

HANDOUTS: Lecture 9 (Aspect&Tense, 27.06.2022)

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1. Compositionality of Aspect

The category of aspect is the universal linguistic category, which is distinctive for all languages, and is a very fruitful research area. In particular, it is the case for Slavic languages owing to their reach morphological structure. Despite of many scientific investigations done in this field, aspect remains the most mysterious one. There are several approaches how to treat aspect in several languages including the most discrepant ones. The most recent investigation confirmed that there are even several aspects: lexical, terminative or 'inner' and viewpoint or 'outer' aspects.

Terminology

First of all, we must give some terminology overview used in several aspectual theories because the distinction between perfective/imperfective cases has subsequently been 'rediscovered' and renamed several times. We give the following list of some terms which have been used by different researchers (extended of Dahl, 1981, in 'On the definition of the telic-atelic (bounded-unbounded) distinction')¹: Distinction between A - e.g. *write* and B - e.g. *write a letter*

A	B
Energeia	Kineses (Aristotle)
Imperfective	Perfective
Cursive	Terminative
Irresultative	Resultative
Durative	Terminative
Nonpunctual	Punctual
Nonconclusive	Conclusive
Noncyclic	Cyclic (Bull, 1963)
Atelic	Telic (Garey, 1957)
Nonbounded	Bounded (Allen, 1966)
Activity	Accomplishment (Vendler, 1957)
Activity	Performance (Kenny, 1963)
Nepredel'nyj	Predel'nyj (Russian)
Nicht-grenzbezogen	Grenzbezogen (German)
Holding	Culminating (Parsons, 1985)

Table 1 *Terminology for aspectual opposition*

The most widespread and well-known terms are (im)perfective, (a)telic and terminative/durative aspect. We will use the terminology used by Verkyul (1972,1993) to avoid confusion. For morphological opposition, we will use standard well-known terms such *imperfective/perfective* and for aspect the terms '*terminative/durative*' would be

¹ The list may be incomplete.

appropriate.

1.1 Ingredients of the Aspectual Composition

Before we start with the important issues of Verkuyl's theory on compositional aspect consider the following English sentences:

- (1) a. Judith ate a sandwich (*terminative*)
 b. # Judith ate a sandwich for an hour
 c. Judith ate a sandwich in an hour
- (2) a. Judith ate sandwiches (*durative*)
 b. Judith ate sandwiches for an hour
 c. ? Judith ate sandwiches in an hour
- (3) a. Nobody ate a sandwich (*durative*)
 b. For an hour nobody ate a sandwich
 c. ? In an hour nobody ate a sandwich
- (4) a. Judith dislike a sandwich (*durative*)
 b. Judith disliked a sandwich for an hour
 c. ? Judith disliked a sandwich in an hour

The examples above show us that not only the verb (it is kept constant in examples 1-3) plays a role in the determination of aspectuality but also an internal argument. The same applies to the external argument: the only difference between (3a) and (4a) is a difference between the NP *Judith* and *Nobody*.

The basic idea of a compositionally formed aspect is that the aspectual information is contributed by the verb and its arguments or complements together. Aspectuality has been treated by Verkuyl on the basis of 'amalgamating' the meanings of the verb and its arguments into larger units. The proper way to go is from the bottom of the phrase structure to the top of it. Verkuyl's basic schema is:

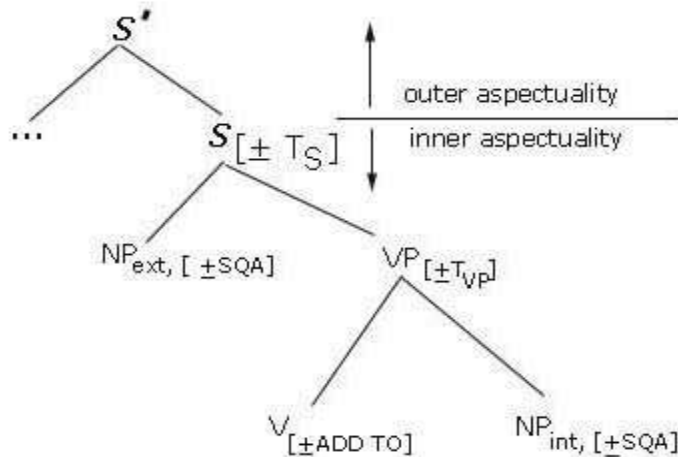


Figure 1 *Aspectual composition*

The ‘inner aspectuality’ is aspectual information expressed by the ‘kernel structure’ which consists of the verb and its internal and external argument(-s).

