# The Quantization Puzzle

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## 1 Introduction

Recent discussions of Slavic perfective aspect commonly make two assumptions: First, perfective verb forms are semantically quantized, or, to use other terms, telic or event-denoting (see Krifka, 1986, 1992; Piñón, 1995, for example). Second, verbal prefixes are aspectual markers of perfective aspect, because they often serve to derive perfective verb forms from imperfective ones (see Forsyth, 1970; Binnick, 1991; Krifka, 1992; Piñón, 1994; Zucchi, 1999, Schoorlemmer, 1995, for example). I will argue that the first claim is essentially correct, provided that we properly constrain the property of 'quantization'. However, the second claim must be rejected.

The first claim concerns the semantics of the category 'aspect', understood as a grammatical category. In this sense, 'aspect' is used as a cover term for formal categories on the level of inflectional morphology or syntax that fall under the main perfective-imperfective distinction. It is standardly illustrated (see Comrie, 1976:3, for instance) by examples of the English progressive construction, an imperfective subcategory, as in *John was recovering*, or the French passé simple-imparfait inflectional suffixes, as in *Jean travers-a la rue* 'John crossed the street' vs. *Jean travers-ait la rue* 'John was crossing the street', 'John (repeatedly) crossed the street', for example. The mereological notion of 'quantization', introduced by Krifka (1986), is here used interchangeably with 'telic', and also with 'event-denoting'[1]. Saying that Slavic

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[1]This means that 'telic' is here not understood in its original narrower sense coined by (Garey, 1957) and who derived it from the Greek word *télos* meaning 'goal' or 'purpose'. Gary characterizes telic verbs as "... a category of

perfective verb forms are semantically quantized means that they denote eventualities (in the sense of Bach, 1981) with an inherent (temporal) delimitation; in Krifka's mereological terms, this means that no proper part of an event denoted by a perfective verb can be an event of the same kind as the whole event. For example, the Russian perfective verb <u>zamjórzla</u>[P] 'she froze up', 'she became frozen', as in (1a), denotes events that are delimited by, and necessarily end at, the state in which the river reaches the state of being completely frozen. (The superscripts 'I' and 'P' here stand for the imperfective and perfective aspect of a verb.)

(1)    Reká zamjórzla[P]. (event)
        'The river has frozen up /froze up.'

<u>Zamjórzla</u>[P] is clearly quantized, since no proper part of the event of the river freezing up can be in the denotation of this verb. Imperfective sentences based on state (2) and process (3) predicates denote eventualities without an inherent delimitation:

(2)    Reká blestéla[I]. (process)
        'The river sparkled.' / 'The river was sparkling.'

(3)    Reká byla[I] cholodná. (state)
        'The river was cold.'

Both the state of being cold and the process of sparkling may have proper parts that are states and processes of the same kind as the main state and process. Hence, the imperfective predicates <u>blestéla</u>[I] (2) and <u>byla</u>[I] <u>cholodná</u> (3) are not quantized; they are cumulative. Notice also that the imperfective sentence (2) allows for a progressive interpretation, but not the state imperfective

verbs expressing an action tending towards a goal envisaged as realized in a perfective tense, but as contingent in an imperfective tense" (Garey, 1957:6). Although this suggests that telic verbs describe goal-oriented actions with human agents, this is not necessarily so, given that Garey also includes verbs like *mourir* 'to die' and *noyer* 'to drown' among his telic verbs. Atelic verbs, on the other hand, do not involve any such goal or boundary in their semantic structure. They are characterized as verbs denoting actions that "are realized as soon as they begin" (Garey, 1957:6). Here, 'telic' is used in its wider, and well-established sense for all verbal predicates that entail some delimitation in their semantic structure, regardless of its nature and regardless whether they have animate, inanimate, human or non-human subjects (see Hopper and Thompson, 1980; Rappaport and Levin, 1988; Dowty, 1991; Zaenen, 1993; Krifka, 1986, 1989, among many others).

A similar definition of telicity as in Garey can be found in Depraetere (1995:3): "A clause is telic if the situation is described as having a natural (cf. (1a) *The bullet hit the target* and (1b) *Sheila collapsed*) or an intended endpoint (cf. (1c) *Sheila deliberately swam for 2 hours*) which has to be reached for the situation as it is described in the sentence to be complete and beyond which it cannot continue" (p.3). On Depraetere's view, a sentence like *John lived in London for a year* is atelic (1995:5,7). However, on the wider view of telicity subscribed here, both the sentences *Sheila deliberately swam for 2 hours* and *John lived in London for a year* are telic (or quantized), by virtue of being explicitly delimited by durative adverbials.

Most recently, Krifka (1998) introduces a distinction between telicity and quantization. He argues that quantized predicates are telic, but not every telic predicate is quantized (1998:207, 215). He uses the notion 'telicity' in the sense of 'boundedness' in Depraetere (1995) (see p.232, fn.2): "(Un)boundedness relates to whether or not a situation is described as having reached a temporal boundary, (cf. Declerck 1989, p. 277; 1991, p.121)" (Depraetere, 1995:2-3).

sentence (3), and both (2) and (3) can freely be used for iterative, habitual and generic statements in a suitable context.

However, the aspectual system of Russian verbs is more complex than the above presentation suggests, when we look at the whole range of the relevant data. Here, I will focus on just one of the complications: namely, the claim that all perfective verbs are quantized. This claim is problematic given that certain perfective verbs appear not to be quantized due to the quantificational and measurement properties of prefixes they contain, and yet with respect to most distributional tests they behave just like perfective verbs that are quantized in the mereological sense introduced by Krifka (1986). This is troublesome given that each Slavic language has a set of about twenty verbal prefixes, many of which have quantificational and/or measurement content, and prefixation is one of the most common ways to derive perfective verb stems. As a case in point I examine Russian perfective verbs with the accumulative prefix na-, which adds to the verb the meanings of a large quantity, measure or degree in a variety of ways, and verbs with the attenuative prefix po-, which contributes the opposite meanings of a small quantity, measure or degree. The semantics of these prefixes is comparable to the English vague quantifiers like *a lot (of), many, a little, a few* or to nominal expressions encoding vague measure functions like *a (relatively) large/small quantity / piece / extent of.* I propose that the Russian prefixes na- and po-, and other such prefixes with a vague measure and/or quantificational meaning, can be analyzed as contributing an extensive measure function to the meaning of a verb. Independently, Krifka (1998) argues that extensive measure functions can be used to define quantized predicates. If the prefixes na- and po- are taken to express extensive measure functions, perfective verbs containing them do not constitute counterexamples to the claim that Slavic perfective verbs in general are quantized or event-denoting.

Although the analysis of prefixes as quantizers appears to be compatible with the second assumption, namely that prefixes are overt grammatical markers of perfective aspect, I will argue that this assumption must be rejected. The reason is that verbal prefixes clearly behave like derivational rather than inflectional morphemes. Verbal aspect in Slavic languages is standardly taken to be a grammatical category (see Spencer, 1991, for example), and if this also implies that it is an inflectional category, then prefixes cannot be *aspectual* morphemes, because such morphemes ought to have inflectional characteristics. Therefore, a prefixed perfective verb in Slavic languages is best seen as a new verb that stands in a derivational relation to its base, rather than being an aspectually different form of one and the same lexeme, contrary to frequently made claims.

This leads me to proposing that verbal prefixes are eventuality description modifiers. At the lexical level, eventuality descriptions (events, processes and states) are denoted by verbal predicates with all their argument positions filled by variables or constants. The application of prefixes to perfective and imperfective verbs can be semantically interpreted as an instantiation of a

function that maps sets of eventualities of any type (states, processes or events) onto sets of events. Since prefixes serve to form perfective *and also* imperfective verbal stems, not only perfective *but also* imperfective verbs may contain prefixes and be semantically quantized, i.e. denote events. But this also means that quantization is insufficient for semantically distinguishing perfective verbs from imperfective ones, and that the semantic contribution of verbal prefixes to a sentence's semantics must be distinguished from that of perfective and imperfective aspect. I propose that aspectual operators are interpreted in terms of conditions that operate on eventuality descriptions. The perfective aspect restricts the denotation of any eventuality description to *total* (or complete) events: $\lambda P \lambda e[P(e) \wedge TOT(P)]$. (The event variable 'e' is here used in a way in which it was introduced in Davidson, 1967; Parsons, 1986; Kratzer, 1989b, 1995.) The *TOT* condition is encoded by perfective verbal stems, regardless whether they contain zero, one or more prefixes. The imperfective aspect contributes the partitivity condition *PART* to the semantic representation of imperfective verbs: $\lambda P \lambda e [P(e) \wedge PART(P)]$. *PART* is defined in terms of the mereological part-of relation '$\leq$'. The imperfective operator combines with predicates of states, processes and events and yields the corresponding predicates of partial states, processes and events.

One of the consequences of distinguishing between the semantic contribution of verbal prefixes and that of perfective and imperfective aspect to a sentence's semantics is that we need to draw a clear line between eventuality types and the semantics of grammatical aspect. The distinction between the two is often blurred in approaches that characterize the semantic contribution of perfective and imperfective (and progressive) operators in terms of functions that map sets of eventualities of a certain type onto eventualities of some (possibly) other type (e.g., in Vlach, 1981; Mourelatos, 1978/1981:197; Bennett, 1981:15; Kamp and Rohrer, 1983; Hinrichs, 1986; Piñón, 1995:46, 56-7, for example).

The examination of verbal prefixes with a quantificational and/or measurement content bears on a number of difficult theoretical issues not only in the domain of grammatical aspect and eventuality types, but also quantification. Slavic languages are not unique in having quantificational and measurement verbal prefixes. Morphological operators that are applied to a verb at a lexical level and whose quantificational and closely related content, such as measure, constrains the interpretation of one of the predicate's arguments can be found in a number of typologically unrelated languages. Such morphemes can be found in Australian aboriginal languages (see Hale, 1989; Evans, 1989, 1991, 1995), American Indian languages (see Bach et al. eds., 1995, for example), and American Sign Language (see Petronio, 1995), among others. The observation that quantification and closely related notions can be expressed by other means than just determiner quantifiers within noun phrases led Partee, Bach and Kratzer (1987) to identify D-quantification and A-quantification as a main typological distinction in the expression of quantification across languages. D-quantifiers syntactically form a constituent with a projection of

the lexical category Noun.  These are determiner quantifiers, or D-quantifiers, like *every, all, most, some.*  A-quantifiers syntactically form a constituent with some projection of the lexical category Verb.  A-quantifiers are a large and heterogeneous class which includes adverbs of quantification, such as *usually, always, in most cases* (see Lewis, 1975), "floated" quantifiers (*both, all, each*), auxiliaries, verbal affixes, and various argument-structure adjusters.  One of the goals of this paper is to show that Slavic verbal prefixes with a quantificational and/or measurement content belong to a subclass of A-quantifiers, namely lexical A-quantifiers (see also Partee, 1991, 1995)[2].

The paper is structured as follows.  In section 2, I will introduce the mereological notions of 'quantization' and 'cumulativity' as well as their use in the characterization of Slavic aspect and of eventuality types (in the sense of Bach, 1981).  In order to illustrate the nature of the quantization puzzle, I will show why perfective verbs with the accumulative <u>na-</u> and attenuative <u>po-</u> fail the definition of quantization introduced by Krifka (1986).  In section 3, I will discuss Zucchi and White's (1996) solution to a similar quantization puzzle in the nominal domain, Krifka's (1997, 1998) treatment of various measure expressions, including those expressed by Slavic verbal prefixes, and Kiparsky's (1998) treatment of the accumulative <u>na-</u> and attenuative <u>po-</u> in Russian.  In section 4, I will propose that the prefixes <u>na-</u> and <u>po-</u> can be analyzed as measure functions, and hence, they are quantizers.  This has the advantage that perfective verbs formed with such prefixes, as well as other prefixes with a quantificational and/or measurement content, do not constitute an exception to the generalization that perfective verbs as a class are semantically quantized.  In section 5, a number of data will be given showing that verbal prefixes are clearly derivational morphemes, and therefore cannot be viewed as grammatical markers of perfectivity.  From the point of view of event structure, they are eventuality type modifiers that yield quantized (or event-denoting) eventuality descriptions.  In section 6, I will address the semantics of perfective and imperfective aspect, which is here treated in terms of operators that are applied to eventuality descriptions.  The semantic contribution of perfective and imperfective operators to a sentence's semantics is separate from that of the eventuality type of a sentence.

Although most examples in this paper are taken from Russian, the analysis proposed is assumed to be valid for Slavic languages in general.  The question for future research is to what extent the results reached here can be generalized to other typologically unrelated languages.

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[2]The differences among various A-quantifiers lead Partee (1991, 1995) to the conclusion that the class of A-quantifiers is not a natural class and should be split into two main types: "(i) true A-quantification, with unselective quantifiers and a syntactic (or topic/focus (...)) basis for determining, insofar as it is determinate, what is being quantified over, and (ii) lexical quantification, where an operator with some quantificational force (and perhaps further content as well) is applied directly to a verb or other predicate at a lexical level, with (potentially) morphological, syntactic, and semantic effects on the argument structure of the predicate" (Partee, 1995:559).

## 2 Slavic aspect and the quantized-cumulative distinction

## 2.1 The quantized-cumulative distinction

It is commonly assumed that perfective verb forms in Slavic languages are quantized and imperfective verb forms cumulative, or at least those based on process and state predicates. In the most explicit way this is expressed by Krifka (1989:186-189; 1992:49-51) who takes Czech as an exemplary case. He proposes that the perfective operator can only be applied to quantized verbal predicates, while the imperfective operator mostly to cumulative ones. On his view, a part of the meaning of perfective verbs can be represented by the formula given in (4a) (cf. 1992:50). In analogy, a part of the semantics of imperfective verbs may contain (4b):

(4)   a. $\lambda P \lambda e\, [P(e) \wedge QUA(P)]$
      b. $\lambda P \lambda e\, [P(e) \wedge CUM(P)]$

'Quantization' and 'cumulativity' are mereologically based and they presuppose that the domain of universe, which contains individuals, times and eventualities, has a mereological part structure that is (partially) ordered by the part relation '$\leq_P$'. (The definitions are given in the Appendix.) The relevant part structures are modelled by complete join semi-lattices (see Link, 1983, 1987; Bach, 1986). Krifka's (1997) definitions of 'quantization' and 'cumulativity' are given in (5)[3]:

(5)   a. A predicate P is **quantized** iff $\forall x,y[P(x) \wedge P(y) \rightarrow \neg\, y <_P x]$
         [A predicate P is quantized iff, whenever it applies to x and y,
         y cannot be a proper part of x.]

      b. A predicate P is **cumulative** iff $\forall x,y[[P(x) \wedge P(y) \rightarrow P(x \oplus_P y)] \wedge card(P){\geq}2]$
         [A predicate P is cumulative iff, whenever it applies to x and y, it also applies
         to the sum of x and y, provided that it applies to at least two distinct entities.]

