Perfectivity in Russian: A modal analysis*

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1. Overview

The perfective has never been among those aspectual categories that are believed to deserve a modal analysis. Unlike what happens with the progressive (Dowty 1979, Landman 1992, Portner 1998, a.m.o.), events described by the perfective occur entirely in the actual world, leaving no room for anything like the Imperfective Paradox to emerge. Unlike the perfect (Katz 2003, Portner 2003), the perfective does not give rise to modal presuppositions related to its current relevance and/or temporal orientation.

However, in this paper I would like to argue that properties of the perfective (in Slavic languages at least) are best accounted for if its semantics is endowed with a modal component, too. Specifically, I propose that the contribution of the Slavic perfective to the interpretation is two-fold. First, it introduces, as is commonly assumed, an operator mapping predicates of events to predicates of times in Klein's (1994) style. Secondly and crucially, the perfective indicates that the evaluation world is one of those where an event that falls under a given event description is maximally realized. To implement this idea, a circumstantial modal base and an event-maximizing ordering source are introduced, the former defining a set of worlds where a relevant event occurs, the latter imposing a strict partial order on this set. One good consequence of this analysis is that it allows to derive peculiar aspectual compositional effects characteristic of Slavic languages whereby undetermined plural and mass incremental arguments receive what Filip (2005a) calls unique maximal interpretation.

2. The problem: perfectivity and aspectual composition

In this section, I summarize the data showing that perfective sentences in Russian (and similar languages) are significantly different from perfective sentences in English (and similar languages) in terms of aspectual composition.

Aspectual composition, discussed systematically at least since Verkuyl 1972, is an interaction between properties of a verbal predicate and properties of its argument(s) in determining telicity of VP and/or a clause. In English and similar languages, verbs like *eat* can head either telic of atelic VPs depending on characteristics of their internal incremental (Krifka 1989, 1992, 1998) argument.

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(1) **Telic perfective sentences in English**
a. Indefinite DP based on a singular countable noun
John ate an apple $^{??}$for ten minutes/^{OK}in ten minutes.

b. Definite DP based on a singular countable noun
John ate the apple $^{??}$for ten minutes/^{OK}in ten minutes.

c. (In)definite DP with a cardinal numeral
John ate (the) three apples $^{??}$for ten minutes/^{OK}in ten minutes.

d. Definite plural DP
John ate the apples $^{??}$for ten minutes/^{OK}in ten minutes.

(2) **Atelic perfective sentences in English**
a. Indefinite mass DP
John ate soup ^{OK}for ten minutes/*in ten minutes.

b. Indefinite plural DP
John ate apples ^{OK}for ten minutes/*in ten minutes.

(1)-(2) differ as to their telicity, as evidenced by the common test on co-occurrence with durative and time-span adverbials. Since all the sentences in (1)-(2) contain the same past perfective verb form, *ate*, one has to conclude that the source of the variable behavior of the VP are properties of the internal argument of *eat*. I will be referring to the pattern in (1)-(2) as English-type aspectual composition. In the literature, a number of accounts for the aspectual compositional effects like (1)-(2) have been proposed, including Krifka's mereological theory (Krifka 1989, 1992, 1998), Verkuyl's PLUG^{+} theory (Verkuyl 1972, 1993, 1999), Rothstein's theory of contextual atomicity (Rothstein 2004), and a family of theories framed within the degree semantics frmawork (Hay et al. 1999, Kennedy, Levin 2002, 2008, Piñon 2008, Kennedy 2012).

The below discussion follows basic assumptions and analytical techniques of the mereological theory. In a nutshell, Krifka's account for the English-type aspectual composition consists of two ingredients. First, verbs like *eat* denote incremental relations between individuals and events which guarantees a homomorphism from objects to events. Secondly, both complex event descriptions (i.e. VPs like *eat three apples, eat apples,* etc.) and their nominal arguments (*three apples, apples,* etc.), if analyzed as predicates, can be characterized as cumulative or quantized. A predicate is quantized iff whenever it applies to an entity x, it does not apply to any proper part of x. A predicate is cumulative iff whenever it applies to distinct entities x and y it also applies to their mereological sum.[1]

What nominals like 'the apple', 'three apples', 'the apples', etc., have in common is: if analyzed as predicates of individuals, they all are quantized. For instance, no proper part of an entity which can be described as *three apples* is three apples. Expressions like *eat the apple, eat three apples, eat the apples*, etc., if analyzed as event predicates, are quantized, too. No proper part of an event in which three apples are eaten can be described as *eat three apples*. Similar reasoning applies to cumulativity. (See, however, Krifka 1998: 218-219 for significant qualifications.)