The ‘outer aspectuality’ is used for the result of applying modifying adverbials to inner aspectual information.

Semantic information here is expressed by the features $[\pm \text{ADDTO}]$ and $[\pm \text{SQA}]$ which may be taken as semantic atoms. The $[\pm \text{ADDTO}]$ property of the verb expresses *dynamic progress, change, non-stativity*. The $[\pm \text{SQA}]$ is a ‘*specified quantity of A*’ where A stands for N from the NP. This feature expresses that NP is related to a specified quantity of things or mass denoted by its head noun as in (5a) or contains $[-\text{SQA}]$ –NPs as in (5b):

- (5) a. She played a sonata, three sonatas, some sonatas, a piece of music, that sonata, Schumann’s last sonata for piano
 b. She played music, sonatas, that (sort of) music, form that to the end

It must be noticed here that $[\pm \text{SQA}]$ -NP is not based on definiteness or indefiniteness. “A $[\pm \text{SQA}]$ -NP pertains to something discernible that can be separated from other things and as soon as you can do that, one may count or measure. This semantic information is located in the determiner part of an NP” (Verkuyl, 1999). The $[\pm \text{T}]$ value stands for \pm terminative.

Verkuyl distinguishes between two levels of phrase structure. The process on the VP-level, how the information is contributed by the verb and its internal arguments, differs from the process of the merging the information expressed by the VP and the external argument NP (ext). “*The relation between external NP and VP can be taken in terms of a multiplication relation in which each of the members of the NP-denotation obtains its own VP*”. This is called by Verkuyl the notion of Path (see below).

1.2 The Verb

Consider the following examples:

- (6) a. Mary walked three miles
b. Mary walked miles

When we apply the basic schema, we can account the differences between VPs *walk three miles* and *walk miles*:

- (7) a. $V[+Addto] + NP(int)[+SQA] \rightarrow [+T(VP)]$
b. $V[+Addto] + NP(int)[-SQA] \rightarrow [-T(VP)]$

Again, the verb kept constant, but in 7a the verb phrase is terminative, while in 7b we got a durative one. It is obvious that the complement is responsible for different aspectual values of VP. Verkuyl uses the feature algebra to calculate the plus/minus value of terminativity at the sentence level:

- (8) a. [s Mary [vp walk three miles]]
[+Ts[+SQA] [+Tvp[+ADD TO] [+SQA]]] \rightarrow terminative

b. [s Mary [vp walk miles]]
[-Ts[+SQA] [-Tvp[+ADD TO] [-SQA]]] \rightarrow durative

c. [s Children [vp walk three miles]]
[-Ts[-SQA] [+Tvp[+ADD TO] [+SQA]]] \rightarrow durative

d. [s Mary [vp save three miles]]
[-Ts[+SQA] [-Tvp[-ADD TO] [+SQA]]] \rightarrow durative

He formulated so-called Plus-Principle, which says that one minus-value below in the tree is sufficient to yield a [-T] at the top of the Figure 1. 'The natural domain of the Principle' is 'the domain of inner aspectuality.'

1.3 Terminativity and the Notion of Path

Let us formalize of the notion of terminativity and terminative/culmination point. Several definitions were given in the literature:

A situation, process, action etc. or the verb phrase, sentence, etc, expressing this situation, etc, has the property $[\pm T]$ iff

It is directed toward attaining a goal or limit at which the action exhausts itself and passed into something else (S,G, Andersson 1972)

It leads up to a well-defined point behind which the process cannot continue (Comrie 1976)

Östen Dahl (1981) gives the definition as a terminal point *t* such that

- a. if *t* is reached, the process cannot continue
- b. *t* will be reached in the normal course of events (= if nothing unexpected intervenes)
- c. *t* will be reached in all possible courses of events.

