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A default-free solution to the imperfective paradox

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Abstract This article advances the first semantics that is neither for nor against a default implicational link between the progressive and perfective forms, when it comes to solving the imperfective paradox. Depending on the doxastic context of its use, we contend that the progressive form sometimes allows and sometimes does not allow the inference of the corresponding simple form. In other words, the preparatory phase of an event might or might not be believed to lead to its culmination. Indeed, the context can put constraints on beliefs about the time of the culmination and whether or not it allows this inference to be made. From a formal perspective, this new solution to the imperfective paradox combines a specific modal approach with an event-structure analysis originating in event semantics. Finally, this approach solves the associated difficulties (e.g., pauses, past futures, interruptions and sensibility to description) that have plagued the most well-known theories in this field.

Keywords Imperfective paradox · Progressive · Beliefs

All the concepts, theses and discussions that form the content of this paper sprang from a genuine collective work of both authors. Since he wrote down the whole formal part of the paper which presents the core of our solution, Mathieu Vidal's name features in first position.

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1 Introduction

This paper seeks to propose a new solution to the imperfective paradox. As a reminder, the origin of this issue in contemporary debate can be traced back to Kenny (1963), who noticed that the automatic inference from the progressive to the simple form is valid for processes [sentences (1) and (2)] but not for terminations [sentences (3) and (4)].

(1) Mary was pushing a cart.
(2) $\Rightarrow$ Mary pushed a cart.
(3) Mary was building her house.
(4) $\not\Rightarrow$ Mary built her house.

Dowty (1979) was the first to employ the term *imperfective paradox* to speak about this difference in behaviour. However, researchers cannot agree on either its status or its content. We thus prefer to make an explicit distinction between the two main ways of elaborating on this point[1] and specify our own point of view.

Some authors[2] maintain that the paradox is independent of any theory. Considering the verb phrase (VP) of a sentence, the lexical meaning of an accomplishment VP arguably itself involves the coming about of a resulting state of affairs. For instance, the meaning of "to build a house" involves the state of affairs of a house having been built. As Kenny (1963) puts it: "Any performance [Kenny's own term for accomplishment and achievement] is describable in the form: 'bringing it about that p.'" However, it has long been observed that the progressive form of accomplishment and achievement verb phrases (3) in sentences does not entail the corresponding perfective form (4). The paradox therefore consists of the apparent contradiction between the entailment supported by the lexical meaning and the cancellation of this entailment through the progressive form. As the result of two contradictory semantic features of language itself, the paradox is independent of any theory.

Other researchers[3] argue that the paradox stems from inadequate semantic theories. More specifically, they contend that it stems from an inadequate account of the semantic conditions of the progressive form of accomplishment and achievement VPs. For instance, Bennett and Partee's initial motivation was to propose a theory of tense extending Montague's semantics. Later on, they discover that their proposal had the unfortunate following consequence. The truth of a past progressive VP that ended before the present always implies that there exists a later point in time at which the preterit form is true. Along this line, the imperfective paradox therefore consists of the contradiction between the entailment link posited by semantic theory (as illustrated in Bennett and Partee's case) and the obvious inexistence of this link in English. Stemming from the contradiction between the actual semantics of natural language and semantic theory, the paradox is dependent on the theory.

[1] Some are rather neutral on this point, such as Binnick (1991).

[2] Vendler (1957), Kenny (1963), Dowty (1979), Vlach (1981), Lascarides (1991) and Baggio and Lambalgen (2007).

[3] Bennett and Partee (1978) and Parsons (1989).

We think there is more to the imperfective paradox than just the mere question of theoretical inadequacy. In this paper, we shall tackle the imperfective paradox as an intrinsic semantic feature of certain English verb phrases, one that is at the very least surprising but not unintelligible. We thus set ourselves the task of accounting for the prima facie contradiction between the entailment that the lexical meaning apparently carries out and its cancellation by the progressive form. Basically, we should distinguish between *conceptual involvement* and *semantic entailment*. The former means that one needs a certain concept to understand another concept, while the latter means that the truth of one expression inevitably posits the truth of another one. In our view, the meaning of an accomplishment VP simply involves the concept of the described activity and not its truth. In other words, the mentioned concept is required to understand the accomplishment VP, but it in no way requires the truth of the latter to imply the actuality of the former. Since there is no entailment link due to the lexical meaning, there is nothing that the progressive form can cancel, laying the paradox at rest.

Consequently, we prefer to say that the truth conditions of the progressive form are neutral with regard to the entailment relation with the perfective form, as far as accomplishments and achievements are concerned. Hence, our solution to this issue departs from prior solutions, as we do not systematically validate or invalidate the inference from the progressive to the simple form for terminations. We argue that the context in which interlocutors judge the sentence will modulate this inference. In some cases, the inference will be considered valid by interlocutors and in other cases, the inference will be considered invalid. On the one hand, the possibility of nonculmination makes it possible to explain why some progressive constructions have an associated process that contains pauses or is interrupted. On the other hand, the possibility of the inference explains why, after hearing a progressive, a person will frequently act as if the culmination will be obtained.

This paper proceeds along the following plan. In Sect. 2, we show that existing solutions to the imperfective paradox posit either an implicational link or a nonimplicational link by default. In Sect. 3, we argue for a theory whereby the validity or invalidity of this inference is not systematic and we defend our approach against what we call the *process-culmination divide objection*. In Sect. 4, we detail the preliminary elements of our formal semantics. We further extend this approach in Sect. 5, by integrating doxastic functions and demonstrating how this solves the paradox. In the final section, we show how this proposal deals with the usual related issues, such as pauses, interruptions, and sensibility to descriptions.

2 A classification of the solutions to the imperfective paradox

With a view to charting the debate and introducing our own solution, we argue that existing theories offer two kinds of solutions to the imperfective paradox. All these solutions posit a default tenet relative to the entailment link between the progressive form of accomplishment and achievement VPs and its corresponding perfective form. According to the first point of view, a default entailment link exists. Among the various ways in which this claim has been formulated, one should distinguish between a

moderate and a strong version. As for the second point of view, it maintains that there is a default non-entailment link. We would like to examine each of these points of views in turn by considering a canonical formulation for each one.

2.1 The moderate default entailment-link approach

According to the approach defended by Dowty (1979), progressive accomplishment VPs entail a corresponding perfective form, not in the actual world but in some possible worlds. Indeed, as it is argued, such an entailment link is required to account for the truth-conditional difference between, for instance, "drawing a horse" and "drawing a unicorn" as such activities do not reach their respective conclusions. But accomplishments do carry out such an entailment in a certain set of possible worlds called *inertia worlds*[4] rather than in the actual world, since an accomplishment is often not concluded or only partially completed. A similar modal strategy is adopted in Hinrichs (1983), Cooper (1985), Landman (1992) and Swart (1998). "The real entailment […] is that it was possible that"[5] for example, Mary's activity continued so that a house came into existence. Dowty thus conceives of conceptual involvement in terms of the possible outcomes of the activity expressed by an accomplishment VP. Technically, this is done using possible worlds. Therefore, such a view can be labelled the modal default entailment-link approach.

As we see it, this solution makes it possible to both avoid the entailment relation in the actual world and preserve the intrinsic character of the culmination with regard to the meaning of accomplishment VPs. But it does so at a certain price. It should be accepted that the culmination does occur, even if it is not in the actual world. Thus, the entailment is maintained in a modal form. Another problem of the present form of this approach is that it does not take into account the beliefs of the person judging the sentence. As we will argue in details soon, this is an essential ingredient for a theory of the progressive.

