The modality of (im)perfectivity[1]

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1. Introduction: temporal relations and modality in viewpoint aspect

The two main categories of viewpoint aspect, perfective and imperfective, have a common semantic component: they are both used to assert the existence of some event. In other respects, however, they seem to be in opposition. The most obvious difference involves the kind of temporal relations they introduce, a common view being that perfective and imperfective introduce different relations of inclusion between *event time* and *topic time* (cf. Klein 1994). Thus, Hacquard (2006, 2009) gives the following partial translations (the symbol '≈' meaning 'is translated as').

(1)   a. Perfective ≈ $\lambda P \lambda t. \exists e[P(e) \wedge \tau(e) \subseteq t]$
        b. Imperfective ≈ $\lambda P \lambda t. \exists e[P(e) \wedge t \subset \tau(e)]$

Here, the meaning of viewpoint aspect is defined as a function which takes a predicate of events P and a time interval t (the topic time) as arguments, asserts the existence of a P-event e, and relates the time span $\tau(e)$ of e to the topic time t through an inclusion relation. In the perfective case (1a), the event time is (possibly improperly) contained within the reference time, while in the imperfective case (1b), it is the reference time which is properly contained in the event time. In other words, the perfective presents an event as completed, whereas the imperfective presents it as ongoing.

A second difference involves their distinct modal properties. The perfective is *anchored* in the world of evaluation, by which I mean that the event described in a perfective sentence is interpreted as taking place in the world of evaluation. Consider in this respect the Spanish examples in (2). While (2a) entails that a triangle came into existence in the actual world (i.e., the default world of evaluation) at some point in the past, the truth of (2b) requires, in every accessible world in the relevant epistemic modal base (i.e. those worlds compatible with Juan's thoughts), that a triangle have been drawn in that world.

(2)   a. Juan dibujó   un triángulo.
           Juan drew_PFV a   triangle

        b. Juan piensa que María dibujó   un triángulo.
           Juan thinks that Maria drew_PFV a   triangle

In contrast to (2a, b), a sentence in the imperfective has to be evaluated with respect to a background set of possible developments, whether lexical modals are present or not. Thus, the progressive reading of a sentence like (3) does not entail the existence of a triangle at any point in time in the actual world: it only conveys that a triangle could have been, or could still be, a possible outcome of Juan's activity, not a necessary one.

(3)   Juan dibujaba   un triángulo.
        Juan drew$_{IPFV}$ a   triangle

Now, as Dowty (1979) points out, the interpretation of an accomplishment verb phrase requires "the coming about of a particular state of affairs", suggesting that the imperfective in (3) should be treated in terms of possible worlds, since it is not necessarily the case that a triangle was produced by Juan in the actual world.

At this point, the question arises whether the particular combinations of temporal and modal properties encoded in perfective and imperfective morphology are just an accidental feature of UG, or can be given a principled explanation. In this squib, I will try to show that the apparent difference between these viewpoint aspects in terms of modality does not have to be stipulated in the lexical entry of the relevant items, and that the translations in (1), along with Dowty's notion of possible developments (in its more recent Portnerian implementation), provide us with the necessary conceptual tools to understand why the perfective should be anchored in the world of evaluation.

The outline is as follows. Section 2 focuses on the formal characterization of possible developments as inertia worlds, and elaborates on the precise extent of their relation to the world of evaluation, the main point being that inertia worlds cannot differ from the world of evaluation with respect to the (contextually defined) relevant facts at topic time. Section 3 then introduces the proposal that viewpoint aspect has a uniform modal component, a necessity operator over inertia worlds. Given that the latter are identical to the world of evaluation with respect to the relevant facts at topic time, the anchoring of the perfective in the world of evaluation is shown to follow from the interaction of this common modal component and the independently defined temporal properties of the perfective, which places the time of the event within topic time. Section 4 concludes the squib.