According to the definition of quantization in (5a), whenever a given property P applies to two entities *x* and *y*, *y* cannot be a proper subpart of *x*. For example, if an individual falls in the denotation of *an apple*, it cannot have a proper part that also falls under *an apple*. Hence, *an apple* is quantized. Such singular count terms have individuals in their extension that are atomic, they have only themselves as parts. Quantized predicates are expressed by singular count nouns and also by measure (*three cups of water*) and quantified (*three books*, *all the books*) noun phrases. Mass predicates (*water*) and plurals (*apples*) fail to be quantized: A quantity of water (or apples) denoted by *water* (or *apples*) will have proper parts that will also fall under the denotation of *water* (or *apples*). The definition of cumulativity in (5b) says that if a predicate applies to two distinct

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[3]See Krifka (1986, 1989) for the original definitions of 'quantization' and 'cumulativity', alternative definitions can be also found in Krifka (1990, 1992).

entities, it also applies to their sum. For example, mass predicates like *water* and plurals like *apples* are cumulative: any sum of parts which are water is water, and any two sums of apples add up to a sum of apples.

The quantized-cumulative distinction is also used in connection with the classification of verbal predicates and sentences into eventuality types (in the sense of Bach, 1981): events, processes and states. Event predicates like *closed the door* in *John closed the door* are quantized. *Closed the door* is quantized, since no proper part of the event denoted by it can be an event of the same kind: if it took John five minutes to close the door, then that closing of the door did not take place during the second minute of the interval of five minutes. *Closed the door* is not cumulative, since adding two distinct events of closing of the door (once) amounts to a sum event of closing of the door twice. By contrast, process and state predicates are cumulative. Take a process-denoting predicate like *swam*, as in *John swam*, for example. If John swam for five minutes without interruptions, then he also swam during the second minute of the interval of five minutes. Given that *swam* is divisive, it cannot be quantized. Now, suppose that John swam continuously for an hour. Then, adding some chunk of John's swimming during the first half hour and his swimming during the second half hour amounts to swimming. Hence, *swam* is cumulative. For the domain of verbal predicates I assume that Krifka's quantized-cumulative distinction corresponds to the telic-atelic distinction (see Hopper and Thompson, 1980; Rappaport and Levin, 1988; Dowty, 1991; Zaenen, 1993; Krifka, 1987, 1989, among many others), the bounded-unbounded distinction (see Talmy, 1986; Jackendoff, 1990, for example), the delimited-undelimited distinction (Tenny, 1987, 1994), as well as to a number of other comparable distinctions that are based on the same or similar intuitions described above. (For summaries see S.-G. Andersson, 1972 and Dahl, 1981:80.)

The quantized-cumulative distinction and the finer-grained eventuality types (states, processes and events) are also used for the characterization of the contribution of grammatical aspect to a sentence's semantics. Vlach (1981) treats the whole class of progressive predicates as stative predicates. Mourelatos (1978/1981:197) and Bennett (1981:15) argue that progressives are semantically activities (i.e., processes in the terminology used here). Kamp and Rohrer (1983) propose that passé simple sentences in French refer to events, while imparfait denote states. According to Hinrichs (1986), progressive predicates in English introduce state variables, just like lexical state predicates. It is in the tradition of such proposals that Krifka characterizes perfective predicates in Czech (and other Slavic languages) as being quantized and imperfective predicates as mostly cumulative. Similarly, Piñón (1995:46, 56-7) proposes that perfective verb forms in Polish denote sets of events, while imperfective ones sets of processes. Schoorlemmer (1995) argues that the distribution of perfective and imperfective verbs in Russian is based on telicity. All of these approaches have in common that they characterize the semantic contribution of perfective and

imperfective (and progressive) operators in terms of functions that map sets of eventualities of a certain type onto eventualities of some (possibly) other type. Consequently, the line between eventuality types (events, processes and states) and the semantics of grammatical aspect (perfective, imperfective) becomes blured. One of the goals of this paper is to argue that this is empirically problematic.

## 2.2 The quantization puzzle

The claim that perfective verb forms are quantized holds for a number of perfective verbs in Slavic languages. In general, these are perfective verbs that denote events characterized by a well-defined inherent final state and perfective verbs that have punctual or point-like events in their denotation[4]. Examples are unprefixed perfective verbs like the Russian zakrýl$^P$ 'he closed' in (6), prefixed perfective verbs like pročitál$^P$ 'he read through (from the beginning to end)' in (7b) and semelfactive verbs with the suffix -nu- like kyvnút'$^P$ 'to nod (once)' in (8b).

(6)     Ivan  zakrýl$^P$     dver'.
        Ivan  close.PAST  door.SG.ACC
        'Ivan closed a/the door.'

(7)  a. Ja  čitál$^I$     knígu.                 b. Ja  pročitál$^P$          knígu.
        I   read.PAST  book.SG.ACC                  I   PREF-read.PAST  book.SG.ACC
        (i) 'I read a/the book.'                     'I read the book.' [to the end]
        (ii)'I was reading a/the book.'              'I read the whole book.'

(8)  a. kyvát'$^I$                                 b. kyvnút'$^P$
        'to nod (repeatedly)'; 'to be nodding'       'to nod (once)'

However, the claim that perfective verb forms are quantized is problematic for certain classes of Slavic perfective verbs. Especially intriguing among them are perfective verbs derived with prefixes that have quantificational, measurement and other closely related meanings. Here I will focus on two Russian prefixes of this type, namely the accumulative na- and attenuative po-. Examples in (9) show that they can be attached to one and the same simple imperfective verb guljál$^I$ 'he walked', 'he was walking' and derive new perfective verbs, each with a different meaning.

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[4]In traditional grammars, such perfective verbs fall under the characterization of perfectivity in terms of the completive, resultative and punctual meanings, for example. See Comrie (1976:16-21) for a discussion of such traditional characterizations of perfectivity.

(9)  a.  Ivan  guljál$^I$.
         Ivan  walk.PAST
         'Ivan walked.' / 'Ivan was walking.'

     b.  Ivan  **NA-**guljálsja$^P$        po      górodu.
         Ivan  **ACM**-walk.PAST.REFL  around  town
         'Ivan walked a lot / enough / to his heart's content around the town.'

     c.  Ivan  **PO-**guljál$^P$         po      górodu.
         Ivan  **ATN**-walk.PAST       around  town
         'Ivan took a (short) walk around the town.'


Other such triples are fairly easy to find and some examples are given in the Appendix.  In the most general terms, na- adds to the verb the meaning of a sufficient or large quantity or a high degree with respect to some standard or subjective expectation value.  This amounts to meanings comparable to English vague quantifiers like *a lot (of), many*, and to vague measure expressions like *a (relatively) large quantity / piece / extent of*.  The prefix po- contributes to the verb the opposite meaning of a small quantity or a low degree relative to some expectation value, which is comparable to vague quantifiers like *a little, a few* and vague measure expressions like *a (relatively) small quantity / piece / extent of*.  Closely related to the quantificational and measurement meanings are strong affective connotations.  For example, na- adds satiation ('to one's heart's content', 'to tire oneself with V-ing'), high intensity ('to perform V in a protracted, uninterrupted, persistent, intensive manner'), while po- is often associated with connotations like 'superficially', or 'lightly'[5].  These uses of the prefixes na- and po- are here mnemonically glossed '(ac)cumulative' (ACM) and 'attenuative' (ATN), respectively, following the traditional Aktionsart (German for 'manner of action') studies (see Isačenko, 1960:385-418, 1962, for example).  Of course, the prefixes na- and po- also have other meanings, when attached to other verbs, a matter I will disregard here.

     The basic accumulative and attenuative meanings are manifested in a variety of ways, depending on the lexical semantics of the classes of base verbs with which na- and po- combine, and on the linguistic and extra-linguistic context. Let us first look at the accumulative prefix na- in (9b)[6].  If (9b) describes a single walking event, naguljálsja$^P$ most naturally amounts to 'he walked for a long time' and/or 'he covered a long distance by walking'.  That is, na- functions as a

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[5]The various connotations of the accumulative na- are paraphrased in Isačenko (1960:246) with vdóvol' 'in abundance', 'enough'; do krájnosti 'to the extreme', vlast' 'to one's heart's content', 'as one likes'.  Those of the attenuative po- are described in Isačenko (1960:239) with the adverbs slegká  'lightly', 'gently', 'slightly', němnógo 'little', and otčásti 'partly'.

[6]The following exposition of the relevant uses of na- is mainly based on Isačenko (1960) and Russell (1985).

temporal measure and/or a Path measure[7] over events.  As a temporal measure, na- has a meaning comparable to a temporal durative phrase like '(for) a long time'[8].  If na- functions as a Path measure, we may assume that the Path is introduced by the motion verb 'walk' into the semantic description of (9b).  That is, 'walk' can be analyzed as a three-place relation WALK that relates a moving individual Ivan, Holistic Theme (in the sense of Dowty, 1988, 1991), and a Path to an event: $\llbracket walk \rrbracket = \lambda x \lambda y \lambda e[\text{WALK}(e) \wedge \text{HolTh}(y,e) \wedge \text{Path}(x,e)]$.  We can monitor the progress of the motion event by the positional changes of the (Holistic) Theme participant along the Path[9]. What is important is that the Path on its own does not provide any information about its (starting and final) endpoints nor its extent.  In English such information is typically expressed by Extent phrases or directional prepositional phrases (Goal and Source), as in *John walked* vs. *John walked a mile* (Extent), *John walked to the post office* (Goal), *John walked out of the room* (Source).  In Slavic languages this information is often carried by verbal prefixes.  In (9b), the prefix na- carves out a certain bounded portion out of the implicit Path continuum, which results in the delimitation of the denoted motion event.

Apart from functioning as a measure over single events by delimiting their temporal trace or Path, na- in (9b) may function as a quantifier or a vague measure over events (or 'cases', that is, complex entities consisting of individuals and situations, cf. Lewis, 1975).  (9b) can be then paraphrased as 'There were many occasions on which Ivan took a walk around the town', 'Ivan often walked around the town', or 'Ivan took a lot of / enough walks around the town'[10].  It is important to mention that the different uses of the prefix na- just described are not mutually exclusive and they often jointly contribute to the meaning of a single prefixed verb.  For example, in a suitable context (9b) can be interpreted as meaning approximately 'Ivan covered a long distance on each of the numerous occasions when he walked around the town'.

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[7]Both these meanings are implicit in the entry for na-gulját'sja[P] 'to have had a long walk' in *The Concise Oxford Dictionary* (1996:196).

[8]Independently, parallels between durative adverbials and measure expressions are discussed in L. Carlson (1981:46) and Bach (1981:74; 1986:11).

[9]See Krifka (1992:33; 1998) for formal definitions of the temporal trace function and Path function, both of which are essentially analyzed as a one-dimensional axis that is non-branching, non-circular and directed.  For a thorough description of the role of the Path participant in the event structure, see also Tenny (1994, 1995) and Jackendoff (1996), for example.  With the notion of 'Path' we can represent changes of state in various dimensions, and not just the change of position in the spatial domain.  For example, we can represent qualitative incremental changes that characterize unaccusatives and their transitive counterparts, such as a change in the consistency of an object: cp. *The butter melted/was melting* and *The cook melted/was melting the butter*.  Such an incremental change of state can be thought as being decomposable into distinguishable separate stages, each of which can be represented as a segment on a directed Path.  Any changes that can be measured on a scale can be represented as a motion through certain segments on a directed Path in this way, as has been proposed by Tenny (1987, 1994, 1995), Jackendoff (1990, 1996) and Krifka (1998).

[10]Following Křížková (1958), Isačenko (1960:247) labels this the 'saturative-frequentative' use of the accumulative na-.

The prefix na- not only functions as a quantifier or a vague measure over events, but it can also assume a similar function with respect to individuals, as is illustrated in (10):

(10)  a. Děti          **NA**-rváli[P]        cvéty        / cvetóv              na lugú.
         child.NOM.PL  **ACM**-take.PAST   flower.PL.ACC / flower.PL.GEN      on meadow
         'The children picked a lot of/many/a (large) quantity of flowers in the meadow.'

      b. **NA**-slúšalsja[P]          vsjákoj  čepuchí.                    Isačenko, 1960:248
         **ACM**-hear.PAST.REFL    any      nonsense.SG.GEN
         'He listened to a lot of various nonsense.'
         'He has had enough of listening to all sorts of nonsense.'

      c. Gostéj          **NA**-échalo[P]        na dáču.      (Spat'      negdé.)
         guest.PL.GEN  **ACM**-arrive.PAST    on cottage     (sleep.INF  nowhere)
         'Many guests arrived at the weekend cottage. (There was nowhere else for them to sleep.)'


Although the accumulative prefix na- is here directly attached to the verb, it functions as a vague quantifier, meaning approximately 'a lot of', 'many', or 'a relatively large quantity/group of', with respect to the individual variables introduced by the direct objects 'flowers' and 'nonsense' in (10a,b) and the subject 'guests' in (10c)[11].