2.2 The strong default entailment-link approach

Both (Wulf 2000) and Baggio and Lambalgen (2007) argue that the entailment from the progressive to the perfect is the default feature. However, it is possible to disable or retract the default conclusion via the influence of the surrounding discourse or context, allowing to explain the imperfective paradox. We will detail here Baggio and van Lambalgen's approach which is the most well-known. They contend that progressive accomplishment VPs together with a causal theory entail the corresponding perfective form in cognitive constructs that may be aligned with the actual world. In order to understand the core intuition supporting this view, it is useful to recall its overall framework. It creates a semantics that fits the way cognitive subjects actually process language. The chosen theoretical model of linguistic processing is path-planning in

[4] Inertia worlds are possible worlds identical to the actual world up to the time in question and whose future development is the most compatible with the past events.

[5] Dowty (1979).

robotics (van Lambalgen and Hamm 2005). With this approach, we process the progressive tense of accomplishments together with causal principles (law of inertia and closed world assumption) as entailing its perfective correspondent, absent any disabling condition.[6] The progressive thus has to be considered as merely allowing itself to be supplemented by the expression of such a condition. It is "sensitive to the presence of a disabling condition in the discourse context", as Baggio and van Lambalgen put it. In case no such expression is added, however, there is no reason to suppose the culmination of the accomplishment is not attained. For Baggio and van Lambalgen, this processing fact has to be reflected by the formal semantic counterpart. In other words, a default semantic feature of the progressive of accomplishments has to be that they entail their respective perfective.[7]

Provided that Baggio and van Lambalgen view the paradox as a theory-independent phenomenon, their solution is that the relationship of entailment intrinsic to the lexical meaning of accomplishment VPs coupled with their causal theory is only cancelled due to additional disabling conditions, not by virtue of the progressive tense itself. Thus, the appearance of a paradox fades away. As they put it, "it is precisely the *possibility to retract* previously inferred conclusions which allows a rigorous treatment of the imperfective paradox"; "the representation of the goal state is both essential to the meaning of the progressive VP […] and *suppressible* on the basis of additional discourse information".[8] According to them, the apparent entailment cancellation boils down to mere recomputation in case additional information occurs. An important corollary of this solution is that the attainment of the goal can be implied, even if only for a minimal model of the situation considered.

We praise Baggio and van Lambalgen's analysis for having recognized that the progressive of accomplishment VPs together with a causal theory can entail the corresponding perfective. However, we depart from their view, as they posit the mentioned possibility as a default mechanism. If we understand well Baggio and van Lambalgen, absent any explicit disabling conditions, no difference can be found concerning the inference from the progressive to the perfect for accomplishments. On the contrary, we think that there are cases where no explicit circumstances are needed in order to think that the accomplishment could terminate before its term. For instance, we predict that some tasks like 'writing alone an encyclopedia' or 'building alone a castle' have less chance to be endorsed as leading to their culmination than other ones like 'writing alone an SMS' or 'building alone a birdhouse' because people generally believe that difficult tasks and goals which need long-term efforts are less likely to be completed.[9]

[6] Baggio and Lambalgen (2007) and Baggio et al. (2008) provide strong empirical evidence of this claim related to our linguistic intuitions.

[7] On a more technical level, Baggio and van Lambalgen draw on the Event Calculus framework elaborated in van Lambalgen and Hamm (2005).

[8] Baggio and Lambalgen (2007).

[9] This difference between the two theories could be tested experimentally, for instance, by observing whether there is a correlation between the difficulty or the duration of an accomplishment and the belief that it will terminate, without the need of explicit disabling conditions.

2.3 The default non-entailment-link approach

The opposite view favouring a non-entailment default mechanism relies on two chief tenets. First, there is the *semantic independence tenet* (positive tenet) whereby for primarily ontological reasons, the description of the preparatory phase of an accomplishment is semantically independent from the culmination phase. The progressive captures the activity/process component of the accomplishment. Thus, it does not require the occurrence of the culmination to be true. Second, there is its corollary, whereby the *non-entailment tenet* (negative tenet) says that regardless of the world in which it is posited (possible or actual), the entailment link has to be rejected: "Progressive construal does not require access to culmination points either in this world or a possible world".[10]

We would like to briefly present Lascarides (1991)'s elaboration on these tenets.[11] On her core intuition, characterizing the state of affairs that renders a progressive true, the (possible) culmination of the accomplishment should not be solicited. It should be recalled that, according to Dowty's argument, one has to resort to culmination in order to characterize the actual activity as "drawing a horse" rather than "drawing a unicorn" when nothing actual makes it possible to create such a distinction. The outcome that would result from the current activity is thus required for it to qualify as a specific accomplishment. A chief semantic corollary is that for "drawing a horse" to be applied truthfully, one has to incorporate the possible outcome among the truth conditions of the progressive accomplishment VP. "For Dowty, the preparatory process that leads to the culmination of an event occurs *during* the interval at which the event itself occurs" says Lascarides (1991) who bites the bullet by claiming that the preparatory process of an event occurs during an interval distinct from and prior to the interval when the event occurs. In other words, the preparation of a culmination is not the occurrence of the culmination, but an utterly distinct process. Lascarides consequently proposes to identify the preparatory phase independently from the possible culmination.[12] This is the semantic independence tenet. In short, the preparatory process that the progressive form of an event (achievement or accomplishment) sentence describes is "deictically identified in context". For instance, drawing on the specific context of use of (3), one has to carry out a deictic identification of the preparatory process of the culmination, which could turn out to be:

(3') Mary is spending money on building materials.

Such a description of the preparatory phase of (4) requires neither the possible nor the actual occurrence of the culmination. Consequently, this is the negative tenet, the progressive form of an event verb can be true, as it describes the preparatory process, without the corresponding perfective form that describes the culmination being true. But here again a certain price has to be paid. No due right is made to Baggio and

[10] Michaelis (2003).

[11] Parsons (1989) provides another important formulation of this same view but the differences are not relevant to our argument.

[12] Parsons (1989) similarly maintains the following: "The difference between a progressive and a non-progressive event sentence is, roughly, whether the sentence requires for its truth that the eventuality picked out by the verb culminates, or whether it only needs to 'go on' for a while [to 'hold' in Parsons' terms]".

van Lambalgen's intuitions and cases, under which a progressive form can entail its perfective counterpart. Moreover, even if the right account of the progressive form of an accomplishment turned out to say that it describes the preparatory process of an event and that this process is deictically identified in context, whether or not this process should be held as entailing a certain event or not would remain an open question. Absent any conceptual involvement, a given proposition can still be held as entailing the truth of another proposition in context.

3 Favouring a default-free semantics for solving the imperfective paradox

With a view to introducing our own solution, we have charted the field of existing solutions to the imperfective paradox. We have observed that they all assume there is a semantic feature in English that consists of either the existence of a default entailment relation between the progressive forms of VPs and their corresponding perfective forms or the existence of a default non-entailment relation. On the contrary, we defend the idea that from a strict semantic point of view, the progressive form neither *entails* nor does *not entail* the corresponding perfective form. Basically, we favour a *default-free* semantics. Correlatively, we argue that other factors than the lexical meaning independent from any context are required to determine the truth conditions of a progressive verb phrase. We therefore side with the more general contextualist approach to truth conditional semantics that has been increasingly endorsed over the past decades by many researchers in the field (Sperber and Wilson 1996; Recanati 2004; Korta and Perry 2011). Provided that the meaning of the progressive alone provides no answer for the entailment issue, at least one other feature is required to carry out this determination task. In our view, this feature includes many things (the action project in which the interlocutors are engaged, the specific lexical meaning of the VP, the beliefs shared by the interlocutors, etc.). In particular, the doxastic context, which includes the general knowledge of the world plus more local beliefs, is considerably important. We side here with epistemic logicians who incorporate doxastic features in their formal semantics (see Fagin et al. 2003).