[1] (i) a. $\forall P[QUA(P) \leftrightarrow \forall x \forall y\ [P(x) \wedge P(y) \rightarrow \neg x<y]]$
b. $\forall P[CUM(P) \leftrightarrow \forall x \forall y\ [P(x) \wedge P(y) \rightarrow P(x \oplus y)] \wedge \exists x,y[P(x) \wedge P(y) \wedge \neg x=y]]$ (Krifka 1989, 1992, 1998)

Since the incremental relation establishes a homomorphism from objects to events, an event predicate is quantized (i.e., telic) if its nominal argument is quantized. It fails to be quantized if this is not the case. Thus, in *eat three apples* and *eat apples*, the relation between the theme and the event argument is incremental; in the course of the event an apple /apples is/are eaten part by part, and the temporal progress of the event corresponds to the spatial extent of what is being eaten. Since a proper part of *three apples* is not three apples, eating a proper part of three apples is not eating three apples, hence *eat an apple* is quantized. In contrast, a proper part of *apples* is still apples, so if *e* is an event of eating apples, then a proper part of *e* is also an event of eating apples.

Russian and many other languages make a case for **Russian-type aspectual composition** (Krifka 1992, Verkuyl 1999, Piñon 2001, Paslawska, von Stechow 2003, Filip 1993/1999, 2004, 2005a,b; Romanova 2006, Padučeva, Pentus 2008, Tatevosov 2014). In Russian, **perfective verbs** restrict interpretation of **the internal incremental argument**. Undetermined plural/mass incremental arguments receive the **definite interpretation** whereby they refer to the maximal individual consisting of all entities of a particular type available in the universe of discourse. The verbal predicate is obligatorily telic. This is illustrated in (3):

(3) **Perfective sentence; undetermined plural DP**, cf. (1d) and (2b)

Vasja	*s''-e-l*	jablok-i	(za	dva	čas-a /	* dva	čas-a).
Vasja	PRF-eat-PST.M	apple-ACC.PL	in	two-ACC	hour-GEN	two-ACC	hour-GEN

1. 'Vasja ate (all) the apples (in two hours).'
2. * 'Vasja ate apples (for two hours).'

Maximality is an entailment of (3). Explicit indication that there are individuals not involved in the event yields a contradiction:

(4)

#Vasja	*s''-e-l*	jablok-i,	no	osta-l-o-s'	ešče	neskol'ko.
Vasja	PRF-eat-PST.M	apple-ACC.PL	but	remain-PST-N-REFL	more	a.few

'Vasja ate (all) the apples, but there are a few more (apples to eat).'

If an incremental internal argument DP is based on a singular countable noun or a numerical QP, telicity is obligatory, but the DP allows for both definite and indefinite readings.

(5) **Perfective sentence; undetermined singular DP; count noun**, cf. (1a-b)

Vasja	*s''-e-l*	jablok-o	(za	dva	čas-a /	* dva	čas-a).
Vasja	PRF-eat-PST.M	apple-ACC	in	two-ACC	hour-GEN	two-ACC	hour-GEN

'Vasja ate an/the apple in two hours/*for two hours.'

(6) **Perfective sentence; undetermined DP with a cardinal numeral,** cf. (1c)

Vasja	*s''-e-l*	tri	jablok-a	(za	dva	čas-a /
Vasja	PRF-eat-PST.M	three	apple-GEN	in	two-ACC	hour-GEN
*dva	čas-a).					
two-ACC	hour-GEN					

'Vasja ate (the) three apples in two hours / *for two hours.'

From (3)-(6) two generalizations can be derived. First, **Russian is like English** in that complex event predicates denoted by *v*Ps/VPs are quantized (=telic) iff their incremental arguments are quantized. Thus, (3), (5)-(6) all correspond to (1a-d) from English. Secondly, R**ussian is unlike English,** since perfective clauses like (3) **must** be quantized/telic. As a consequence, their arguments must be quantized, too. Perfective atelic clauses with an indefinite plural/mass incremental theme similar to (2a-b) from English do not exist in Russian. The question, then, is why this should be the case.

The intuition behind most current approaches to the typology of aspectual composition (Krifka 1992, Verkuyl 1999, Piñon 2001) seems to be very straightforward. In languages like English, it is an internal incremental argument that decides if the whole VP is quantized (Scheme 1). In languages like Russian, the perfective declares the whole VP quantized. As soon as the VP is quantized, an incremental argument cannot escape from being quantized, too (Scheme 2).

(7)

Scheme 1. English-type aspectual composition. Scheme 2. Slavic-type aspectual composition.

