

## The Aspectual Type BEGIN

Mariana Damova and Sabine Bergler

Computer Science Department, Concordia University, 1455 de Maisonnauve blvd. W,  
Montreal (Quebec), Canada, H3G 1M8, e-mail: {damova,bergler}@cs.concordia.ca

---

### Abstract

This paper deals with the notion of aspect as it is understood in the eventuality structure based formal approaches to aspect. These approaches typically link aspect to the interpretation of the philosophical and ontological notion of event, seen as a conceptual entity with rigid edges: *beginning*, *protraction* and *end*, and analyse and study extensively the *end* part of events ((Vendler, 1967), (Moens & Steedman, 1988), (Smith, 1991), (Pustejovsky, 1991), (Krifka, 1989), (Partee, 1984), (Hinrichs, 1986), etc.). The *beginning*, a semantic counterpart of the culmination on the other hand, has not been discussed so much at large. We analyse various language means that convey *beginning* and argue for the need of a mechanism to provide a uniform interpretation for them. We define the aspectual type BEGIN, and develop its semantic representation along the general lines of accounts of temporal reference of Discourse Representation Theory ((Kamp, 1979); (Kamp & Reyle, 1993)). We extend the DRT analysis of tense and aspect in postulating a three layered formal representation for aspect. The aspectual type BEGIN introduces a DRS aspectual operator, instead of a temporal discourse referent. We embed its explicit event structure into the operator's definition, by adopting Pustejovsky's formalisation (Pustejovsky, 1995). We show that the proposed approach represents the aspectual type BEGIN correctly across categories, that is, it works on all relevant levels: lexical semantics, grammatical devices, secondary predication, discourse, and it covers the semantics of BEGIN in a uniform way.

---

### 1. Introduction

Consistent and comprehensive formalisation of language phenomena is an important part in the building of natural language processing systems, based on logical approaches. Tense and aspect are the language phenomena which convey information about temporal reference in texts, and establish the temporal cohesive links between sentences. Singling out events in sequences of sentences is essential for the proper representation of the temporal structure of texts. The governing principles of the temporal reference postulate that *events* push the narrative time forward, whereas *states* do not ((Partee, 1984), (Hinrichs, 1986), (Kamp, 1979), (Kamp & Rohrer, 1988), (Kamp & Reyle, 1993), (Sandström, 1993), (Eberle, 1991), etc.). Determining whether an *event* or a *state* is described by the analysed language expressions depends on the ontological properties of the *states of affairs* or *eventualities* ((Bach, 1986), (Moens & Steedman, 1988), (Kamp & Reyle, 1993), etc.) they reflect. *States of affairs* or *eventualities* are typically

classified according to the intrinsic temporal parameters - *temporal extendedness* and *terminal point* - characterising them ((Vendler, 1967), (Bach, 1986), (Pustejovsky, 1991), (Krifka, 1989), (Moens & Steedman, 1988), (Smith, 1991)): (i) eventualities can be *punctual* as described by the verb *to die* or *to knock* and *protracted* as described by the verbs *to run* or *to work*; (ii) eventualities can be *telic* as in the expression *write a letter* or *atelic* as in the expression *walk in the park*. These parameters pertaining to the internal temporal profile of the eventualities described by language expressions are referred to in the literature as *aspectual*, and aspect is represented in terms of ontological schemes of event structure with components: protraction, culmination, consecutive state.

The temporal reference properties of language expressions in the approaches we consider in the present paper depend on whether they describe an *event* or a *state* ((Partee, 1984), (Hinrichs, 1986), (Kamp, 1979), (Kamp & Rohrer, 1988), (Kamp & Reyle, 1993), (Sandström, 1993), (Eberle, 1991), etc.), e.g. on the ontological profile of the eventualities described. For example, in (Partee, 1984), (Hinrichs, 1986), (Moens & Steedman, 1988) *atelic* eventualities are considered as *states*, and *telic* eventualities with attained culmination are considered as *events* because of the different temporal relations of respectively overlap or sequence they establish with the current temporal referent. Especially in compositional frameworks ((Dowty, 1981), (Moens & Steedman, 1988), (Krifka, 1989), (Pustejovsky, 1991), (Smith, 1991)) evidence from English has shown that not only the ontological structure of single lexical items, but also their combination with tenses and types of arguments play distinguished roles in determining the ontological type of the eventuality described, and hence the temporal relations that could be invoked in discourse. Studies on tense and aspect usually focus on the *end*, the terminal point of the eventuality or event structure ((Vendler, 1967), (Bach, 1986), (Pustejovsky, 1991), (Krifka, 1989), (Moens & Steedman, 1988), (Smith, 1991)) because of the semantic, causal effects and different entailments triggered by attaining the culmination point. On the other hand, the *beginning*, an obvious, semantic counterpart of the culmination has been acknowledged, but not discussed much and at large in the literature. The analysis of its prototypical lexicalization - the verb *begin*, is mentioned in connection with discussions on the semantics of aspectual verbs in the framework of formal semantics (Dowty, 1981), and in a thorough theoretical syntax-semantics account on aspect (terMeulen, 1995). The aspectual composition model of (White, 1994) includes the component “*beginning*→*protraction*” into the ontological scheme of event structures encoded in a temporal reasoning system as discussed in (Steedman, 1997).

