'ga pisala tri pis'ma.

Sentence (9a) says that Olga was involved in the writing of three letters or engaged in doing so and (9b) shows that there is no problem with taking a durational adverbial. Obtaining the aspectual information in (5a) at the sentential level can be seen as compositional, there being no need for coercion or other forms of transfer rules.

### 3.2. Following the Compositional Track in Russian

The generative goal of universal grammar as formulated in Chomsky (1965) implies that what can be expressed aspectually by a verb in Slavic languages, has its (near-)equivalent at the level of phrase structure in non-Slavic languages, as will be demonstrated in Figure 3. On the basis of this assumption, the compositional thesis says that *all* four sentences in (5) and in (7) should be dealt with in terms of the scheme in (4). It also means that the semantic clash in both (6a) and (8a) qualifies

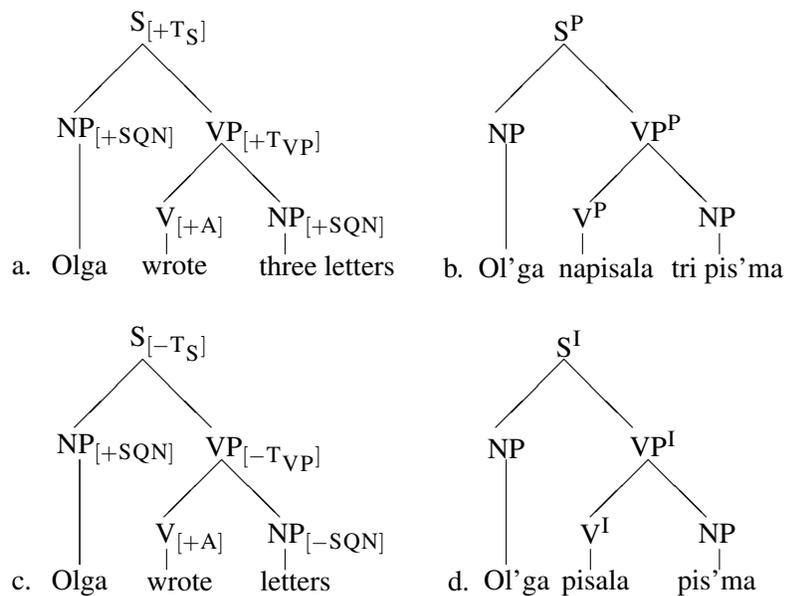


Figure 3. Comparing English and Russian

itself, in principle, as a universal to be interpreted as a clash between discreteness and continuity. The left-hand side of Figure 3 illustrates this for (5a) and for (5b). In (5a), the [+SQN]-NP *three letters* contributes the restrictive [+SQN]-meaning to the formation of the aspectual meaning of the VP, abbreviated as [+T<sub>VP</sub>]. Note that the VP in Figure 3a already expresses the incompatibility with a durational adverbial: *#to write three letters for an hour* is unwellformed in the sense discussed above for sentence (6a). The top of Figure 3a has a feature [+T<sub>S</sub>] due to the fact that the [+T<sub>VP</sub>]-VP combines with the [+SQN]-NP *Olga*, thus pertaining to a discrete temporal entity.<sup>12</sup> The leading idea is that the quantificational information of the arguments of the verb plays a role (though differently) in the construction of the complex aspectual information which is ‘collected’ at the top of the tree. Plus-values contribute to discretizing temporal entities in the sense of temporal completion: they are discernible in the flow of time, so to speak.

A long tradition in Russian grammar amounts to the two pictures at the right-hand side of Figure 3. At the verbal level it is customary to speak about the difference between *napisat* and *pisat* as a difference between two verbs rather than between two forms of the same verb. Each if them is then considered to make up an aspectually complete verbal lexeme and so the difference between (roughly) ‘continuity’ and ‘completion’ is essentially treated as a matter of the verb rather than phrase structure. The “aspectual completeness” of *napisat* in Figure 3c is sufficient for many grammarians to ignore both the internal argument and the external argument and to assume an aspectual meaning element P at the top of the predication having percolated from the bottom to the top of the tree and expressing some form of completion.

