Constraining aspectual composition

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Abstract

In Modern Greek there is a rich aspectual system, which involves both morphologically expressed grammatical aspect and eventuality types, carried primarily by the meaning of the verbal predicate. Particular emphasis is paid to the interaction between grammatical aspect and eventuality types, since it is due to this interaction that the verbal predicate acquires distinct meanings. In order to explain potential changes in the meaning of the eventualities caused by the interaction with grammatical aspect, I propose a formal analysis within HPSG, using Minimal Recursion Semantics (MRS) for the semantic representations. Following the MRS architecture, I introduce a number of relations, which represent both grammatical aspect and eventuality types. The close interaction between grammatical aspect and eventuality types triggers special meanings which traditionally can be explained by inserting contextual information into the representations. In this paper, I argue against such an analysis, providing an alternative which is based on the introduction of subeventual templates formulated by Michaelis (2003) and Pustejovsky (1995). In this context, grammatical aspect combines with eventuality types and selects eventualities or subeventualities appropriate to its selection restrictions, using information that is already there in the denotation of the eventualities.

1 Introduction

Traditionally, aspectual composition refers to the combination of a verb with its arguments (NPs, PPs) and how this combination affects the aspectual denotation of the verb (Aktionsart) (Krifka, 1998; Smith, 1997; de Swart, 1998). For instance, in (2a) the eventuality *walk a mile* is an accomplishment, which changes into a process in (2b) once the argument gets pluralised (*walk miles*).

(1) a. Mary walked a mile.
b. Mary walked miles.

Another instance of aspectual composition occurs when grammatical aspect (perfective and imperfective) and eventuality types (accomplishment, achievement, process, state) carried by the verb along with its arguments combine to trigger particular meanings. This aspectual composition may change the denotation of the eventuality type resulting to aspectual shifts (Moens and Steedman, 1988; Jackendoff, 1990; Pustejovsky, 1995; Pulman, 1997; Krifka, 1998; de Swart, 1998; Filip, 2000; Bonami, 2001; Giannakidou, 2002; Egg, 2002; Michaelis, 2004).

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An instance of this phenomenon is found in Modern Greek (M.G.) where there is a contrast between perfective and imperfective aspect, being overt in the morphology of the verb. The information, grammatical aspect presents, is affected by the eventuality type it combines with, which is implicit in the meaning of the verb phrase.

The accomplishment eventuality *write the letter* in (2) denotes a situation which starts with the beginning of the *writing* and reaches a culmination with the completion of *the letter*. When this eventuality combines with perfective aspect in (2a), it retains its culmination point and the meaning does not change. When the same eventuality combines with imperfective aspect, it gets a shifted reading (2b) i.e. process or habitual reading. In this way it is no longer visible when *the letter* reaches a culmination and if it actually does.

(2) a. O Giannis e -graps -e to gramma.
the giannis Aug -write.Perf -3sg.Past the letter
'Giannis wrote the letter' (basic reading)

b. O Giannis e -graf -e to gramma.
the giannis Aug -write.Imperf -3sg.Past the letter
'Giannis was writing the letter' (process reading)
'Giannis used to write the letter' (habitual reading)

The same is the case in (3), which is an instance of an achievement eventuality combined with perfective aspect in (3a) and imperfective aspect in (3b). As was the case with the accomplishment in (2), grammatical aspect modifies the eventuality giving particular meanings.

(3) a. I Maria kerdis -e sta hartia.
the maria win.Perf -3sg.Past in-the cards
'Maria won in the game of cards' (basic reading)

b. I Maria kerdiz -e sta hartia.
the maria win.Imperf -3sg.Past in-the cards
'Maria was winning in the game of cards' (process reading)
'Maria used to win in the game of cards' (habitual reading)

In (4) the eventuality *love Anna* denotes a situation, which is not clear when it starts and when and whether it finishes. When this eventuality occurs with imperfective aspect in (4a), it gets the default meaning of the eventuality, where no culmination point is denoted and no visible endpoints. In (4b) the same eventuality combines with perfective aspect, which may focus either on the initial stages of the eventuality in which case it acquires an inchoative reading or simply adds both endpoints, in which case there is a bounded reading.