2. On the relation between inertia worlds and the world of evaluation

Following Dowty (1979), I will henceforth assume that the progressive reading of the imperfective results from the presence of a modal operator on possible developments, or *inertia worlds*. Intuitively, (3) is true in the world of evaluation w^{ev} at utterance time iff the topic time t precedes the utterance time, and in every possible development of the state of affairs at $<w^{ev}, t>$ in which the natural course of events is not interrupted, Juan

draws a triangle. Let us then delve into the question of what the proper characterization of inertia worlds should be. I will follow the basics of Portner (1998)'s approach to this question, which is in turn framed within Kratzer (1977, 1981, 1991)'s theory of modals. Portner suggests that the set of inertia worlds is defined on the basis of a circumstantial modal base – call it $M(w^{ev})$ - including the set of relevant facts in the world of evaluation, and an ordering source – call it $O(w^{ev})$ - containing the set of factors that need to obtain in order for the proposition in the scope of the modal to be true. Consider again example (2a), repeated here in (4).

(4)   Juan dibujaba   un triángulo.
        Juan drew$_{IPFV}$ a   triangle

The modal base $M(w^{ev})$ here will contain such contextually-defined facts as "Juan intended to draw a triangle", "Juan was engaged in the drawing of a non-curve geometrical figure", "Juan had some kind of drawing support", and the like, facts relevant to the interpretation of (4). Now, the set $\cap M(w^{ev})$ of worlds in which all these facts hold contains worlds in which Juan indeed completes his triangle, as well as worlds in which he is interrupted by some outside factor. The role of the ordering source $O(w^{ev})$ is to rank these worlds according to an ideal of non-interruption of the event described by the VP. Thus, $O(w^{ev})$ could contain such propositions as "Juan does not get eaten by a bear", "Juan's pen has enough ink", "Juan does not suddenly decide to draw a parallelogram instead of a triangle", etc. A world w_1 will be better than a world w_2 from the point of view of $O(w^{ev})$ if every proposition of $O(w^{ev})$ that is true in w_2 is also true in w_1, but not all the propositions of $O(w^{ev})$ that are true in w_1 are also true in w_2. The corresponding notation will be as in (5).

(5) $w_1 <_{O(w)} w_2$

Given these two components, the set of inertia worlds is defined by the function Best, which picks the best worlds in $\cap M(w^{ev})$ from the point of view of the ideal in O.

(6)   Best(M, O, w^{ev}) = the set of worlds w' in $\cap M(w^{ev})$ such that there is no w'' in $\cap M(w^{ev})$ where w'' $<_{O(w)}$ w'.

I will assume this approach to be on the right track, with some refinements being necessary. First, as Ferreira (2005) notes, the set $M(w^{ev})$ of potential relevant facts should be restricted to those holding at topic time: in order to interpret (4), we do not need to know about Juan's activities a day, or a year before the moment referred to in discourse. Following Ferreira's observation as a starting point, let us then take the modal base M to

be the set of relevant facts in the world of evaluation at topic time t - call it $M(w^{ev}, t)$. Correspondingly, a fourth argument must be added to the function Best, yielding (7).

(7) $Best(M, O, w^{ev}, t)$ = the set of worlds w' in $\cap M(w^{ev}, t)$ such that there is no w'' in $\cap M(w^{ev}, t)$ where $w'' <_{O(w)} w'$.

A second refinement involves the sensitivity of the modal base to the description of the event. Thus, Portner notes that (8a, b) can be simultaneously true, and describe the same essential state of affairs.

(8)   a. Max was crossing the street.
        b. Max was walking into the path of an oncoming bus.

Suppose a bus did hit Max before he could cross the street: (8a) will still be judged true. In Portner's approach, this intuition is explained through the idea that the facts involving the bus are not necessary for the interpretation of the sentence: if one only considers what Max is doing, he is crossing the street. In other words, the interpretation of progressive sentences like (8a) involves a judgment about which facts are part of the set of relevant facts $M(w^{ev}, t)$. Now, consider (8b). According to Portner, it is a description of the same state of affairs, but now it has to be true in the corresponding inertia worlds that Max is hit by the bus. This makes sense: the choice of the relevant facts is a matter of interpretation, but there is no getting around the participants involved in the description of the event - to which the modal base is sensitive. Therefore, the modal base and Best must take an event description P as an additional argument. The set of inertia worlds will then be defined as in (9).

(9) $Best(M, O, w^{ev}, t, P)$ = the set of worlds w' in $\cap M(w^{ev}, t, P)$ such that there is no w'' in $\cap M(w^{ev}, t, P)$ where $w'' <_{O(w)} w'$.