As Krifka (1992:50) puts it, "If we assume the normal transfer of properties for the object role of verbs like *eat* and *drink*, then we see that only with a quantized object the complex verbal predicate will be quantized as well. If the perfective aspect forces a quantized interpretation of the complex verbal predicate, the complex verbal predicate will again force a quantized interpretation of the object NP."

Crucially, if the perfective is not there, the interpretation of the incremental argument is no longer restricted.

(8) **Imperfective sentence; undetermined plural argument**

Vasja	*e-l*	jablok-i.
Vasja	eat-PST.M	apple-ACC.PL

1. 'Vasja was eating the apples.'
2. 'Vasja was eating apples.'

The key question that emerges at this point is what it is that makes the Russian perfective "force the quantized interpretation of the complex verbal predicate". The literature, to which we turn in the next section, suggests that the perfective shows this capacity to the extent that something goes wrong if it tries to combine with a non-quantized and cumulative predicate. This effectively makes perfective atelic clauses of the English type in (2) non-existent in Russian, and leaves us with perfective telic clauses in (3)-(6) as the only option.

3. Approaching perfectivity

3.1 Generating predicates

To see how perfective operators proposed in the literature work, let us first specify semantics for uninflected event predicates. I will be assuming following Paslawska, von Stechow 2003, Grønn, von Stechow 2010, Tatevosov 2011, 2014 that in both Russian and English semantic aspects enter the derivation as part of the functional domain of the clause. This is where the difference between the two types of languages emerges. At the *v*P level, both are associated with the same range of semantic possibilities.

Assume that the NP 'apples' denotes a predicate of individuals that has sums of atomic apples in its extension. This predicate is cumulative:

(9) **NP denotation: a predicate of individuals**

$\| [_{NP} \text{ 'apples' }] \| = \lambda x.\mathbf{apples}(x)$

$\text{CUM}(\mathbf{apples})$

Assume as well that DP denotations in Russian are derived by phonologically silent determiners[2], as shown in (10)-(11).

(10) **DP denotations**

a. Definite DP (of type e)

$\| [_{DP} \varnothing_{\sigma} [_{NP} \text{ 'apples' }]] \| = \sigma x.\text{apples}(x)$

where σ is an operator that applies to a predicate and yields the maximal individual from its extension if there is one, undefined otherwise (Link 1983)

b. Indefinite DP (of type <<e,t>,t>)

$\| [_{DP} \varnothing_{\exists} [_{NP} \text{ 'apples' }]] \| = \lambda P.\exists x[P(x) \wedge \text{apples}(x)]$

A transitive verb's denotation is a relation between events and two individuals in (11):

(11) **V denotation : a relation between two individuals and events**

$\| [_{V} \text{ 'eat' }] \| = \lambda e.\lambda y.\lambda x.[\text{agent}(x)(e) \wedge \text{eat}(e) \wedge \text{theme}(y)(e)]$[3]

Following von Stechow 2010, who develops ideas from Heim and Kratzer 1998, I will be assuming that the event argument is a first argument of the verb. A semantically empty pronoun PRO, with no meaning and no type, merges as a sister of V. Later on, it undergoes movement for type reasons. Leaving a trace of type v and creating a λ-abstract of type <v,t>. (12) shows an event predicate based on the definite DP in (10a).

(12) *v*P denotation based on (11a): a quantized predicate of events

$\| [_{vP} \cancel{\text{PRO}} \; \lambda_1 [_{vP} \text{ Vasja } v_{\text{trans}} [_{VP} [\text{ 'eat' } t_1] [_{DP} \varnothing_{\sigma} [_{NP} \text{ 'apples' }]]]]] \| =$

$\lambda e[\text{agent}(\text{vasja})(e) \wedge \text{eat}(e) \wedge \text{theme}(\sigma y.\text{apples}(y))(e)]$

(12) represents a set of eating events in which Vasja is the agent and the maximal individual consisting of all the (discourse salient) apples is the theme. It is not difficult to see that the event predicate in (12) is quantized (and not cumulative). Informally, it is quantized, since no proper part of an event in which all the apples have been eaten is an event in which all the apples have been eaten.

Its indefinite plural counterpart, based on (10b) is represented in (13):

(13) *v*P denotation based on (11b): a non-quantized and cumulative predicate

$\| [_{vP} \cancel{\text{PRO}} \; \lambda_1 [[_{DP} \varnothing_{\exists} [_{NP} \text{ 'apples' }]] \; \lambda_3 [_{vP} \text{ Vasja } v_{\text{trans}} [_{VP} [\text{ 'eat' } t_1] \; t_3]]]] \| =$

$\lambda e \exists y[\text{apples}(y) \wedge \text{agent}(\text{Vasja})(e) \wedge \text{eat}(e) \wedge \text{theme}(y)(e)]$

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[2] Alternatively, nominal expressions in Russian can be analyzed as NPs to which available type shifting operators apply. Nothing in what follows depends on any particular choice.