This way of dealing with phrase structure clearly runs counter to the idea of compositionality. There are two possible alternatives: (a) to accept that Russian (and other Slavic languages) have a unique position and to maintain the right-hand side of Figure 3; or (b) to use the principle of compositionality and see how far one gets by applying it. In the remaining part of the present chapter the latter option will be taken in order to show that this turns out to be a profitable way of analyzing complex phenomena.

In spite of the existence of a small group of verbs without an aspectual prefix, the perfective *napisat* can be seen as being built up from the verb stem *-pisat* and a perfectivizing prefix *na-*. Yet, one cannot deny that there is a clear difference between the dynamicity of the English verb in Figure 3a, marked here as the feature [+A], and the perfectivity of its Russian counterpart in Figure 3b, an obvious reason being that both the imperfective *pisat* and the perfective *napisat* are [+A]. But the question is how apparent a clear difference may be. The principle of compositionality is compatible with a situation in which a difference between the verbs at the bottom of Figure 3a and 3b is “corrected” at higher levels of phrase structure.

The basic observation to begin with is that the lexical definition of a verb is in general not immediately applicable to a domain of interpretation. In a sentence like (5a) *Olga wrote three letters*, one cannot pick out the verb *write* and interpret it apart from *Olga* and *three letters*. Being a (two-place) predicate and not a predication itself the verb *write* provides a sort of scheme with variable spots in it that have to be filled in at higher levels of phrase structure, along the lines sketched in Figure 3a. The top S in this diagram is the lowest one in Figure 2, which means that the final interpretation of temporal and aspectual information of (5a) is settled at the top S' in Figure 2.<sup>13</sup> If one says that the verb *napisat* expresses completion, one is obliged to put the question: at what level of interpretation is it possible to express this specific sort of completion? In other words, isn't it simply a matter of being terminologically imprecise if one says that a verb expresses completion? What does completion mean at the level of interpretation of a verb? And what does it mean at the top of a phrase? These questions have hardly received any careful attention in the literature based on Vendler's quadripartition.

Anyhow, if one characterizes the verb *napisat* as expressing completion, there is no way of making this concrete other than by formulating conditions on its arguments. In Figure 3a, the verb phrase *to write three letters* as a semantic unit receives the feature [+T<sub>VP</sub>] due to the combination of a [+A]-verb and a [+SQN]-Noun. Its Russian counterpart *napisat tri pis'ma* in Figure 3b consists of three elements that play an aspectual role in obtaining [+T<sub>VP</sub>]: (i) the verb stem *-pisat* contributes the [+A]-feature; (ii) the Noun Phrase *tri pis'ma* contributes [+SQN] due to the presence of the determiner *tri* (three); and (iii) the prefix *na-* imposes a [+SQN]-interpretation on the internal argument NP as part of the VP-interpretation.

In this analysis, the prefix *na-* seems to play a redundant role but this is not the case in verb phrases like *napisat pis'ma*, where the NP *pis'ma* is in itself indeterminate with respect to [+SQN] or [-SQN] and where *na-* clearly has the function of requiring that the NP be interpreted as [+SQN]. The sentence *Ol'ga napisala pis'ma* is to be translated as *Olga wrote the letters* where *the letters* pertains to a specified quantity of letters identified already in earlier discourse. In other words and simplified: *na + pis'ma*  $\approx$  [+SQN] *letters*] and *na + tri pis'ma*  $\approx$  [+SQN] *three letters*].

One step higher the role of the external argument turns out to be crucial for determining whether the [+T<sub>VP</sub>]-information may be part of the sense of completion expressed as [+T<sub>S</sub>]. It is imperative for a [+T<sub>S</sub>]-sentence to have a [+SQN]-NP as external argument both in the English sentence *Olga wrote three letters* and in its Russian translation *Ol'ga napisala tri pis'ma*. In the English sentence *Nobody wrote three letters* the resulting aspectual interpretation is one in which no completion is expressed: the sentence is durative. This is due to the [-SQN]-"leak" caused by the presence of *nobody*. The same applies *mutatis mutandis* to Russian:

a sentence like *Nikto ne pisal tri pis'ma* ('Nobody wrote three letters') is [-T<sub>S</sub>] as well due to the presence of *nikto* (nobody), the difference with English being that in Russian the prefix *na-* is not allowed in this negative context.<sup>14</sup> Note that the VP *pisal tri pis'ma* contains [+A]- and [+SQN]-information neutralized by the negative elements *nikto* and *ne*, analogous to the neutralizing effect of *not* in English.

