Constraining Aspectual Composition*

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1 Introduction

Aspectual composition occurs when grammatical aspect (perfective and imperfective) and eventuality types (accomplishments, achievements, processes, states) 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).

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 (1) 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 (1a), it retains its culmination point and the meaning does not change. When the same eventuality combines with imperfective aspect, it gets a shifted reading (1b) i.e. process or habitual reading. It is no longer visible when *the letter* reaches a culmination and if it actually does.

(1) 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)

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In (2) 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 (2a), it gets the default meaning of the eventuality, where no culmination point is denoted and no visible endpoints. In (2b) 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 we get a bounded reading.

(2) 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)

The aspectual shifts involved are subtypes of type shifts, which in the literature are formalised with the usage of a functor argument relation: $f(a)$, where f is the functor and a the argument. In the case of aspectual shifts, there is a functor-argument relation between grammatical aspect and eventuality types (3):

(3) *aspect(eventuality type)*

Aspect is further instantiated into the perfective functor, which normally takes as argument accomplishments and achievements (4a) and the imperfective functor which combines with processes and states (4b).

(4) a. $perfective(accomplishment; achievement)$
b. $imperfective(process; state)$

There are cases where the argument is not the appropriate input for the functor, that is the perfective aspect combines with processes and states (2b) and the imperfective with accomplishments and achievements (1b). However, there is no ungramaticality involved but just reinterpretations occur, which remedy the conflict.

An explanation for these reinterpretations lies in the sphere of extralinguistic knowledge. This is captured by the introduction of a *coercion function G* in Jackendoff (1997), *free variables* in Pulman (1997), *coercion operators* in de Swart (1998). 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.

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

2 The analysis

The analysis proposed follows the framework of Head-Driven Phrase Structure Grammar (HPSG) (Pollard and Sag 1994), using 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. 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 a monotonic resolution of such partial semantic representations to be achieved.

Following MRS architecture, we introduce a number of relations, which represent both the grammatical aspect functor and the eventuality type argument given in (3). These relations have to be introduced within the verbal lexeme since in M.G. grammatical aspect and eventuality types are instantiated in the verb. Following Koenig and Davis (2003), we apply MRS to the lexemic level, where semantic decomposition is achieved by introducing more than one relation in the EP's semantic type. Hence, in the case of aspectual composition, I claim that the relations introduced by the verbal lexeme are 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 (Pustejovsky 1995), *process-rel* and *state-rel*.

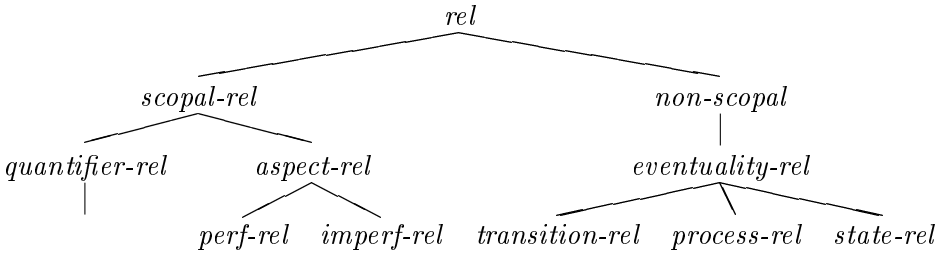

Figure 1: Hierarchy of relations

The *aspect-rel* also introduces the features L(a)B(e)L and BINDS as indicated in (5). The LBL has as value the type *handle*, which identifies the relation and shows its scopal connection with the other relations. The BINDS feature shows the eventuality the *aspect-rel* has to bind with. There is also the event structure EVENT-STR feature because the *aspect-rel* combines with an eventuality through the BINDS feature and gives back the same or a different eventuality which is shown with the EVENT-STR feature.

(5)
$$\begin{bmatrix} \textit{aspect-rel} \\ \text{LBL } \textit{handle} \\ \text{EVENT-STR } \textit{event-str} \\ \text{BINDS } \textit{event-str} \\ \text{SCOPE } \textit{handle} \end{bmatrix}$$

2.1 Subeventual templates

The eventualities are decomposed into subparts so as grammatical aspect to be able to select the appropriate subpart in each case. Following Pustejovsky (1995), we 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 (6) introduces apart from the attribute LBL, the attribute EVENT-STR, which has two subeventualities. An EVENT1 with value the *process* type and an EVENT2 with value the *state* type. Their temporal ordering is guaranteed through the RESTR(iction) attribute, which states that there is a precedence temporal relation between EVENT1 and EVENT2.

(6)
$$\begin{bmatrix} \textit{transition-rel} & \\ \text{LBL } \textit{handle} & \\ \text{EVENT-STR } \boxed{3} & \begin{bmatrix} \text{EVENT1 } \boxed{1}\textit{process} \\ \text{EVENT2 } \boxed{2}\textit{state} \\ \text{RESTR } \left\{\boxed{1} \prec \boxed{2}\right\} \end{bmatrix} \end{bmatrix}$$

The *process-rel* in (7) 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.