Returning to the literature on the imperfective paradox, it is enlightening to compare our own view with that of Baggio and Lambalgen (2007). We agree with them when they say that the pure linguistic analysis of an expression generally does not make it possible to derive the processes involved in producing or comprehending utterances in which the expression occurs. Additional processes are certainly required, in our cases mainly the beliefs. However, we depart from their analysis regarding the default entailment link that they defend. Our own solution diverges from theirs because we do not posit any default semantic mechanism regarding the entailment of the perfective form.

Some examples will be helpful to illustrate our core idea. Arguably, the non-implicational link from (5) to (6) can be considered rather obvious:

(5) When I saw him, he was building a car.
(6) He built a car.

By contrast, the implication link from the last sentence of (7) to the first sentence of (8) is used by the person A to draw the inference:

(7) - A: Do you know where C is?
- B: I've just met him two minutes ago. He was heading towards room 3.
(8) - A: OK, C is already in room 3 to prepare the meeting. I will go there.

The progressive form is the same in both cases, but its capacity to generate an implicational link varies according to the related background world knowledge associated with the specific lexical meaning of the accomplishment VPs in (5) and (7). Absent any disabling condition, the last sentence of (7) allows the person A to infer the first sentence of (8) because, as we know, walking toward a room is a common and simple activity. As for (5), the specific content of the executed accomplishment is such that the certainty that the task will be carried out is dramatically lower. These examples illustrate the correlative world knowledge through which we interpret the diversity of accomplishment VPs. If we are on the right track, the implicational/non implicational link between progressive and perfective forms is thus largely sensitive to the beliefs we associate to the specific lexical meaning of the VP. Depending on the cases we want to analyse, these beliefs are the ones of the person who expresses the sentence (the speaker), who hears it (the hearer), and so on. Consequently, the question involving whether or not such a link holds cannot be resolved at the level of the lexical meaning. The skill of world-knowledge must also be involved. We saw that people sometimes draw the inference and sometimes do not. For this reason, we favour the simplest explanation which is a neutral semantics concerning this inference, contrary to more complex theories which favour the non-entailment or the entailment link, coupled with enabling or disabling conditions, in our actual world or in a possible world. In other words, we favour a semantics that is itself neutral in this respect and which has to be completed mainly by beliefs about the world in order for the truth conditions to be completely determined.

We would now like to consider an objection that threatens our approach and propose some replies in order to lay it at rest. Let us call it *the process-culmination divide objection*, which runs as follows. Even in the case of (7)–(8), there is no implicational link. After all, maybe the person in question did not manage to go to room 3 because she was interrupted. More specifically, this possibility is due to the very ontological category of accomplishments. Indeed, according to a minimal ontological analysis, an accomplishment includes both a preparatory phase and a culminating phase. The use of an accomplishment VP in the progressive refers to the first of these two phases, whereas its use in the perfective refers to the second. Now, according to the same minimal analysis, the occurrence of the preparatory phase in no way secures the occurrence of the culmination. This ontological fact is precisely what motivates and is semantically reflected in the non-entailment link from the progressive to the perfective form of accomplishments. It thus precedes any potential further pragmatic process. Therefore, the truth conditions of the progressive form are wholly determined by its linguistic meaning and, as such, they set no implicational link to the corresponding perfective form. All in all, a default semantics claiming that there is no implicational link should be adopted. Drawing on a phrase used by Dowty (1979), asserting that the person actually goes to room 3 is just an "invited inference". While it is indeed due

to our world knowledge, it is completely supplementary to the truth conditions of the progressive VP, which are wholly determined by its linguistic meaning. We have to confront this engaging objection. In doing so, we need to clear off two tenets taken for granted by the solutions which reject the possibility of entailment and promote the objection.

The first tenet holds that the conditions for satisfying an accomplishment VP are determined by the *ontological* features expressed by the VP's lexical meaning. Against this tenet, we argue that it is also possible for epistemic states to carry out the task of determination. Take the following conversation:

(9) - A: Did C go to the conference?
- B: When I visited him four days ago, he was packing his suitcase.

On an intuitive analysis of (9), in a context in which A and B both believe that C does not change his mind once he has made it up, the progressive form of B's reply implies that C actually did go to the conference. In such a doxastic context, the implicational link holds. C packed his suitcase and went to the conference. Note that, in such a case, recourse to the progressive form can be motivated by the fact that packing his suitcase was the process C was engaged in when B arrived at C's flat, while he stayed there and when he left C's flat, rather than by the fact that B would like to emphasize the unfinished aspect of C's activity and the possibility of its not having been carried out to its conclusion. Let us now consider the same piece of conversation within a different doxastic context. A and B both believe that C is fickle and that what B saw guarantees nothing. In this case, it is clear that the implication does not hold. Thus, in total, the progressive form of the accomplishment VP can either entail or not entail the corresponding perfective form, depending on the doxastic context of its interpretation. In the idiom of possible worlds, depending on the doxastically accessible worlds by means of which the sentence is interpreted, the entailment either holds or not.

Interestingly, Dowty himself—despite defending one version of the default entailment link approach—considers that it can be relevant to bring the beliefs of speakers and hearers to bear on the truth conditions of the progressive forms of accomplishment VPs. On one hand, he says: "We must of course resist the temptation to make the meaning of progressive sentences a function of the speaker of the sentence (i.e., the function of his particular beliefs) or the hearer or of any other particular person" because "the meaning of expressions of a language [is] not [to] be treated as a part of the private experience or beliefs of individuals". However, "agreement on the truth of progressive sentences […] presupposes that such beliefs are held in common" because meaning is "the common property of all users of language".[13] Our own view can be seen as following up on Dowty's suggestion and draws on the fact that the extent of the "common" beliefs required is variable. Such a set of beliefs can, in particular, be restricted to the beliefs of the interlocutors engaged in a given conversation, as in the previous example. But this leads us to depart from Dowty in two respects. First, since it is not required that the entire linguistic community be in agreement, there can be a truth conditional variation from one context to another for the linguistic meaning of the progressive. Second, as a result, such linguistic meaning is neutral on the entail-

[13] Dowty (1979).

ment to the perfective as far as accomplishment VPs are concerned. On the whole, we restrict the meaning of the progressive in order to make room for the determining role of particular doxastic contexts with respect to the truth conditions of progressive sentences.

We also contest a second tenet claiming that even if one admits, according to the preceding section, that the doxastic context can be relevant for determining the truth conditions of an accomplishment in the progressive, the threat of doubt makes it very unlikely that one would ever consider the progressive form as entailing its perfective counterpart. In short, the former ontological divide is duplicated through doubt at the doxastic level, and the *ubiquity* of doubt renders the non-implicational link itself ubiquitous. In other words, it always makes sense to conjure up the possibility that, if a progressive form is true, the corresponding perfective form is false. Similarly, in doxastic terms, it always makes sense to raise a doubt as to whether the link holds or not.