The attenuative prefix po- is most frequently used as a temporal measure, contributing roughly the meaning of a durative adverbial like 'for a (short) while' (cf. Isačenko, 1960:238-240; Pulkina, 1964:217, for example). Much less frequently, po- is used as a Path measure with verbs of motion. Occasionally, the attenuative sense of po- is manifested as quantification over events contributing approximately the meaning of '[action of short duration repeated] a few times, sporadically', 'on and off a few times': cp. kričát'[I] 'to yell', 'to scream'; 'to be yelling', 'to be screaming' → po-kričát'[P] 'to cry out a few times'. The attenuative po- can also function as a quantifier over individuals, as in (11b):

_____

[11]This use of the prefix na- is classified as the *partitive-cumulative* use in Isačenko (1960:248), one of the reasons being that the direct object noun phrase in this case can be realized in the partitive genitive case, as in nadélat'[P] (mnógo) ošíbok 'to make a lot of mistakes'. The genitive suffix is occasionally claimed to indicate a (subjectively, relatively) larger quantity of entities denoted by the noun to which it is attached than the accusative case.

    It is important to mention that the accumulative prefix na- is independent of the reflexive particle -sja. Na- occurs with -sja, as in (9b and 10b) and also without it, as in (10a), and also in such examples as Za étot sezón on nabégal[P] svyše trechsót kilométrov 'During this season he ran up over three hundred kilometers' (example taken from Isačenko, 1960:248).

(11)  a.  Píl[I]          čaj.
          drink.PAST     tea.SG.ACC
          'He had tea.' / 'He was drinking tea.'

      b. **PO-**píl[P]          čáju          / čája.
          **ATN**-drink.PAST   tea.SG.PART   / tea.SG.GEN
          'He drank up (some small portion of) the tea.' / 'He had a little bit of tea.'


      Let us now look at the quantization puzzle posed by the prefixes <u>po-</u> and <u>na-</u>. Take <u>poguljat'</u>[P] in the sense of 'to walk for a (short) time', where <u>po-</u> functions as a measure of time. Suppose that *e* is an event of walking for a short time, then there is a proper subevent of *e*, *e'*, which also counts as an event of walking for a short time. Hence, both *e* and *e'* fall under the denotation of <u>poguljat'</u>[P], and consequently <u>poguljat'</u>[P] fails to be quantized, according to (5a). At the same time <u>poguljat'</u>[P] fails to be cumulative, according to (5b), because two events of walking for a (short) time do not necessarily add up to one event of walking for a short time.

      Now let us take <u>naguljat'sja</u>[P] in the sense of 'to walk for a long time'. If six hours of walking is considered to be walking for a long time in a given context (event *e*), then in the same context walking for five hours (event *e'*), may be as well, but not walking for one hour (event *e''*). This means that there are events like *e* (walking for six hours) in the denotation of <u>naguljat'sja</u>[P] 'to walk for a long time' that have a proper subpart like *e'* (walking for five hours) which is also an event in the denotation of this verb. Therefore, <u>naguljat'sja</u>[P] fails to be quantized, according to (5a), and it qualifies as cumulative, according to (5b), as the sum of two events like *e* and *e'* or *e* and *e''* will count as walking for a long time.

      Moreover, not only do <u>na-</u> and <u>po-</u>verbs fail to be quantized, but they also behave in idiosyncratic ways with respect to temporal adverbials. The distribution of verbs with respect to temporal adverbials is standardly taken to test for their perfective or imperfective status. The domain of application of durative adverbials, such as <u>désat' minút</u> 'for ten minutes', is restricted to imperfective verbs. The domain of application of time-span adverbials, such as such as <u>za désat' minút</u> 'in ten minutes', is mostly restricted to perfective verbs, and when applied to imperfective verbs, they enforce certain reinterpretations (e.g., iterative, generic, inchoative, for example). This is shown in (12) that contains the perfective verb <u>zakryl</u>[P] 'he closed' and the corresponding imperfective verb <u>zakryval</u>[I] 'he closed', 'he was closing':


(12)  a.   Ivan zakryl[P]       dver'           *désat' minút     /   za désat' minút.
           Ivan close.PAST    door.SG.ACC *ten   minutes    /   in ten minutes
           'Ivan closed the door (*)for ten minutes / in ten minutes.'

b.　　Ivan zakryval$^I$　　　dver'　　　　désat' minút　　　/　?za désat' minút.
　　　　　　Ivan close.IPF.PAST door.SG.ACC　ten　　　minutes　　　/　?in ten minutes
　　　　　　'Ivan closed the door (*)for ten minutes / in ten minutes.'

In (12b) with the imperfective verb <u>zakryval</u>$^I$, '?' indicates that the combination of the imperfective verb with the time-span adverbial <u>za désat' minút</u> 'in ten minutes' is acceptable if the intended interpretation is iterative or generic, for example.

　　　In sharp contrast to most perfective verbs, <u>po-</u>verbs are not acceptable with time-span adverbials, and they behave like imperfective verbs in that they freely co-occur with durative adverbials, as (13a) shows.　<u>Na-</u>verbs are acceptable with time-span adverbials only in certain restricted circumstances: for example, when time-span adverbials receive a special emphasis, as at the outset of a sentence.　So (13b) would be acceptable with a slightly different word order in the following context: <u>Ivan pošól</u>$^P$ <u>v park, i za čas naguljálsja</u>$^P$ 'Ivan went to the park and in an hour he had enough of walking.'

(13)　a. Ivan **PO-**guljál$^P$　　　čas　/ *za čas　　v párke.
　　　　　Ivan **ATN**-walk.PAST　hour / *in hour in park
　　　　　'Ivan took a walk in the park for an hour / (*) in an hour.'

　　　b. Ivan **NA-**guljálsja$^P$　　　　*čas　　　　　/ #za čas　　　　　v párke.
　　　　　Ivan **ACM**-walk.PAST.REFL　*hour.SG.ACC　/ #in hour.SG.ACC　in park
　　　　　'Ivan walked a lot in the park *for an hour / #in an hour.'
　　　　　('Ivan had enough of walking in the park in an hour.')
　　　　　('It took Ivan an hour to have enough of walking in the park.')

The behavior of perfective and imperfective verbs with respect to temporal adverbials as well as that of <u>po-</u> and <u>na-</u>verbs is summarized in Table I:

| Table I: | compatibility with temporal adverbials | <u>durative</u> | <u>time-span</u> |
|---|---|---|---|
| | | čas 'for an hour' | za čas 'in an hour' |
| | a. perfective (quantized) verbs | * | + |
| | b. imperfective verbs | + | ? |
| | c. attenuative *po*-verbs | + | * |
| | d. accumulative *na*-verbs | * | # |

From the above observations, one could conclude that accumulative <u>na-</u>verbs and attenuative <u>po-</u>verbs are quirky, and do not neatly fit either into the perfective or imperfective class.　However, matters are not as simple as that, because with regard to other standard tests, <u>na-</u>verbs and <u>po-</u>verbs clearly align themselves with verbs that are both clearly perfective and quantized, according to (5a).　Some of the most important distributional tests are summarized in Table II:

Table II:     Some tests for distinguishing perfective verb forms from imperfective ones

|  | perfective | imperfective |
|---|---|---|
| compatibility with time point adverbials like *right now* | - | + |
| future time reference in the present tense | + | ? |
| compatibility with the future auxiliary | - | + |
| compatibility with phasal verbs   (*start, stop*, etc.) | - | + |

'?' indicates that imperfective present tense verb forms may have a future reference in appropriate contexts (e.g., when they co-occur with future temporal adverbs, for example).  Since such tests are well-known and described in great detail in standard grammar books, I will not discuss them here.  Examples of how the tests in Table II work are given in the Appendix.

        To sum up, the quantization puzzle is this: Perfective verbs with the accumulative prefix na- and attenuative po- are not quantized, according to the definition in (5a).  Yet, with respect to most standard distributional tests, they behave like perfective verbs that are quantized in the sense of (5a).  This behavior of accumulative na-verbs and attenuative po-verbs cannot be simply written off as quirky or exceptional, because other prefixed verbs of this type are easy to find.   For example, among Russian prefixed verbs that are perfective according to the tests in Table II and that fail to be quantized in the sense of (5a) are verbs with the prefix pro- (as in prostoját'$^P$ 'to stand for a relatively long time'), pri- (as in prisypát'$^P$ sol' 'to pour, sprinkle some more salt/spice') and ot- (as in otlít'$^P$ 'to pour (some quantity of liquid) off (some larger quantity of liquid)').

        The existence of verbal prefixes that encode vague quantificational and/or measurement notions within perfective stems complicates the uniform semantic characterization of perfective verbs in terms of quantization.  In fact, the question whether it is possible to provide a uniform semantic characterization for all perfective verbs is quite old.  It is one of the most discussed questions in traditional and structuralist linguistics, and the rich semantics of verbal prefixes is here taken to be one of the main obstacles to characterizing the semantic core, or the 'perfective invariant' in structuralist terms, shared by all perfective verbs and their contextual variants.  All the candidate notions proposed have been found inadequate, because there seem to be always some classes of verbs that constitute exceptions to any of them, as Kučera (1983:174), Comrie (1976:16ff.) and Binnick (1991), for example, observe.  In structuralist accounts, the lack of a uniform and generally accepted semantic characterization of perfectivity is problematic given that verbal aspect is taken to be a grammatical category, and yet unlike other grammatical categories, it appears to resist a uniform semantic characterization.  Independently of the semantics of perfective aspect, the idiosyncratic lexical semantic contribution of prefixes to the meaning of verbs has been extensively studied from the point of view of the lexicalization of various 'Aktionsart' classes, or 'manner of action' classes (cf. Agrell, 1908; Maslov, 1959; Isačenko, 1960, 1962:385-418).  The

distinguishing criteria on which 'Aktionsart' classes are based include quantificational, measurement, and closely related notions (e.g., 'distributivity', 'partitivity', 'frequentativity', 'accumulation (of a large/small quantity of)', for example), and we find verbal prefixes that express notions comparable to quantifiers like *some, many, much, a lot, a few, a little, several* (see Isačenko, 1960:385-418, for example). Therefore, the discussion of the quantization puzzle cannot be restricted just to the semantics of perfective aspect, and not even just to the general domain of event structure, but rather it must be viewed in connection with the theory of quantification and semantic typology. Given the above observations, I pose the following questions:

1. What is the relation between quantization and the semantics of perfectivity in general? Should we abandon the assumption that all perfective verbs are quantized?

2. What is the function of prefixes in the aspectual system? Are prefixes, including those that express measure and/or quantification, grammatical markers of the perfective aspect? What is the relation of measure and/or quantification functions to the semantics of perfective aspect?

## 3  Previous related proposals

The accumulative prefix <u>na-</u> and attenuative <u>po-</u> bear close semantic parallels to nonstandard vague measures of amount like *a long/short distance*, *a large/small quantity*, *a large/small piece*, and to vague determiner quantifiers like *many, a lot* and *(a) few*. Noun phrases with such vague measure expressions and determiner quantifiers give rise to a similar quantization puzzle as Slavic perfective verbs with the prefixes <u>na-</u> and <u>po-</u> do. They fail to be quantized, when analyzed in isolation as predicates, nevertheless they behave like uncontroversial quantized noun phrases with respect to aspectual composition and temporal adverbials (cf. L. Carlson, 1981:54; Mittwoch, 1988:fn.24; Dahl, 1991:815; Moltmann, 1991; White, 1994; Zucchi and White, 1996, for example)[12]. A recent discussion of this puzzle is provided by Zucchi and White (1996). Let me illustrate the nature of the problem with *a sequence (of numbers)* they discuss. The sequence *1, 2, 3, 4*, for instance, has the sequence *1, 2, 3*, the sequence *2, 3, 4*, and *2, 3* as its proper parts. Since there are members of the extension of *a sequence (of numbers)* having proper parts which are also members of the extension of *a sequence (of numbers)*, the predicate *is a sequence (of numbers)* cannot be quantized, according to the definition in (5a). Yet, *a sequence (of numbers)* interacts with time-span *in*-adverbials in the same way as quantized noun phrases like *a letter* do, which suggests that it is quantized. This is shown in (14):

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[12]The same problematic behavior is also exhibited by noun phrases with other vague quantifiers like *some* and *most*, definite noun phrases like *the water* and possessive noun phrases like *my friends*.

(14)  a. John wrote a letter ??for an hour / in  an hour.                          Zucchi and White, 1996
      b. John wrote a sequence (of numbers) ??for ten minutes / in ten minutes.

Temporal adverbials serve as a litmus test for the quantization status of a verbal predicate:  The
domain of application of durative adverbials, such as <u>for</u>-PPs,  are process (cumulative) predicates;
when applied to event (quantized) predicates, they enforce certain reinterpretations.  The domain of
application of time-span adverbials, such as <u>in</u>-PPs, are event (quantized) predicates; when applied
to process (cumulative) predicates, they enforce certain reinterpretations.  In (14b) the compatibility
of *wrote a sequence (of numbers)* with the time-span adverbial *in ten minutes* indicates that *wrote a
sequence (of numbers)* is quantized.  Since *wrote a sequence (of numbers)* is quantized, *a
sequence (of numbers)* must be, as well.  This follows from the assumption that it is the
Incremental Theme argument of *wrote* (cf. Dowty, 1988, 1991) and the principle of aspectual
composition, formulated here following some proposals in Krifka (1986, 1990, 1992).

(15)  <u>aspectual composition</u>:  An episodic verb combined with a quantized Incremental Theme
      argument yields a quantized verbal predicate, while a cumulative Incremental Theme
      argument yields a cumulative verbal predicate, provided the whole sentence expresses a
      statement about a single eventuality.

Aspectual composition relies on the assumption that verbs like 'write' relate proper parts of the
object denoted by the Incremental Theme argument and the proper parts of the event to each other
in a one-to-one fashion.  For example, the semantic representation of *write a letter* would express
that every proper part of writing corresponds to exactly one proper part of a letter, and vice versa.
This relation is modelled by means of a homomorphism (a one-to-one mapping) between the part
structure of the denotation of the Incremental Theme argument and the part structure of the event,
where the event and object part structures are represented by means of complete join semi-lattices
(see Link, 1983; Bach, 1986).  Krifka also proposes that the homomorphism is encoded as part of
the definition of a particular thematic role, his 'successive' or 'gradual Patient', which corresponds
to Dowty's (1988, 1991) Proto-Patient property 'Incremental Theme'.   (Krifka's definition of
'Gradual Patient' thematic role is given in the Appendix)[13].