In spite of the similarity in the behavior of the English and Russian sentences demonstrated here, the question must be pursued whether or not the compositional label [+T] may replace the perfective label P at the sentential level.<sup>15</sup> There are two ways in which a translation between Russian and English may reveal a difference between P and [+T] (or between I and [-T]):

- a. Russian sentences with a V<sup>I</sup>-verb may have a [+T]-interpretation. This will be called *terminative imperfectivity*.
- b. Russian sentences with a V<sup>P</sup>-verb may have a [-T]-interpretation. This will be called *durative perfectivity*.

These are the two logical possibilities but due to the fact that in general Russian verbs form an aspectual pair (V<sup>I</sup>/V<sup>P</sup>), the difference between a and b made here turns out to be somewhat diffuse.

### 3.2.1. Terminative Imperfectivity

In general it is not easy to find counterexamples against the identification of P and [+T], if one only takes into account the use of the Imperfective aspect as expressing the counterpart of the English Progressive Form and as expressing habituality. So in the case of terminative imperfectivity one has to look for cases in which the predication pertains to episodic sentences containing imperfective verbs which occur in predications that translate as [+T]-predications. Borik (2006) discusses exactly this type of sentence, which seems to run counter to the claim of full identity, such as (10a).

- (10) a. Petja uže peresekal<sup>I</sup> etot kanal v ponedel'nik i vo vtornik.
- b. Peter already crossed-Imp this canal on Monday and on Tuesday.
- c. Petja uže peresjok<sup>P</sup> etot kanal v ponedel'nik i vo vtornik.

In spite of the imperfective aspect in *peresekal* ('crossed') (10a) may express two separate events of crossing the canal, one on Monday and the other on Tuesday, as the corresponding English [+T]-sentence in (10b) does.

The test used by Borik was proposed in Verkuyl (1972) for Dutch and English. The basic observation underlying it is that there is a difference between *on Monday and on Tuesday* and *on Monday and Tuesday*, as visible in (11). In (11a), it is

necessary for them to have had two trips to Paris, one on Monday and the other on Tuesday; in (11b), it may have taken two days before they were in Paris.

- (11) a. They drove to Paris on Monday and on Tuesday  
b. They drove to Paris on Monday and Tuesday.

Now, suppose that one leaves off *to Paris* obtaining the [-T]-predication *They drove*. In that case, (11a) strongly suggests two different trips, one on Monday and the other on Tuesday. In the case of (11b), however, it is as strongly suggested that they drove on continuously as part of one trip. Returning to the sentences in (10), there are differences between (10a) and (10c): (10c) requires two crossings, one on Monday and one on Tuesday, where (10a) does not do so. In other words, Russian and English behave exactly the same: sentence (12) may be interpreted as pertaining to one crossing.

- (12) Petja uže peresekal<sup>I</sup> etot kanal v ponedel'nik i vtornik.  
'Peter already crossed this canal on Monday and Tuesday.'

What remains is to explain why both Russian and English allow [+T]-interpretations to be determined by temporal adverbials. A plausible explanation is that the temporal adverbials under discussion here, identify a complete domain in which the eventuality is to be properly included. In terms of the binary tense system of section 2:  $k \prec j$ , where  $j$  is identified as the unified domain MondayTuesday, taken as the sum of Monday and Tuesday. Recall that  $j$  is to be considered the present of the eventuality marked by  $k$ . In (12) this means that the crossing of the canal is part of the MondayTuesday-domain not providing information about the termination of the crossing.

This is not the first place where the conclusion has to be drawn that the contribution of temporal adverbials is essential in helping to complete a compositional analysis. Rosetta (1994) needed the contribution of temporal adverbials to achieve compositional translation. It does not seem to make sense to reject compositionality if the sentential structure lacks information that turns out to be essential for a proper interpretation. In other words, one can only see the use of *peresekal<sup>I</sup>* in (12) as a counterexample to the claim that [P] = [+T] if one can argue successfully that the presence of the temporal adverbial does not play a role in the choice between perfective or imperfective aspect.