(7)
$$\begin{bmatrix} \textit{process-rel} & \\ \text{LBL } \textit{handle} & \\ \text{EVENT-STR } \boxed{3} & \begin{bmatrix} \text{EVENT1 } \boxed{1}\textit{process} \\ \text{RESTR } \textit{restr} \end{bmatrix} \end{bmatrix}$$

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

3 Aspectual combinations

Following Michaelis (2003, 2004), we support that as in the Romance languages, perfective and imperfective aspect in M.G. are type-selecting operators, which reflect the eventuality type of their arguments. They modulate when it is necessary the aspectual properties of their argument and both denote eventuality types and place constraints upon the types they combine with. This kind of combination is guaranteed by the *Aktionsart preservation principle*, where no extra material is needed intervene in the functor argument relation.

Hence, perfective and imperfective functor take as argument particular eventualities and when the argument is not the appropriate input, the functor selects or adds a subpart to the eventuality it combines with. The mechanism works thanks to the introduction of subeventual structure, where subeventualties can be added or chosen in each case. Thus, perfective and imperfective functor place different constraints according to what the argument is.

3.1 Perfective functor

The perfective is a two argument functor F_{perf} defined in (8), 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 (8b) 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.

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 (8c) 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.

(8) a. $F_{perf}(X,Y)=Z$

b. if $Y=\begin{bmatrix}\text{EVENT1}\ \textit{process}\\ \text{EVENT2}\ \textit{state}\end{bmatrix}$, then $Z = Y\begin{bmatrix}\text{EVENT1}\ \textit{process}\\ \text{EVENT2}\ \textit{state}\end{bmatrix}$

c. if $Y = \left[\text{EVENT1}\ \textit{process}\right]$, then $Z = Y \oplus \left[\text{EVENT2}\ \textit{state}\right]$

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 (9). The output of this combination is the same as the input as it is licensed by the constraint in (8b).

(9)
$$\begin{bmatrix} \textit{mrs} \\ \text{RELS}\left\langle \begin{bmatrix} \textit{perf-rel} \\ \text{LBL}\ \boxed{1} \\ \text{SCOPE}\ \boxed{2} \\ \text{EVENT-STR}\ F_{perf}\left(\boxed{6},\boxed{3}\right) \\ \text{BINDS}\left\langle \boxed{3} \right\rangle \end{bmatrix}, \begin{bmatrix} \textit{transition-rel} \\ \text{LBL}\ \boxed{2} \\ \text{EVENT-STR}\ \boxed{3}\begin{bmatrix} \text{EVENT1}\ \boxed{4}\textit{process} \\ \text{EVENT2}\ \boxed{5}\textit{state} \\ \text{RESTR}\left\{\boxed{4} \prec \boxed{5}\right\} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

When the *perf-rel* combines with a *process-rel*, the constraint in (8c) 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* (10).

(10)
$$\begin{bmatrix} \textit{mrs} \\ \text{RELS}\left\langle \begin{bmatrix} \textit{perf-rel} \\ \text{LBL}\ \boxed{1} \\ \text{SCOPE}\ \boxed{2} \\ \text{EVENT-STR}\ F_{perf}\left(\boxed{6},\boxed{3}\right) \\ \text{BINDS}\left\langle \boxed{3} \right\rangle \end{bmatrix}, \begin{bmatrix} \textit{process-rel} \\ \text{LBL}\ \boxed{2} \\ \text{EVENT-STR}\ \boxed{3}\begin{bmatrix} \text{EVENT1}\ \boxed{1}\textit{process} \\ \text{RESTR}\ \textit{restr} \end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

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 (11), where when the input is a *process* the output is a *process* as well (11b). When the input is a *transition* then the output is just the *process* subevent (11c).

(11) a. $F_{imperf}(X,Y) = Z$

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].

(12)
$$\begin{bmatrix} \textit{mrs} \\ \text{RELS} \left\langle \begin{bmatrix} \textit{imperf-rel} \\ \text{LBL } \boxed{1} \\ \text{SCOPE } \boxed{2} \\ \text{EVENT-STR } F_{imperf}\left(\boxed{6},\boxed{3}\right) \\ \text{BINDS } \boxed{3} \end{bmatrix}, \begin{bmatrix} \textit{process-rel} \\ \text{LBL } \boxed{2} \\ \text{EVENT-STR } \boxed{3}\begin{bmatrix}\text{EVENT1 } \boxed{1}\textit{process}\\ \text{RESTR } \{\}\end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

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 (13). This is guaranteed by the constraint in (11c).

(13)
$$\begin{bmatrix} \textit{mrs} \\ \text{RELS} \left\langle \begin{bmatrix} \textit{imperf-rel} \\ \text{LBL } \boxed{1} \\ \text{SCOPE } \boxed{2} \\ \text{EVENT-STR } F_{imperf}\left(\boxed{6},\boxed{3}\right) \\ \text{BINDS } \left\langle \boxed{3} \right\rangle \end{bmatrix}, \begin{bmatrix} \textit{transition-rel} \\ \text{LBL } \boxed{2} \\ \text{EVENT-STR } \boxed{3}\begin{bmatrix}\text{EVENT1 } \boxed{4}\textit{process}\\ \text{EVENT2 } \boxed{5}\textit{state}\\ \text{RESTR } \left\{\boxed{4} \prec \boxed{5}\right\}\end{bmatrix} \end{bmatrix} \right\rangle \end{bmatrix}$$

4 Conclusion

Through the account provided we have shown that 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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