Against such a claim, we first concede that the very fact that the doxastic context can participate in the determination of the truth conditions of an accomplishment VP is not sufficient, in itself, to say that accomplishment VPs sometimes entail their perfective form. But we also insist that the doubt about the generation of an entailment relation by a progressive accomplishment VP is just one of the many possible forms the doxastic context of interpretation can assume. As Wittgenstein (1969) has emphasized, doubting is not an omnipresent and universal condition of our cognitive life. It is not ubiquitous. It is a doxastic state that intervenes at *certain* stages of a process of interlocution under *certain* circumstances. Therefore, the doxastic context of interpretation of a progressive form does not necessarily make room for a doubt about the holding of the implication link after all. Returning to (9), it could be that, on second thought, A and B had some doubt about C's behaviour. But it could also be that the doubt arises on second thought only and for certain specific reasons or that it never arises at all. A useful way to validate these remarks against the ontological argument and its replication at the doxastic level is to emphasize that it is much more likely to grasp our beliefs in looking at how we act than in calling upon a supposed implicit ontology. The way people act often provides useful insight into what they believe. With this in mind, consider this variation of our preceding example:

(10) - A: Do you know where C is?
- B: I've just met him. He was heading towards room 3.

It is highly likely that A will make his way towards room 3 after this brief exchange (provided A needs to speak to C at once). A's action makes it clear which link he posits under such circumstances between:

(10') C was heading towards room 3.

And:

(10'') C headed towards room 3.

Hence, the behaviour adopted by A shows us what inference did the person drawn.

If the process-culmination divide objection has to be abandoned along the proposed lines, then one should accept that there are cases in which the implication link holds in

addition to ones in which it does not. A last argument in favour of semantic neutrality is whatever the default entailment or non-entailment approach adopted, it would predict conflict with the cases in which, for pragmatic reasons, the opposite relation is set in context. But there is no such conflict in the examples we examined. Opposing theories predict that there should be something like an opposition between pragmatic and semantic levels, but there is no trace of such a conflict. Provided that the variation in context for the VP in the progressive can lead to a variation concerning the implication link, we argue that it is preferable to adopt a default-free semantics. In short, the linguistic meaning of the progressive form of an accomplishment VP underdetermines its generation of the implication of the corresponding perfective form.

4 Eventualities and simple tenses: some preliminary elements

In order to introduce our formal solution to the paradox, we would first like to present some technical elements issued from event semantics and Hans Reichenbach's analysis of time. In this section, we make no claim about particular originality. We are simply rearranging and renaming proposals previously made by different authors. Nonetheless, as terminology in the field is always fluctuating, this section will help to clarify the elementary foundations of our own theory.

4.1 Aspects

First, we would like to provide an event-structure analysis of sentences. To keep the explanation as simple as possible, we will stay at the propositional level for this exposition. At the more general level of analysis, a sentence can describe a state (s) or an event (e). A state denotes permanence, and an event denotes a change. As Moens and Steedman (1988) argued, an event can be further broken down into its preparatory phase, which we call a process (p), its goal which we call its culmination (c) or a combination of these elements. Like Bach (1981) and Parsons (1989), we will use the convenient term *eventuality* to refer at once to states, events and their different decompositions. Notice that the reuse of this generic term does not force us to adopt Bach's and Parson's programmes. These different relations are depicted in Fig. 1.

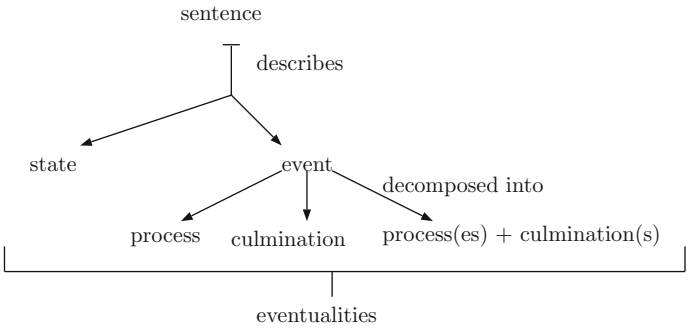

Fig. 1 Event-structure analysis of a sentence

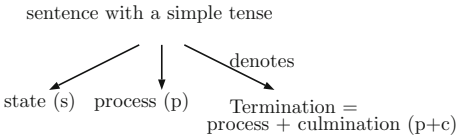

Fig. 2 Eventualities denoted by a simple tense sentence

By definition, a sentence with a simple tense does not display any special aspectual indication related to the progressive. In that case, a sentence can only denote three major types of eventualities: state (s), process (p) and termination (p+c), which is a process followed by its culmination. For instance, *this car is red* denotes a state, *Mary walked* denotes a process, and *Mary finished her first marathon* denotes a termination. Moens and Steedman add the type of points to these basic categories. Indeed, they consider that *Mary hiccups* has no associated consequent state. However, there is no consensus concerning this last addition, and we choose to treat them here as terminations. Indeed, we consider that a point is a preparation rapidly followed by a culmination. In our example, the preparation is the contraction of Mary's diaphragm, and the culmination is the sound produced. Certainly, they are both close temporally but they are nevertheless distinct. Figure 2 sums up the three possible eventualities denoted by a sentence with a simple tense.

We will use the function $\mathcal{E}(A)$ applied to an atomic sentence A to select the eventuality associated with the sentence.

Definition 4.1 Eventualities with Simple Tense. $\mathcal{E}(A) = s/p/p + c$

An objection to this tripartition could be the observation that Vendler (1957)'s classification of aspects distinguishes between four classes: states, activities, accomplishments and achievements. As Vendler's proposal has been very influential in this area, we would like to further defend our choice. By comparing Vendler's classification and our proposal, we see that states remain unchanged, activities are here called processes, and accomplishments and achievements are grouped under terminations (see Table 1).

Hence, contrary to Vendler, we attribute no special status to achievements. Such a tripartite classification has already been defended by Vlach (1981), Bach (1981) and Chierchia and McConnell-Ginet (1990). Our own reasons for this tripartite delineation are that the aspectual class of achievement is too obscure to be kept in a scientific taxonomy. In his article, Vendler gives us *recognizing* and *reaching the summit* as examples of verbal expressions that "fall squarely into the class of achievements". But both expressions fail all the tests Vendler himself gives for belonging to the class of achievements. First, they can be used in progressive constructions: *he was reaching the summit* and *he was recognizing his wife when the sound of her voice confirmed his first impression*. Second, they can be used as answers to the question *what is he doing?*

Table 1 Correspondence between Vendler's classification and our proposal

Vendler	States	Activities	Accomplishments	Achievements
Proposal	States	Processes	Terminations	

He is reaching the summit or *Wait a minute! Look at his face! He is recognizing his wife!* Third, both can be put in the imperative form: *reach the summit and you will become a true mountaineer* or *recognize your wife in the dark in less than a minute*. Fourth, they can be combined with intentional adverbs: *he deliberately reached the summit* or *he carefully recognized his wife.* Reuse of this aspectual class with slight modifications of its definition by other authors like Dowty (1979) and Moens and Steedman (1988) have not helped to clarify the exact criteria that should be applied. Finally, achievements can be put into the progressive form like the points. Indeed, we maintain that, in the macroscopic world, every culmination of an event is attained through a preparatory phase. Hence, there is no single event that can occur as a whole in a unique instant. Hence, it is logical to group accomplishments and achievements within the single class of terminations, at least for this paper, which focuses on the progressive.