(4) a. O Giannis agapous -e tin Anna.
the giannis love.Imperf -Past.3sg the anna
'Giannis was loving Anna'
'Giannis used to love Anna' (basic reading)

b. O Giannis agapis -e tin Anna.
the giannis love.Perf -Past.3sg the anna
'Giannis loved Anna (and does not love her any more)'
(bounded reading)
'Giannis fell in love with Anna' (inchoative reading)

In the above examples grammatical aspect and eventuality types interact and the meaning of the eventuality is affected by grammatical aspect. When the perfective aspect combines with accomplishments and achievements there is no change in the denotation of the eventuality. As Smith (1997) observes perfective aspect and accomplishments - achievements have similar properties They all have endpoints and reach a culmination. That is why there is no change in the eventuality denotation once combined with perfective. The same result occurs when imperefective aspect and processes - states combine. No aspectual shifts are observed because they have no endpoints and hence no culmination happens.

In order to formalise and explain the interaction between grammatical aspect and eventuality types, it is standard in the literature to assume that there is a functor argument relation: $f(a)$, where f is the functor and a the argument. In the case of aspectual interactions, the relation between functor and argument becomes more concrete and translates into (5), where there is a functor-argument relation between grammatical aspect and eventuality types.

(5) *aspect(eventuality)*

We may further instantiate the aspectual functor into the perfective functor, which normally takes as argument accomplishments and achievements (6a), as was observed in the examples above. A similar case occurs with the imperfective functor which normally combines with processes and states in (6b).

(6) a. $perfective(accomplishment \vee achievement)$
b. $imperfective(process \vee state)$

Nevertheless, there are cases where the argument is not the appropriate input for the functor. Instances of this can be found in (4b) where the perfective aspect combines with a process and in (2b) and (3b), where the imperfective functor occurs with an accomplishment or achievement respectively. If the argument is not the appropriate input for the functor,

this does not mean that the combination is not acceptable but just that reinterpretations occur which remedy the conflict.

In the literature there is a main trend for the explanation of these type shifts. Extralinguistic knowledge may be involved where the context plays an important role in the resolution of the conflict and it is manifested with the introduction of operators licensed by the context.

Jackendoff (1997) argues that "the process of composition interpolates a 'coercing function' G to create instead the structure F(G(X)) where X is a suitable argument for G, and G(X) is a suitable argument for F." This means that in type-shifting the process of semantic composition may add meanings absent in the syntax in order to ensure that certain functors receive suitable arguments. This extra meaning added is referred to as *enriched composition*.

A similar explanation comes from de Swart (1998, 2000) who argues that coercion is "syntactically and morphologically invisible: it is governed by implicit contextual reinterpretation mechanisms triggered by the need to resolve [semantic] conflicts." (de Swart (1998):360)

In a similar way aspect shifts are treated as type coercions by Moens and Steedman (1988); Pulman (1997); Pustejovsky (1995, 1991); Pustejovsky and Bouillon (1995); de Swart (1998, 2000). The main idea is that the basic aspectual class of an eventuality description may be changed under the influence of tenses, aspectual adverbials and aspectual auxiliares. These are functions which may coerce eventuality types so as to become appropriate inputs for them. The reinterpretation in this case is achieved with the introduction of operators which alter the type of the argument so as to become appropriate for the functor. The licensing of a particular operator depends on the context.

Hence, the general relation *f(Op(a))* is used, where the operator *Op* added, is given by pragmatic context. A major drawback of these approaches is that these operators can not be appropriately constrained, so that they occur only where and when needed. [1]

Different solutions have been provided, where the operators are either constrained using a network of contigent aspectual relations (Moens and Steedman, 1988), a *qualia structure*, where the possible selections are enlisted beforehand (Pustejovsky, 1995) or underspecification in the selection is involved, where the functor does not combine immediately with an argument but there is space in between for other items to intervene, which are left underspecified (Egg, 2002).

The solution pursuit in this paper is different. Following Michaelis (2004) and Pustejovsky (1995), I develop a highly constructed inventory of eventuality types, which consists of eventualities as well as their subeventualities. These interact with grammatical aspect, which adds or selects the whole or subparts of the eventualities according to its selection restrictions. Hence,

[1] For a detailed discussion see Flouraki (2005).

there is no new material added by context but the one that is already there is appropriately constrained by grammatical aspect.

2 The analysis

2.1 Minimal Recursion Semantics

The analysis proposed uses Minimal Recursion Semantics (MRS) for the semantic representations Copestake et al. (2000). MRS is a metalanguage, which describes semantic structures within the framework of HPSG Pollard and Sag (1994). The object language may be any semantic theory ranging from predicate calculus to lambda-calculus and DRT. Semantic representations are shown using metavariables and relations between these metavariables. In this way partial semantic representations are given which allow underspecification to be used in such a way so as monotonic resolution of such partial semantic representations to be achieved. MRS deals mainly with scope ambiguities, where the key idea is that it is not necessary for a scope ambiguity to be resolved as yet at the semantic level. This can be achieved through underspecification.