[3] Tatevosov (2011) argues that prefixed verb stems like *s''jed* 'eat' are associated with an accomplishment event structure consisting of an eventive component and a result state, causally connected. For ease of exposition, I ignore this refinement here.

(13) is a set of eating events in which Vasja is the agent and some individual that falls under *apples* is the theme. This predicate is not quantized and is cumulative, since if e is an event where an individuals described as 'apples' was eaten, and e′ is an event of the same type, then their sum $e \oplus e'$ is also an event in which some apples have been eaten (namely, the sum what is eaten in e and e′).

Given the observations from the preceding section, we want the Slavic perfective to be only compatible with the quantized predicate in (12), but not with the cumulative predicate in (13) to rule out perfective atelic sentences.

3.2 Klein's perfectivity

Taking (12)-(13) to be the denotations of uninflected *v*Ps, is immediately obvious that Klein's perfectivity, shown in (14), cannot derive the desired result.

(14) **Klein 1994 and elsewhere: topic time includes event time**
$\|\ \mathrm{PFV}\ \| = \lambda P.\lambda t.\exists e[P(e) \wedge \tau(e) \subseteq t]$

There is nothing in the semantics of the perfective that prevents its successful application to a predicate no matter what the quantization status of that predicate is. Combining (14) with the cumulative predicate in (13) yields (15):

(15) **Klein's PFV applied to (13)**
$\|\ [_{\mathrm{AspP}}\ \mathrm{PFV}\ [_{vP}\ \cancel{\mathrm{PRO}}\ \lambda_1\ [_{\mathrm{DP}}\ \varnothing_{\exists}\ [_{\mathrm{NP}}\ \text{jabloki}\ ]]\ \lambda_3\ [_{vP}\ \text{Vasja}\ v\ [_{\mathrm{VP}}\ [\text{s''-jed-}\ t_1\ ]\ t_3\ ]]]]\ \| =$
$\lambda t.\exists e\exists y\ [\tau(e) \subseteq t \wedge \mathrm{apples}(y) \wedge \mathrm{agent}(\mathrm{Vasja})(e) \wedge \mathrm{eat}(e) \wedge \mathrm{theme}(y)(e)]$

As (3) shows, the non-quantized event predicate in (13) never appears in fully inflected perfective clauses. But (15) incorrectly predicts exactly this reading. While (15) may turn out to be the right semantic representation for (2b) in English, it is clear that (14) does not suffice to derive aspectual compositional effects of the Slavic perfective[4].

3.3 Krifka-Piñon's perfectivity

In a brief note on the perfective in Slavic, Krifka's argues that part of its meaning is the requirement that its argument must be quantized:

(16) At least part of the meaning of the perfective can be captured by the modifier $\lambda P.\lambda e.[P(e) \wedge \mathrm{QUA}(P)]$ (Krifka 1992:50)

(16) derives Russian-type aspectual compositional effects by making the QUA(P) conjunct trivially false when P is a non-quantized event predicate. Therefore, application of Krifka's perfective to the predicate in (13) yields the empty set of events. For Krifka, it is for this reason that we do not observe perfective sentences where the incremental theme has the bare plural interpretation. QUA(P) filters out cumulative event predicates based on bare plural DPs like (13). When the perfective combines with a quantized predicate like (12), the output predicate denotes the same set of events as the input one.

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[4] In Klein 1995, semantics for the Slavic perfective has been developed that crucially relies on the assumption that the perfective takes a relation between events and result states as its argument, not a predicate of events. However, in itself, this analysis does not provide us with a fix for the problem identified above. See Tatevosov 2014 for the discussion.