Assuming (9) as a proper characterization of a set of inertia worlds, let us conclude this section by asking a different question: how different from the world of evaluation can an inertia world be? The answer seems to involve the topic time t as a crucial parameter. After t, the world of evaluation can differ completely from the inertia worlds – consider example (8a) under the bus scenario. On the other hand, facts preceding t appear to be largely irrelevant to the truth of an imperfective sentence, as was already mentioned. Hence, the similarity or dissimilarity of inertia worlds with respect to the world of evaluation before t seems also irrelevant. Now, what happens during t? The inertia worlds are based on a set of relevant facts in the world of evaluation at t, so these facts must hold in every inertia world. This is not to say that the inertia worlds are identical to the world of evaluation at t: it is still necessary to remove the real bus from the inertia worlds in

(8a). But the main point here is the answer to the question above: the inertia worlds, by definition, cannot differ from the world of evaluation with respect to the set of relevant facts at t, that is, the set $M(w^{ev}, t, P)$. This will be an important point in the next section.

3. Proposal: same modality for perfective and imperfective

I will now propose that viewpoint aspect has a unique modal component: a necessity operator over inertia worlds, which I will assume to be part of the meaning of the perfective (Pfv) **and** the imperfective (Ipfv). More concretely, I will adopt the following translations:

(10)   a. Pfv $\approx \lambda P \lambda t. \forall w \in Best(M, O, w^{ev}, t, P): \exists e[P(e, w) \wedge \tau(e) \subseteq t]$
       b. Ipfv $\approx \lambda P \lambda t. \forall w \in Best(M, O, w^{ev}, t, P): \exists e[P(e, w) \wedge t \subset \tau(e)]$

This is the kind of modality one expects when dealing with imperfective sentences. But now I am proposing that the meaning of perfective sentences is also calculated with respect to a set of inertia worlds. This seems counter-intuitive, since perfective sentences are anchored in the world of evaluation (cf.2), while imperfective sentences are not (cf. 3) – which was the reason to postulate inertia worlds in the first place. However, I will argue that (i) the fact that inertia worlds cannot differ from the world of evaluation with respect to the set of relevant facts $M(w^{ev}, t, P)$, combined with (ii) the requirement of perfective aspect that the event time is contained within the topic time t, predicts in fact the anchoring of a perfective sentence in the world of evaluation.

Before getting to that particular point, consider first the derivation of an imperfective sentence under the relevant assumptions. The calculation is shown in (12), given the simplified clausal structure in (11) – AspP is a viewpoint aspect phrase, P_1 is a event property constant (type $<s, <\varepsilon, t>>$, where ε is the type of events), R is a variable of type $<\tau, t>$ (where τ is the type of time intervals), t* is the speech time.

(11)   [$_{TP}$ PST [$_{AspP}$ Ipfv [VP]]]

(12)   a. VP $\approx \lambda w \lambda e. P_1(e, w)$
       b. Ipfv $\approx \lambda P \lambda t. \forall w \in Best(M, O, w^{ev}, t, P): \exists e[P(e, w) \wedge t \subset \tau(e)]$
       c. AspP $\approx \lambda t. \forall w \in Best(M, O, w^{ev}, t, P_1): \exists e[P_1(e, w) \wedge t \subset \tau(e)]$
       d. PST $\approx \lambda R.[t < t^* \wedge R(t)]$
       e. TP $\approx t < t^* \wedge \forall w \in Best(M, O, w^{ev}, t, P_1): \exists e[P_1(e, w) \wedge t \subset \tau(e)]$

The truth conditions of a past imperfective simple sentence are therefore predicted to be as in (13) – g_c is a contextually defined assignment function, which sets the free t variable as the topic time.

(13) $[[TP]]^{gc}$ = true iff the topic time $g_c(t)$ precedes the speech time t^*, and for every inertia world accessible from the actual world given the set of relevant facts at $g_c(t)$, there is a P_1-event e such that the time span of e in that world properly includes $g_c(t)$.

Consider now the derivation of a perfective sentence. It will follow the pattern in (12), but the contribution of the aspectual head is now that of Pfv – cf. (10a).