Dahl distinguishes between ‘potential (intended or probable) terminal point’ and ‘actually achieved terminal point’. Consider the following sentences:

- (9)
- a. John is studying for a bachelor’s degree (potential result)
 - b. John has completed a bachelor’s degree (actually achieved result)
 - c. I am going to France for two months (potential duration)
 - d. I traveled in France for two months (actual duration)
 - e. I am staying until returns (potential temporal limit)
 - g. I stayed until he returned (actual temporal limit)

Lascarides 1988 has formalized as follows:

- (10)
- a. Mary walked [Pr Mary walk]
 - b. Mary walked three miles [Cp Mary walk three miles]
 - c. Mary walked miles [Pr Mary walk miles]
 - d. Mary ran in four minutes [Cp[Pr Mary run]]

where Pr in (10a) and (10b) expresses **process**, Cp in (10b) stands for **culmination point** and to express in (10d) that Mary **accomplished** her daily run in four minutes Moens/Lascarides put Cp as an operator in front of [Pr Mary run] with result as in (10d) to enable an interpretation expressing a **culmination point**. These notions are tied up to scheme in Figure 2 below.

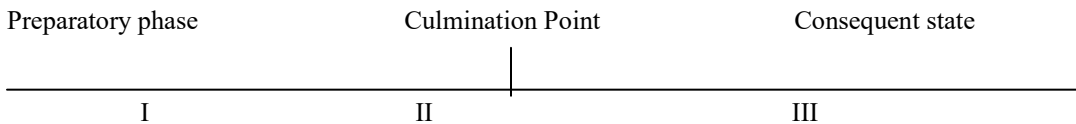


Figure 2: Phasal structure

Pr as an operator may coerce Cp-proposition *Mary walk three miles* into a proposition expressing the preparatory phase as in *Mary was walking three miles*: PROG(Pr) [Cp Mary walk three miles]. We see that Pr brings one in the Preparatory phase and Cp-operator at the culmination point. Unfortunately the Figure 2 raises some important questions of whether or not the notion of culmination point is something that has an explanatory force in aspectual composition and which element contributes the culmination point expressed by the sentence directly and can predicate itself have such information.

On Verkuyl's view the answer to above question should be negative. He introduced his own schema for aspectual composition. His [+SQA] - or quantized information is contributed by the determiner of the internal argument-NP. It is given a place in the complex information at the VP-level as a whole expressing a Path. 'Relating the NP_{int} to a V so as to form a VP is "going through (=computing) the way in which quantificational information contributed by the internal argument is integrated in a temporal structure". The relation itself can be accounted for in terms of a Parth-function ℓ_x picking its input values from the successor function s contributed by the verb and providing the sense of additivity connected with progress. Consider the sentence:

(11) Mary mailed five letters while still in France

NP_{int} builds the co-domain of this function. The simplified picture of a possible application of this function is given in Figure 3.

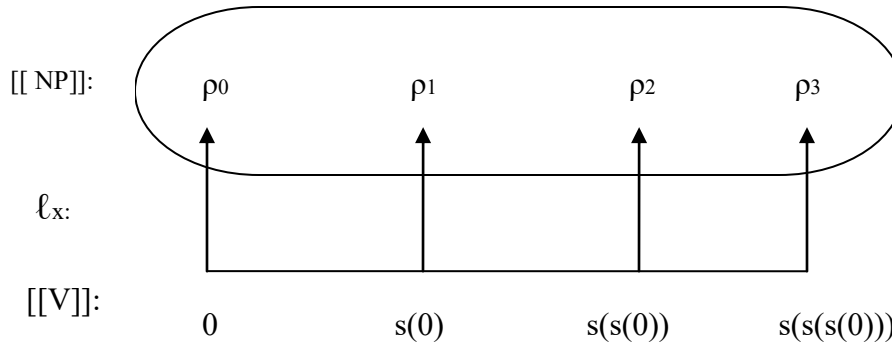


Figure 3: *A Path*

where the progress expressed by (11) may count three mailing (sub-) events (for example 2 letters in Paris, 1 in Marseille and 2 in Lyon). We do not know exactly what really happened, unless specific information is given. It is just one of many possibilities for (11). The final point of a Path has no specific value on its own and there is no single linguistic element that provides it. The internal argument provides its quantificational information and this makes the Path bounded or unbounded. [+SQA]-NP do not contribute a culmination point, neither do verbs.