Piñon (2001) exploits a similar idea, even though his proposal, represented with minor simplifications in (17), differs from Krifka’s one in at least two respects. First, the filtering-out condition is formulated in terms of non-cumulativity instead of quantization. Secondly, it is directly imposed on nominal arguments, analyzed as generalized quantifiers, rather than on the resulting event predicate obtained after individual argument positions are saturated:

(17) **Perfective verb according to Piñon:**
prze-czytać ‘read_{PFV}’ =
$\lambda \underline{Q} \lambda \underline{P} \lambda e[\underline{P}(e, \lambda x.\lambda e'.[\underline{Q}(e', \lambda y.\lambda e''.[\text{Read}^{+}(e'', x, y)])]) \wedge$
$\forall x[\neg \mathbf{CUM}(\underline{Q}(\lambda y \lambda e'[\text{Read}^{+}(e', x, y)]))] \wedge$
$\forall y[\neg \mathbf{CUM}(\underline{P}(\lambda x \lambda e'[\text{Read}^{+}(e', x, y)]))]]$
where $\underline{Q}$ and $\underline{P}$ are generalized quantifier arguments of ‘read’ (of type <<e, vt >, vt>), and $\text{Read}^{+}(e, x, y) = \text{Read}(e) \wedge \text{Agent}(e, x) \wedge \text{Patient}(e, y)$

In (17), the perfective verb takes two generalized quantifier arguments of type <<e, vt>, vt>. The semantics in (17) requires a result of the application of both of them to a relation between events and a relevant individual argument of ‘read’ be non-cumulative.

I believe that the intuitions behind Krifka’s and Piñon’s proposals are exactly right. The Russian-type perfective cannot successfully combine with a cumulative event description. This prevents cumulative event predicates generated at the *v*P/VP level from participating in the further semantic derivation. Quantized predicates, in contrast, are successfully licensed with the effect that in perfective sentences one only observes quantized incremental nominal arguments.

However, (16) and (17) more look like a re-description of facts than like a real explanation. One may want to be able to derive the effect of Krifks’a **QUA**(P) in a less stipulative manner.

In the next section, I will try to show that an analysis of the Slavic perfective framed within Kratzer’s (1977, 1981 and elsewhere) double relative theory of modality can give a certain promise as to accounting for aspectual composition in perfective sentences.

4. Entering modality

4.1 Impossibility and maximality

In the literature, two significant related intuitions about the meaning of the perfective in Slavic can be found. Filip (2008:241) indicates: “Whenever verbs are used to describe some state of affairs, a decision must be made whether it is to be expressed by a perfective verb, and represented **as a maximal event** <emphasis mine — S.T.>.” Klein (1995: 679), discussing Timberlake’s (1985) theory of aspect, argues: “It is not the existence of a boundary <of the event — S.T.> in the real (or narrated world) which matters but **whether the action could go on** after this boundary <emphasis mine — S.T.>.” Therefore, the Slavic perfective, according to Klein and Filip and the huge literature on Slavic aspect going back to Chernyj 1877, Miklosich 1883 is about **maximality** (“represented as a maximal event”) and **(im)possility** (“whether the action could go on”). The two intuitions seem to be reducible to the same thing.

What does it mean exactly when one says that a state of affairs is represented as a maximal event? A natural way of thinking about maximality is to couch this notion in modal terms: maximal entities are those that cannot extend beyond what they are. If the door has been opened or a sandwich has been eaten in an event e in a world w, then no e′ such that e < e′ is an event of opening the door/eating a sandwith in any world.

However simplistic this reasoning may appear, in what follows I will argue that the notion of maximal realization of an e event under a particular event description, understood in modal terms, can gain success in accounting for the main peculiarity of the Slavic perfective, its incompatibility with cumulative event predicates.

4.2 Capturing maximality through (im)possibility

Let us start with an informal characterization:

(18) In Slavic, perfective sentences assert that an event e of an event type P occurs in the evaluation world and that no continuation of e occurs in any accessible world provided that the continuation falls under P as well.

This idea allows, among other things, to think of the perfective and progressive (Dowty 1979, Landman 1992, Portner 1998) along similar lines. While the progressive looks at accessible worlds trying to find those where the event continues and culminates, the Slavic perfective makes sure that the event does not continue in accessible worlds, hence culminates in the evaluation world.

Crucially, this will allow us to derive the effect of Krifka's QUA(P) without *ad hoc* stipulations.

(18) is made more explicit in (19):

(19) **Semantics of PFV**:
PFV(P)(t) is true of a world w iff

(i) there is an event e in w such that P(e) in w and t includes τ(e) in w and
(Klein's perfectivity)

(ii) w is a member of the set p of best worlds for e relative to P,
p = BEST(CIRC, CONT, P, e) **(Modal component)**

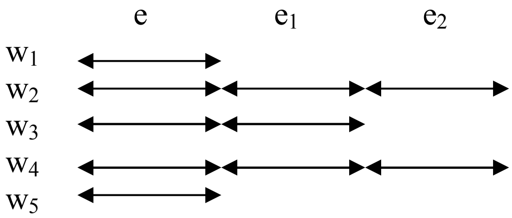
where CIRC is a circumstantial modal base and CONT is an event-maximizing ordering source

According to (19), the meaning of the perfective consists of the two elements, Klein's perfectivity in (i) and the modal component in (ii). Klein's perfectivity is there to derive temporal properties of perfective sentences in Russian, which Russian shares with languages like English. Due to space limitations, I cannot go into further detail here; see Tatevosov 2014 for elaboration.