This paper explores a variety of language means that convey “*beginning*” and argues for the necessity of establishing means to account for them in a uniform way. We define *ASPECTUAL TYPES* to denote distinct parts of the internal temporal structure of eventualities. The aspectual type *BEGIN* in particular pertains to the initial part of a protracted eventuality and can be entailed in different ways. The verb *begin* is the prototypical case. Its complement can be realized by a verb form as in “*John began reading<sub>(verb\_form)</sub> a book*”, or implicitly through associating an event incorporated into the lexical semantics of a noun (Pustejovsky, 1991) as in “*John began<sub>[verb\_form e]</sub> a book*”. The verbs *commence*, *initiate*, *start*, *try*, *attempt* also entail the aspectual type *BEGIN*. Other language means like the syntactic structures, phrasal constructs, discourse relations, grammatical devices also entail the aspectual type *BEGIN*. We develop the semantic representation and the semantic construction of the aspectual type *BEGIN* within the framework of Discourse Representation Theory (Kamp & Reyle, 1993). We show that this approach represents aspectual type correctly, across categories, that is, it works on different levels - lexical semantic, grammatical, secondary predication, etc. We propose a semantic representation of

BEGIN that accounts uniformly for all these linguistic devices.

## 2. Lexicalization of the Aspectual Type BEGIN

English verbs like *begin*, *start*, *cease*, *resume*, *end*, *stop* are called *aspectual* (Dowty, 1981) because of their lexical semantics. They pertain to the temporal structure of the eventuality described by its syntactic complement. Depending on their lexical semantics, they select for particular eventuality types for their complements. The complement of *begin* has to be a protracted eventuality - a *process*, or a *state*<sup>1</sup>. Examples (1) and (2) show this:

- (1) Meanwhile, Northrop's own board *began* inquiring<sub>(process)</sub> about what happened to the hotel – the Seoul Palace, it was to be called – and the \$6,250,000. It was at that point, the filing alleges, that a cover-up<sub>(process)</sub> *began*.

(WSJ 89-10-27)

- (2) There had been times, lately, when he had *begun* to wonder<sub>(state)</sub> whether he was entirely suited to the career in which he had been launched some fifteen years earlier, not so much by personal choice as by the mere impetus of his remarkable First.

(David Lodge, *Changing Places*)

The verb *begin* is a special marker in the process of temporal reference resolution in texts. As it is the case with any full verb, its tensed forms keep the cohesiveness of discourse by introducing temporal referents which can be anaphorically referred back to or anchor the temporal reference point. On the other hand, its semantics affects the temporal structure of its complement. This role of the aspectual verb *begin* is semantically “auxiliary” in the way English *tenses* and *the progressive* are. It refers to a specific phase of the eventuality described by its complement, and is naturally interpreted as a part of the eventuality described by their complement. This is the way it is interpreted in the compositional accounts referred to earlier in our discussion.

But, the lexical semantics of *begin*, referring to the initial point of a protracted eventuality, has particular consequences for the semantics of single clauses and discourse that have not been accounted for. We consider some of them.