Let us discuss the notion of Path in more details. There are three function involved in the composition of aspectuality:

1. the function s contributed by the verb and providing for the sense of progress in the verbs expressing change;
2. the function ℓ amalgamating the V and its internal argument into the VP-denotation [VP]

3. the function π relating the members of the external argument denotation to [VP]

1.3.1 The successor function s

Each verb in Verkuyl's aspectual composition has the feature $[\pm\text{ADDTO}]$. Each $[\text{+ADDTO}]$ -verb is interpreted as introducing a well-ordered set I of indices ι . Let $I := \mathbb{N}$ (\mathbb{N} natural numbers), that I is taken as the set of natural numbers, which by Definition 1 are the endpoints of intervals in \mathbb{R} , the set of real numbers

Definition 1 $I_v := \{(0, k) \subseteq \mathbb{R} \mid k \in \mathbb{N}\}$

The successor function $s: I \rightarrow I$ is defined over I by $\forall k \in I: s(k) = k+1$. The connection between I and I_v is made by a function $\text{succ}: I_v \rightarrow I_v$ defined such that $\forall k \in \mathbb{N}: \text{succ}((0, k)) = (0, s(k))$. Indices are introduced as part of the information expressed by a $[\text{+ADDTO}]$ -verb, ignoring at this stage the information about the external argument X . For example the verb *lift* in *Mary lifted four tables* introduces indices of which the information about the internal argument Y is made dependent:

(12) $\dots \lambda \iota \lambda Y. [[\text{lift}]] (\iota) (Y)(X)$

1.3.2 The Path function ℓ

Consider the Figure 4:

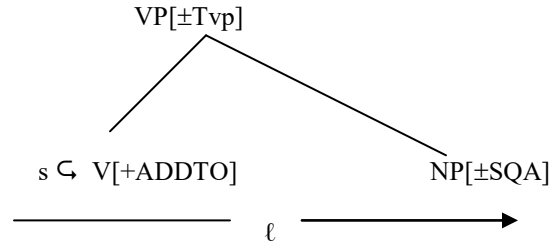


Figure 4 The Path function ℓ

At this point it is sufficient to observe that by the presence of the $[\text{+SQA}]$ the co-domain of ℓ is finite. The $[\text{-SQA}]$, e.g. *Judith ate sandwiches*, indicates that the co-domain of ℓ is not finite. Dependent on the plus-/minus-values of the NP, the VP will become VP-terminative or VP-durative.

The domain of ℓ is the set I , its co-domain DL is set of 'positions' ρ making up the internal argument denotation

Definition 2 $\ell_x^\iota: I \rightarrow \text{DL}$ with $\ell_x = \{ \langle \iota, \rho \rangle : [[\text{AT}(\rho)(x)]] M, \iota = 1 \}$

As the definition of the Path function contains a place for information concerning the external argument, ℓ will be subscripted with x when necessary for the exposition.

Definition 2 characterizes the injective function ℓ as a set of pairs $\langle i, \rho \rangle$ such that x is in the position ρ at i , given a model M . The term ‘position’ is used to indicate that ℓ defines a Path in the sense of the so-called localistic tradition in the linguistic analysis of verb expressing change. The localistic element is AT-predicate which localizes the external argument x in a certain position with respect to the predication involved. Thus, ℓx constitutes a ‘Path of x ’ keeping track of how x relates to the members of the internal argument denotation as far as satisfaction of the predicate is concerned. For example in *Three girls lifted four tables* there are three x -s involved each obtaining a Path, a way in which they are involved in the predication.

The information expressed by the VP is built up cumulatively. For example, for the sentence *Mary lifted four tables*, T (set of tables) $= \{t_1, t_2, t_3, t_4\}$. The Path of Mary ℓ_{Mary} would be: $\{\langle 1, \rho_1 \rangle, \langle 2, \rho_2 \rangle, \langle 3, \rho_3 \rangle\}$,

(13)	$\langle \text{Mary}, \langle 1, \rho_1 \rangle \rangle$	$\langle \text{Mary}, \langle 1, \{\{ t_1, t_2 \} \} \rangle \rangle$
	$\langle \text{Mary}, \langle 2, \rho_2 \rangle \rangle$	$\langle \text{Mary}, \langle 2, \{\{ t_1, t_2 \}, \{ t_3 \} \} \rangle \rangle$
	$\langle \text{Mary}, \langle 3, \rho_3 \rangle \rangle$	$\langle \text{Mary}, \langle 3, \{\{ t_1, t_2 \}, \{ t_3 \}, \{ t_4 \} \} \rangle \rangle$
	$\langle \text{Mary}, \langle 3, \{\rho_1, \rho_2, \rho_3\} \rangle \rangle$	$\langle \text{Mary}, \langle 3, T \rangle \rangle$