For instance (7a), has two readings where *every* has wide scope in (7b) and narrow scope in (7c).

(7) a. Every woman loves some man.
b. $\forall x.woman'(x) \longrightarrow \exists y.man'(y) \wedge love'(x, y)$
c. $\exists y.man'(y) \wedge \forall x.woman'(x) \longrightarrow love'(x, y)$

In order to achieve underspecification and at the same time be able to retrieve the correct scopal readings, a flat representation is used as well as metavariables. Each lexeme corresponds to an *elementary predication (EP)*, which is a relation with its associated arguments. Every such relation is identified by a metavariable (*handle*), which should be thought of as grabbing hold of a particular *EP* and connecting it with the other *EPs*. The handles are represented with the metavariables h1, h2, ... whereas the underspecified handles hA and hB capture multiple scopes as shown in (8).

(8) *h1:every(x,h2,hA), h2:woman(x), h3:some(y,h4,hB), h4:man(y), h5:love(x,y)*

The key ideas behind MRS may be easily captured in the feature structure representation of HPSG. Thus a semantic object is created of the type *mrs* in (9), which has appropriate attributes and values. It introduces a bag of *EPs* represented as a list that functions as the value of the feature RELS, a list of constraints on the scopal relations among the *EPs* represented by the feature H-CONS and the HOOK feature. The RELS and HCONS attributes are always accumulated. The variable equivalence is represented by coindexation.

(9)
$$\begin{bmatrix} \textit{mrs} \\ \text{HOOK} \begin{bmatrix} \text{LTOP } \textit{handle} \\ \text{INDEX } \boxed{z} \end{bmatrix} \\ \text{RELS} \left\langle \begin{bmatrix} \textit{every-rel} \\ \text{LBL } \boxed{1}\ \textit{handle} \\ \text{ARG } \boxed{x}\ \textit{ref-ind} \\ \text{RESTR } \boxed{2}\ \textit{handle} \\ \text{BODY } \textit{handle} \end{bmatrix}, \begin{bmatrix} \textit{woman-rel} \\ \text{LBL } \boxed{3}\ \textit{handle} \\ \text{ARG } \boxed{x}\ \textit{ref-ind} \end{bmatrix}, \begin{bmatrix} \textit{love-rel} \\ \text{LBL } \boxed{4} \\ \text{ARG1 } \boxed{x}\ \textit{ref-ind} \\ \text{ARG2 } \boxed{y}\ \textit{ref-ind} \\ \text{ARG3 } \boxed{z} \end{bmatrix}, \begin{bmatrix} \textit{some-rel} \\ \text{LBL } \boxed{5}\ \textit{handle} \\ \text{ARG } \boxed{y}\ \textit{ref-ind} \\ \text{RESTR } \boxed{6}\ \textit{handle} \\ \text{BODY } \textit{handle} \end{bmatrix}, \begin{bmatrix} \textit{man-rel} \\ \text{LBL } \boxed{7}\ \textit{handle} \\ \text{ARG } \boxed{y}\ \textit{ref-ind} \end{bmatrix} \right\rangle \\ \text{H-CONS} \left\langle \begin{bmatrix} \textit{qeq} \\ \text{HARG } \boxed{2} \\ \text{LARG } \boxed{3} \end{bmatrix}, \begin{bmatrix} \textit{qeq} \\ \text{HARG } \boxed{6} \\ \text{LARG } \boxed{7} \end{bmatrix} \right\rangle \end{bmatrix}$$

Both quantifiers *every* and *some* introduce scopal relations, which are represented as feature structures of type *every-rel* and *some-rel* respectively. They have as appropriate features a label (LBL), which identifies them and an argument (ARG), which corresponds to the bound variable argument. Moreover, there is a RESTR feature which represents the object they bind with and a BODY feature which shows the object they scope over. Both these features are left underspecified, since there is scopal ambiguity.

The verb *love* is represented as a *love-rel*, which is not scopal. Hence, the RESTR and the BODY attributes are not needed but only the feature LBL is introduced along with appropriate arguments for the relation. These arguments show the participants in the relation i.e. ARG x and ARG y as well as the eventuality type introduced (ARG z). This is coindexed with the INDEX feature in HOOK, which represents the eventuality type of the whole phrase.