The occurrence of *begin* in a sentence plays the role of a disambiguation factor for the eventuality type of its syntactic complement. For example, punctual eventualities - *points* or *achievements* - typically have two possible interpretations. They either describe the single occurrence of the punctual eventuality or the process of repeated (habitual) occurrences of the punctual eventuality. For example, the verbs *kick*, *sneeze*, *win*, *see*, *spot* are classified as points, but if particular context is in place they are interpreted as *processes*, e.g. their eventuality type is coerced into another, compatible one ((Moens & Steedman, 1988), (Pustejovsky, 1995), etc.). When *begin* combines in a sentence with a verb describing an instantaneous situation like *kick*, *sneeze*, *win*, *see*, *spot*, it enforces the type coercion of their prototypical classification as *points* into protracted *processes*, and excludes their punctual episodic reading. The sentence in example 3(a) describes the *beginning* of a process of repeated *kicking*, and the sentence in example 3(b) describes the *beginning* of the state of *being aware*, as *see* here must be interpreted in its metaphorical meaning of *understand*.

---

<sup>1</sup>In the terminology of (Moens & Steedman, 1988), (Kamp & Reyle, 1993), (Smith, 1991), (Vendler, 1967), (Bach, 1986), (Partee, 1984), (Eberle, 1992), etc.

- (3) a. John began kicking the ball.  
 b. John began to see the point of that argument.

This is due to the inferential effects of the lexical semantics of *begin*. The aspectual verb *begin* in 3(a) and 3(b) predictably enforces the coercion of a punctual complement verb into a *process*. Thus, we see it as: (i) an independent lexical unit with appropriate characteristics - an eventuality with internal temporal structure (*aktionsart class* (Vendler, 1967)), as any other verb; grammatical paradigm (tenses, progressive forms); and (ii) a semantically integral part of the eventuality described by its complement - formally it can be regarded as part of the eventuality described by its complement. Thus, the functional role of the verb *begin* requires particular representation, since it has to be made technically accessible as an independent semantic item. It also has to be considered as part of the eventuality described by its complement. We argue that in order to be able to capture and correctly represent the role of *begin* in texts, we are in need of two theoretical notions: one to account for its semantic function and one to account for its discourse representation function.

Generally, the syntactic role of *begin* as a main verb implies its role as a carrier of the tense marking and of the information which establishes the temporal cohesive links with the surrounding discourse. Example (4) shows that the referent introduced by the tensed verb *begin* temporally connects with the rest of the discourse. The when-clause of (4) is temporally located with respect to the *beginning* and not to the *letter writing*, described by the main clause itself, which arguably may never have proceeded any further.

- (4) John began to write a letter to Mary when he received this message from her.

On the other hand, example (5) illustrates that in some cases not the *beginning*, but the initiated process is anaphorically referred to in subsequent sentences. The eventuality described by the second sentence of (5), in fact, refers anaphorically back to the process described by the complement verb, and not to its beginning. *Begin* here initiates the flow of narrative time (Webber, 1988).

- (5) John began to write a letter to Mary last night. He finished it by 2:00 am.

Some cases of temporal reference involving the verb *begin* are ambiguous. The pronoun *it* of the second sentences of examples 6(a)-(d) could be interpreted as referring back either to the *beginning*, described by the verb *begin* or to the *initiated processes*, described by the complement verbs *diet*, *walk*, *kick*, and *win*. This ambiguity does not have to be resolved if it does not impact subsequent interpretation, but it is not difficult to add the appropriate context which will prove the necessity of having a way to keep these two possible interpretations separate.

- (6) a. John began dieting. I saw it on his pants.  
 b. John began to give his talk. I saw it on TV.  
 c. The baby began to walk. His mother was very excited because she saw it.  
 d. John began to win in his chess club. His friends could not believe it.

So, the first sentences of (5) and 6(a)-(d) contain two eventualities each: (i) the start, which is described by the syntactically governing, and semantically auxiliary verb *begin*, and (ii) the

## The Aspectual Type BEGIN

complement process, which is described by the syntactically subordinated, yet semantically topical eventuality. Both can be referred to anaphorically by subsequent sentences.

The role of the aspectual type BEGIN and its prototypical lexicalization the aspectual verb *begin* in embedded discourse gives another reason to look more precisely at their semantics. The inferential context triggered by the lexical meaning of the aspectual verb *begin* even allows for the construction of a well-formed embedded discourse, where pronoun and anaphoric antecedent are separated by several sentences, and provides relevant information for correctly resolving the established anaphoric links. For example, the pronoun *it* in the last sentence of discourse (7) refers back to the process of *singing*, described in the complement of the verb *begin* in its first sentence.