### 3.2.2. Durative Perfectivity

There is another empirical reason for Borik to detach the opposition between a [+T]- or [-T]-predication from the opposition between Perfective and Imperfective

aspect. In (13a) the verb *prosidel* is perfective in spite of the [-T]-predication ‘Peter be in prison’.<sup>16</sup>

- (13) a. Petja prosidel<sup>P</sup> v tjur’me do starosti.  
 ‘Peter was in prison till old age/until he was old.’  
 b. Petja sidel<sup>I</sup> v tjur’me do starosti.  
 ‘Peter was in prison till old age/until he was old.’

Borik (2006, p.196) argues that for (13a) there is no implication “as to whether Peter is still alive or died 10 years ago”. She also points out that for (13a) to be successful it is essential that Petja be in prison at the moment at which he can be considered old. The difference between (13a) and (13b) shows up only in discourse, because (13a) and not (13b) would contribute to establishing a sequence due to the difference in perspective. Again, the presence of the subordinate adverbial (clause) *do starosti* (‘till old age’) is necessary to enforce the use of the Perfective prefix *pro-* in (13a): it brings in the requirement of completion of the period characterized by the [-T]-predication. But this completion has nothing to do with the nature of this predication: it is brought about by the temporal adverbial and this explains the difference between (13a) and (13b) in discourse.

### 3.2.3. Combining Tense and Aspect Compositionally

One way of compromising between the two positions  $[+T] = P$  and  $[+T] \neq P$  is to see that in Germanic languages the [+T]-information enters via the bottom S in the tense structure sketched in Figure 2. On the assumption that tense is basically a means to contribute to the organization of discourse, it can be argued that in Dutch (and English) the PERF-operator plays a role in providing the perspective which in Russian is given by a perfectivizing prefix (or its covert equivalent) because there is no tense form available for expressing completion. Due to the poverty of the Russian tense system the perfectivizing prefix seems to have a double duty: (a) to be part of the compositional machinery providing predicational [+T]-information; and (b) to take the role of what in Germanic languages is expressed by PERF. In short,  $P = [+T] + X$ , where X stands for factors that in Germanic languages are contributed by tense, in particular PERF.

This line of thought retains compositionality in the aspectual domain as far as the construal of [+T] is concerned, but it would also profit from compositionality in the binary tense system discussed in section 2. So, the key to a solution of determining how much [+T]-information is contained in P-information is possibly to go back to the sentences (2) and (3) at the end of section 2 and focus on the contribution of the information expressed by  $k \preceq j$  and by  $k \prec j$ .<sup>17</sup> Recall that  $j$  is considered as the present of the eventuality. In Dutch and English the difference

between the tense operators IMP and PERF is expressed by  $k \preceq j$  and by  $k \prec j$  respectively, but in such a way that the aspectual nature of the eventuality index  $k$  is independent from  $j$ : the present of an eventuality is not interested in the eventuality itself, so to speak.

Now, there is an interesting problem connected to the difference between the two Dutch sentences in (14).

- (14) a. Olga heeft de brief geschreven.  
 ‘Olga has written the letter.’  
 a.’ ... [Write(k)(b)(m)  $\wedge$   $k \prec j \wedge j \simeq i \wedge i \circ n$ ]  
 b. Olga heeft geschreven.  
 ‘Olga has written.’  
 b.’ ... [Write(k)(m)  $\wedge$   $k \prec j \wedge j \simeq i \wedge i \circ n$ ]

In (14a) the predication itself is [+T] and the Present Perfect requires  $k \prec j$ , as sketched in Figure 4a. But it also does in the case of the [-T]-predication in (14b),

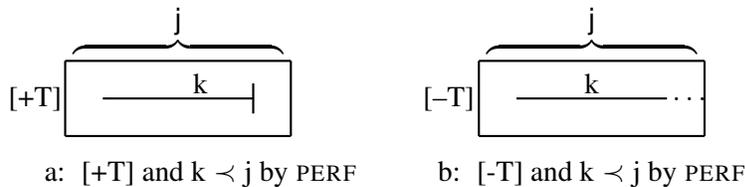


Figure 4. The Perfect in [+T]- and [-T]-predications

as sketched in Figure 4b, where the continuity of  $k$  is blocked by the right-hand boundary: there is no way out. In both cases the eventuality index  $k$  is to be properly included in spite of the predicational differences.