HOOK "is used to group together the features that specify the parts of an MRS which are visible to semantic functors" (Copestake et al. (2000):24). In semantic composition the HOOK of the mother is always the HOOK of the semantic head daughter. The LTOP remains underspecified if the *EP* that takes scope over everything else is a quantifier. In this way it is guaranteed that no quantifier takes scope over the other so as the representation remains underspecified.

Each lexical item has a single distinguished main EP, which is captured by the feature KEY. In case of a phrase all the other EPs either share a label with the key EP, or are equal to it, or are equal to a scopal argument of the key EP. Usually the key EP is equal to the LTOP unless it is a floating EP in which case it is left underspecified as is the case in (9).

The *EPs* are connected with each other through an outscopes relation represented in H-CONS. An EP E immediately outscopes an EP E', if the value of one of the handle taking arguments of E is the label of E'.

2.2 MRS in Aspectual Representations

As we saw in section 1 in M.G. grammatical aspect and eventuality types are represented within the verbal lexeme itself. Hence, having in mind the *mrs* architecture as presented in 2.1, we have to enrich the semantic representation of the *verb-rel*, so as aspect to be represented. The arguments showing the participant roles stay as such but the third argument representing the verbal eventuality has to become more complex in order to show the aspectual interaction. Hence, ARG3 in (9) takes as value a feature structure, which is itself an *mrs* object introducing different relations.

These relations represent both the grammatical aspect functor and the eventuality type argument. They have to be introduced within the verbal lexeme since in M.G. grammatical aspect and eventuality types are instantiated in the verb. Koenig and Davis (2003) apply MRS to the lexemic level, where semantic decomposition is achieved by introducing more than one relation in the EP's semantic type. Based on that Bonami (2001) decomposes the verbal lexeme so as to accomodate the tense functor in French. In his analysis, the verbal lexeme introduces not one but three relations. There is a *tense-rel*, a *verb-rel* and an *asp-op-rel*, representing the contextual operators discussed in section 1. The idea is that the *asp-op-rel* binds with an eventuality through the BEV feature and reinterpets it into another eventuality with the EVY feature. Then the *tense-rel* combines with the reinterpreted eventuality through BEV as shown in (10).

(10)
$$\left[\text{RELS}\left\langle\begin{bmatrix}\textit{tense-rel}\\ \text{LBL } \boxed{1}\\ \text{SCOPE } \boxed{2}\\ \text{BEV } \boxed{y}\end{bmatrix},\begin{bmatrix}\textit{asp-op-rel}\\ \text{LBL } \boxed{2}\\ \text{EVY } \boxed{y}\\ \text{BEV } \boxed{x}\\ \text{SCOPE } \boxed{3}\end{bmatrix},\begin{bmatrix}\textit{verb-rel}\\ \text{LBL } \boxed{3}\\ \text{EVY } \boxed{x}\\ \text{ACTOR } \textit{idn-ind}\\ \text{UNDER } \textit{idn-ind}\end{bmatrix}\right\rangle\right]$$

Even though the reasoning behind Bonami's analysis is correct for reasons explained in section 1, I do not want any interference of the context or the introduction of contextual operators. Hence, in the case of aspectual composition, I claim that the relations introduced by the verbal lexeme are

just an aspectual relation of type *aspect-rel* and an eventuality relation of type *eventuality-rel*.

Each relation is part of an hierarchy of relations given in figure 1, where the *aspect-rel* is a subtype of the *scopal-rel*, which introduces the feature SCOPE. This means that this particular relation has to take scope over another one. The *eventuality-rel* is a subtype of the *non-scopal-rel*. The *aspect-rel* has as subtypes the perfective (*perf-rel*) and the imperfective relation (*imperf-rel*), corresponding to the perfective and imperfective aspect respectively. The *eventuality-rel* has as sutypes the eventualities *transition-rel*, which corresponds to accomplishments and achievements [2], *process-rel* and *state-rel*.