- (7) John *began* singing<sub>i</sub>. He was in a good mood. He had spent a marvelous week end. He went to that famous island. The weather was nice, his company bearable, the atmosphere relaxing. Unfortunately, he was off key. He had never had an ear for music. “Stop it<sub>i</sub>!” someone shouted.

So, the discourse referent introduced by the process of *singing* has to remain accessible for later reference. This evidence shows that in order to be able to build the formal structure of discourses containing the verb *begin* or aspectual verbs in general, we have to provide means to make both the eventuality described by the verb *begin* and the eventuality described by its complement accessible for anaphoric reference.

A further reason to search for representing the aspectual verb *begin* and its complement separately is the fact that *begin* may occur in the progressive, which itself has aspectual meaning. The sentences in 8(a)-(c) with the verb *begin* in progressive convey situations in which the *beginning* of the process at stake is described as coming about.

- (8) a. He was beginning to play soccer.  
b. He was beginning to learn Spanish.  
c. He was finally beginning to build a house.

Furthermore, the progressive of the verb *begin* conveys the expected temporal relation of overlap with the eventuality described by an adjacent clause. For example, the *when* clauses of sentences 9(a)-(b) describe eventualities which overlap with the intended *beginning* and not with the process of the complement verb.

- (9) a. John was beginning to run, when the rain started.  
b. He was beginning to paint the walls in his kitchen, when the doorbell rang.

Thus, on the one hand, *begin* signals the starting point of the process described by its complement, on the other hand the progressive modifies the situation referred to with *begin* as imminent. This phenomenon has obviously a semantic effect and communicational value which need to be accounted for.

We claim that the semantic dichotomy exhibited by the aspectual verb *begin* requires more than one theoretical notion, e.g. it is necessary to make explicit on the one hand the relation of the verb *begin* to the eventuality described by its complement verb, and on the other hand its functional role in texts as provider of cohesive and inferential information (through tense, progressive, lexical semantics, etc.).

### 3. Language Devices Incorporating the Aspectual Type BEGIN

The aspectual verb *begin* is not the only way of conveying the aspectual type BEGIN. There are other lexical and periphrastic language devices in English with the same semantic effect. We are going to mention the most prominent ones.

Intentional predicates like *try* and *attempt* also carry in their semantics a parameter which evokes the aspectual type BEGIN. This can be seen in the extended contexts of examples 10(a)-(c).

- (10) a. John attempted to reach the station on time, but traffic did not let him.  
b. John attempted to read the book on time, but that accident had caught his attention for a while.  
c. John attempted to go to the movie theatre, but he met his old friend Jack on the way.

Each second sentence in 10(a)-(c) gives a reason why the result, e.g. the taking place of the eventuality of the intentional predicate's complement, could not be realized. We associate this argument with the argument Landman (Landman, 1992) raises in his paper on the progressive. In it he gives a formal account for the progressive in a neodavidsonian framework by introducing the notion of *partial event* and describing the progressive as conveying *partial events*. The notion of *partial event* accommodates very conveniently the interpretation of intentional predicates such as *try* and *attempt*, whose semantics is analysed as close to the semantics of the English progressive. On the other hand they can be interpreted as containing in their semantics a presupposition of the aspectual type BEGIN.

Sentences with achievement verbs in simple past typically describe resultative situations. There exist however some regular syntactic alterations which modify the semantic effect of achievements. Such an alteration is the attachment of prepositional phrase with the preposition *at* as second argument of normally transitive verbs (Levin, 1993). Thus, while the sentence in 11(a) describes at least one event of stabbing, where the knife has penetrated the ham, sentence 11(b) describes a situation where the stabbing of the ham may not actually have taken place, but has at least been initiated, e.g. repeated attempts have been made to stab the ham. This alteration of transforming a transitive achievement describing verb into an intransitive activity describing verb is known in the literature as inchoative (Levin, 1993). The semantics of the verb *stab at* is thus close to the semantic effect of the aspectual verb *begin* in 11(c), which also describes an initiated process, where penetration of the knife may or may not occur.

- (11) a. John stabbed the ham with a knife.  
b. John stabbed at the frozen ham with a knife.  
c. John began stabbing the ham with a knife.

These examples show that different syntactic patterns lead to the same semantic interpretation, referring to the aspectual type BEGIN.