We would now like to present our analysis of simple tenses, which is a reformulation of Reichenbach (1947)'s proposal. In particular, we use his differentiation between the *time of speech* (t_S) and the *reference point* (t_R). The distinction between the speech time and the reference point makes it possible, for instance, to employ the present tense to speak about past or future events.

(11) Yesterday, I met Mary. We are in a bar when …
(12) Tomorrow, I take the train.

In both sentences, the speech time is the present. The adverbs "yesterday" and "tomorrow" introduce a different reference point. The present tense, then, is used relative to this reference point.[14]

Furthermore, an eventuality occurs at a time that we will call *eventuality time* (t_E). This is a variation of Reichenbach's event time, in which we replace the word "event" with word "eventuality" which refers to both states and events in our theory. To keep things simple in this exposition and have t_S, t_R and t_E all being points, we treat the eventuality time as any moment at which the process of an eventuality is underway. However, an extension of the theory could be easily imagined when t_E is a stretch of time and represented by an interval.

4.2 Tenses

Let us now turn to the basic formulation of the tenses. According to Binnick (1991), three major tenses are always distinguished in Indo-European languages: past, present and future. Different syntactic ways are used to express them, especially in English in which modals ("will" and "shall") are specifically used to express the future. However, we will not delve into these syntactic issues and will simply adopt the operators PAST, PRESENT and FUTURE, which apply to whole sentences and not to verbs. The

[14] Notice that Reichenbach also uses the reference point in his analysis of perfect tenses. For instance, in the sentence *John had run*, we do not speak directly about the event time at which John runs but instead use an intermediate point t_R for the event time preceding this reference time, which itself occurs before the speech time. However, we will not deal with perfect tenses in this article and instead focus exclusively on progressive tenses.

meaning of these operators is the following. First, all of them state that the eventuality associated with the sentence takes place at the eventuality time (first condition in the three following definitions). Second, each tense operator relates the reference point and the eventuality time in a particular way. Unsurprisingly, past, present and future express the eventuality time as being respectively before, at the same moment as and after the reference point (second condition in the three following definitions). Thus, we obtain the following truth-conditions for the three temporal operators.

Definition 4.2 PAST(A) is true at t_R iff

(i) $\mathcal{E}(A)$ is true at t_E
(ii) $t_E < t_R$

Definition 4.3 PRESENT(A) is true at t_R iff

(i) $\mathcal{E}(A)$ is true at t_E
(ii) $t_E = t_R$

Definition 4.4 FUTURE(A) is true at t_R iff

(i) $\mathcal{E}(A)$ is true at t_E
(ii) $t_E > t_R$

These definitions could be considered as being very close to Priorian tense operators (see Prior 1957, 1967). However, there is one important difference. It is not only the sentence taken as an atom that is considered to be true or false at the time of reference, but also the sentence as expressing a lexical aspect category (a so-called Aktionsart or an eventuality in our own vocabulary). This element is crucial as we shall see that the progressive operates based on the denoted eventuality. Hence, by remaining at the purely atomic level and not taking the eventualities into account, Priorian tense logic does not have the suitable means for correctly handling the aspectual meaning of tenses (on this point, see Kuhn and Portner 2006). This is why we adopt Reichenbach's approach here.

We must now provide further details concerning terminations. Contrary to states and processes, they are composed of two parts: a process that precedes a culmination. But which part of the termination is true at the eventuality time? Consider an example. We can say *Mary will win the race* before the race finishes. Imagine that we assert it after the start of the race. Here, the preparatory phase has already begun and was true at the reference point. However, winning will only be true in the future. Hence, the culmination phase is true at the eventuality time for terminations.

Definition 4.5 For a termination $p + c$, $p + c$ is true at t_E iff c is true at t_E and $\exists t_{E1}$ such that $t_{E1} < t_E$ and p is true at t_{E1}.

We would like to illustrate these truth-conditions with several examples using a sentence A.

(i) A = *this flower is red* with $\mathcal{E}(A)$ = s (a state)
A is true iff s is true at t_E and $t_E = t_R$
(ii) A = *Mary ran* with $\mathcal{E}(A)$ = p (a process)
A is true iff p is true at t_E and $t_E < t_R$

(iii) A = *Mary will win the race* with $\mathcal{E}(A)$ = p+c (a termination)
A is true iff c is true at t_E and $\exists t_{E1}$ such that $t_{E1} < t_E$ and p is true at t_{E1} and $t_E > t_R$

Our last step is to add the speech time in our truth-conditions. In general, the discourse provides information about the temporal relation between the speech time and the reference time. But without any explicit hint, we consider that the reference point and the time of speech occur at the same moment.

Definition 4.6 Relation between the Reference Point and the Speech Time. Unless otherwise indicated, the reference point is the speech time.

To illustrate the integration of the speech time in our truth-conditions, we close this section by considering two simple examples.

(i) A = *this flower is red* in the discourse *"This flower is red."* with $\mathcal{E}(A)$ = s (a state)
A is true iff s is true at t_E and $t_E = t_R$ and $t_R = t_S$
(ii) A = *She is happy* in the discourse *"Yesterday, I met Mary. She is happy and we start to talk about …"* $\mathcal{E}(A)$ = s (a state)
A is true iff s is true at t_E and $t_E = t_R$ and $t_R < t_S$

5 A new solution to the imperfective paradox

5.1 Semantics of the progressive

We can now turn to the progressive, which is usually considered as an aspectual modifier of a sentence. Indeed, it changes the eventuality denoted by the sentence in the case of a termination, by advancing the process and concealing the culmination.

Definition 5.1 PROG(A) is defined iff $p \in \mathcal{E}(A)$. Then, $\mathcal{E}(PROG(A)) = p$

The first consequence of this definition is that the progressive does not apply to states. Indeed, we do not say *the chameleon is being red* but simply *the chameleon is red* for a state description and *the chameleon is becoming red* for a change. Furthermore, the progressive can be applied to processes and does not change the eventuality denoted because it is already a lone process. The question *What did she do today?* can be answered in spoken English by either *At noon, she was pushing a cart* or *At noon, she pushed a cart*. The important consequence of this definition for our present issue is that it affects terminations by focusing only on their processes. As Moens and Steedman (1988) argued, this is done by removing the culmination part of the event that is being focused on.

In combination with the tense operators, we obtain the following truth-conditions for continuous tenses applied to terminations:

Theorem 5.1 *PAST(PROG(A)) is true at t_R for a termination p+c iff*

(i) *p is true at t_E*
(ii) $t_E < t_R$

Theorem 5.2 *PRESENT(PROG(A)) is true at t_R for a termination p+c iff*

(i) *p is true at* t_E
(ii) $t_E = t_R$

Theorem 5.3 *FUTURE(PROG(A)) is true at* t_R *for a termination p+c iff*

(i) *p is true at* t_E
(ii) $t_E > t_R$

Hence, the progressive applied to a termination means that its preparatory phase is true at the eventuality time. For instance, *Mary was building her house* means that at the past time denoted by the eventuality, Mary's process of building her house is under way. Furthermore, there is no engagement concerning the culmination of the event. We do not know when and even whether Mary will manage to finish building.