It is possible to analyze the cases discussed in (13) in terms of the difference between (13a) and (13b). In the latter case, the boundary cannot be provided by the predication *Petja sidel v tjur'me* because the verb *sidel* is imperfective. It is necessary to have a temporal adverbial such as *do starosti* ('till old age') identifying the present of the eventuality  $j$  as having its right-hand boundary at the beginning of Petja's old age. Temporal adverbials are arguably modifiers of  $j$  and this means that a perfective boundary can be put around the [-T]-predication analogously to what happens in the Dutch sentence (14b) by means of the use of PERF. In this way, compositionality can be seen as a regular feature of Russian predication by taking into account the different levels of phrase structure, as in non-Slavic languages.

### 3.2.4. Problems at the Bottom: How Much Lexical Information?

That different factors may play a role in the analysis of the difference between [+T] and P is also demonstrated by sentences like (15) in Comrie (1976, p.19).

- (15) On dolgo ugovarival<sup>I</sup>menja, no ne ugovoril.<sup>P</sup>  
lit: For a long time he persuaded me, but he didn't persuade me.  
'He spent a long time trying to persuade me, but he didn't actually persuade me.'

As shown in Tenny (1987) the Plus-Principle of the feature algebra in (4)—the requirement that a plus-value at the top can only be obtained if all relevant features are plus—meets some difficulties at the bottom. A sentence like *Olga painted the door* may pertain to something going on indefinitely as shown by *Olga painted the door for hours* but this is not the case for *#Olga painted the door green for hours*. It is as if in *Olga painted the door* the verb *paint* is too weak to be [+A], *the door* and *Olga* both being [+SQN]. *To push the cart* may mean that 'to give one or more pushes to the cart so that the cart moves' but it can also mean 'to exert force to' in cases where the cart does not move. Chapter 14 of Verkuyl (1993) explained these cases by assuming that the internal argument of these verbs is thematically not a direct object but rather an indirect object, so that the verb needs particles as *green*, *away*, *out of*, etc. in order for the verb to reach the [+A]-status.

Note, however, that the last sentence of the preceding paragraph reveals the essence of the problem quite well: it is correct to say that a chapter 14 explains this case but one cannot say (16a).

- (16) a. \*?Chapter 14 explained this case for an hour.  
b. #Olga explained this case for an hour.

The unwellformedness of (16a) is quite different from the one connected with the forced repetition in (16b). Sentence (16a) does not allow a durational adverbial because the external argument of the verb is [-Animate] and that leads to a non-sensical interpretation. Only if one thinks about chapter 14 as having been copied on a CD and being read aloud, for example, can one treat (16a) and (16b) alike as expressing that this case was repeatedly and mechanically explained over and over again to an audience. Yet, even then it should be clear that the [-Animate]-status of the external argument of *explain* deprives this verb of its [+A]-feature: it is no longer a verb expressing nonstativity in the sense of going through a process terminated by the internal argument.

The assumption about the thematic nature of the internal argument discussed earlier is thus broadened by assuming that the opposition between [+A] and [-A] should not be taken as purely lexical: verbs like *explain*, *persuade*, *convince*,

*run* (in *These lines run parallel*) have to “wait” till the external argument before they may be taken as fully [+A]. What is generally called meaning extension of a verb concerns its arguments. As discussed above in the case of *explain*, a non-animate external argument need not use temporal structure because it need not display the sort of nonstative progress in time accounted for by [+A], so that the value of A is minus or underdetermined (e.g. in a situation in which Chapter 14 is read aloud). This holds for verbs like *convince*, *protect*, *remain*, etc., Russian counterparts of which are discussed in Comrie (1976), Timberlake (1985), Borik (2006) and Paducheva (2009), among others.

## 4. Conclusion

The present chapter has focussed on the role of the principle of compositionality as a fruitful guide in analyzing temporal phenomena. In section 2 on tense and compositionality it was shown that the structure of the Reichenbachian tense system makes it impossible to treat it compositionally. Even stronger: any serious attempt to improve on the ternary system such as an extension of the number of reference points suggests that a binary method of working is more fruitful.