        The strategy pursued by Zucchi and White (1996) in solving the quantization puzzle is to
prevent that proper parts of individuals in the denotation of the problematic noun phrases ever enter
into calculation of the quantization status of a complex predicate they are part of.  In order to

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[13] There have been a number of other proposals attempting to motivate aspectual composition in terms of general
rules and principles.  The predicate-argument relation, which Krifka (1986, 1992) labels 'gradual/successive Patient'
and Dowty (1988, 1991) the 'Incremental Theme' relation, is described as the 'ADD-TO' relation in Verkuyl (1972,
1993), the 'measuring out' relation in Tenny (1987, 1994), and the 'structure-preserving' relations in Jackendoff
(1996).

guarantee this, Zucchi and White (1996) introduce the notion of a 'maximal participant', an individual that is not a proper part of another individual that satisfies the same predicate:

(16)   $\forall x[Max(P, x) \leftrightarrow \neg\exists y[P(y) \wedge x<y]]$                    Zucchi and White, 1996:340

Given (16), events in the denotation of *wrote a (sequence of numbers)*, as in (14b), must have maximal participants denoted by *a sequence (of numbers)* as Incremental Themes, namely, sums of all numbers written at *t*.  Hence, no proper sequences of the sequence John wrote can count for establishing whether the predicate *wrote a sequence (of numbers)* is quantized.  From this it follows that (14b) is quantized, according to Zucchi and White (1996).

Zucchi and White's (1996) notion of a 'maximal participant' is related to Kratzer's (1989a) notion of a 'maximal situation', a situation that is not a part of some other situation(s) (p.611). Kratzer proposes that propositions are sets of possible situations rather than simply sets of possible worlds.  That is, along with possible worlds, we distinguish their parts, which are situations. Since worlds are parts of themselves, they are also situations.  Intuitively, it makes sense to claim that the denotation of such noun phrases as *a sequence* is satisfied by maximal participants.  For example, if someone is asked to write a sequence of prime numbers, and writes *2, 3, 5, 7, 10, 11*, then the person failed to provide a felicitous answer, although this sequence contains the sequence *3, 5, 7* as its proper part.  The most plausible and cooperative strategy to interpret *write a sequence of prime numbers* is to take it as conversationally implicating 'write a sequence of consecutive prime numbers not properly contained in any other sequence of numbers' (see also Krifka, 1998:220).  Moreover, it would seem plausible and cooperative to interpret *a sequence of prime numbers* as conversationally implicating the *maximal* consecutive sequence of numbers, rather than some *minimal* sequence of numbers, which would comprise exactly two numbers.  In our example, the minimal sequences of prime numbers are *3, 5* and *5, 7*.  Although writing any of these two minimal sequences would strictly constitute a correct answer, it would seem odd to constrain the interpretation of *a sequence of prime numbers* to just the minimal sequence of exactly two numbers.  However, the problem with Zucchi and White's (1996) notion of 'maximal participant' is that it is too restrictive, because it denies that a subsequence like *3, 5* of the sequence *2, 3, 5, 7, 10, 11*, for example, can ever count as a sequence of numbers.

Another candidate notion for the representation of the semantic contribution of prefixes with a vague quantificational or measurement content is Krifka's (1997) 'maximal separated entity'.  For example, the translation for the Czech perfective verb pospal[P] 'he slept for a short while' with the attenuative prefix po- is rendered as follows:

(17)   $[\![po\text{-}spal]\!]$   =   {e | MS(SLEEP)(e) $\wedge$ SHORT(e)}
       [the set of sleeping events each of which is a maximally separated event; SHORT is a
       predicate applying to events and it is true iff the event e is short]

(17) says that the perfective verb form applies only to 'maximal separated events' of the type SLEEP, which is represented with the predicate *MS*. In addition, the attenuative prefix po- expresses that each sleeping event is of short duration. *MS* is defined in (18):

(18)  a. MS(P)(x), x is a <u>maximal separated entity</u> of type P if P(x), and for all y with P(y) and $x<_P y$, it holds that every z with $z<_P y$ and $\neg x\otimes_P z$ is not adjacent to x.

b. Standardization:  MS#(P)(x) = 1 if MS(P)(x)
Generalization: $\forall x,y[\neg x\otimes_P y \rightarrow MS\#(P)(x\oplus_P y) = MS\#(P)(x) + MS\#(P)(y)]$

'#' is the atomic number function, a kind of extensive measure function:
If At(x), then #(x) = 1; if $\neg x\otimes_P y$, then $\#(x\oplus_P y) = \#(x) + \#(y)$.

The topological notion of 'adjacency' in (18a) is to be understood in the following way: "adjacent elements do not overlap, and (...) if an element *x* is adjacent to an element *y* that is a part of an element *z*, either *x* is also adjacent to *z*, or *x* overlaps *z*" (Krifka, 1998:203). (The mereological proper part '$<_P$' and overlap '$\otimes_P$' relations are defined in the Appendix.) Combining mereological with topological notions has proven to be useful for the description of other phenomena within natural language semantics, and also in a number of cognitive science disciplines (see Eschenbach, et al, 1994; Pianesi, F. and A. C. Varzi, 1994, for example). *MS* serves as the basis for the definition of the extensive measure function *MS#*, defined in (18b). In general, when applied to a given entity, extensive measure functions yield as value positive real numbers. The use of *MS* and *MS#* is illustrated in (19):

(19)  ⟦*a large piece of gold*⟧  =  {x | MS(PIECE)(x) ∧ GOLD(x) ∧ LARGE(x)}
⟦*three pieces of gold*⟧  =  {x | MS#(PIECE)(x) = 3 ∧ GOLD(x)}
⟦*rain three times*⟧   =  {e | MS#(RAIN)(e) = 3}

The introduction of *MS* is independently motivated by the necessity to ensure that entities in the denotation of expressions involving extensive measure functions are (temporally and spatially) disjoint, and hence satisfy additivity, the hallmark property of extensive measure functions (see also Higginbotham, 1995; Krifka, 1998:199, 201). For example, *two cups of water* is quantized, according to (5a), because no proper part of a quantity of two cups of water falls under *two cups of water*. However, *two cups of water* differs from quantized noun phrases like *two apples*. While *two apples* denotes sets of two disjoint entities, entities that have inherent spatial boundaries separating one entity from any other entity, *two cups of water* denotes sets of two entities that may overlap. This poses the following problem: Even though *two cups of water* do not overlap mereologically, they may apply to quantities of water in a jug that spatially overlap. If two quantities of two cups of water spatially overlap, they do not add up to a quantity of four cups of water, that is, if we have CUP(x)=2 and CUP(y)=2, then CUP(x⊕y)≠4. Using *MS* in the semantic

description of *two cups of water* ensures that adding $CUP(x)=2$ to $CUP(y)=2$ yields $CUP(x\oplus y)=4$, hence the additivity property of measure functions is satisfied: cp. $[\![$ *two cups of water* $]\!] = \{x|MS\#(CUP)(x)=2\wedge WATER(x)\}$. Independently, Krifka (1998) argues that predicates defined in terms of extensive measure functions are quantized.

Notice that the standardization clause (18b) requires that the predicate denoting a maximal separated entity be atomic, and independently Krifka (1987) proposes that measure terms denote atomic entities. This idea is appealing, because it explicitly captures the long-standing intuition that perfective verbs express 'an action as a single or indivisible whole', going back as far as Razmusen (1891) and Maslov (1959:309), for example. (For a historical overview see Forsyth, 1970:7-8). Relating the semantics of perfectivity to atomicity of denoted events is also proposed by Kiparsky (1998). According to him, the attenuative prefix <u>po-</u> and accumulative <u>na-</u> in Russian are morphological elements that serve to form bounded predicates. 'Bounded' predicates in Kiparsky's terms have *only* atomic elements in their denotation. In addition, to guarantee that certain predicates, such as those expressed by perfective verbs with the accumulative <u>na-</u> and attenuative <u>po-</u>, qualify as bounded, even though they appear to be divisible, Kiparsky proposes that they satisfy the following diversity condition:

(20)   P is DIVERSE iff $\forall x\forall y[P(x) \wedge P(y)\wedge x\neq y\rightarrow\neg x<y\wedge\neg y<x]$

However, Kiparsky's definition of diversity given in (20) is almost identical to Krifka's definition of quantization given in (5a) ('$\neg y<x$' in (20) is not necessary for the definition)[14], and therefore, it raises the same quantization puzzle that Krifka's (5a) does. Another problem has to do with Kiparsky's claim that bounded predicates disallow degree adverbs. However, the incompatibility with degree adverbs is not a suitable diagnostic for the boundedness (in Kiparsky's sense) of a predicate in Russian and English. For example, the verb *drop* that he classifies as bounded can occur with degree adverbs like *a lot* and *somewhat*: cp. *During the turbulence, the plane dropped a lot/somewhat* [i.e., it dropped once and a long/short way]. <u>Na-</u>verbs in Russian are compatible with adverbs indicating a relatively high degree, as (21a) shows, while <u>po-</u>verbs sanction degree adverbs indicating a relatively low degree, as in (21b):

(21)  a. Vot  ja <u>vdóvol'</u> /  *<u>němnóžko</u>    **NA-**guljálsja$^P$!
         well  I  <u>enough</u> /  *<u>a little</u>        **ACM-**walk.PAST.REFL
         'Boy, did I walk a lot!'

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[14]Despite the fact that Kiparsky's definition of 'diversity' is almost identical to Krifka's definition of 'quantization', Kiparsky's bounded predicates only partially overlap with Krifka's quantized predicates. Kiparsky's list of bounded predicates comprises predicates that qualify as quantized in Krifka's sense (e.g., *kill (a bear), find (the key)*) as well as those that are cumulative in Krifka's sense (e.g., *own (the book), marry, contain (the necklace)*).

b. Ja *<u>vdóvol'</u>/   <u>němnóžko</u>   **PO-**guljál<sup>P</sup>.
   I  *<u>enough</u>  /  <u>a.little</u>     **ATN**-walk.PAST
   'I took a short walk' / 'I walked only a little.'

c. Ja <u>mnógo</u>  /  <u>vdóvol'</u> /  <u>nědólgo</u> /  <u>němnógo</u>   guljál<sup>I</sup>.
   I  <u>a.lot</u>   /  <u>enough</u>  /  <u>not.long</u> /  <u>not.a.lot</u>   walk.PAST
   'I walked a lot' / 'I walked for a short while.'

The restrictions on the distribution of degree adverbs must be due to the semantics of the prefixes <u>na-</u> and <u>po-</u>, because no such restrictions are operative in (21c) without these prefixes. At least in some contexts, degree adverbs that are compatible with <u>na-</u>verbs and <u>po-</u>verbs can be omitted without changing the truth-conditional content of whole sentences. In (21a) and (21b) this holds for <u>vdóvol'</u> 'enough', 'in abundance' and <u>němnóžko</u> 'a little'. This behavior suggests that degree adverbs and the prefixes <u>na-</u> and <u>po-</u> semantically overlap. The restrictions on their co-occurrence could be treated as a kind of agreement.

The most problematic in both Krifka's and Kiparsky's analysis of Slavic prefixed perfective verbs is the requirement that such verbs denote atomic events. One reason is that perfective verbs can freely occur in reciprocal statements. If perfective verbs had atomic events in their denotation, that is, events with no internal part structure, then a reciprocal, such as (22), should not be possible.

(22) Děti         obnjális<sup>P</sup>       / obnjáli<sup>P</sup>       drug drugá.
     children   embrace.PAST.REC / embrace.PAST   friend.SG.NOM friend.SG.ACC
     'The children embraced each other.'

In (22), the reciprocal suffix <u>-s</u> and the reciprocal phrase <u>drug drugá</u> 'each other', 'one another' are interpreted with respect to the members of the group denoted by <u>děti</u> 'children', the reciprocal's antecedent. If the domain of the reciprocal is a group with two members, say Peter and Irene, each group member is required to stand in the stated relation to the other member, that is, (22) can be paraphrased as consisting of two subevents: 'Peter embraced Irene and Irene embraced Peter'[15]. In reciprocal sentences perfective verbs denote events with an internal part structure that must be accessible for the purposes of the reciprocal quantifier. Given such data as (22), for example, it appears best not to restrict the denotation of perfective verbs to atomic events[16].

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[15]This qualifies as the Strong Reciprocity reading, see Langendoen (1978), Dalrymple et al. (1994, 1998).

[16]Krifka (1997), along with Bennett (1975) and Link (1984), for example, allows that atoms be internally complex to treat group nouns like *orchestra, department* and *couple*. However, there has been some discussion whether this is indeed justified. If we treated singular group nouns like *department* as having an internal structure, how could we distinguish them from expressions that are syntactically and semantically plural? Lasersohn (1988/90), Schwarzschild (1991) and Barker (1992) argue that singular group expressions differ semantically and

What emerges out of the above proposals is that the most promising way of analyzing the semantics of the prefixes <u>na-</u> and <u>po-</u> is in terms of measure functions. If verbal prefixes with a vague quantificational and/or measurement content are analyzed as measure functions, then perfective verbs containing them do not constitute an exception to the generalization that perfective verbs as a class are semantically quantized. In the next section I will explore this idea in detail.

## 4  The semantics of prefixes with a vague measure function

The general formula for the semantic representation of verbal prefixes that express some notion of measure or quantity can be given as in (23):

(23)   $[\![prefix]\!] = \lambda P\lambda x[P(x) \wedge m_c(x)$, where P is homogeneous]

      '$m_c$': a free variable over (extensive) measure functions that are linguistically or contextually specified

In (23), the contribution of a verbal prefix is characterized in terms of an extensive measure function $m_c$, that is applied to an entity *x*, an individual or event, of type *P*. $m_c$ is a free variable over measure functions, where the subscript *c* indicates its contextual dependency. The value of $m_c$, some extensive measure function (e.g., a non-standard measure, such as *quantity, piece*, or a standard measure, such as *hour, kilometer, liter*) is determined by contextual factors that narrow down the sorts of entities that are intended to be measured by a given prefix. Following some proposals in Higginbotham (1995) and Krifka (1998) the measure function can be defined for a part structure *P* as in (24). (The definition of a part structure *P* is given in the Appendix.)