From a philosophical point of view, one problem is knowing why the preparatory phase is in itself the preparation of precisely this culmination and not another (for two opposite solutions to this issue, see Dowty 1979; Lascarides 1991). In our theory, *build her house* describes a termination that is an eventuality with a process and a culmination part. Hence, from the very beginning, the speaker thinks of the preparation and its culmination as a whole. By removing the culmination part and focusing on the process during the application of the progressive, the person memorizes their former association. Hence, there is no mystery, then, regarding why this particular process is connected to this particular culmination, contrary to the theories whereby both elements are first considered as semantically independent from each other (Parsons 1989; Lascarides 1991). But at the same time, provided the distinction we made between conceptual involvement and semantic entailment, such a link does not oblige us to posit an implication default semantics for the progressive, contrary to the theories where the process is considered as entailing the culmination, be it in a possible or actual world (Dowty 1979; Baggio and Lambalgen 2007).

5.2 Solving the imperfective paradox

Let us now turn to the imperfective paradox. As a first step, we would like to consider its usual analysis. First, we have to check whether a sentence in the progressive form denoting a process implies the same sentence but with the simple form [sentences (1) and (2)]. Second, we must verify that the same inference is false when the sentence at hand denotes a termination [sentences (3) and (4)]. Here, we reuse the examples previously presented in the introduction.

(1) Mary was pushing a cart.
(2) $\Rightarrow$ Mary pushed a cart.
(3) Mary was building her house.
(4) $\not\Rightarrow$ Mary built her house.

Our analysis correctly predicts that for processes, the inference from the progressive to the simple form is valid, and that this is so for every other tense. In the following proofs, we will provide the demonstration only for the progressive past. The proofs are exactly the same with the present and future operators, apart from the fact that the temporal relation $<$ must be replaced respectively by $=$ and $>$. Notice finally that while we do not take into account the speech time here, it could be easily added.

Theorem 5.4 *PAST(PROG(A)) ⇒ PAST(A) for* $\mathcal{E}(A) = p$

Proof If $PAST(PROG(A))$ is true at t_R then $\mathcal{E}(PROG(A))$ is true at t_E and $t_E < t_R$ (from Definition 4.2). Because $\mathcal{E}(A) = p$, $\mathcal{E}(PROG(A))$ is defined and $\mathcal{E}(PROG(A)) = p$ (from Definition 5.1). Thus, p is true at t_E and $t_E < t_R$. Because $\mathcal{E}(A) = p$, $\mathcal{E}(A)$ is true at t_E and $t_E < t_R$. Then, $PAST(A)$ is true at t_R (from Definition 4.2). □

It is easy to see that the inference is also valid in the other direction. Hence, contrary to the result presented by Lascarides (1991), the following two sentences imply each other:

(13) Max was running.
(14) Max ran.

In Lascarides's semantics, (14) ⇒ (13) is not valid. However, she does agree that such an inference is expected. In order to adapt her theory, she refers to the difference between truth and assertability. She argues that the only model that renders (14) true and (13) false is not assertable. Hence, all the cases in which the assertion of (14) is possible are cases in which the assertion of (13) is correct. However, we think that this solicitation of pragmatic principles at this point in the theory is particularly ad hoc. Hence, a theory without such an expedient is preferable.

Our analysis correctly predicts that, for terminations, the inference is not always valid. Indeed, the progressive does not automatically imply the culmination contrary to the simple tenses.

Theorem 5.5 *PAST(PROG(A)) ⇏ PAST(A) for* $\mathcal{E}(A) = p + c$

Proof By the same reasoning as the preceding proof, if PAST(PROG(A)) is true at t_R, then p is true at t_E and $t_E < t_R$. But this is insufficient to prove that p+c is true at t_E and $t_E < t_R$. Then, the truth of PAST(A) cannot be proved in t_R. □

However, this preliminary answer is unsatisfactory. Indeed, the knowledge of the world often allows a hearer to infer that the culmination was obtained, despite the fact that the progressive was employed for a termination. For instance, consider the sentence *when she entered, the water balloon was exploding*. Under normal circumstances, nothing will stop the culmination (i.e., the explosion of water balloon). We must therefore consider doxastic knowledge in our solution to the imperfective paradox. This incorporation is the most original aspect of our approach and allows us to offer a neutral solution for the implicational issue.[15]

To represent the doxastic knowledge of a person, we use a set of trivalent possible worlds.[16] Indeed, as cognitive agents, we have firm beliefs concerning only a limited number of facts, for which we can say that they are either true or false. But, for numerous sentences, there is no reason to choose one truth-value over another. For

[15] (Naumann and Piñón 1997) already insisted on the importance of considering the beliefs of the speaker in an analysis of the imperfective paradox.

[16] (Priest 2008) is a good manual for an introduction to semantics associating possible worlds with more than two truth-values.

instance, we do not know whether Einstein had an even or an odd amount of hair when he died. One objection to this approach could be that what we are defining here is a subjective and private notion of truth. To meet this objection, it is useful to recall our contextualist stand. On contextualism, the lexical meaning of an expression strongly underdetermines the truth-conditional content it expresses as it is uttered in context. Something must intervene to go from the former to the latter. In particular, this is required for the implicational features of the content expressed. In our view, the doxastic worlds of the interlocutors in context carry out the latter task. Sometimes, these doxastic worlds are identical with the actual world, at least concerning the parts used to evaluate the signification of the expression. This happens when the state of the world is publicly observable. For instance, we have the knowledge that "during the day, the sun is in the sky" because its truth-value can be publicly checked. But sometimes, such direct and public observation of the world is not available. In that case, the doxastic worlds can vary greatly and be more or less close with the actual world. This is particularly clear as it comes to accounting for the way people act. In many cases, the interlocutors take it for granted that there is an implicational link when the progressive is used and they behave accordingly, even if they do not have a direct access to the success or failure of the culmination. We describe this case, just as the previous one, in terms of a semantic determination role played by beliefs, though beliefs of different types carry out the determination task in each case. Eventuality-centered and evaluation-centered beliefs are the two doxastic ways of going from the level of the lexical meaning to the level of the implicational features. In the first case, the doxastic worlds are identical with the actual world and in the second case, they differ.[17]

The first advantage of a trivalent semantics is that it makes it possible to assign to this sentence an indeterminate truth-value. Furthermore, by only mentioning the sentences that are true or false, we reduce the footprint of the possible world and obtain a model that is closer in size to what is psychologically desirable. The second advantage is that trivalent possible worlds repel the validation of inferences that are not welcomed in doxastic contexts and which are valid under bivalence. For instance, following the classical modal logic, $A \equiv (A \wedge (B \vee \neg B))$ is valid. Hence, the following sentences, inspired by a famous example from Goodman (1947), would be equivalent.

(15) She was striking the match.
(16) She was striking the match and the match was dry or the match was not dry.

However, we have a stronger tendency to consider that the match will be lit in (15) rather than in (16). If the disjunction is not mentioned as it is in (15), it is assumed that we face the most normal case in which the match is dry. Thus, under normal circumstances, the progressive is actually supposed to lead to its culmination.[18] But this is not the case for (16). This shows that both sentences are not synonymous, contrary to their equivalence in bivalent classical modal logic. We call this puzzle the "sensitivity to additional disjunctions". This issue is directly related to the imperfective

[17] For a similar though distinct move, see the distinction between objective and subjective truth argued in (Wulf 2000).

[18] This is what is defended by (Dowty 1979) with the inertia worlds.

paradox, as both sentences use a past progressive and the first one naturally leads to the culmination, contrary to the second one. By sticking to a bivalent approach, we cannot discriminate between the sentences (15) and (16). Hence, we prefer to use trivalent possible worlds to formally construct a doxastic state, in which these two sentences are not equivalent. Here, the doxastic states will only take into account the salient elements concerning the situation under evaluation. For instance, we have a determinate truth-value concerning whether our age is 20, 40 or 60. However, in evaluating the building of Mary's house, our age has little chance of being relevant. Hence, it will not be part of the possible worlds representing the doxastic state used in the evaluation of this process.