The left-hand side of (13) says that ℓ_{Mary} distinguishes three positions at each of which the model satisfies the Lift-predication applied to Mary and subset of T . Mary reached the position at which $\text{AT}(\{\{ t_1, t_2 \} \}) (\text{Mary})=1$ at index 1; $\text{AT}(\{\{ t_1, t_2 \}, \{ t_3 \} \}) (\text{Mary})=1$ at index 2, etc. In this way, ℓ keeps track of the way in which the individual members of the external argument of the predicate are involved in the predication. It is also explained why the function s comes to stop. This accounts for the terminativity.

Leaving out some details, the NP four tables is represented as:

$$\lambda P \exists W [W \subseteq [\text{table}]] \wedge |W| = 4 \wedge \exists Q \text{ps} W [Q = P]$$

W - is set of four tables having a cardinality of 4 structured as a partition Q such that Q is the collection P of sets of things being lifted.

In *Zeus walked* $\lambda X \lambda i [\text{walk}] (i) (X)$ there is no internal argument Y to bring s to stop. We assume that in this case the co-domain of ℓ yields the empty set for every application of s . For bare plurals like sandwiches the representation does not contain cardinality information of the form $|W| = k$. Therefore, the co-domain of ℓ cannot be bounded, so the partitioning is unbounded and s does not come to a stop. This explains the durativity in *Judith ate sandwiches*.

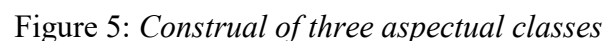
Conclusion we can make here that the notion of Path allow us to formalize the terminativity as follows: if the internal argument has $[+SQA]$ -value the co-domain of function ℓ is finite, the function s come to stop, therefore the Path is bounded and the VP becomes terminative; if the internal argument has $[-SQA]$ -value of there is no internal

The notion of Path is a very powerful tool for terminativity vs durativity determination.

In the previous section, it was mentioned that the domain of the viewpoint aspect is the domain of the ‘*outer*’ (above VP in the generative tree) aspectuality in terms of Verkuyl. The **viewpoint** aspect is also called **perspective** aspect. The crucial words here are ‘from outside’. The following definition was given by Comrie(1976):

This is exactly how a speaker's point of view or perspective on a certain eventuality can be stated. The most serious problem within this approach is the absence of sufficient formalization of the notion of viewpoint. Smith (1997), Filip (1993) and de Swart (1998) made an attempt to formalize the notion of viewpoint. Schematically, the model can be represented as follows:

There are three levels of representation, which can accommodate aspectual information. The first level is the level of the eventuality description; there are three possible types of eventuality description: states, processes and events. Semantically, the predicates were separated into two classes: states and processes are durative (atelic) and events, on the other hand, are quantized (terminative/telic). The following figure applies theory of Verkuyl to these three types of eventuality description:



At the next level of representation in (14) a number of aspectual operators can be applied to an atomic eventuality type. For example, if the main type of an eventuality at the predication level is an event, the application of the progressive operator PROG maps it

into state. Here is example of some operator acting at the same time in English sentence (15):

- (15) a. Jane has been writing a letter
b. [PRES[PERF[PROG[Jane write a letter]]]]

It means more than one operator can be applied to a given eventuality description. Furthermore, some aspectual information can be accommodated in the tense. This happens when tense operators are sensitive to an eventuality type they apply to.