Critical for our purposes is the other component, which says that the evaluation world, where a P-type event e occurs, is among the best worlds for P-type events. To see what kind of 'better of' relation the perfective is based on, consider (20), which represents one continuation stretch of an event e.

In (20), worlds w_1, w_2, w_3, w_4, w_5 are all worlds where our event e occurs. Assume that e falls under an event predicate P. The event e stops in w_1 and w_5 and is continued by e_1 in w_2, w_3, w_4; then $e \oplus e_1$ stops in w_3 and is continued by e_2 in w_2 and w_3. We want to say that the worlds w_2, w_3, and w_4 are better for e than w_1 and w_5, and that worlds w_2 and w_4 are better than w_3. We also require that e, while extending, still be an event of type P in any world where it extends. Therefore, in (20), $\{w_2, w_4\}$ is the set of best worlds for e relative to P.

(20) **One continuation stretch of e:**



With this concept of the 'better on' relation associated with the perfective, we can give the BEST relation from (19ii) a more precise characterization.

4.3 The BEST relation, modal base and ordering source

If a P-type event e occurs in a world w, the best worlds for e come from the set determined by the circumstantial modal base CIRC, while their ordering is provided by the event-maximizing ordering source CONT. This makes our theory of the perfective rely on the double relative theory of modality (Kratzer 1977, 1987, 1991 and elsewhere).

As usual, the modal base CIRC picks out a set relevant worlds. Those will be all worlds where our P-type event e occurs. If we are talking about an apple-eating event, we are only interested in those worlds where our event continues as apple-eating. I will be assuming cross-world identity of events.

CONT imposes a strict partial order on this set. The more a P-type event e extends in a world, the better this world is for e. If we reach a world w where an extension of the initial event still occurs, but cannot find a world w′ where it extends yet a bit more, then w is (one of) the best worlds. The best relation is then defined as in (21):

(21) **The BEST relation**
BEST(CIRC, CONT, P, e) = the set of worlds w′ in $\cap$CIRC(P)(e) such that there is no w″ in $\cap$CIRC(P)(e) such that $w'' <_{\text{CONT(P)(e)}} w'$.

Therefore, the BEST relation picks out the set of worlds from the modal base (more precisely: from the intersection of all propositions in the modal base $\cap$CIRC(P)(e) that come closest to the ideal established by the ordering source CONT(P)(e). What we need at this point is to make more explicit how the modal base and ordering source are generated.

The modal base CIRC (of type <vt, <v, <st, t>>>) assigns a set of propositions to an event predicate P and an event e. We require that one of these propositions be a set of worlds w such that e occurs in w while falling under the event description P.

(22) **Modal base**
CIRC(P)(e) = {…, {w | P(e) in w}, … }

Possibly, CIRC(P)(e) contains other propositions that describe facts relevant for what it means for e to develop as a P-type event (cf. Portner's (1998:774-777) discussion of the modal base for the progressive). However, what is crucially needed for defining the semantics for the perfective the proposition {w | P(e) in w}, which says that we only look at worlds where e falls under P.

One good consequence of defining the modal base relative to an event description is that we do not need to take special care of the fact the extension of nominal predicates can vary across worlds, which has consequences for the truth of perfective sentences.

Consider an event e in which three apples a_1, a_2, and a_3 have been eaten. In a world w where a_1, a_2, and a_3 are all apples that there are, the predicate 'John ate all the apples' will be true of e. But in a world w′ where there are apples other than a_1, a_2, and a_3 the same predicate will be false of e.

Relativizing the modal base to properties of events allows deriving this result for free. The extension of **apples** in w is then the set $\{ a_1, a_2, a_3, a_1 \oplus a_2, a_2 \oplus a_3, a_1 \oplus a_3, a_1 \oplus a_2 \oplus a_3\}$. In w, $a_1 \oplus a_2 \oplus a_3 = \sigma y.\text{apples}(y)$. Therefore, if $a_1 \oplus a_2 \oplus a_3$ has been eaten in e in w, e falls under $\lambda e.\ [\ \ldots\ \text{eat}(e) \wedge \text{theme}(\sigma y.\text{apples}(y))(e)\ \ldots]$ in w, hence $w \in \cap\textsc{Circ}(\lambda e\ [\ \ldots\ \text{eat}(e) \wedge \text{theme}(\sigma y.\text{apples}(y))(e)\ \ldots])(e)$. To the extent that w is among the best worlds for e (which it is, see below), the sentence 'Volodja ate all the apples' will come out true in w.