We would like to show how to expand our formal semantics in order to incorporate these trivalent possible worlds. In order to model the judgments about temporal relations that are made when we use the progressive, we will order our beliefs temporally. They will be associated with the time about which they hold. More precisely, we will associate an eventuality time with the different beliefs that a person can have concerning the arrangement of the world at that precise time. For instance, I can have different beliefs concerning the day of my birth. I can know where I was born, the number of persons present and whether the delivery went well or was difficult. This could be represented by a set of possible worlds W_1. I can also have other beliefs concerning my twentieth birthday, like whether I organized a party with my friends or my family and whether I was thrilled or not. This other stock of beliefs could be represented by a set of possible worlds W_2. Hence, my doxastic state concerning the judgment at hand can be represented by the union of all the relevant beliefs, divided up according to the time they involve. If D^t is the doxastic state held at time t, then $D^t = \{W_1^t, \ldots, W_n^t\}$. Hence, the superscript represents the time at which the beliefs are held and the subscript the time involved by the beliefs.

Notice that we do not pretend that all our beliefs are effectively temporally ordered in this way. But, at least, when the understanding of the meaning implies a temporal relation, we have ideas about the eventualities that precede the others. Hence, we can consider that such a temporal organization holds for the beliefs that are relevant to the judgment at hand. Finally, all these beliefs are held at the same time, which is the time of judgment. A person's doxastic state will evolve throughout his or her life. But concerning the utterance or the understanding of a sentence, here we will only consider the time when the cognitive task is carried out. That is why we generally omit the superscript for D and W in the following. Hence, we have a doxastic state that is held at a unique point in time and which is composed of beliefs about different points in time. In the following, when we speak about beliefs or eventualities that are true at a time t, we mean that these beliefs or eventualities are about time t and are believed to be true.

If the person is certain about all the elements concerning the situation at hand, this set of beliefs is a singleton. But if the person has concurrent opinions concerning the status of the world at this time, the doxastic state contains several elements. For instance, consider a process p about the eventuality time t_{E1} as evaluated true. If the agent is sure about all the elements of his beliefs, this means that p is also true for $\{w\}$, the singleton corresponding to his doxastic state. But if the person has conflicting opinions concerning other eventualities than the process p, then p is true for all elements

of $\{w_1, \ldots, w_n\}$ with n the number of different possible worlds constituting his or her set of doxastic states. Notice that we can speak indifferently of an eventuality that is true about a time t, true at t or true in the associated doxastic state.

Definition 5.2 Let t_1 be an eventuality time and $\{w_1, \ldots, w_n\}$ the set representing the associated doxastic state. Then
$\mathcal{E}(A)$ is true at t_1 iff $\forall w \in \{w_1, \ldots, w_n\}$, $\mathcal{E}(A)$ is true in w.

The question underlying the imperfective paradox is whether the culmination c will be true about a time t_2, knowing that its process p is true in W_1, the set of beliefs in the doxastic state about the time t_1. As a cognitive agent and starting from W_1, we can imagine several different futures at t_2. We will represent this imagination of the future consequences by means of a doxastic function f. Its first argument is W_1, the initial set of beliefs about the eventuality time of the process. Its second argument is t_2, the targeted eventuality time. Its result is the set of beliefs about t_2 grounded on W_1.

Definition 5.3 Let W be a set of trivalent possible worlds, R an accessibility relation between these possible worlds and T the set of times. Then
F is a set of doxastic functions from $2^W \times T \rightarrow 2^W$ such that

$$f(W_1, t_2) = \{w_2 \mid w_2 \text{ is about } t_2 \text{ and } \exists w_1 \in W_1 \text{ such that } w_1 R w_2\}$$

We can now prove the following property. If our beliefs make sure that the process will culminate in the past, then the progressive form allows for the simple tense form to be inferred. Like before, the same proof can be obtained for the present and future tenses by replacing $<$ with = and $>$.

Theorem 5.6 *For $\mathcal{E}(A) = p + c$, let PAST(PROG(A)) be such that p is true in W_1 associated with t_1, $t_1 < t_R$ and it exists t_2 an eventuality time such that $t_1 < t_2 < t_R$. If $\forall w \in f(W_1, t_2)$, c is true in w, then PAST(PROG(A)) $\Rightarrow$ PAST(A).*

Proof If PAST(PROG(A)) is true at t_R, then p is true at t_1 (see Theorem 5.1). If $\forall w \in f(W_1, t_2)$, c is true in w, then c is true in W_2, the set of beliefs about t_2. As p is the process of c, p is true at t_1, c is true at t_2 and $t_1 < t_2$, we obtain that p+c is true at t_2. Finally, as $t_2 < t_R$, PAST(A) is true at t_R. □

We obtained the desired result. If the doxastic function leads to a set of beliefs in which the culmination is always obtained, then the inference is valid. But this property does not hold for all progressives, as the set of beliefs may contain possible worlds in which this culmination does not happen.

By way of an illustration, we will first take up example (3): *Mary was building her house*. This is modelled by making the process of construction in the set of beliefs W_1 true about a past time t_1. Building a house is a long-term undertaking with different possibilities of never being completed. Hence, the doxastic function describing the possible outcomes of this effort between t_1 and today will partly lead to worlds in which the building is not achieved. Thus, the culmination is not certain to be obtained, and people who judge this sentence will conclude that the house is not sure to be yet finished. Let us now consider the progressive in this example that we already

examined *A: Do you know where C is? B: I've just met him. He was heading towards room 3*. Again, the mobility of the person is true for all the beliefs about the past time t_1. Without notable reasons for the person changing his destination, the outputs of the doxastic function will all be worlds in which the person effectively reached room 3. According to these beliefs and the inference that is made, A will go to this room to meet John. But notice that these beliefs can always be updated in light of new information.[19]

6 Solutions to related issues

In this section, we shall put our account to the test in order to provide additional reasons for adopting it, independent of the particular problem of the imperfective paradox. Indeed, various puzzles are related to this problem and the way they are solved makes it possible to test the efficiency of the global solution. With the objective of assessing our own proposal, we shall now examine some of these well-known puzzles. Here, we will examine a list of issues mainly inspired by Portner (2011).

First of all, the progressive cannot be combined with stative verbs (see Vendler 1967 or Dowty 1979). This is what we predict because, in our theory, the progressive can only apply to a sentence if its eventuality contains a process. If the eventuality denoted is a state, the progressive cannot occur. However, this rule must sometimes be weakened. Indeed, some verbs that could be qualified as stative according to some criteria allow the application of the progressive. A related problem noticed by Bach (1981) is that there is no progressive of progressive constructions as in *# Max was being running*. The usual answer to these two issues is to solicit coercion which is an adjustment of the eventuality denoted to the requirements of the context (see for instance Moens and Steedman 1988 or Swart 1998). Regarding the first problem, the meaning of some stative verbs can sometimes be shifted by coercion in order to meet the aspectual restriction imposed by the progressive, meaning to express a process. In particular, this mechanism can be triggered if the state described is not permanent, as in *she was being happy*. As for the second problem, the application of the progressive can again lead by coercion to a stative construction, as indicated by the usage of the particle *be*. Hence, the progressive cannot be applied again. We end up with two additional rules motivated by coercion. First, a progressive applied to a changing state transforms it into a process. Second, the result of a progressive applied to a process is a state. As our proposal is based on event semantics, which is the basis for the usual coercion solutions, this expansion of our theory is quite direct.