Not only verbs or verb alterations have as part of their semantics the meaning of the aspectual type BEGIN. The combination of the meanings of some adverbials with the meaning of some verbs triggers the same semantic effect. It can only be recognised after the entire sentence is processed. An example of this kind of phenomenon is the combination of punctual adverbial

modifiers and process describing predicates of verbs in simple past. The sentences in 12(a)-(c) trigger inchoative context, which in our approach corresponds to the aspectual type BEGIN. Its interpretation is semantically identical with the interpretation of the verb *begin* combined with its complement.

- (12) a. Suddenly John knew the answer.  
b. John sang at once.  
c. John began to know the answer.

Only a special semantic construction rule is necessary to ensure the correct semantic representation.

#### **4. Representation of the Aspectual Type BEGIN**

We develop the semantic representation of the aspectual type BEGIN along the general lines of accounts of temporal reference of Discourse Representation Theory ((Kamp, 1979); (Kamp & Reyle, 1993)). We extend the DRT analysis of tense and aspect in postulating a three layered formal representation for aspect, which gives a unified account to cope with single expressions and entire texts. The aspectual type BEGIN introduces a DRS aspectual operator, instead of a temporal discourse referent. Its meaning is described in a meaning postulate, and does not appear in the DRS of the processed discourse. This captures one of the semantic features of BEGIN, namely the function of modifier of its complement eventuality. In order to adequately represent this modification, we embed the explicit event structure account of Pustejovsky (Pustejovsky, 1995) into the operator's definition, e.g. its meaning postulate. The DRT discourse referents *event* and *state* remain operative in the DRS. We adopt their definitions in order to represent the discourse semantics effects of aspect and the aspectual type BEGIN. We show that the proposed approach represents the aspectual type BEGIN correctly across categories, that is, it works on the levels of lexical semantics, grammatical devices, secondary predication, discourse, etc., and it covers the semantics of BEGIN in a uniform way.

##### **4.1. Discourse Representation Theory**

Discourse Representation Theory ((Kamp, 1979); (Kamp & Reyle, 1993)) considers the fact that it is in general not possible to represent the truth conditions of a text as a simple conjunction of the truth conditions of the sentences of which it consists, because many sentences contain anaphoric elements which connect them semantically to earlier sentences in the text. Such phenomena, pertaining to temporal and nominal anaphora in discourse, can only be properly analysed by using a model of discourse, in which the cohesive links between the elements of the consequent sentences are made explicit. Thus, DRT combines a definition of truth with a systematic account of semantic representation. The analysis of a sequence of clauses proceeds in two steps: (i) after a syntactic analysis of language input, discourse representation rules are applied which map the sequence onto a discourse representation structure, (ii) the discourse representation is given a truth-conditional interpretation relative to a model of the world (and the individual sentences are not truth-conditionally interpreted directly). Formally this means that in a model which represents the "real world" as it develops through time, the sequence of sentences taken in its entirety is true at the time they were uttered. The formal mechanism to handle the increasing information conveyed by each successive sentence in discourse are the

Discourse Representation Structures (DRSs), which provide a bridge between the linguistic expressions and the truth model of discourse. DRSs are designed to describe the informational content of texts. They consist of two components, forming a logically connected pair  $\langle U, C \rangle$  of: (i) a set of discourse referents  $\langle U \rangle$  - the universe of the DRS, (ii) a set of DRS-conditions or formulas  $\langle C \rangle$ , in which predicates are combined with chosen discourse referents to encode which individuals satisfy which predicates in the DRS-conditions, describing in logical conjunctions the ways in which the discourse referents relate to each other. DRS operators with explicit semantics given in meaning postulates, extend the representational potential of DRT by allowing to have accessible further semantic information.

Central in Kamp's theory of temporal reference (Kamp, 1979) is the transformation of event structure into instant structures. This representation involves a contraction of what are in physical terms protracted happenings to indivisible temporal units, which DRT defines as *events*. For example, something may emerge as an instant in the instant structure induced by the discourse representations, but from a common sense physical or ontological point of view it may be temporally extended. The interpretation of such an example leads to temporally ordered structures in which "events" do play the role of instants. The time model of DRT defines a partially ordered structure of instants such that for each of the events there is a certain set of instants at each of which the event is "ongoing" (Kamp, 1979). The temporal relations evoked in such constructions are the one of complete precedence, holding between *events* and the one of temporal overlap involving *states*.