Section 3 on aspect and compositionality argues that contrary to scholars underscoring the unique position of Slavic aspect, the compositionality principle opens the way to a different view. It makes it possible to formulate the equation  $P = [+T] + X$  where P can be argued to be compositionally formed as [+T] and where X is temporal information that Russian needs in order to compensate for its impoverished tense. The argument is straightforward: predicational composition is tenseless, which explains why [+T] is tenseless. The obvious differences between Slavic and non-Slavic languages can be explained maintaining compositionality as the basis for translational equivalence: in Germanic languages like English and Dutch the X comprises tense operators, in Russian the X-information is encapsulated in the predication itself and it has to be sorted out by sticking to predicational composition. In this way, it can be made clear that an aspectual perfectivizing prefix like *na-* contributes to the organization of discourse in a way comparable to what the tense element PERF does in Germanic languages. Thus the gap between scholars of Slavic languages on the one hand and scholars of Germanic and Romance languages can be made smaller by pointing out that the principle of compositionality can be seen as a fruitful way for analyzing complex temporal information on the basis of a common ground.

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## Notes

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<sup>2</sup>In general, Montague is as compositional in his treatment of tense as Prior (1967). Note, however, that Janssen (1983) in his analysis of Montague’s PTQ-system comes close to a binary reformulation of the tense system. By extending Reichenbach’s system, Rosetta (1994) develops a ternary tense system which makes it possible to translate compositionally.

<sup>3</sup>The symbol  $\mapsto$  means: ‘maps to’. In the case of **anterior** HAVE<sub>inf</sub> has E – R as its unique value.

<sup>4</sup>Also by Reichenbach himself: “The use of the future tenses is sometimes combined with certain deviations from the original meaning of the tenses. In the sentence *Now I shall go* the simple future has the meaning S,R – E; this follows from the principle of positional use of the reference point. However, in the sentence *I shall go tomorrow* the same principle compels us to interpret the future tense in the form S – R,E. The simple future, then is capable of two interpretations, and since there is no prevalent usage of the one or the other we cannot regard one interpretation as the correct one” (1966:295).

<sup>5</sup>And not only the Dutch tense forms: the oppositions apply to other languages as well, including English, in spite of differences between them, as discussed in detail in Verkuyl (2008), which also discusses languages with less (Chinese, Russian) and languages with more than eight tenses (French, Bulgarian, Georgian). In this work, Te Winkel’s system has been not only described but it has also been formalized and extended. In order to express the flexibility of the notion of point in *point of reference*, the notion index will be used: the i-index is used in the first opposition, the j-index in the second and the eventuality index k in the third opposition, n denoting the point of speech.

<sup>6</sup>The representation (1b) is to be taken as expressing that the tenseless predication is a set of indices  $\alpha$  at which the two-place predicate Write(o,b) is true—in (1b) written type-logically as Write (b)(o)— where b stands for *the letter* and o for *Olga*.

<sup>7</sup>In semantic cloth:  $\llbracket \text{walked} \rrbracket = \llbracket \text{PAST}(\text{walk}_{inf}) \rrbracket = \llbracket \text{PAST} \rrbracket(\llbracket \text{walk}_{inf} \rrbracket)$ .

<sup>8</sup>Note that in this explication  $\text{PAST}(\text{walk}_{inf}) = \text{walked}$  is short for a representation in which the external argument of the verb is included. Likewise HAVE<sub>inf</sub>(walk<sub>inf</sub>) = *walked* abbreviates an analysis in which room is available for the Past Participle.

<sup>9</sup>The existential quantifier  $\exists!$  uniquely identifies the index  $i$ . So, (2b) expresses that there is a uniquely identified index  $i$  (the present of the moment of speech  $n$ ) which synchronizes with the present  $j$  of the eventuality indexed  $k$ , which is taken to be the meaning of the symbol ' $\simeq$ '. The difference between (2b) and (3b) is that in (2b)  $k$  is a proper part of its (larger) present  $j$  (the symbol ' $\prec$ ' is used to express that  $k$  precedes  $j$  in the way in which a set containing 3 members precedes a set containing 4 members), whereas in (3b) one is under-informed about whether or not  $k$  coincides completely with its present  $j$ . Note that the pastness of (3a) is due to  $4 < n$ . The Reichenbachian representations in (2c) and (3c) come close to those in (2b) and (3b) but they cannot be derived in a ternary system. They are added here in order to help understanding (2b) and (3b) in the current standard notation.