(14)   a. $VP \approx \lambda w \lambda e.P_1(e, w)$
         b. $Pfv \approx \lambda P \lambda t.\forall w \in Best(M, O, w^{ev}, t, P): \exists e[P(e, w) \wedge \tau(e) \subseteq t]$
         c. $AspP \approx \lambda t.\forall w \in Best(M, O, w^{ev}, t, P_1): \exists e[P_1(e, w) \wedge \tau(e) \subseteq t]$
         d. $PST \approx \lambda R.[t < t^* \wedge R(t)]$
         e. $TP \approx t < t^* \wedge \forall w \in Best(M, O, w^{ev}, t, P_1): \exists e[P_1(e, w) \tau(e) \subseteq t]$

The resulting truth conditions of a simple sentence in the past perfective can be described as follows.

(15) $[[TP]]^{gc}$ = true iff the topic time $g_c(t)$ precedes the speech time t^*, and for every inertia world accessible from the actual world given the set of relevant facts at $g_c(t)$, there is a P_1-event e such that the time span of e in that world is included in $g_c(t)$.

Now, (15) establishes that a particular P-event is included in $g_c(t)$ in every inertia world: it is therefore a completed P-event at $g_c(t)$. But inertia worlds are identical to the world of evaluation with respect to the relevant facts at $g_c(t)$. From any perspective, the completion of a P-event is part of the facts relevant to the interpretation of a sentence containing a description of a P-event. It follows automatically that the P-event has to be completed in the world of evaluation at $g_c(t)$. This captures the intuition that a sentence like (2a) - *Juan dibujó un triángulo*,'John drew_PFV a triangle' - entails the coming into existence of a triangle in the actual world.
Notice that the anchoring of the perfective in the world of evaluation does not depend on which particular set of inertia worlds is under consideration: the anchoring follows strictly from the interaction of independently defined properties of the perfective's meaning: (i) the assumed definition of what an inertia world is and how it is rooted in the world of evaluation through the set $M(w^{ev}, t, P)$ of relevant facts at topic time, and (ii) the temporal relations imposed by the perfective, which require that the event be completed at topic time.
Before concluding, I would like to take a closer look at what should count as an inertia world for a perfective sentence. The reason is that, contrary to imperfective sentences,

perfective ones end up telling more about the world of evaluation at $g_c(t)$ than they do about any possible development stemming from $<w^{ev}, g_c(t)>$, which might seem paradoxical since I am arguing that they are interpreted against a background set of possible developments in which the course of events at $g_c(t)$ is not interrupted. But there is no paradox: the fact that the P-event is completed at topic time makes superfluous the effects of any possible ordering source which ranks as best the worlds in $\cap M(w^{ev}, t, P)$ in which the P-event is not interrupted. Consider (16).

(16)   Juan cruzó   la pista.
        Juan crossed$_{PFV}$ the road/street.

On the one hand, the modal base involved behaves as expected: it will take into account the set of relevant facts in the world of evaluation at topic time, including the fact that Juan's street-crossing event is completed, which – as argued - can be independently inferred from the properties of the perfective's meaning. On the other hand, the ordering source will be empty, since the ideal of non-interruption of the event described by the VP is vacuously satisfied by the completion of the event at topic time. This holds of perfective sentences generally. Consequently, the set of inertia worlds for a perfective sentence is the complete modal base $\cap M(w^{ev}, t, P)$, corresponding to any world identical to the world of evaluation with respect to the set $M(w^{ev}, t, P)$ of relevant facts at topic time. The name 'inertia world' is somewhat misleading in this case, because no inertia world defined in this way includes a possible development of the event described by the VP after $g_c(t)$. But this has to do with what we consider an appropriate way to name the worlds belonging to the set defined by the function $Best(M, O, w^{ev}, t, P)$: it is not a problem of the definition itself. The label 'inertia worlds' is to be understood in this technical sense.

4. Conclusion
I hope to have shown that it is possible to conceive viewpoint aspect as modally uniform, a welcome result on theoretical grounds. It remains to be shown that the proposed approach can be made compatible with other kinds of modality associated to imperfective aspect, notably the expression of habituality – I refer the reader to Linares (2009) for such an attempt, framed in a theory of viewpoint aspect based on the notion of binary antonymy.

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