While this theory provides a straightforward account for handling the temporal relations in texts, it does not ensure smooth use of inferencing information with respect to the internal ontological profile of eventualities.. On the other hand, the examples we discussed so far showed the need of a formal representation of event structure which will allow to have explicit access to the different components of the basic ontological eventuality profiles like *accomplishments*, *achievements* and the like. Such a formal account is developed by Pustejovsky in ((Pustejovsky, 1991), (Pustejovsky, 1995)).

#### 4.2. Pustejovsky's event structure

Pustejovsky's (Pustejovsky, 1991) syntax of event structure is based on the idea of creating a method for a structured representation of lexical and compositional semantics information relying on the belief that word meaning is highly structured. In this one level of semantic description involves an event-based interpretation of words or phrases, e.g. their *event structure*. *Event* or "*event-type*" in Pustejovsky's view describes the properties of certain lexical items, phrases or sentences with respect to their internal ontological temporal structure. Their *event structures* are configurations where events (or rather *subevents*) are not only ordered by temporal precedence, but also by relative prominence to cope with the event structures in a generative way. Relative prominence provides a way of indicating a type of foregrounding and backgrounding of event arguments and is referred to with the notion of *event headedness*. Instead of describing them through collection of feature attribute values, Pustejovsky elaborates a unified structural description of the ontological types of activities, accomplishments, achievements, states, generalizing them into a single notion of *event*. Three components characterize any given event structure: 1) the primitive *event type* of the lexical item, 2) the rules of *event composition*, 3) the mapping rules to lexical structure. Three basic event types ( $E$ , where  $E$  is a variable for any event type) are defined: (i) *states* ( $S$ ), single events which are evaluated relative to no other event, (ii) *processes* ( $P$ ), sequences of events of the same semantic expression with structural



representation, and (iii) *transitions* ( $T$ ), events identifying a semantic expression, which is evaluated relative to its opposition with structural representation. Headedness is a property of all event sorts, but acts to distinguish the set of transitions, specifying what part of the core event is being referred to by the language expression. The head is thus defined as the most prominent subevent in the event structure of a predicate. Thus, the head of an event, denoted with  $*$ , for example  $e^*$ , marks the part of the *event structure* which is available for further reference.

So, Pustejovsky's approach provides the rich event structure formalization within a generative framework, and connects it with surface language expressions, but it does not have the formal means to handle the temporal structure of discourse, which DRT has.

Our discussion showed that in order to have a full unified account for the semantic role of the aspectual type BEGIN at a lexical, phrasal and discourse levels we cannot just adopt one of the two outlined theories, because they give powerful solutions for specific levels of interpretation. We find that developing a hybrid framework by combining these two approaches would bring the necessary expressiveness to meet the specifics of the empirical evidence outlined in our analysis.

### 4.3. Proposal

Our proposal to represent the aspectual type BEGIN introduces new parameterized ways of modifying DRS temporal referents, *events* and *states* which result in the definition of new aspectual operators with new meaning postulates.

Like the semantically related progressive, the aspectual type BEGIN introduces a DRS aspectual operator, instead of a temporal discourse referent. Its meaning is described in a meaning postulate, and will not appear in the DRS of the processed discourse. This captures the role of BEGIN as a modifier of its complement eventuality. In order to adequately represent this modification, we embed the explicit event structure account of Pustejovsky (Pustejovsky, 1991) into the operator's definition, e.g. meaning postulate. The DRT discourse referents *event* and *state* remain operative in the DRS, and provide the mechanisms to cope with the temporal relations in discourse. To capture the second semantic component of BEGIN and to make explicit its relatedness to the eventuality described by its complement, we introduce an eventuality discourse referent  $\sigma$ , associating the entity described with its internal temporal profile *point*, *process*, *culminated process*, *culmination*, *state*, *habitual state*, which can be regarded a place holder of the complement verb and permits access to its semantics<sup>2</sup>.