De Swart states that the aspectual operators impose a certain **view point** on the eventuality description. Here several delimiting adverbials play a very important role. This class comprises temporal adverbials like *for an hour*, *between 3 and 5*, *till December* etc. The semantic of these adverbials is often associated with determining temporal boundaries of an eventuality. The duration adverbials like *for an hour* acting as operators change the type of eventuality either state or process into event:

- (16) a. Ann ran
b. Ann ran for two hours

Sentence (16a) express process, the durative adverbial *for two hours* change it into event. In de Swart's analysis, predicates with delimiters change their basic eventuality type from process or state to event after temporal modification has applied. De Swart supports her analysis using the progressive entailment test. It shows that states and processes license the inference from past progressive to simple past, whereas events block it:

- (17) a. Andrew was swimming → Andrew swam
b. Andrew was swimming for three hours -\ → Andrew swam for three hours
c. Eve was drawing a circle -\ → Eve drew a circle

De Swart describes the entailment results as follows (de Swart, 1998): "*As far as the semantic inferences of sentences involving for-adverbials are concerned, they pattern with the event sentence..., rather than with the process sentence... measurement phrases make a predicate quantized.*"

De Swart has analyzed only adverbials like *for X time*, but there other duration adverbials, in principle, with the same semantic effect and should not differ in any crucial way from the contribution of '*for X time*'-adverbial. Let us check how it works , e.g. *between 4 and 7 p.m.*

- (18) a. Andrew was working between 4 and 7 p.m. -\ → Andrew worked between 4 and 7 p.m.
b. The computer was working between 4 and 7 p.m. -/\ → The computer worked between 4 and 7 p.m.

According to the Swart's theory it should no difference between (18a) and (18b).

The ‘*in X time*’-adverbials are actually compatible with both telic and atelic expressions. Consider the following examples:

- (19) a. [Andrew swam a mile] in a week.
b. [Andrew swam for three hours] in a week
c. (After he saw a cat,) [my dog ran] in a second.

The interpretation that the in-adverbial gets with the basic event in (19a), is not available for the derived eventuality type in (19b). The last one gets the interpretation of a basic event.

The conclusion we can make here is that there is no sufficiently distinguishing between the aspectual phenomena at different levels discusses on the example of the analysis of temporal delimiting expressions in de Swart. There is no evidence supporting the claim that delimiters change the basic eventuality/predicate type established at the predication level composed e.g. by Verkuyl.

It is another formalization needed for the viewpoint aspect. Reinhart (2000) suggests that the differences in point of view should be formulated and captured in terms of **Reference time**, the notion that defines perspective.

3 Reference time

Delimiting temporal expressions, as has been shown by de Swart, influence temporal interpretation of sentences in discourse:

- (20) [It was a lovely performance]. The entertainer told jokes for fifteen minutes, sang for half an hour and danced for another half an hour.
(21) [It was a lovely performance]. The entertainer told jokes, sang and danced.

The delimited predicates in (20) can trigger a sequence interpretation; in (21) an overlap interpretation arises: eventualities are not temporally ordered.

The idea to relate delimitedness to the notion of **Reference time** was put forward in Reinhart (1986, 2000). Reinhart argues that delimiting adverbials do not operate on a predicate itself and, therefore, do not modify, change or influence the properties of a predicate, they restrict actually the Reference time interval.

Reinhart noticed that Reference time, more precisely the relation between **Reference time** and **Speech time** is the closest conceptual entity to the informal notion of ‘*perspective*’ or ‘*point of view*’ in literature on aspect. Reference time is a tool to account for both perspective, which underlines the point of view approach to aspect, and delimitedness, which is often considered to be relevant for aspectual theory at the discourse level.

In her work, Reinhart gives a uniform account of R-time, a theory that does not need either several notions of R-time or different rules for the tense system. Reinhart's theory is cast in the framework of interval semantics, which means that the denotation of E, R or S is always a temporal interval or a set of temporal intervals. Reinhart modified the system of S-R-E relations as follows:

- The E-R relation is fixed, i.e. $E \subseteq R$ by default (except for progressive);
- The S-E relation determines the truth conditions and the temporal interpretation of a sentence;
- The S-R relation determines perspective and morphological tense.

3.3 E-R

Reinhart proposed to establish a unified relation between E and R, irrespective of the aspectual status of a predicate. This idea is based on a modified view of what it means for an E-time to be contained in a R-time.

An eventuality described by an durative predicate, can bear 3 different relations to the R-time: it can include, be included or overlap with the current R-time. Consider the following sentences:

- (22) a. Last week Mary was sick.
 b. Last week Mary was sick but Friday she had recovered
 c. Last week Mary was (still) sick and she has not recovered (yet).