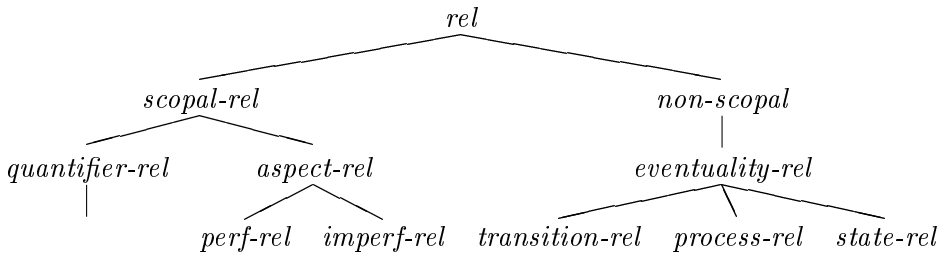

Figure 1: Hierarchy of relations

The *aspect-rel* introduces the features L(a)B(e)L and BINDS as indicated in (11). The LBL has as value the type *handle*, which identifies the relation and shows its scopal connection with the other relations. The *aspect-rel* combines with an eventuality through the BINDS feature and gives back the same or a different eventuality represented by the EVENT-STR(ucture) feature. Both BINDS and EVENT-STR take as value an *event-str*, which represents the subparts of the eventualities as we will see in the following section.

(11)
$$\begin{bmatrix} \textit{aspect-rel} \\ \text{LBL } \textit{handle} \\ \text{SCOPE } \textit{handle} \\ \text{EVENT-STR } \textit{event-str} \\ \text{BINDS } \textit{event-str} \end{bmatrix}$$

[2] This categorisation belongs to Pustejovsky (1991)

2.3 Subeventual templates

As was mentioned in section 1, a way to eliminate the contextual operator is to decompose the eventualities into subparts so as grammatical aspect to be able to select the appropriate subpart in each case.

Pustejovsky (1991) argues that the predicates have a subeventual structure, which provides a template for verbal decomposition and lexical semantics. In his theory there are three basic eventuality types: the states, the processes and the transitions. The states are evaluated relative to no other eventualities, while the processes denote a sequence of events which identify the same semantic expression. The transitions are complex types and equivalent to the accomplishments and achievements. These consist of a process and a state subevent and denote a transition from the process of an eventuality coming about, to the state of being about through the culmination point. Hence if we take the accomplisment *build the house*, the process lies on the steps that lead to the completion of the house whereas the state is its completion stage.

The ordering of these subevents is guaranteed by a temporal relation: *exhaustive ordered part of* ($\prec$) which denotes that a complex event e_3 consists of two subevents e_1 and e_2, where e_1 temporally precedes e_2. Hence, in the case of the accomplishments there is an event structure which consists of a process and a state and the process temporally precedes the state.

Achievements also consist of two subeventualities i.e. process and state and the process temporally precedes the state. In the achievement *reach the top*, the process of reaching the top precedes the state of being at the top.

In order to differentiate the accomplishements from the achievements Pustejovsky introduces another kind of relation: the *event headedness*. This "provides a way of foregrounding and backgrounding of event arguments" and indicates their "relative prominence". The head indicates the most prominent subevent which contributes to the 'focus' of interpretation. In the case of accomplishments the head is the process while in the case of achievements the head is the state. As far as the processes and states are concerned their head is underspecified since they consist only of one eventuality and the focus is on that eventuality anyway.

Following Pustejovsky (1991), I support that each *eventuality-rel* has an event structure (EVENT-STR), whose value is a feature structure, that consists of different subeventualities indicated by the features EVENT1 and EVENT2.

The *transition-rel* in (12) introduces apart from the attribute LBL, the attribute EVENT-STR, which takes as values a subeventual structure that consists of two eventualities. An EVENT1 with value a *process* type and an EVENT2 with value the *state* type. Their temporal ordering is guaranteed through the RESTRiction attribute, which states that there is a precedence temporal relation between the EVENT1 and the EVENT2.

(12)
$$\begin{bmatrix} \textit{transition-rel} \\ \text{LBL } \textit{handle} \\ \text{EVENT-STR } \boxed{3} \begin{bmatrix} \text{EVENT1 } \boxed{1}\textit{process} \\ \text{EVENT2 } \boxed{2}\textit{state} \\ \text{RESTR } \left\{ \boxed{1} \prec \boxed{2} \right\} \end{bmatrix} \end{bmatrix}$$

In order to differentiate the *accomplishment-rel* from the *achievement-rel* an extra feature is introduced: the feature EVentuality-FOCus , which takes as value one of the two subevents of the event structure. In the case of the accomplishments the EV-FOC has as value the EVENT1 as shown in (13), while in the case of achievements the EV-FOC has as value the EVENT2 (14).