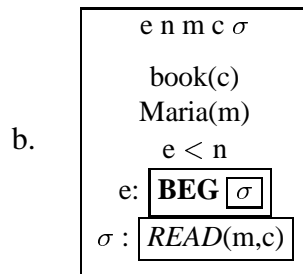
The DRS 13(b) of sentence 13(a) contains the condition  $\sigma$ :  $\boxed{READ(m,c)}$ , and the event  $e$  derived from the application of the **BEG** operator to  $\sigma$ . The meaning postulate **BEG** is given in 13(c). It describes an event  $e$  (the *beginning*), denoting the start of  $\sigma$ , the eventuality described by the complement verb. The meaning postulate makes this explicit by stating the temporal relation of immediate precedence ( $s1 \supset \subset e \supset \subset s2$ ) between a state  $s1$  prior to the state of existence of the eventuality  $\sigma$ ,  $s2$ . The ontological type of the eventuality  $\sigma$  is further specified by structural representation - which follows the generative lexicon definitions of event types. Thus, the meaning postulate of the newly introduced DRS operator **BEG** correctly represents the intuition that while the culmination is intuitively a transition from an eventuality  $\sigma$  to its abrogation, inchoatives represent transitions from the abrogation of  $\sigma$  to its taking place, or

---

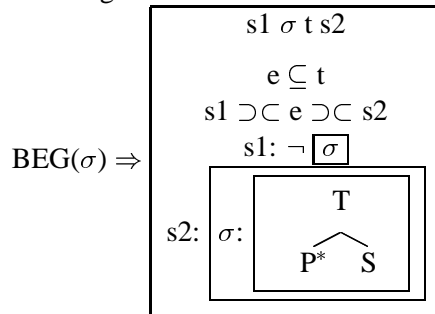
<sup>2</sup>A different evidence of grammatical aspect from other languages including Bulgarian, and independent motivation for the use of two *event* notions: *textual event* and *ontological eventuality type* in the DRS construction is given in (Damova, 1999) and (Damova, 2000).

obtaining. A similar idea to interpret the meaning of the verb *begin* as a separate event marking the beginning of a process, rather than as a part of this process, is advanced by Alice ter Meulen in (terMeulen, 1995) where she includes it into a different representational framework, favoring a lexical semantics approach.

- (13) a. Maria began to read the book.



- c. Meaning Postulate for **BEG**:

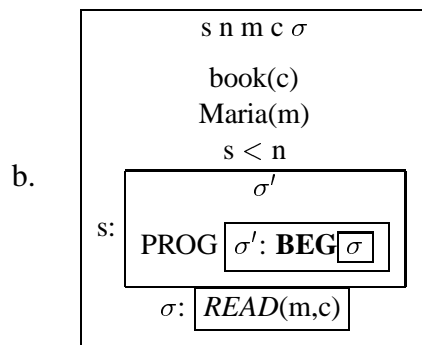


Thus, our notion of ontological eventuality  $\sigma$  associates the entity described with its internal temporal profile - *point, process, culminated process, culmination, state, habitual state*. The operator **BEG** is defined as taking an argument  $\sigma$ , explicitly entered as a discourse referent for the ontological eventuality of the complement. The meaning postulate captures the temporal semantics that  $\sigma$  did not obtain before the point in time associated with the event invoked by **BEG** but holds after. Moreover, the aspectual type of **BEG**'s argument  $\sigma$  is represented in the process reading of Pustejovsky's transition event type by the head feature \*, making thus explicit the correct intuition that the complement of the aspectual type **BEGIN** must be a process.

The combination of the meaning postulate and the actual DRS makes explicit the entire range of temporal information contained in this sentence. This way of approaching the representation and the interpretation of aspectual predicates mirrors the semantic role of the aspectual types, and the syntactic function of aspectual verbs in discourse. It allows us to represent the temporal structure of the processed discourse and to preserve and be able to trace the additional information conveyed by the aspectual predicate. This mechanism quite appropriately mirrors the natural role of aspectual verbs in discourse, and provides further advantages.

Thus, the proposed approach allows us to represent accumulated aspectual markers in a plausible way. For example, this method can correctly represent a sentence with *begin* in progressive simply by applying the **PROG** operator (Kamp & Reyle, 1993) to the eventuality derived by the **BEG** operator. The sentence in 14(a), which has the verb *begin* in *past progressive* will trigger DRS 14(b).

- (14) a. Maria was beginning to read the book.



Here both  $\sigma$  and  $s$  will be accessible, which is what is needed. The eventuality of the complement of *begin* is introduced into the DRS by the discourse referent  $\sigma$ . The argument of the discourse referent triggered by the progressive form of *begin* outlines explicitly in a DRS-condition the nature of the state  $s$ .