(24)   *m* is an extensive measure function for a part structure *P* iff:
    a. *m* is a function from $U_P$ to the set of positive real numbers.
    b. <u>additivity</u>: $\forall x,y \in U_P[\neg x \otimes_P y \rightarrow m(x \oplus_P y) = m(x) + m(y)]$
    c. <u>commensurability</u>: $\forall x,y \in U_P[m(x){>}0 \wedge \exists z \in U[x{=}y \oplus_P z] \rightarrow m(y){>}0]]$

The property of additivity, the essential property of measure functions, is defined in (24b). According to (24b), a measure function has the property that the sum of the measure of non-overlapping elements is the measure of their sum (where '+' is the arithmetical addition). Hence, extensive measure predicates cannot be cumulative, they are quantized. In general, extensive measure functions can only be applied to homogeneous predicates and yield quantized predicates. This is captured in (23) with the presuppositional *where*-clause on *P*. Homogeneous predicates are cumulative, as defined in (5b) above, and they are also divisive (see Link, 1983; Bach, 1986).

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syntactically from plurals such as *the men* and conjunctions such as *John and Bill*. Only singular group expressions, but not plurals, denote atomic individuals, entities lacking internal structure. Landman (1996), on the other hand, emphasizes the similarity between plural noun phrases like *the journalists* and singular group noun

*Water* is divisive, as proper parts of some quantity of water count as water (at least down to a certain level of 'minimal' water parts). Similarly, process verbs like *walk* are homogeneous: walking and walking amounts to walking, and parts of walking are again walking.

The measure function applied to some entity *x* yields as a value some positive real number. In the case of the accumulative prefix <u>na-</u> this number meets or exceeds some contextually determined expectation value, while in the case of the attenuative prefix <u>po-</u> it meets or falls short of some contextually determined and relatively low value. The translations for <u>na-</u> and <u>po-</u> may be stated as in (25):

(25)  a. $[\![na\text{-}]\!] = \lambda P \lambda x [P(x) \wedge m_c(x) \geq r_c$, where P is homogeneous]
      b. $[\![po\text{-}]\!] = \lambda P \lambda x [P(x) \wedge m_c(x) \leq s_c$, where P is homogeneous]
          '$r_c$', '$s_c$': contextually determined expectation value (e.g., positive integer)

The two occurrences of the subscript *c* in (25a,b) indicate the contextual dependency of both the measure function and the expectation value. Intuitively, the contribution of <u>po-</u> and <u>na-</u>, analyzed as measure functions, can be thought of as carving out a chunk of a certain size out of the extension of a base process verb. Similarly, a vague measure expression like *a large/small quantity of x* carves out a chunk out of the extension of a mass noun: *chocolate - a large/small quantity of chocolate.*

Let us now look at some examples. Consider again <u>naguljálsja</u>[P] as in (9b), repeated here in (26):

(26)  Ivan  **NA-**guljálsja[P]        po      górodu.
      Ivan  **ACM**-walk.PAST.REFL  around  town
      'Ivan walked a lot / enough / to his heart's content around the town.'

If (26) is intended to mean 'Ivan walked for a long time' or 'Ivan spent a lot of time walking', its representation will contain the formula $\lambda e[\text{WALK}(e) \wedge \text{HolTh}(y,e) \wedge \text{Path}(x,e) \wedge \tau(e) \geq r_c]$. 'Walk' is here analyzed as a three-place relation WALK that relates the Holistic Theme argument and the Path argument to the event. The relevant contextually determined measure function is the temporal trace function $\tau$ that assigns to each eventuality *e* the time *t* that *e* takes up, its temporal trace. The temporal trace function $\tau$ is a function from events to times. It is a homomorphism (a one-to-one mapping) relative to the sum operation: $\forall e,e'[\tau(e \oplus e') = \tau(e) \oplus \tau(e')]$ (see Krifka, 1992:32, 1998:205ff.). That is, for any two events *e* and *e'*, the sum of their temporal traces equals the

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phrases like *the press*: For example, when they appear as subjects of the verb phrase *asked the president five questions*, they do not differ from each other with respect to implications regarding collective responsibility.

temporal trace assigned to the sum of these events (additivity), provided the two events do not temporally overlap: $\neg[\tau(e)\otimes\tau(e')]$. In the above representation, '$\tau(e)\geq r_c$' expresses that the temporal trace assigned to the event meets or exceeds some contextually specified expectation value. Given that $\tau$ is a homomorphism from events to times, we can measure events by the time they take: If the temporal trace associated with a given described event corresponds to some temporally delimited time interval, as it is in our example due to the measure prefix na-, the predicate denoting that event will be temporally delimited, and hence quantized.

The extensive measure function may be implicit, as in (26), or made explicit, as in Za étot sezón Ivan nabégal<sup>P</sup> trechsót kilométrov 'During this season he ran up three hundred kilometers' (cf. Isačenko, 1960:248), where the measure phrase 'three hundred kilometers' delimits the extent of the Path: $\lambda x \lambda y \lambda e[\text{RUN}(e)\wedge\text{HolTh}(y,e)\wedge\text{Path}(x,e)\wedge(km(x)=300)\geq r_c]$. The contribution of na- in this example is the entailment that the quantity met or exceeded some contextually determined expectation value, as well as the component of gradual 'accumulation' of the Path quantity.

In Za étot sezón Ivan nabégal<sup>P</sup> trechsót kilométrov 'During this season he ran up three hundred kilometers' the described event is measured by the Path covered during its course. Notice that (26) may also describe an event measured by its associated Path, it may be intended to mean 'Ivan walked long ways / covered a long distance in walking around the town'. Intuitively, the progress of the motion event described in such examples can be measured according to the position of Ivan, Holistic Theme, on the Path. If the motion event has not been completed, only a part of the Path has been traversed by Ivan. If Ivan reaches the end of the Path, the event must necessarily end. What we have here is a homomorphism between the parts of an event and the parts of a Path, or 'Incremental Path Theme' in Dowty's (1988, 1991) terms: Every part of the motion event corresponds to exactly one part of the Incremental Path Theme, and vice versa. We may assume that the homomorphism is here established by the relevant motion verb. If the (explicit or implicit) Incremental Path Theme argument is quantized, the complex predicate describing the event is as well. Incremental relations of this type are clearly parallel to cases like *John wrote a letter* in (14a) in which the quantificational properties of the Incremental Theme noun phrase *a letter* determine the telicity of a verbal predicate. In the event described by *John wrote a letter*, the letter undergoes incremental changes, changes part by part, which can be correlated with the incremental development of the writing event. If the writing event has not been completed, only a part of the letter has been written. Once the whole letter is written, the writing event must necessarily end. Given this parallelism it is easy to see that Krifka's principle of aspectual composition given here in (15) can be extended to the 'Incremental Path Theme-event' mappings.

Other examples in which the prefixes are used as measure functions over individual variables are (10) and (11), repeated here as (27a, b):

(27) a. Děti         **NA**-rváli$^P$       cvéty       / cvetóv         na lugú.
          child.NOM.PL   **ACM**-take.PAST   flower.PL.ACC / flower.PL.GEN     on meadow
          'The children picked a lot of/many/a (large) quantity of flowers in the meadow.'

     b. **PO-**píl$^P$          čáju       / čája.
          **ATN**-drink.PAST   tea.SG.PART   / tea.SG.GEN
          'He drank up (some small portion of) the tea.' / 'He had a little bit of tea.'

In (27a), the prefix <u>na-</u> can only function as a measure over the individual variable introduced by the direct object argument 'flowers'. Crucially, the prefix <u>na-</u> does not here function as a measure over the individual variable supplied by the subject noun phrase, because (27a) does not mean 'Many children picked (some) flowers' or 'Many children picked many flowers'. Nor can (27a) mean 'The children often / many times picked flowers', a reading one would expect if <u>na-</u> functioned as a measure of a plurality of events. Notice also that the prefix <u>na-</u> does not here contribute various temporal or manner specifications, for example, to the meaning of a sentence, that is, (27a) does not mean something like 'The children spent a lot of time/energy picking flowers'. Similarly, (27b) *only* means 'He drank (up) a small quantity of tea'. In sum, we may view the combination of <u>na-</u>+'flowers' in (27a) as being roughly comparable to English noun phrases like *a (large) quantity of flowers*, *many flowers, a lot of flowers*, while <u>po-</u>+'tea' in (27b) as being approximately comparable to *a/some small quantity of tea*, for example.

     Most importantly, both the direct object arguments denoting individuals over which <u>na-</u> imposes a measure in (27) are entailed the Incremental Theme property by the main prefixed verbs. (See also Filip, 1992, 1993/99.) The Incremental Theme direct objects must be quantized, because the prefixes impose a measure over the individual variables they introduce. Given that the Incremental Theme direct objects are quantized, the principle of aspectual composition, here given in (15), predicts that the complex verbal predicate must be quantized, as well.

     (27a) shows that measure prefixes can function as measures over pluralities of entities. They can also function as measures over pluralities of events. For example, (26) can also be understood as meaning 'There was a large number/quantity of occasions on which Ivan took a walk around the town'. In order to capture this use of measure prefixes, we may slightly modify the basic formula in (23) as follows:

(28)   a. $[\![ na\text{-} ]\!] = \lambda P \lambda x [{}^*P(x) \wedge m_c(x) \geq r_c$, where P is homogeneous]
     b. $[\![ po\text{-} ]\!] = \lambda P \lambda x [{}^*P(x) \wedge m_c(x) \leq s_c$, where P is homogeneous]

*P stands for the plural predicate variable, derived with the operation of semantic pluralization '*' from the singular predicate variable P (see Link, 1983). It has been observed that measure prefixes map homogeneous predicates onto quantized predicates. Any plural quantity presupposes the existence of a number discrete singular entities that make it up. Since an imperfective verb like gulját'[1] 'to walk', 'to be walking' is process-denoting, its domain is non-atomic, that is, it does not necessarily consist of clearly identifiable discrete events. Therefore, the pluralization of the imperfective gulját'[1] 'to walk', 'to be walking' presupposes that gulját'[1] first undergoes a process-to-event shift, WALK $\rightarrow$ E(WALK), and then pluralization: E(WALK) $\rightarrow$ *(E(WALK)). A plural predicate like *(E(WALK)) is homogeneous, because it is both cumulative and divisive: Adding a number of walking events to a number of walking events amounts to a number of walking events. At the same time, a number of walking events will have proper parts that are also walking events. When applied to a predicate denoting a plurality of entities, the effect of a measure prefix is then to shift its interpretation from a plural interpretation to a singular interpretation: a measured quantity of (atomic) entities.

To summarize, the prefixes na- and po- yield quantized predicates by imposing a measure over the individual or event variable introduced by one of the predicate's arguments. In each case they can measure the extent (or some other quantitative dimension) of a *single* entity (individual or event) or impose a measure over a *plurality* of entities. If the prefixes impose a measure over an individual variable, this variable will be introduced by an argument associated with the Incremental (Path) Theme. This yields a quantized Incremental (Path) Theme argument, and from the principle of aspectual composition, here given in (15), it then follows that the complex verbal predicate must be quantized.

The behavior of the Russian prefixes na- and po- in the examples given above illustrates one striking property of verbal prefixes in Slavic languages: namely, their selectivity in targeting specific arguments of a verb for their semantic effects. Slavic languages share this property with other morphological V-operators in a number of other languages. (See Partee, et al., 1987, 1991, 1995:556 for cross-linguistic data and discussion). As far as Slavic languages are concerned, the selection of the appropriate verbal argument seems to be subject to the following general constraint (cf. also Filip, 1993/99, 1996):

(29) Lexical V-operators that function as quantifiers or measures over episodic predicates and their arguments are linked to the Incremental (Path) Theme argument or to the eventuality argument. If there is neither, quantification or measurement is undefined.

The term 'lexical V-operators' here refers to the operators that are part of verbal morphology and express quantification and/or measurement at the lexical level, rather than by means of determiners, or sentence-level operators (see also Partee, 1995:559). When a lexical V-operator is 'linked' to a

verbal argument, it binds the variable introduced by the noun phrase filling the corresponding argument position. The noun phrase describes what entity/entities the quantification or measurement expressed by the lexical V-operator is restricted to range over. (For a similar use of the notion of 'linking' see also Partee, Bach and Kratzer, 1987:21-2.) The hypothesis (29) has important consequences for the relation between lexicon and quantification as well as closely related measurement functions in so far as it evokes a verb's argument structure in determining the linking of a quantifier or a measure function expressed by a lexical V-operator (here, a verbal prefix) to the appropriate argument of a verb. (29) will have to be refined in the future, in its present form it serves as a useful working hypothesis that narrows down the range of possible arguments that verbal prefixes select for their semantic effects in Slavic languages[17].

The hypothesis that the accumulative prefix na- and the attenuative po- express vague measure functions can be seen confirmed by the semantic restrictions that these prefixes impose on their inputs. Let me illustrate this point with the accumulative prefix na-. (30) shows that na- is only compatible with a bare plural or mass Incremental Theme noun phrase, but not with a singular count one:

(30) **NA**-rvál$^P$        *jábloka      /*jábloko      / jáblok (jábloka)              / siréni.
     **ACM**-pick.PAST   *apple.SG.GEN  /*apple.SG.ACC / apple.PL.GEN (apple.PL.ACC) / lilac.SG.GEN
     'He picked *a lot of an apple / a lot of apples / a lot of lilac.'

On the analysis of na- as a measure function, this behavior is expected, given that the application of measure functions is restricted to homogeneous predicates. Na- is also incompatible with quantified Incremental Theme noun phrases containing cardinal quantifiers that indicate a relatively small number or measure, such as the numeral pjat' 'five' or the indefinite néskol'ko 'several', 'a few', as (31) shows:

(31) Irina **NA**-peklá$^P$        *pjat'   pirogóv        /  *néskol'ko pirogóv.
     Irene **ACM**-bake.PAST   *five    pirog.PL.GEN   /  *several      pirog.PL.GEN
     'Irene baked five pirogi / several pirogi.'

Finally (32) shows that na- is incompatible with quantified Incremental Theme noun phrases containing strong and weak universal quantifiers (cf. Milsark, 1974) like káždyj 'every', 'each' and vse 'all':

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[17]To my knowledge, there has been only one other proposal that addresses the selectivity of lexical A-quantifiers: namely, that of Evans (cited in Partee, 1991, 1995) who argues that many of the lexical A-quantifiers expressed by preverbs or verbal prefixes in Warlpiri and Gun-djeyhmi (Australian aboriginal languages) show particular patterns of thematic affinity. Evans identifies four: actor/subject scope ("acting together, all doing the same thing"), absolutive scope ("completely", "fully"), VP or verb plus object scope ("again / another / repetitive"), and place / time / manner / theme / action scope.