(13)
$$\begin{bmatrix} \textit{accomplishment-rel} \\ \text{LBL } \textit{handle} \\ \text{EVENT-STR } \boxed{3} \left[\text{EV-FOC } \boxed{1} \right] \end{bmatrix}$$

(14)
$$\begin{bmatrix} \textit{achievement-rel} \\ \text{LBL } \textit{handle} \\ \text{EVENT-STR } \boxed{3} \left[\text{EV-FOC } \boxed{2} \right] \end{bmatrix}$$

The *process-rel* in (15) introduces an EVENT-STR, where there is only one eventuality attribute EVENT1, which denotes a *process*. The RESTR is left underspecified, since this *eventuality-rel* consists only of one subevent.

(15)
$$\begin{bmatrix} \textit{process-rel} \\ \text{LBL } \textit{handle} \\ \text{EVENT-STR } \boxed{3} \begin{bmatrix} \text{EVENT1 } \boxed{1}\textit{process} \\ \text{RESTR } \textit{restr} \end{bmatrix} \end{bmatrix}$$

The second step in the representation of aspectual meaning is to combine these subeventual templates with grammatical aspect.

2.4 Composition

The relations introduced by the verbal lexeme i.e. *aspect-rel* and *eventuality-rel* have to combine to denote the semantics of the overall verbal lexeme. The HOOK feature is introduced in order to achieve semantic composition. HOOK as we saw in section 2.1 has as values the LTOP and the INDEX. The LTOP is equated with the highest scopal relation and the INDEX represents the eventuality of the overall phrase.

In the case of the verbal EP in M.G. there is an interaction between grammatical aspect and eventuality types and this interaction indicates the

eventuality type of the overall verbal lexeme. This interaction is represented by the *aspect-rel* and the *eventuality-rel*. The *aspect-rel* has a fixed scope over the *eventuality-rel* and bears the feature SCOPE. How is then the LTOP of the overall EP determined? When there is a scopal combination the LTOP of the verbal EP is equated with the LTOP of the relation that bears the SCOPE feature and the INDEX is coreferential with the EVENT-STR of the relation that scopes over all the others.

(16)
$$\left[\begin{array}{l} \textit{mrs} \\ \text{HOOK} \left[\begin{array}{l} \text{LTOP } \boxed{1} \\ \text{INDEX } \boxed{4} \end{array}\right] \\ \text{RELS} \left\langle \left[\begin{array}{l} \textit{perf-rel} \\ \text{LBL } \boxed{1} \\ \text{SCOPE } \boxed{2} \\ \text{EVENT-STR } \boxed{4} \\ \text{BINDS} \left\langle \boxed{3} \right\rangle \end{array}\right], \left[\begin{array}{l} \textit{transition-rel} \\ \text{LBL } \boxed{2} \\ \text{EVENT-STR } \boxed{3} \left[\begin{array}{l} \text{EVENT1 } \boxed{4}\textit{process} \\ \text{EVENT2 } \boxed{5}\textit{state} \\ \text{RESTR} \left\{ \boxed{4} \prec \boxed{5} \right\} \end{array}\right] \end{array}\right] \right\rangle \end{array}\right]$$

In this way combination between grammatical aspect and eventuality types is achieved. Another issue that arises though is how we can indicate that grammatical aspect combines with certain eventuality types and changes nothing in their denotation while with others there are aspectual shifts as we saw in section 1. This is an issue, I am going to explore in the following section where certain selectional constraints on grammatical aspect will be introduced.

3 Aspectual combinations

Following Michaelis (2003, 2004), I support that as in Romance languages, perfective and imperfective aspect in M.G. are type-selecting operators reflecting the eventuality type of their arguments. Hence, the perfective functor in (17a) combines with non-stative eventualities and returns bounded ones while the imperfective functor in (17b) combines with stative ones and returns unbounded ones. Essentially the non-stative are equivalent to bounded and the stative to non-bounded.

(17) a. $\lambda e_{+BD}.perf(\lambda e'_{-ST}.write'(mary', the.letter')(e'))(e)$
b. $\lambda e_{-BD}.imperf(\lambda e'_{-ST}.run'(mary')(e'))(e)$

Even though these two classes of operators have a distinct function they both can potentially modulate when it is necessary the aspectual properties of their argument and both operators denote event types and place constraints upon the lexically expressed types they combine with. This kind of

combination between the functor and the argument is guaranteed with the *Aktionsart preservation principle*, which states that that no extra material is needed intervene in the functor argument relation. Michaelis supports that "In an aspectual mapping, whether implicit or explicit, input and output types must share some portion of their respective causal and/or temporal representations. " (Michaelis (2004):16)

The *Aktionsart Preservation principle* as well as the assumption that no extra material is needed interve in the functor-argument relation is the basis of the theory assumed here. Hence, the perfective and imperfective functor take as argument particular eventualities and when the argument is not the appropriate input for the functor then the functor selects or adds a subpart to the eventuality it combines with. The mechanism works thanks to the introduction of the subeventual structure where subeventualties can be added or chosen in each case.