## 5. Conclusion

We discussed and analysed various language means that convey *beginning*, a semantic counterpart to the culmination, in eventuality structure based formal approaches to aspect. We argued that a mechanism is needed to provide a uniform interpretation of their semantics. We defined the aspectual type BEGIN, and developed its semantic representation along the general lines of accounts of temporal reference of Discourse Representation Theory ((Kamp, 1979); (Kamp & Reyle, 1993)). We extended the DRT analysis of tense and aspect in postulating a three layered formal representation for aspect, which gives a unified account to cope with single expressions and entire texts. The aspectual type BEGIN introduced a DRS aspectual operator, instead of a temporal discourse referent. Its meaning was described in a meaning postulate, and remained hidden but accessible for the DRS of the processed discourse. We embedded its explicit event structure and inferential properties into the operator's definition, e.g. its meaning postulate, by adopting Pustejovsky's formalisation (Pustejovsky, 1995). We showed that the proposed approach represents the aspectual type BEGIN correctly across categories, that is, it works on all discussed levels: lexical semantics, grammatical devices, secondary predication, discourse. Thus, we demonstrated the convenience of adopting a method combining two powerful formal frameworks to achieve the required result.

## References

- BACH E. (1986). The algebra of events. *Linguistics and Philosophy*, 9(1).
- DAMOVA M. (1999). *Tense and Aspect in Discourse: A Study of the interaction between aspect, discourse relations and temporal reference within DRT with special attention to Bulgarian*. Sofia: FDC Publishing Agency.
- DAMOVA M. (2000). The notion of aspect and the bulgarian *wid* within discourse representation theory. In L. H. ILA DIMITROVA-VYLCHANOVA, ILIYANA KRAPOVA, Ed., *Papers from Third Conference on Formal Approaches to South Slavic and Balkan Languages. Plovdiv, September 1999.*, number 34 in Working Papers in Linguistics, p. 262–275, Dragvoll: University of Trondheim.
- DOWTY D. R. (1981). *Word meaning and Montague Grammar*. Kluwer Academic Publishers.
- EBERLE K. (1991). *LiLoG*, chapter On Representing the Temporal Structure of Texts, p. 313–341. Springer Verlag.

- EBERLE K. (1992). On representing the temporal structure of a natural language text. In *Proceedings Coling'92*, p. 288–294.
- HINRICHS E. (1986). Temporal anaphora in discourses of english. *Linguistics and Philosophy*, **9**(1), 63–82.
- KAMP H. (1979). *Semantics from Different Points of View*, chapter Events, Instants and Temporal Reference. Springer-Verlag.
- KAMP H. & REYLE U. (1993). *From Discourse to Logic*. Kluwer Academic Publishers.
- KAMP H. & ROHRER C. (1988). Temporal reference in french. Manuscript, IMS, University of Stuttgart.
- KRIFKA M. (1989). Nominalreferenz, zeitkonstitution, aspekt, aktionsart: Eine semantische erklärung ihrer interaktion. Manuscript, Universität Tübingen.
- LANDMAN F. (1992). The progressive. *Natural Language Semantics*.
- LEVIN B. (1993). *English Verb Classes and Alternations*. The University of Chicago Press.
- MOENS M. & STEEDMAN M. (1988). Temporal ontology and temporal reference. *Computational Linguistics*.
- PARTEE B. (1984). Nominal and temporal anaphora. *Linguistics and Philosophy*, **7**, 243–286.
- PUSTEJOVSKY J. (1991). The syntax of event structure. *Cognition*, **41**, 47–81.
- PUSTEJOVSKY J. (1995). *The Generative Lexicon*. MIT Press.
- SANDSTRÖM G. (1993). *When-clauses and the Temporal Interpretation of Narrative Discourse*. PhD thesis, Dept. of Linguistics, University of Umea.
- SMITH C. (1991). *The Parameter of Aspect*. Kluwer Academic Publishers.
- STEEDMAN M. (1997). Temporality. In J. VAN BENTHEM & A. TER MEULEN, Eds., *Handbook of Logic and Language*, p. 179–239. The MIT Press and North Holland.
- TERMEULEN A. G. (1995). *Representing Time in Natural Language*. MIT Press.
- VENDLER Z. (1967). Verbs and times. In *Linguistics and Philosophy*. Cornell University Press.
- WEBBER B. (1988). Tense and discourse anaphora. *Computational Linguistics*, **14**(2), 61–73.
- WHITE M. (1994). *A compositional approach to aspectual composition*. PhD thesis, University of Pennsylvania, Philadelphia.