(32) Irina **NA**-peklá[P]      *vse       pirógi      /  *kážyj      piróg.
    Irene **ACM**-bake.PAST  *all.PL.ACC pirog.PL.ACC  /  *every.SG.ACC  pirog.SG.ACC
    'Irene baked all the pirogi / each pirog.'

Na- may occur with Incremental Theme noun phrases that contain quantifiers or measure expressions whose content overlaps with the measurement content of na-. For example, na- freely co-occurs with the quantifier mnógo 'a lot', 'many', as (33) shows.


(33) Irina **NA**-peklá[P]       (mnógo) pirogóv.
    Irene **ACM**-bake.PAST  (a.lot)   pirog.PL.GEN
    'Irene baked many / a lot of pirogi.'

The optional use of the quantifier mnógo 'a lot', 'many' in (33) indicates that (33) with this quantifier and the corresponding sentence without it are truth-conditionally equivalent. The quantifier mnógo 'a lot', 'many' does not add any new quantity information over and above that conveyed by the prefix na-. The connection between the prefix na- on a transitive verb and the quantifier mnógo 'a lot', 'many' within its direct object noun phrase seems to be to a large extent conventionalized, which is also reflected in the lexical entries of such transitive na-verbs in standard dictionaries. They typically list various examples of transitive na-verbs together with the quantifier mnógo 'a lot', 'many'.

It has been observed that the homogeneity input condition on the application of na- is also satisfied by predicates denoting a plurality of events. Given that measure expressions are not scope taking[18], we would expect that na- should take a narrow scope with respect to various adverbial quantifiers. This prediction is borne out, as examples in (34) show:


(34) Ivan  **NA**-gulívalsja[I]         (*)tri razá   / (*)částo / (*)eẑednévno   / (*)obýčno  v párke.
    Ivan  **ACM**-walk.IPF.PAST.REFL  (*)three times / (*)often / (*)daily        / (*)usually   in park
    'Ivan walked a lot (*)three times / (*)often / (*)daily / (*)usually in the park.'

(34) contains iterative ('three times'), frequency ('often') and generic ('every day', 'usually') adverbs[19]. '(*)' here indicates that na- is unacceptable or very odd if it takes a wide scope with

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[18]See also Tenny and Heny (1993) on measure adverbials like *partly.*

[19]In (34) the verb form in which na- occurs is imperfective. In order to test the behavior of na- with adverbs of quantification, we need to use na- as part of an imperfective verb, because the combination of a perfective verb with such adverbs is in most cases ungrammatical in Russian. The two parameters that are often mentioned in determining whether a perfective or an imperfective verb form is used with a given adverb of quantification are: (i) cardinality of the subevent occurrences constituting the sum event (high vs. low cardinality, definite vs. indefinite cardinality), (ii) the distribution of subevent occurrences over a short or long temporal interval, and (ii) completion vs. non-completion of each individual event (see Timberlake, 1982:315-316, for example). For example, Townsend (1970:56) states for Russian that "[i]f the context calls for words like (…) vsegdá or částo, of course, an imperfective is clearly required (...)", as in Ona částo perečítyvala[I] / *perečitála[P] egó pismó 'She often read his letter over' (the example is taken from Maltzoff, 1965:165). However, Townsend (1970:60) also notices that a perfective

respect to such adverbs of quantification, and it is acceptable if it takes a narrow scope. The narrow scope interpretation of <u>na-</u> yields readings approximately like 'Three times / often / every day / usually [Ivan walked a lot in the park]', for example. Since the corresponding unprefixed imperfective verb <u>guljál</u>[I] 'he walked', 'he was walking' can freely occur with any type of adverb of quantification, as (35) shows, the scope effects observed in (34) must be due to the prefix <u>na-</u>.

(35) Ivan guljál[I]    tri razá   / částo  / eždenévno   / obýčnov párke.
     Ivan  walk.PAST three.times / often   / every day    / usually    around park
     'Ivan ran three times / often / every day / usually in the park.'

     To summarize, if verbal prefixes with a vague quantificational and/or measurement content are analyzed as measure functions on the level of verbal morphology, then perfective verbs containing them do not constitute an exception to the generalization that perfective verbs are semantically quantized. This analysis of verbal prefixes as quantizers appears to be compatible with the commonly made claim that prefixes are overt grammatical markers of perfective aspect (see Krifka, 1992:50; Piñón, 1994; Zucchi, 1997, Schoorlemmer, 1995). For example, according to Piñón (1994), verbal prefixes are perfectivizers of imperfective verbs, that is, semantically they express an event function $\varepsilon$, $\varepsilon: P \mapsto E$, which maps (sets of) processes (P) onto (sets of) events (E). However, matters are more complicated than that, and in the next section I will argue that verbal prefixes are not markers of perfective aspect, despite the claim that they contribute quantization to the meaning of a verb.

## 5 Prefixes are not markers of perfectivity

In Slavic languages prefixation is one of the most common ways to derive a perfective verb from an imperfective one. Advocates of the view that prefixes are aspectual markers of perfective aspect emphasize the presentation of Slavic verbs in the form given in (36), taken from Binnick (1991:137). Here, a prefixed perfective verb is formed from a simple imperfective verb, and both are translated with one English lexeme, implying that they are two aspectually different forms of one and the same lexeme, or 'aspectual pairs'.

(36)  'to write':     pisát'[I]     $\rightarrow$   **NA**-pisát'[P]
     'to do':       délat'[I]     $\rightarrow$   **S**-délat'[P]
     'to build':     stróit'[I]     $\rightarrow$   **PO**-stróit'[P]
     'to go blind':  slepnút'[I]   $\rightarrow$   **O**-slepnút'[P]
     'to read':     čitát'[I]     $\rightarrow$   **PRO**-čitát'[P]

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verb is occasionally seen with <u>částo</u>, as in: <u>Eto móžno částo pročitát'</u>[P] <u>v nášich gazétach</u> 'You (can) read about that frequently in our newspapers' (p. 60).

Examples like those in (36) are typically used in support of the claim that "generally speaking there exist two parallel sets of verb forms carrying identical lexical meaning, i.e. denoting one and the same type of action" (Forsyth, 1970:1). This also implies that prefixes only serve to mark aspect (see Binnick, 1991:137, for example), and have no idiosyncratic lexical semantic properties. Moreover, the characterization of prefixes as markers of perfective aspect presupposes that prefixes can be *only* applied to imperfective verbs (see Piñón, 1994:493-4, for example). The view that Slavic verbal prefixes are aspectual markers of perfective aspect is also evident in prefixes being treated as aspectual opposites of the imperfectivizing suffix <u>-va-</u>. The suffix <u>-va-</u> has clear inflectional characteristics, it is applied to perfective verbs, simple or prefixed, and yields imperfective verbs, as is illustrated by the Russian examples in (37):

(37)  <u>simple imperfective</u>     →     <u>perfective</u>     →     <u>(secondary) imperfective</u>

  pisát'$^I$                **VY**-pisát'$^P$              **VY**-písy-**VA**-t'$^I$
  write.INF                 **PREF**-write.INF            **PREF**-write-**IPF**-INF
  'to write', 'to be writing'   'to write out'            'to write out', 'to be writing out'

                            dat'$^P$                       da-**VA**-t'$^I$
                            give.INF                       give-**IPF**-INF
                            'to give'                      'to give', 'to be giving'

For example, Zucchi (1999) proposed that the function of a perfectivizing prefix corresponds, at the verb level, to the function *Cul* assigned by Parsons (1980, 1986, 1990) to perfective aspect and the imperfective suffix <u>-va-</u> instantiates the function *PROG* posited by Landman (1992) to interpret progressive aspect. In what follows I will argue that the description of Slavic verbal prefixes and aspect along the lines sketched above involves certain oversimplifications that ultimately lead to wrong predictions about the formal and semantic properties of prefixes and their status in the grammatical system. I will provide arguments showing that verbal prefixes in Slavic languages are not markers of perfective aspect, but rather derivational morphemes, and clearly differ in their distributional and semantic properties from typical inflectional and constructional markers of grammatical aspect.

Since the identification of aspectual pairs is closely tied to the semantic properties of prefixes, the questions to ask are 'Which prefixes, if any, do only contribute the meaning assigned to perfective aspect?' and 'What is the semantics of perfective aspect?' These questions generated a lot of discussions[20] in Slavic linguistics, and it is fair to say that there is no general consensus on

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[20]They are often marred by circular arguments: Identifying what the semantics of perfectivity is presupposes that we can identify imperfective and perfective verb forms that minimally differ only in the aspectual contribution of the perfective form. Identifying such pairs of verb forms presupposes that one already knows what the semantics of perfectivity is. Identifying the semantic contribution of perfective aspect to the sentential semantics is crucial in approaches that subscribe to the view of aspect as a privative opposition. On such a view, perfective is the marked

how they ought to be answered.  The answers to the first question cover a whole spectrum, from claims that there is a fairly large number of prefixes that "are semantically empty, serving merely to mark aspect" (Binnick, 1991:137) to arguments that there are none, as in Isačenko (1960, 1962), for example.  The main reason for this remarkable disagreement has to do with the effects of prefixes on the lexical semantics of verbs, which are often unsystematic and unpredictable, and problems associated with their description.  First, many prefixes historically developed from prepositions and adverbials used for the expression of location and direction in space and time and these meaning components are still clearly detectable in their semantic make-up.  Prefixes may also have a number of modificational meanings and some have quantificational and/or measurement meanings.  Even in such simple cases of putative aspectual pairs as those in (36), the prefixes <u>na-</u> and <u>pro-</u> have effects (albeit subtle) on the lexical semantic properties of verbs.  Including the fact that imperfective verb forms cover the range of progressives and nonprogressives, a more adequate presentation of the data in (36), would have to look more like (38):

(38)   <u>simple imperfective</u>                    →    <u>perfective</u>

     pisát'$^I$                                      **NA**-pisát'$^P$
     write.INF                                    **PREF**-write.INF
     'to write', 'to be writing'                   'to write (up/down)'

     délat'$^I$                                      **S**-délat'$^P$
     do.INF                                          **PREF**-do.INF
     'to do', 'to be doing'                        'to have done'

     stróit'$^I$                                     **PO-**stróit'$^P$
     build.INF                                     **PREF**-build.INF
     'to build', 'to be building'                  'to (finish) build(ing)'

     slepnút'$^I$                                    **O-**slepnút'$^P$
     go.blind.INF                                 **PREF**- go.blind.INF
     'to go blind', 'to be going blind'            'to (have) gone blind'

     čitát'$^I$                                      **PRO-**čitát'$^P$
     read.INF                                      **PREF**-read.INF
     'to read', 'to be reading'                    'to read through'

     Second, prefixes also exhibit polysemy and homonymy, the meaning of the combination 'prefix+base' is not always transparently compositional, but often partly or fully lexicalized, and not all prefixes attach to all verbs.  One prefix can be applied to different imperfective verbs, or classes of verbs, with different semantic effects, as is shown in (39).

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member with a specific positive semantic invariant feature, while the unmarked imperfective member is defined as not opposing any positive or negative meaning to that of the marked member.  However, the unmarked member

(39)  u-bežát'^P       'to run away', 'to run off'
     u-pít'sja^P      'to get drunk (on)'
     u-sidét'^P       'to keep one's place, 'to remain sitting'
     u-stróit'^P      'to make', 'to construct'; 'to arrange', 'to organize'
     u-vídet'^P       'to catch sight of'

Third, different prefixes can be attached to one verb stem, as in (40), so that to one and the same simple imperfective verb we typically get a cluster of prefixed perfective verbs, rather than just one prefixed perfective verb.

(40)  simple imperfective   →   prefixed perfective
     pisát' 'to write',        v-pisát'    'to enter', 'to insert'
        'to be writing'        vy-pisát'   'to write out', 'to excerpt'; 'to use up by writing'
                               za-pisát'   'to note down', 'to record'
                               na-pisát'   'to write (up)'
                               nad-pisát'  'to inscribe'
                               do-pisát'   'to finish writing'
                               o-pisát'    'to describe', 'to list', 'to circumscribe'
                               po-pisát'   'to do a bit of writing'
                               pere-pisát' 'to write over/again', 'to copy'
                               pri-pisát'  'to add (to something written)', 'to register',
                                           'to attribute (to)'
                               pro-pisát'  'to prescribe'
                               ras-pisát'  'to enter', 'to note down', 'to assign'
                               s-pisát'    'to copy from', 'to copy (off)'

Finally, prefixes induce changes in the lexical semantic properties of verbs, which in turn may be related to the change in valence and/or (morphological) case government, and the grammatical function status of arguments. Prefixes often serve as arity-augmenting, transitivizing, devices. In short, there does not seem to be a single all-purpose neutral prefix or a set of such prefixes that would have a constant semantic contribution *only* associated with perfective aspect and that could be uniformly attached to all or most imperfective verbs to form perfective ones.