<sup>10</sup>Verkuyl (1972) used a generative-semantic notation for semantic atoms; Verkuyl (1976) reformulated this by using features. A feature notation does not meet the logical-semantic requirement of having an interpretation function relating sentences to domains of interpretation. The underlying formal semantics of the features under discussion as proposed in Verkuyl (1993, 1999, 2008) makes use of the so-called successor function accounting for temporal progress and quantificational information expressed by the determiner of NPs, which brings the successor function to a stop (terminativity) or not (durativity). An explanation in terms of features suffices here to shed light on the compositional process underlying aspect formation as governed by the Plus-principle.

<sup>11</sup>Dutch (and German) may add prefixes expressing finalization: *Olga schreef drie brieven af* (lit: Olga 'na'-wrote three letters), where *afschrijven* means 'write and finish it'.

<sup>12</sup>The picture is more complicated than sketched here. Recall that the feature algebra used here abbreviates a formal semantic machinery explained in detail in Verkuyl (1993,1999). Ambiguous sentences like *Three men lifted a table* and *Olga wrote three letters* (three on one occasion vs. one on three occasions) can be handled compositionally by the use of function composition.

<sup>13</sup>This objection also holds for those who adhere to Vendler-classes in spite of the many objections against his quadripartition: Dowty (1979), Piñón (1993), Rothstein (2008), Kiefer (2009) among many others. Vendler's classes are typically verb classes. As soon as one treats them as classes at higher levels of structure than the verb one has to take into account information coming from its arguments. But that means automatically that the quadripartition cannot be maintained and should be replaced by the phrase structural tripartition State-Process-Event proposed by Mourelatos (1978) because its members are compositionally formed: (4c) can be argued to express a state at the level of  $[-T_S]$ , (4a) is about an event only at the level of predication (not earlier), so it is to be marked as  $[+T_S]$ , and (4b) may be considered to be about a process of writing letters containing a VP being marked as  $[-T_{VP}]$  but containing a  $[+A]$ -verb. Note that the negation of (4b) is to be considered as State. In fact, it is impossible to have both compositionality and Vendler's verb classes, because there is no way to "collect" the basic ingredients making up these classes at higher levels of phrase structure, as argued in detail in Verkuyl (1993).

<sup>14</sup>It is possible to have *na-* in negative sentences such as *Olga nichego ne napisala* (lit: Olga wrote nothing). This is only if the sentence is understood on the basis of the presupposition that it had been Olga's intention to write something. The sentence cannot be used without such a 'perfective presupposition' about what may constitute an internal argument of the verb. Interestingly, it follows that it is impossible to say *#Ves' vecher Ol'ga nichego ne napisala* (lit: 'The whole night Olga wrote nothing') because a presupposition telling that Olga had the intention of repeatedly writing something is absurd. Factors like these are not present at the level of the verb itself, but at the level of complex meaning.

<sup>15</sup>This question has been discussed extensively in Schoorlemmer (1995) and Borik (2006). They both conclude that P and T may not be identified but this does not mean for them that the compositional thesis should not apply to Russian. In the discussion of Russian sentences below, a Russian verb V will be marked as  $V^I$  if it is considered imperfective, whereas  $V^P$  will be used for a perfec-

tive V. In most cases, a  $V^P$  has a formal difference with imperfective verbs in the form of a prefix preceding the verb stem.

<sup>16</sup>It is important to also include the semantics of the Perfective prefix *pro-* into the considerations, which according to Flier (1985, p.50) “typically carries connotations of depth, importance, difficulty, thoroughness and concentration” due to a deep involvement from beginning to end. With respect to [-T]-predications like (13a) Flier observes that the “protracted nature of the time interval delimited by *pro-* virtually requires that the adverbial occur overtly with the delimitive verb” (1985, p.51).

<sup>17</sup>Or in Reichenbachian notation:  $E \subseteq R'$  and  $E \subset R'$ , where  $R'$  is defined as the present of E.