Let us focus on the relation between the temporal interval specified by 'last week' (R-time interval) and the interval at which the durative predicate 'be sick' holds for Mary (E-time interval). In case of (22a) the relation between E and R should be mere overlap, (22b) however suggests that the interval R-time: she was sick through the whole week, but had recovered by the weekend. The interpretation in (22c) is that Mary got sick before last week and is still sick at the S-time: the period of sickness includes the last week.

Despite of these differences, there is a common thing in all three examples in (22): they presuppose the existence of some interval I at which Mary was sick and which is contained in the interval of time denoted by the last week. Reinhart proposes to take this as basic underlying relation of E- and R-intervals for all predicates: an interval I at which a given eventuality holds is contained in the R-time interval.

- Definition 3** a. E(ventuality) time:
 If P is an n -ary predicate and x_1, x_2, \dots, x_n are its arguments, then any interval I , such that $P(x_1, x_2, \dots, x_n, I)$ is called predication time and labelled E(ventuality) time
 b. $E \subseteq R$:
 $\exists R, \exists I$ such that $P(x_1, x_2, \dots, x_n, I) \ \& \ I \subseteq R$

Notation [R E]

The Definition 3 says that eventuality time is a label for an interval I at which P holds and there is at least one of the intervals at which a given predicate P holds has to be included in R. R can contain more than one such interval. The Definition 3 is uniform for all types of predicates, both terminative and durative.

3.4 S-E

Reinhart proposes that the S-E configuration determines the truth conditions and the temporal interpretation of a sentence. Temporal interpretation tells us how to relate the eventuality described in a given sentence to a default anchoring point, i.e. S-time. Given that both S and E are taken as temporal intervals, two intervals can overlap or if the intersection between them is empty, a precedence relation can be established, i.e. they can be ordered. In the case of overlap, the temporal interpretation is present. If S and E are ordered, then we get either past or future interpretation. In other words, the position of E relative to S, tells us whether the eventuality described in a given sentence is *anterior* to, *overlapping* with, or *posterior* to the S-time.

In system of Reinhart, it is important to distinguish between morphological tense and temporal interpretation of a sentence: they are not determined by the same relation. One of the reasons to distinguish between them is the interpretation of the simple past and present perfect tenses in English:

- (23) a. John ate breakfast
b. John has (already) eaten breakfast

Reinhart points out that the two sentences in (23) above have the same truth conditions and temporal interpretation in the sense they both refer to some temporal interval at which the predicate ‘*eat breakfast*’ holds and which precedes S-time. On the other hand, the sentences show different tense morphology, which is the reason to distinguish between the temporal interpretation and tense marking. Reinhart argues that the relation between S and E is not important for determining tense morphology of a finite verb.

3.5 S-R

The S-R relation is crucially important for the theory of aspect. This relation is responsible for morphological tense and perspective. Consider again the sentences in (23). The temporal interpretation of the both sentences is the same, i.e. they report on something that occurred in the past, hence the relative order of S and E is $E < S$ in both cases. They show different morphological tense marking. The only relation what can be responsible for this difference is the S-R relation. The present morphology on the finite verb suggests that S and R should overlap. The definitions for simple past and present perfect should be as follows:

- (24) a. simple past $\exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& E \subseteq R \& R < S)$

b. present perfect $\exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& E \subseteq R \& S \cap R \neq \emptyset \& E < S)$

or shorter representation:

a. simple past $E \subseteq R \& R < S$
b. present perfect $E \subseteq R \& S \cap R \neq \emptyset \& E < S$

It must be noted here, that E is used as a name for an interval I, as defined in Definition 3. Similarly, S is a 'name' for interval I, such that $I \subseteq S$ and $I \subseteq R$. In other words, S in this notation stands not for the whole interval of S, but for its subinterval, which may be the same as S itself, but need not be, included in R.

The representation of morphological tenses in Reinhart's system is:

(25) a. future $\exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& E \subseteq R \& S < R)$
b. present $\exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& E \subseteq R \& E \cap S \neq \emptyset)$
c. past $\exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& E \subseteq R \& R < S)$
d. present perfect $\exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& E \subseteq R \& S \cap R \neq \emptyset \& E < S)$

The S-R relation in Reinhart's theory also determines perspective. Reinhart describes the difference between simple past and present perfect as a difference in perspective. R-time should play crucial role in the account of the present perfect tense. For example, the special effect of the present perfect in English is that the situation described is conceived as relevant for the present moment, as all the English grammars say. Reinhart's representation for present perfect seems to capture this intuition: on the assumption that 'relevance for the present moment' is captured by the relation between R and S. Since S is included in R, then the 'relevance' meaning of the present perfect tense can be attributed to the position of S, which is associated with the present, relative to R, which includes the E-time.