In order to depict these selectional restrictions of grammatical aspect in HPSG, I assume that there is a perfective and an imperfective functor which place different constraints according to what the argument is.

3.1 Perfective functor

The perfective is a two argument functor F_{perf} defined in (18), which normally selects transition eventualities. Since the output of this functor is the same as the input, it is a type-selecting operator. This is guaranteed by the constrain in (18b) which states that when Y is an EVENT-STR of type *transition-rel*, which consists of EVENT1 with value *process* and EVENT2 with value *state*, then Z is equal to Y.

(18) a. $\mathrm{F}_{perf}(\mathrm{X},\mathrm{Y})=\mathrm{Z}$

b. if $\mathrm{Y}=\begin{bmatrix}\textsc{event1} & \textit{process}\\ \textsc{event2} & \textit{state}\end{bmatrix}$, then $\mathrm{Z} = \mathrm{Y}\begin{bmatrix}\textsc{event1} & \textit{process}\\ \textsc{event2} & \textit{state}\end{bmatrix}$

c. if $\mathrm{Y} =\left[\textsc{event1}\ \textit{process}\right]$, then $\mathrm{Z} = \mathrm{Y} \oplus\left[\textsc{event2}\ \textit{state}\right]$

However, the *perf-rel* may combine with a *process-rel* in which case the functor operates on the eventuality and adds a subeventuality to alter the whole event structure into a *transition-rel*. This is ensured by the constraint in (18c) which states that when Y is an eventuality consisting of EVENT1 of value *process*, then Z is equal to Y where the EVENT2 of value *state* is added with the add operation.

Hence, when there is a *transition-rel*, the *perf-rel* selects through the BINDS feature the whole EVENT-STR indicated with the tag [3] in figure 2. The output of this combination is the same as the input as it is licensed by the constraint in (18b).

$$\left[\begin{array}{l} \textit{mrs} \\ \textsc{hook}\ \left[\begin{array}{l}\textsc{ltop}\ \boxed{1}\\ \textsc{index}\ \boxed{6}\end{array}\right] \\ \textsc{rels}\ \left\langle \left[\begin{array}{l}\textit{perf-rel}\\ \textsc{lbl}\ \boxed{1}\\ \textsc{scope}\ \boxed{2}\\ \textsc{event-str}\ F_{perf}\left(\boxed{6},\boxed{3}\right)\\ \textsc{binds}\ \left\langle \boxed{3} \right\rangle\end{array}\right], \left[\begin{array}{l}\textit{transition-rel}\\ \textsc{lbl}\ \boxed{2}\\ \textsc{event-str}\ \boxed{3}\left[\begin{array}{l}\textsc{event}1\ \boxed{4}\textit{process}\\ \textsc{event}2\ \boxed{5}\textit{state}\\ \textsc{restr}\ \left\{\boxed{4} \prec \boxed{5}\right\}\end{array}\right]\end{array}\right] \right\rangle \end{array}\right]$$

Figure 2: combination perfective-transition

When the *perf-rel* combines with a *process-rel*, the constraint in (18c) is applied. Hence,the *perf-rel* selects an eventuality of type *process* through the BINDS feature but adds to it a *state* subevent that alters the *process* eventuality into a *transition* in figure 3.

$$\left[\begin{array}{l} \textit{mrs} \\ \textsc{hook}\ \left[\begin{array}{l}\textsc{ltop}\ \boxed{1}\\ \textsc{index}\ \boxed{6}\end{array}\right] \\ \textsc{rels}\ \left\langle \left[\begin{array}{l}\textit{perf-rel}\\ \textsc{lbl}\ \boxed{1}\\ \textsc{scope}\ \boxed{2}\\ \textsc{event-str}\ F_{perf}\left(\boxed{6},\boxed{3}\right)\\ \textsc{binds}\ \left\langle \boxed{3} \right\rangle\end{array}\right], \left[\begin{array}{l}\textit{process-rel}\\ \textsc{lbl}\ \boxed{2}\\ \textsc{event-str}\ \boxed{3}\left[\begin{array}{l}\textsc{event}1\ \boxed{1}\textit{process}\\ \textsc{restr}\ \textit{restr}\end{array}\right]\end{array}\right] \right\rangle \end{array}\right]$$

Figure 3: combination perfective-process

3.2 Imperfective functor

The imperfective functor consists of two arguments and is a type-selecting operator as well. It selects process eventualities and returns an output of the same eventuality as the input. When it combines with transition eventualities, it selects only the *process* subeventuality which is appropriate for its selection type.