In a world w′, where there are more apples (say, four), the event e, which is still an eating of the same individual of $a_1 \oplus a_2 \oplus a_3$, no longer falls under $\lambda e.\ [\ \ldots\ \text{eat}(e) \wedge \text{theme}(\sigma y.\text{apples}(y))(e)\ \ldots]$. This is so because $\sigma y.\text{apples}(y)$ is now the sum of four apples, and not $a_1 \oplus a_2 \oplus a_3$. Therefore, w′ will not be in the modal base $\cap\textsc{Circ}(\lambda e.\ [\ \ldots\ \text{eat}(e) \wedge \text{theme}(\sigma y.\text{apples}(y))(e)\ \ldots])(e)$, which correctly predicts that 'Volodja ate all the apples' is false in w′.

With this in mind, we can define the ordering source along similar lines, that is, as a function of type <vt, <v, <st, t>>> that relates an event under a particular event description to a set of propositions. Specifically, it takes a description P and an event e and returns a set of propositions that express continuations of e. We keep track of any continuation of e in any world w from the modal base provided that e falls under the extension of P in w.

(23) **Ordering source:**

$\textsc{Cont}(P)(e) = \{\ p_0 = \{w \mid P(e) \text{ in } w\},\ p_1 = \{w \mid P(e \oplus e_1) \text{ in } w\},\ p_2 = \{w \mid P(e \oplus e_1 \oplus e_2) \text{ in } w\}, \ldots\ \}$

The ordering relation is defined in the usual way: we say that w′ is better than w iff any proposition from the ordering source which is true of w is true of w′ as well.

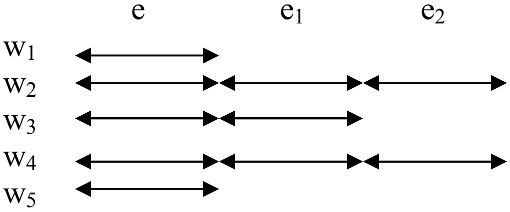
(24) **Ordering relation:**

For any w, w′, $w' <_{\textsc{Cont}(e,P)} w$ iff

$\{p \in \textsc{Cont}(P)(e) \mid w \in p\} \subset \{p \in \textsc{Cont}(P)(e) \mid w' \in p\}$

Consider (20) again. Assume that the worlds $w_1, \ldots, w_5$ are now elements of the modal base $\cap\textsc{Circ}(P)(e)$.

(25) **One continuation stretch of e:**



We see that $\{ w_1, w_2, w_3, w_4, w_5\} \subseteq p_0$, $\{w_2, w_3, w_4\} \subseteq p_1$, and $\{w_2, w_4\} \subseteq p_2$, p_0, p_1, p_2 all being propositions from $\textsc{Cont}(P)(e)$ in (23). In this model, for example, w_2

$<_{\text{CONT}(P)(e)}$ w_3, since $\{p_0, p_1\}$, the set of propositions true in w_3, is a proper subset of $\{p_0, p_1, p_2\}$, the set of propositions true in w_2. This derives the desired effect: the more an event e extends in a world, the better the world is for e. In the simple model in (25) where our P-type event does not continue beyond e_2, the best worlds are w_2 and w_4.

The ordering source in (23) is an infinite set of propositions, which brings in issues related to the limit assumption (Stalnaker 1968, Lewis (1973, 1981), and many others). The semantics of the perfective formulated in (19) says that the evaluation world is to be one of the best worlds, in which, according to (21), an event extends maximally. But if an event can extend infinitely, there will be no best worlds, since for any w where the event extends to a certain point there will always be a better world where it extends more. This looks like a situation manifested by Lewis' (1973:20-21) 'a line more than an inch long' example or Portner's (2009:65-66) Midas example. In the latter case, worlds where Midas has n+1 coins are always better than worlds where he has n coins, which mirrors precisely what we have when events are allowed to extend ad infinitum.

One way of handling this problem would be to make sure that we do not consider infinite events, at least infinite event satisfying a particular event description. If the modal base only contains worlds where events stop sooner of later, the set of best worlds will be possible to identify even if the ordering source is infinite. For example, in the model like (25), worlds w_2 and w_4 will form this set. To achieve this result, it would suffice to add propositions to the modal base that eliminate undesired worlds.

On the other hand, for the purposes of the analysis of the perfective it may be nothing wrong in having no unique set of best worlds in the first place. If there are no best worlds where our event is maximally realized with respect to an event description, the evaluation world w cannot be one of those. The perfective sentence, according to (19ii), will be false in w, which seems to be exactly what we want.