It is a well-known fact that a progressive can describe a process that is not performed during the whole interval denoted by the sentence. Hence, pauses are possible for the event at hand. Related to this issue is the question of interruptions. Even if an event is aborted, the process can be described with the help of the progressive form. These two features can be illustrated by the following examples.

(3") Yesterday, Mary was building her house.

[19] As suggested by some reviewers, improvements of this semantics could be carried, for instance by formally distinguishing the different agents or by using intervals of time.

(17) Mary was crossing the street when she was hit by a truck.

The description provided by sentence (3") is absolutely unproblematic, even if the person takes some breaks, like a lunch break. In the same way, the use of the progressive in sentence (17) is completely correct, even if Mary is unable to reach the other side of the street. Dowty (1979) notices that these two sentences are counter-examples of the superinterval analysis of Bennett and Partee (1978). Because we do not use intervals but, instead, points in time in our approach, we are able to deal with these two issues. In our analysis, the preparatory phase does not have to be true for every instant of the previous day to make sentence (3") true. It is enough to find at least one point in time when the process holds in order to render the sentence true. Hence, an activity can contain many pauses. One objection to this view could be that this analysis is insufficient for (3"') *All day yesterday, Mary was building her house*. However, we have here an explicit quantification concerning the stretch of time. This means that we now need a process that holds for at least the vast majority of the points in time during normal working hours.[20] Hence, our theory allows pauses for processes with a progressive formulation. Concerning the problem of interruptions, it is easily solved in our approach because we do not posit an automatic culmination of the progressive, in either a possible world or the real world. We simply argue that we need the concept of Mary crossing of the street in order to understand (17). But knowing that she was hit by a truck and that, for instance, she was not a cyborg, does not allow us to deduce that she has indeed crossed the street. Hence, the interruption of a process does not cause any problem for our theory.

These two issues are related to the problem of past futures which plagues the theories of Bennett and Partee (1978) and van Lambalgen and Hamm (2005). Indeed, according to them, the following deduction is true contrary to what intuition dictates.

(18) Mary was drawing a circle.
(19) $\Rightarrow$ Mary will have drawn a circle.

Again, the problem of past futures does not hold up in our approach because we do not defend an automatic inference from the progressive to the simple or perfect form. Depending on the context, we will either conclude or not conclude that Mary completed the circle. Hence, the inference from (18) to (19) is uncertain. For instance, we can think that this task is very simple or, on the contrary, if we know that Mary is two years old, some simple doxastic considerations will allow us to conclude that the culmination will probably not occur. Sentence (18) illustrates another issue, which is the failure of existence. Here, we speak of a circle that will perhaps never exist. This problem looms as soon as the analysis is conducted at the quantificational level. Indeed, to analyze the object argument of verbs of creation, we need to posit a constant or an existential variable. For instance, the formal analysis of (18) must include $\exists x\ Circle(x)$. But we know very well that this object will never exist if the creation cannot be achieved. Parsons (1989)'s answer to this issue is to solicit incomplete objects. Until now, the circle created would have just been a part of the whole circle. But as Landman (1992)

[20] Quantification in natural language is sufficiently lax to allow for the domain of quantification to not correspond exactly to the whole set of times constituting the previous day.

points out, this answer is ineffective when speaking of non-existent objects that are suddenly created, such as in *God was creating a unicorn, when he changed his mind*.

According to our approach, the analysis is made in terms of possible worlds that model the beliefs of the speaker or the hearer. Hence, the existence of the object being created is posited among the mere *possibilia*. This domain of quantification does not concern the real world, as is the case in Parson's analysis, but only serves to model the beliefs of the person who simply considers the possible outcome of a situation in order to qualify it. Hence, this existential quantification is harmless because it does not entail the actual existence of the object.[21] This treatment solves also a related puzzle called the impossible outcomes in (Wulf 2009). Imagine that John decides to draw a circle but that he is on desert island with only one pen available. The pen entirely runs out of ink before John manages to completely draw a circle. As it is now learned, it was impossible for John from the outset to draw it. However, John believed it could do it when he began this task and this is modelled by the present account. Indeed, the circle does not need to be an actual possibility in the real world. According to Wulf, this example is a challenge for all preceding modal accounts but it is addressed under the present theory.

Landman (1992) offers another very interesting challenge, this time concerning situations in which certain results are particularly improbable. For instance, imagine that Mary alone attacks several hundred soldiers with her only sword. The following sentence therefore seems difficult to assert:

(20) Mary was wiping out the Roman army.

Indeed, destroying all of the opponents is so far-fetched that (20) appears to be false. This is the reasonableness principle. In our approach, it can be explained by considering that the preparatory phase must be true at some point in time before the culmination. Concerning Mary's attack, the losses suffered by the Roman army must be sufficiently high in order to consider the process as effectively ongoing. Our theory does not indicate the exact limit that needs to be reached. But by representing the doxastic knowledge through a set of trivalent possible worlds, we can model the fact that the process gradually takes shape as long as Mary inflicts more and more damage upon her opponents. This can be done, for instance, by speaking in terms of the relative number of possible worlds in which Mary carries out the deed compared to those in which she does not. This also makes it possible to explain the actuality principle, which says that if Mary manages to effectively destroy the Roman army, despite the improbability of this outcome, then (20) must now be considered true. According to our conception, we do not even have to wait for the culmination to declare the process leading to it to be true. Indeed, the doxastic knowledge evolves gradually, and some can declare the process true if, for instance, 50% of the army was destroyed.

Landman reports another interesting puzzle raised by Roger Schwarzschild, which shows that some conflicting sentences might both be asserted separately. Imagine that Roger is on a plane initially bound for Boston but which is then hijacked to Bismark.

[21] This analysis could be extended to deal with unicorns and other non-existent objects. Several solutions exist within the possible world approach: for instance, see Priest (2005).

The two following sentences therefore seem true when taken separately but false when considered together:

(21) Roger was flying to Boston (when his plane was hijacked).
(22) Roger was flying to Bismark (though he didn't know it).

This phenomenon is the indeterminacy principle. Our theory is particularly well equipped to face this issue. Indeed, by considering Roger's doxastic state before he learned of the hijacking, (21) and not (22) will be true. For the hostage-taker, however, (22) is true and (21) is false. Finally, the knowledge of the right destination will be determined at the end of the flight. According to the landing point, the destinations mentioned in (21) and (22) or another destination will be the real culmination. In the same way, we can explain the sensitivity to the description of the event. Consider the following example borrowed from Portner (1998).

(23) Max was crossing the street.
(24) Max was walking into the path of an oncoming bus.

Depending on the point of view, both sentences could be considered true because doxastic considerations are sensitive to descriptions. Engelberg (2002) describes it as the intention problem, since the intentions of the agent need to be taken into account in order to distinguish between both descriptions. Indeed, if Max wanted to commit suicide, (24) seems a better description than (23). But a bystander who does not know Max's intentions could very well describe the situation by using (23). By differentiating between people's doxastic states, we are able to explain this sensitivity to the description. From an objective point of view and as in the case of the hijacking, Max was not crossing the street because he was not able to attain the other side of the road.

In conclusion, the key point of this theory is the introduction of epistemic considerations in order to modulate the inference from the progressive to the simple form for a termination. This proposal solves the imperfective paradox. But in addition, it furnishes direct solutions or clear directions to follow in order to solve its related puzzles.

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