In all of the respects mentioned above Slavic verbal prefixes behave very much like verbal prefixes in other Indo-European languages, such as German, and prefixes in typologically unrelated languages, such as Hungarian (see also Comrie, 1976:88ff.). Yet, verbal prefixes in neither Hungarian nor German are taken to be grammatical markers of perfective aspect. Moreover, in all the respects mentioned above, Slavic verbal prefixes clearly differ from inflectional markers of perfective aspect like the passé simple suffixes in French, for example. (As Comrie (1976), for example, I regard the 'passé simple-imparfait' distinction in French, and similar distinctions in other Romance languages, to be one in grammatical aspect. However, de Swart (1998) argued for the traditional position that this is mainly a tense distinction.) The French

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may, in specific contexts, take on the opposite semantic value of the perfective (see Jakobson, 1932:74).

passé simple is expressed by a set of fully regular and clearly identifiable suffixes with a constant aspectual meaning in all of their occurrences[21], and when applied to a base verb, they yield new forms of the same verb that minimally differ from the base in aspect marking and aspect semantics. Passé simple forms stand in a systematic opposition to imparfait forms, so that we get clearly identifiable aspectual pairs: e.g., *il mourait* 'he was dying' - *il mourut* 'he died'. Similarly, the English progressive construction is formally clearly identifiable, carries a constant aspectual meaning[22] and it stands in opposition to non-progressive forms: e.g., *John recovered - John was recovering.* Slavic aspectual systems, in contrast, cannot be described in such straightforward terms as English and French ones to which they are often directly compared (see Comrie, 1976; Binnick, 1991, for example), because perfective and imperfective verb forms are typically related to one another by derivational affixes and processes that are formally and semantically idiosyncratic. Moreover, there is no single perfective and imperfective morpheme or a class of such morphemes that would clearly mark *all* verb forms as perfective or imperfective, and have constant interpretations specifically assigned to perfective and imperfective aspect. Uncontroversial aspectual pairs are those that consist of an imperfective -va-verb and its perfective base, as in (37): While the simple imperfective verb pisát'$^I$ and the perfective prefixed verb vy-pisát'$^P$ differ from each other in aspect *and* lexical semantics, the only difference between vy-pisát'$^P$ and vy-písyvat'$^I$ is in aspect. Although suffixation with the imperfectivizing -va- has inflectional characteristics, it is not fully productive, because -va- cannot be attached to all perfective verbs. For example, in Russian there is no imperfective *napísy-va-t'$^I$ derived from the prefixed perfective napisát'$^P$ 'to write (up)'. Other clear aspectual pairs can be found among perfective and imperfective verbs that differ in a theme extension added to the stem, or in the placement of stress, as in urézat'$^P$ 'to cut off'- urezát'$^I$ 'to cut off', 'to be cutting off', for example.

Markers of grammatical aspect, inflectional and syntactic, have another important property that is not shared by Slavic verbal prefixes: namely, they disallow recursive application. For example, one overt expression of the imparfait or passé simple suffix in French precludes the application of another overt expression of the same suffix:

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[21]There are examples in which the contribution of the aspectual operators, passé simple and imparfait, amounts to zero or identity function, that is, they do not seem to contribute any information over and beyond the eventuality type of the predicate to which they are applied. For example, imparfait is the unmarked aspect for state predicates, as in *Jean était triste* 'John was sad'. However, even in such cases the semantic import of imparfait must be seen in opposition to passé simple and the reasons why the speaker chooses to apply the imparfait operator to the state eventuality description *être triste (Jean)*, rather than the passé simple operator. *Jean était triste* 'John was sad', in which the sadness state is predicated of John, is opposed to passé simple *Jean fut triste* 'John (suddenly) became sad', which describes the completed transition into the sadness state.

[22]On some accounts (see Bennett and Partee, 1972/78; Bach, 1986; Krifka, 1992, for example), the constant aspectual meaning of the progressive is taken to involve the notion of 'partitivity'. See section 6 here.

(41)  *il mour-ait-ait              *il mour-ut-ut
      *he die-imparfait-imparfait    *he die-passé.simple-passé.simple

Similarly, progressives of progressives in English are excluded, as Vlach (1981) and Bach (1981) observe, for example:

(42)  a.  John was running.            PAST[PROG[run(John)]]
      b. *John was being running.     *PAST[PROG[PROG[run(John)]]]

If prefixes were markers of perfective aspect, they ought to be applicable *only* to imperfective verbs, and applying prefixes to perfective verbs, simple or prefixed, ought to be in principle excluded, because it would amount to perfectivizing already perfective verbs.  In fact, these are common implicit or explicit assumptions found in various accounts of Slavic verbal aspect (e.g., Kipka, 1990; Piñón, 1994:493-4, for example).  However, they are clearly invalid, as Russian data like (43) and (44) show, where prefixes are applied to verbs that are already perfective, simple or prefixed.

(43)  <u>simple perfective</u>            →      <u>prefixed perfective</u>

      a. dat'$^P$                              **PO**-dát'$^P$
         give.INF                            PREF-give.INF
         'to give'                           'to offer', 'to give'

      b. razvljéč$^P$      bol'nógo            **PO**-razvljéč$^P$   bol'nógo        Isačenko, 1960:239
         distract.INF   sick.SG.ACC          **ATN**-distract    sick.SG.ACC
         'to entertain a sick person'        'to entertain a little a sick person'

(44)  <u>simple imperfective</u>      →      <u>prefixed perfective</u>      →      <u>prefixed perfective</u>

      a. stat'$^I$                           **V**-stat'$^P$                         **PRI-V**-stát'$^P$
         stand.INF                         **DIR**-stand.INF                      **ATN-DIR**-stand.INF
         'to stand'                        'to get up', 'to rise',                'to rise', 'to stand up'
         'to be standing'                  'to stand up'                          (for a moment)

      b. taščít'$^I$                         **NA**-taščít'$^P$                      **PO-NA**-taščít'$^P$
         drag.INF                          **ACM**-drag.INF                        **DISTR-ACM**-drag.INF
         'to drag, lug; to carry';         'to accumulate gradually               'to accumulate gradually
         'to be dragging, lugging;         (a large quantity of x) by             (a large quantity of x) by
         to be carrying'                   lugging or carrying x'                 lugging or carrying x and
                                                                                  do so one x after another'

(44a,b) shows that prefixes can be iterated in certain combinations, and be applied directly to a perfective stem.  Although I here draw on examples from Russian only, analogous examples can be found in other Slavic languages, as well.  Notice that perfective prefixed verbs like <u>pri-v-stát'$^P$</u> 'to rise', 'to stand up' in (44a) have no imperfective verb in their derivational history.  Hence, it

cannot be argued (see Piñón, 1994:493-4, for example, who draws on Polish data) that verb forms with two prefixes conform to the general rule that prefixes are only applicable to imperfective verbs, because the second prefix can only be applied to a complex imperfective verb derived with the suffix -va- from a prefixed perfective verb.  Combinations of two prefixes attached to a single perfective verb stem, as in (44a,b), and even three prefixes on a single perfective verb stem, as in the second column of (45), are easy to find in Slavic languages.

(45)  nosí-t'$^I$ $\longrightarrow$     **vy**-nosí-t'$^P$           $\longrightarrow$     **vy**-naší- **VA** -t'$^I$
      carry-INF              **DIR**-carry-INF                 **DIR**-carry-IPF-INF
      'to carry',            'to take out'                     'to take out', 'to be taking out'
      'to be carrying'                                         ('to bear', 'to be bearing a child')

                            $\downarrow$                      $\downarrow$

                            **na** - **vy** - nosí-t'$^P$     $\longrightarrow$     **na** - **vy** - náši- **VA** -t'$^I$
                            **ACM-DIR-**carry-INF             **ACM-DIR-**carry-IPF-INF
                            'to amass by taking out'          'to amass by taking out', 'to be amassing ... '
                            $\downarrow$                      $\downarrow$

                            **po** - **na** - **vy** - nosí-t'$^P$  $\longrightarrow$  **po** - **na** - **vy** - naší- **VA** -t'$^I$
                            **DISTR- ACM-DIR-**carry- INF     **DISTR- ACM-DIR-**carry-IPF-INF
                            'to take out a lot of x one       'to take out a lot of x one
                            (part/group) after another'       (part/group) after another'
                                                              'to be taking out ...'

To summarize, the assumption that verbal prefixes can be only applied to imperfective verbs is clearly invalid, because prefixes can be attached to perfective verbs, simple or prefixed. Given this observation, one may imagine different possible proposals to preserve the view that prefixes are nevertheless 'perfectivizers', or grammatical markers of perfective aspect.  It could be suggested that only prefixes that are applied to imperfective verbs introduce into the logical form the semantic function assigned for the interpretation of perfective aspect: For example, *Cul*, as in Parsons (1990), which is also adopted in Zucchi (1999).  The aspectual contribution of prefixes applied to verbs that are already perfective would be that of the identity function.  This would exclude complex predicates like *Cul(Cul(P))* in the logical representation of perfective verbs like po-dát'$^P$, for example, that consist of a perfective verb stem and the prefix po-.  However, such a proposal must be rejected, because one and the same prefix can be applied to imperfective and perfective verbs, and therefore its status as a marker of perfective aspect would depend on the aspect of the base verb to which it is applied.  For example, since the accumulative prefix na- in na-vy-nosí-t'$^P$ 'to amass (a quantity of x) by carrying out (x)' is applied to the perfective verb vy-nosí-t'$^P$ 'to carry out' (see (45) above), it does *not* change aspect, but only lexical semantic properties of the verb.  In this case the prefix na- has only a lexical-derivational function.  The same prefix na- with the same (derivational) meaning of accumulation occurs not only in na-vy-nosí-t'$^P$ but also in

the perfective verb <u>na-nestí</u><sup>P</sup> 'to bring (and accumulate) a quantity of x'. However, in <u>na-nestí</u><sup>P</sup> the prefix <u>na-</u> would have to be treated as a formal marker of perfective aspect, because it is applied to the imperfective verb <u>nestí</u><sup>I</sup> 'to carry', 'to be carrying' and derives a new perfective verb. But since the prefix <u>na-</u> also has a derivational function in <u>na-nestí</u><sup>P</sup>, we are faced with the undesirable result that one and the same morpheme simultaneously has a derivational and an inflectional function.

One could also propose that perfective aspect in Slavic languages can be realized not just by a single prefix, but also by a combination of two or more prefixes functioning as a single morphological unit expressing a single aspectual operator. What is problematic for this solution is providing empirical motivation for such combinations of prefixes. Are these actual single morphemes in any language? Can we find any language(s) that conflate(s) within a monomorphemic verbal affix 'distributivity + accumulation + direction + graduality', for example? Such a combination can be found in <u>po-na-vy-nosí-t'</u><sup>P</sup> 'to take out gradually a lot of x one (part/group) after another' (see also (46)). The lack of such monomorphemic affixes in Slavic, for example, would be merely an accidental lexical gap. However, if the relevant simple affixes could not be found in any language, this would be taken as evidence that they are cross-linguistically excluded. We would then have to explain why natural languages do not conflate within a simple affix 'distributivity + accumulation + direction + graduality', for example.

There is another reason against viewing combinations of prefixes on one verb as a single unit. Individual prefixes semantically function as independent units, even in highly conventionalized combinations, such as the distributive <u>po-</u> with the accumulative <u>na-</u> in <u>po-na-stróit'</u><sup>P</sup> <u>domóv</u> 'to build a (large) quantity of houses, one (group) after another' (see also Isačenko, 1960:249). Some prefixes may manifest scope effects and depending on the order in which they are attached to the stem, they may have different scope effects and provide a different contribution to the meaning of a whole sentence.

Another distributional property of prefixes that is problematic for the assumption that prefixes are overt markers of perfective aspect is their co-occurrence with the imperfectivizing suffix <u>-va-</u> within the same verb. This is illustrated by the Russian examples in (45) above, and also in (46) with the accumulative prefix <u>na-</u>:

(46)  **na-**boltá-t'<sup>P</sup>    glúpostej        →    **na-**bálty-**VA**-t'<sup>I</sup>    glúpostej
      **ACM**-talk-INF    nonsense.GEN.PL            **ACM**-talk-**IPF**-INF nonsense.GEN.PL
      'to say a lot of nonsense'                    'to say a lot of nonsense', 'to say repeatedly ...'

(45) and (46) show that the suffix <u>-va-</u> co-occurs with one or more prefixes on the same verb, whereby the suffix and the prefixes are semantically independent of one another and each contributes to a verb's semantics. If Slavic prefixes and the imperfectivizing suffix <u>-va-</u> both were

inflectional markers of aspect, as is most recently proposed by Zucchi (1999), for example, then their co-occurrence on a single verb should be excluded.  It would contradict the standard assumption that formal expressions of different members of a given grammatical category system are in a complementary distribution with one another, which specifically means that overt markers of different members of the same inflectional category do not co-occur on the same verb.  Just as we do not find present and past tense morphemes on the same verb, so we do not find imparfait and passé simple suffixes co-occurring on the same verb in French, for example.  This is shown in (47):

(47)   *il mour-ait-ut                        *il mour-ut-ait
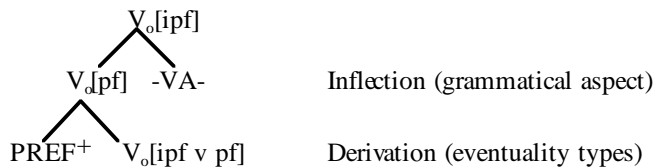         *he die-imparfait-passé.simple      *he die-passé.simple-imparfait

Given that the suffix -va- is an inflectional imperfective marker, as is generally accepted, it follows that prefixes cannot be inflectional markers.

Another argument against viewing Slavic verbal prefixes as aspectual markers of perfective aspect comes from their semantic interaction with the imperfectivizing suffix -va-.  Although prefixes contribute quantization to the meaning of a verb, the property of quantization does not exhaust the semantics of perfectivity.  The reason is that prefixes serve to form imperfective verb stems, including those marked with the imperfectivizing suffix -va- (see examples in (45-46)), and hence not only perfective verbs but also imperfective ones are semantically quantized.  Take, for example, the perfective verb dopisát'[P] 'to finish writing', which is formed with the terminative prefix do- from the imperfective verb pisát'[I] 'to write', 'to be writing'.  From dopisát'[P] 'to finish writing' we can build with the suffix -va- the imperfective verb form dopísyvat'[I] 'to finish writing', 'to be finishing writing'.  Since the terminative prefix do- has the same quantization function in both the perfective dopisát'[P] and the imperfective dopísyvat'[I], both are quantized.  Hence, quantization cannot be used to semantically distinguish perfective verbs from imperfective ones and quantization expressed by prefixes does not exhaust the semantics of perfectivity.  From this it also follows that prefixes cannot be overt markers of the semantic function assigned to perfective markers.  We need to distinguish between the semantic contribution of verbal prefixes to (perfective and imperfective) verbs, on the one hand, from the semantic contribution of perfective and imperfective verbs to a sentence's semantics, on the other hand.