Whatever option turns out to be correct, I believe that the analysis outlined above will not suffer from any significant flaws. In the next section, I will try to convince the reader that the semantics of the perfective developed above makes it dependent on the quantization status of an event predicate P. If P is quantized, the evaluation world is trivially among the best worlds. If P is cumulative, the evaluation world will never be among the best worlds. This will derive the effects of Krifka's QUA without stipulating it.

4.4 Continuation and quantization

Fist, let us look at what happens if an event description P is cumulative. Assume that e falls under P in a world w. Due to cumulativity of P, as long as some e_1, distinct from e, falls under P in w, their sum $e \oplus e_1$ will be in the extension of P in w as well; similarly for any other continuations of e.

Now consider a situation where e stops in w, and $e \oplus e_1$ occurs under P in some world w′ distinct from w. In w′, P(e) and P(e ⊕ e′) both hold. Since P(e) holds in w′, w′ is in the modal base $\cap$CIRC(P)(e) according to (22). Since both p_0 and p_1 from (23) are true in w′, but only p_0 is true in w, w′ is better than w, according to (24). As we have already seen, the bigger continuation we take the better the world is in which this continuation occurs.

Therefore, the evaluation world w, where the event terminates, cannot be among the best ones. The fact that P is cumulative combined with (23) and (24) guarantees that there are worlds better than ours. If the modal base does not contain words where the event extends infinitely, the best relation will pick out the best of them, but the w will not be one of those. If the modal base allows for infinite P-events, the set of best worlds is empty, and $w \notin \emptyset$. In either case the perfective combined with a cumulative event predicate sentence will be false. Exactly the same happens under Krifka's analysis of the perfective when P is cumulative and QUA(P) is false.

This explains why there is no perfective atelic sentences in languages like Russian. The effect of Krifka's QUA(P) condition is thus derived rather than stipulated.

Now consider the second case where P is quantized. Let e fall under P in a world w, as before. Since P is quantized, $e \oplus e_1$ does not fall under P for any e_1 distinct from e itself in any world. For if P(e) and P($e \oplus e_1$) both hold, and $e \neq e_1$, P applies to $e \oplus e_1$ and to its proper part e, that is, is not quantized, contrary to the assumption.

Therefore, sets of worlds $\{w \mid P(e \oplus e_1) \text{ in } w\}$, $\{w \mid P(e \oplus e_1 \oplus e_2) \text{ in } w\}$, and so on are all empty. Our event cannot continue as a P-type event, although can possibly continue as an event of some other type. Hence, the BEST function picks out $\{w \mid P(e) \text{ in } w\}$ as the set of best worlds. According to the initial assumption, our world is among them.

To recapitulate, the modal component in (19), repeated in (26), makes sure that an event is maximally realized in the evaluation world with respect to an event description.

(26) **Semantics of PFV**:
PFV(P)(t) is true of a world w iff
there is an event e in w such that
P(e) and t includes τ(e) and **(Klein's perfectivity)**

w is a member of the set p of best worlds for e relative to P,
p = BEST(CIRC, CONT, P, e) **(Modal component)**

Maximal realization in the evaluation world is only available for events that fall under quantized event descriptions. This accounts for the generalization we started with in section 1: perfective sentences in Russian-type languages can only be telic, and the internal incremental argument must be quantized.

5. Summary and conclusion

Modality plays a role in the interpretation of aspectual categories in various ways. The progressive pioneered the tradition of encapsulating modality in accounts for the meaning of semantic aspects, the driving force behind this move being the Imperfective Paradox. To deal with the paradox, one has to assume that complete events that satisfy an event description exist in some world different from the evaluation world, and the developments of the theory like Dowty 1979, Landman 1992, Portner 1998 were mostly motivated by the need to understand what exactly these worlds are. From this perspective, the Slavic perfective looks, in a sense, like the opposite of the progressive. To say that a perfective sentence is true in a world, we need to make sure that the event does not continue in other accessible worlds as long as it satisfies the event description. I hope to have convinced the reader that evidence from aspectual composition lends significant empirical support for this view. The modal analysis developed above seems to derive aspectual compositional effects of the Slavic perfective without stipulating quantization / non-cumulativity conditions and to capture significant intuitions about maximality entailments associated with perfective sentences. If this analysis is correct for Slavic, then the source of cross-linguistic variation between languages like English and Russian in terms of perfectivity seems to be reducible to the “modal parameter”, that is, to whether the modal component is part of perfective semantics.

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