Thus, Reinhart provides a way to relate the intuitive concept of perspective to a linguistic notion Reference time. What determines perspective in this model is the relation between R and S, the same relation that determines the morphological tense. Perspective is associated with the view of a speaker, which is presumably 'located' at S. If a speaker is 'inside' the R-time domain, the perspective is internal. If the position of a speaker is 'outside' the R-time domain, the perspective is external.

Progressive entailment

The application of the progressive operator yields the reverse relation of E and R, i.e. it turns $E \subseteq R$ into $R \subseteq E$, and the resulting predicate is always durative. Here there is always at least one E'-interval inside R, at which a predicate holds. E' at the same time is the subinterval of E. This means that progressive predicates are always durative, since they have a subinterval property.

Past progressive in Reinhart's system is represented as follows:

$$(26) \exists E \exists R \exists S (P(x_1, x_2, \dots, x_n, E) \& R \subseteq E \& R < S)$$

This reads that there is an interval E at which a predicate holds and which includes R and R precedes S.

Past perfect

Past perfect tense is an anaphoric tense, that is evaluated with respect to a temporal unit other than the S-time. The original system of Reichenbach is E_R_S . Consider the following sentence:

(27) The secretary had already left when this letter arrived.

The common assumption would be that the temporal subordinate clause introduced by when provides the Reference time and the eventuality reported by the main clause is perceived with respect to this R-time. Reinhart proposed two reference time here to account for the past perfect, since she assumes the default relation between R and E always being $E \subseteq R$. In (27) there are two eventualities E_1 ='the secretary had left' and E_2 ='the letter arrived', and the ordering is established between the R-times of the respective predication times E_1 and E_2 . R_2 can be unspecified or understood from the discourse. The common representation of past perfect is given in (28):

$$(28) E_1 \subseteq R_1 \& R_1 < R_2 \& R_2 < S$$

R-time movement

The basic rule for the R-time movement, proposed by Partee (1984) and Hinrichs (1986), makes a crucial difference between stative and eventive sentences, sentences with durative and terminative predicates respectively.

Eventive sentences in narrative discourse move the R-time forward, creating a sequence interpretation. A telic predicate, every time it occurs, holds only at a single interval I. Each interval at which a predicate P holds is included in its R-time. A predicate P that describes a following event is included in another, its own R-time and so forth. The R-times are ordered in the narrative discourse, to capture the temporal progress of narration, and, as a result, the system creates the time movement effect for a string of eventive sentences. However, this neat sequence interpretation can be overruled by different contextual means. For example, temporal specification like *at the same time* or *simultaneously* brings out the overlap reading:

- (29) a. John closed the door. He picked up the receiver and dialled the emergency number.
- b. John closed the door. At the same time, he picked up the receiver and dialled the emergency number.

A predicate P of a stative sentence, even though it is also included in its R-time, can hold 'beyond' its R-time, thus creating an effect of an overlap. The sequence interpretation of sentences with the durative (stative) predicates is only available if they have different expression like *then*, *after that* etc triggering this effect. The sentences with stative predicates and delimiting adverbials must be interpreted sequentially. Reconsider our sentences:

- (30) [It was a lovely performance]. The entertainer told jokes for fifteen minutes,
sang for half an hour and danced for another half an hour.
(31) [It was a lovely performance]. The entertainer told jokes, sang and danced.

Reinhart's system provides a solution. A delimiting adverbial operates on a different entity, namely, the R-time. If the R-time interval is temporally restricted, a new R-time is introduced in the discourse and the discourse proceeds further. A sequence interpretation is obtained by a succession of temporally ordered R-times.

This system is the unified theory of R-time, proposed by Reinhart (1986, 2000). It operates with Reichenbach's notions of Speech time, Event time and Reference time and is formulated in the framework of interval semantics. Reinhart also formalizes the notion of perspective, which is very important for analysis of the aspectual system.