This is guaranteed with the constraint in (19b), where when the input is a *process* the output is a *process* as well. When the input is a *transition* then the output is just the *process* subevent (19c).

(19) a. $F_{impf}(X,Y) = Z$

b. if Y=$\left[\text{EVENT1 } \textit{process}\right]$, then Z= Y$\left[\text{EVENT1 } \textit{process}\right]$

c. if Y =$\begin{bmatrix}\text{EVENT1 } \boxed{1}\textit{process}\\ \text{EVENT2 } \boxed{2}\ \textit{state}\end{bmatrix}$, then Z =$\left[\text{EVENT1= } \boxed{1}\ \textit{process}\right]$

When the imperfective functor indicated by the *imperf-rel* combines with eventualities of type *process-rel*, it selects through the BINDS feature the whole EVENT-STR of the *eventuality-rel*. The EVENT-STR of the *imperf-rel* is the same as the EVENT-STR of the *process-rel* and this is indicated with the coindexing of the tag [3] in figure 4.

$$\begin{bmatrix} \textit{mrs} & & \\ \text{HOOK} & \begin{bmatrix}\text{LTOP } \boxed{1}\\ \text{INDEX } \boxed{6}\end{bmatrix} & \\ \text{RELS} & \left\langle \begin{bmatrix}\textit{imperf-rel}\\ \text{LBL } \boxed{1}\\ \text{SCOPE } \boxed{2}\\ \text{EVENT-STR } F_{impf}\left(\boxed{6},\boxed{3}\right)\\ \text{BINDS } \boxed{3}\end{bmatrix}, \begin{bmatrix}\textit{process-rel}\\ \text{LBL } \boxed{2}\\ \text{EVENT-STR } \boxed{3}\begin{bmatrix}\text{EVENT1 } \boxed{1}\textit{process}\\ \text{RESTR } \{\}\end{bmatrix}\end{bmatrix} \right\rangle \end{bmatrix}$$

Figure 4: combination imperfective-process

When the *transition-rel* combines with the *imperf-rel*, then the *imperf-rel* strips the *transition-rel* of its culmination point and consequent state which is the EVENT2 (figure 5). This is guaranteed by the constraint in (19c).

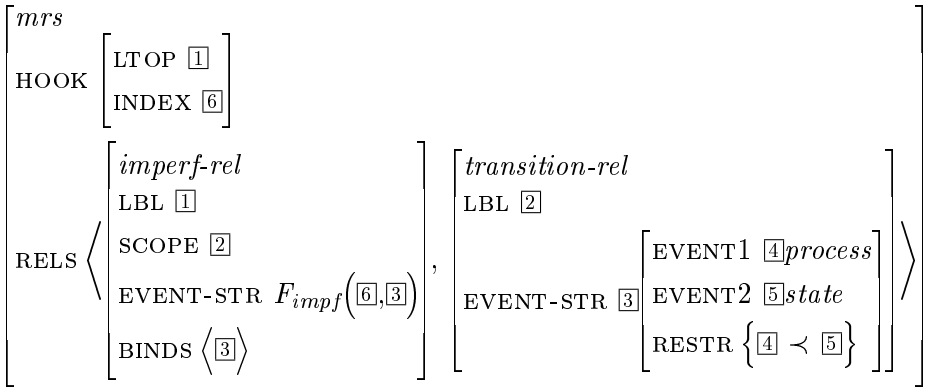

Figure 5: combination imperfective-transition

4 Conclusion

In this paper, I have presented a formal analysis of the combination between grammatical aspect and eventuality types. I have shown that in M.G., there are eventuality types , which combine with the morphologically overt grammatical aspect. This combination triggers particular meanings, which depend on the eventuality type used. There is the view that when the meanings inferred are the non-standard ones, then they can be explained with the use of contextual operators.

I argue against such a contextual interpretation on the ground that it is not possible to appropriately constrain contextual operators. Thus, I provide an analysis where the eventualities consist of subeventual templates and grammatical aspect selects each time an appropriate subeventuality as input according to its selectional restrictions. Particular meanings are inferred which are already there in the denotation of the eventuality and they just need to be picked up by grammatical aspect. Hence, no extra material is needed intervene in the denotation.

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