To summarize, all the above data and observations indicate that prefixes exhibit behavior typical of derivational and not inflectional morphemes.  If verbal aspect in Slavic languages is a grammatical category, as is standardly assumed, and if this also implies that aspect is an inflectional category, then prefixes cannot be *aspectual* (perfective) morphemes, because such markers ought to have inflectional characteristics.  In short, claiming that prefixes are markers of perfective aspect would amount to claiming that we have derivational devices that are

simultaneously inflectional, "a contradiction in terms", as Spencer (1991:196) puts it. Therefore, a perfective prefixed verb in Slavic languages is best seen as a new verb that stands in a derivational relation to its base, rather than being an aspectually different form of one and the same lexeme (cf. also Dahl, 1985; Spencer, 1991). Assuming (with considerable simplification) that inflectional processes apply after all derivational ones, the inflectional imperfectivizing suffix -va- will be attached to the verb after all the derivational prefixes have been. The hierarchical structure of Slavic prefixed verbs can be schematically represented as in (48), where 'PREF$^+$' indicates the occurrence of one or more prefixes:

(48)   Schematic hierarchical structure of Slavic prefixed verbs

$V_o$[ipf]

$V_o$[pf]   -VA-          Inflection (grammatical aspect)

PREF$^+$   $V_o$[ipf v pf]     Derivation (eventuality types)

The (traditional) claim that prefixes are derivational morphemes is consistent with the proposal made in the previous section that verbal prefixes as a whole class can be semantically treated in a uniform way as contributing quantization to the meaning of a verb. In general, verbal prefixes are eventuality type modifiers: They map sets of eventualities of any type (states, processes or events) onto sets of events: PROCESS ∪ STATE ∪ EVENT → EVENT. In the simplest case, it is a lexical predicate with all its argument positions filled by variables or constants, that is, proper names or common nouns in the singular, that denotes a set of eventualities of a given type: events, processes or states[23]. Such basic predicates serve as inputs into various eventuality type modifiers that derive non-basic predicates and associated eventuality descriptions[24]. Among such modifiers are verbal prefixes, and adjuncts, for example. Viewing eventuality description modifiers as mapping sets of eventualities of a certain type onto sets of eventualities of some (possibly other) type allows for eventuality description modifiers to be applied recursively to one another, as in *John walked to campus in twenty minutes every day last year* (see also de Swart, 1998). We have also seen that verbal prefixes in Russian are iterated in certain combinations, whereby prefixed perfective verbs can combine with derivational prefixes to form new perfective verbs. The net semantic effect of verbal prefixes is to derive quantized verbs, or to constrain the denotation of verbs to sets of events.

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[23]Lexical predicates that take Incremental (Path) Theme argument are undetermined with respect to the process or event type. The reason is that the quantization status of such predicates is determined by the quantization status of the noun phrase that satisfies their Incremental (Path) Theme requirement.

To the extent that we can draw a line between derivational and inflectional processes in Slavic languages, we can also draw a line between the expression of eventuality types and grammatical aspect on the level of verbal morphology. If eventuality types and grammatical aspect are two systems that are orthogonal to each other, as it is assumed here, there is nothing contradictory or inconsistent about derivational prefixes being iterated in certain combinations and co-occurring with the inflectional (imperfectivizing) suffix -va- on the same verb. Slavic imperfective verbs containing a prefix and the imperfective -va-, such as those in (45) and (46), are comparable to the English combination of phrasal predicates like *mop up* with the progressive aspect, as in (49):

(49)   He was mopping up the floor.

In addition to their occurrence with explicit markers of grammatical aspect (progressive and imperfective, respectively), English verbal particles and Slavic verbal prefixes both contribute the meaning component of quantization to the meaning of a complex lexical predicate. For example, we can show that the particle *up* enforces the quantized (or telic) reading of a predicate by its behavior with respect to durative and time-span adverbials, as in (50b):

(50)   a. He mopped the floor        for ten minutes  / ?in ten minutes.        atelic/cumulative[25]
       b. He mopped up the floor   *for ten minutes /  in ten minutes.        telic/quantized

If quantization does not exhaust the semantics of perfectivity, as is claimed here, then how is the whole class of perfective verbs semantically distinguished from the class of imperfective verbs? I will turn to the semantics of perfectivity and imperfectivity in the next section.

## 6  The semantics of perfective and imperfective aspect

Eventuality descriptions are neutral with respect to perfective and imperfective aspect. Perfective and imperfective aspectual operators are interpreted in terms of conditions that operate on eventuality descriptions. The perfective operator restricts the denotation of eventuality descriptions to total (or complete) events. This is expressed by the totality condition *TOT* in the semantic representation of perfective verbs:

(51)   $\lambda P \lambda e[P(e) \wedge TOT(P)]$

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[24]See L. Carlson (1981) and de Swart (1998) for a similar distinction into basic and non-basic eventuality descriptions, in their terminology 'atomic' and 'non-atomic'.

[25]*He mopped the floor* preferably seems to have an atelic or a cumulative reading, although a telic or a quantized one is certainly possible in a suitable context.

*TOT* combines with predicates of type *P* denoting (sets of) processes, events or states and yields predicates of total (or complete) events *TOT(P)*. For example, *TOT* can be applied to the abstract process predicate *SLEEP(x,e)* and the resultant complex predicate *TOT(SLEEP(x,e))* will be a part of the semantic representation of a perfective verb, which will have only total or complete sleeping events in its denotation.

The imperfective operator contributes the partitivity condition *PART* to the semantic representation of imperfective verbs, as in (52a). Following some suggestions in Krifka (1992:47), as well as in Bennett and Partee (1972/78) and Bach (1986), *PART* is defined in terms of the mereological part-of relation '$\leq_P$', as in (52b):

(52)  a. $\lambda P \lambda e \ [P(e) \wedge PART(P)]$
      b. $PART = \lambda P \lambda e' \exists e[P(e) \wedge e' \leq_P e]$

In general, the imperfective operator combines with predicates of states, processes or events and yields the corresponding predicates of *partial* states, processes or events. Just as the perfective operator so the imperfective operator applies to states, processes and events alike. However, only the imperfective operator is 'transparent' with respect to the eventuality type of its input in the sense that an imperfective sentence inherits its eventuality type from the eventuality description the imperfective operator *PART* applies to. When applied to the *process* predicate *SLEEP(x,y,e)*, *PART* yields a complex imperfective predicate that has *partial processes* of sleeping in its denotation.

The semantics of perfectivity, but not the semantics of imperfectivity, is directly related to the property of quantization. If a given state of affairs is represented by a verbal predicate in its totality, there must be some limits imposed on its (temporal or spatial) extent, and consequently, it must be quantized. For example, in the verb <u>dopisát'</u>[P] 'to finish writing', the terminative prefix <u>do-</u> contributes the quantization component, namely the information about the final boundary of the writing event. Due to the perfective aspect, the verb entails that the final boundary was reached, that is, the perfective verb has only total events in this sense in its denotation. In contrast, the corresponding imperfective verb <u>dopísyvat'</u>[I] 'to finish writing', 'to be finishing writing' fails to have the completive or totality entailment, although it semantically overlaps with the perfective verb in so far as it contains the same information about the inherent delimitation in its logical representation that is contributed by the prefix <u>do-</u>.

There is typically no straightforward mapping between elements of the logical formulas in (51) and (52) and elements of surface morphology of Slavic verbs. With the exception of the regular association between <u>-va-</u> and the imperfective operator *PART*, the operators *TOT* and *PART* proposed here for the interpretation of perfective and imperfective verbs, respectively, cannot be consistently associated with a clearly identifiable set of special purpose aspectual morphemes. As has been observed above, the only verbal morpheme that is solely dedicated to the expression of

aspect is the imperfectivizing suffix -va-. It clearly marks verbs as imperfective, it can only be attached to perfective verbs, and overtly marks the semantic transition from the interpretation of a perfective verb to the interpretation of an imperfective verb. (Notice that the presence of a suffix -va- marks a given verb as imperfective, regardless of whether it contains any prefixes and how many prefixes it may contain, but the presence of a prefix (or prefixes) does not mark a given verb as being necessarily perfective.) Moreover, the majority of Slavic verb forms, finite and many non-finite (i.e., imperative, infinitive and certain participial forms), are either perfective or imperfective[26]. In contrast to English, in Slavic languages there are no surface uninflected verb forms that are neutral with respect to aspect, such as *write a letter*[27], and that would be semantically associated with eventuality descriptions pure and simple.

It is important to mention that the semantic contribution of the Slavic imperfective operator, and the English progressive operator to a sentence's semantics cannot be treated in the same way, contrary to frequent proposals. For example, Zucchi (1999) proposes that the imperfectivizing suffix -va- can be taken as instantiating the function posited by Landman (1992) for the interpretation of the progressive aspect: namely, it takes as input a predicate of complete events, expressed by a perfective verb in Slavic languages, and yields a predicate of complete/incomplete events. The reason for not treating the progressive and imperfective operators as being semantically equivalent is that the domain of application of the progressive operator is more restricted than that of the imperfective operator. First, the progressive operator requires that predicates in its scope be episodic, i.e., denote some 'temporary' or 'contingent' property[28], while

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[26]Exceptions are so-called 'bi-aspectual' verbs. These are verbs that have just one form for the use as perfectives and imperfectives, an example from Russian is kaznít' 'to execute'. There are also imperfective verbs without perfective counterparts: múdstrovat' 'to philosophize'; privétstvovat' 'to greet' (simple imperfective borrowings from Church Slavonic); obožát' 'to adore'; protivoréčit' 'to contradict' (Church Slavonic imperfectives with prefixes).

[27]Parsons (1990) proposes that uninflected predicates in English like *write a letter* have both complete and incomplete writing events in its denotation. That is, they are neutral with respect to grammatical aspect, and serve as inputs into the perfective operator CUL and the progressive operator HOLD. In contrast to Parsons (1990), Landman (1992) proposes that uninflected predicates in English like *write a letter* have in their denotation complete events of writing of a letter, that is, their semantics is that of perfective predicates.

[28]See Comrie (1976), Carlson (1977), Bach (1981), Timberlake (1982), Smith (1986, 1991/97), for example. The progressive can be applied to state predicates, provided they can be construed as having an episodic sense (Bach's, 1981, "temporary" or "dynamic states"): cp. *John is knowing all the answers to test questions more and more often* (Binnick, 1991:173), *I am understanding more about quantum mechanics as each day goes by* (Comrie, 1976:36). Here, "the reference is not to an unchanging state of comprehension, the degree of comprehension being the same from one time-point to another, but rather of a change in the degree of understanding: on any given day, I understood more about quantum mechanics than on any previous day. Thus the verb *understand* here refers not to a state, but to a developing process, whose individual phases are essentially different from one another" (Comrie, 1976:36-7). *John is being a hero (by standing still and refusing to budge)* (Dowty, 1979:185) can be interpreted as expressing a temporary eventuality 'be acting / behaving in an heroic way' (see Dowty, 1979:185) that counts as a temporary manifestation of the disposition expressed by the basic non-progressive predicate BE A HERO. Most, if not all, state predicates can be construed episodically. The only exceptions seem to be certain constructions with the verb *be*: *Mary is being drunk*, *Mary is being asleep*, and *be* when it combines with a locative prepositional phrase, as in *Mary is being in New York* (see Bach, 1981:77).

the imperfective operator is not sensitive to the episodic-stative distinction. The imperfective operator can be freely applied to episodic and state predicates, including individual-level state predicates. In fact, individual-level state predicates are only imperfective, never perfective. Modal verbs and other verbs for which the perfective-imperfective opposition is neutralized (so-called 'imperfectiva tantum') are also imperfective.

Second, although Slavic imperfective verbs are used in contexts in which English progressives are required, as in the context of temporal adverbials like 'right now', for example, where they denote eventualities in progress, this similarity is often overemphasized at the expense of other contextually determined meanings that imperfectives, but not progressives, can have. Imperfectives, but not progressives, can be used in contexts and with functions typically conveyed by perfective verb forms: most prominently, to denote completed events, as is shown in (53):

(53)   Vy užé obédali$^I$ ?
       'Did you have lunch already?'

In such contexts imperfectives and their perfective counterparts (here <u>poobédali$^P$</u>) are typically interchangeable without changing the truth-conditions of a sentence. Since imperfective verbs can be used to denote total (or complete) events, that is, with the same function as perfective verbs, in traditional and structuralist Slavistics they are considered to be the unmarked member in the aspectual opposition. In order to accommodate the variety of contextually determined uses of imperfectives, including their completive use, the partitivity involved in the imperfective operator is here characterized in terms of the (weak ordering) part relation '$\leq_P$' (see (52)). The part relation allows any eventuality to be a part of itself, which is compatible with the completive reading of imperfectives. By contrast, the progressive operator can be viewed as the marked member in the English aspectual opposition, given that a progressive sentence like *Max was crossing the street* can never be used to assert that the whole event of crossing of the street took place, that is, with the meaning associated with the corresponding non-progressive sentence *Max crossed the street.* In asserting *Max was crossing the street*, the speaker excludes the final part of the denoted event, namely, that subpart that has Max on the other side of the street. If the progressive operator is used to map (sets of) eventualities into their *proper parts*, then the part relation involved in the semantics of the English progressive operator may be best understood in terms of the proper part relation '$<_P$' (a strict ordering relation). A closely related point concerns the necessity for an intensional analysis. In Landman (1992), the progressive operator is treated as an intensional operator[29]. However, given that Slavic imperfectives can be used to denote complete events, there

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[29]The idea that the progressive operator is to be treated within an intensional framework, namely as a "mixed modal-temporal" operator, was introduced into contemporary linguistics by Dowty (1972, 1977, 1979). Dowty

is less motivation than in the case of the English progressive operator to treat the imperfective as an intensional operator. Both the Slavic imperfective and English progressive operator may be best treated as extensional operators (see Parsons' (1990) proposal for the English progressive, for example), but an explicit argument for this position is beyond the scope of this paper.

Third, progressives and imperfectives differ with respect to habitual and generic statements. Progressives are only marginally used for habitual and generic statements (see Smith, 1991/97, for example), while imperfectivity and genericity manifest a number of formal and semantic affinities (see Filip and Carlson, 1997). Slavic languages either always or almost always allow for the expression of genericity by imperfective forms alone. Specifically generic morphemes attach to imperfective bases. Generics are aspectually stative (cf. Carlson and Pelletier, 1995) and the aspectual character of imperfectives seems to be semantically compatible with stativity. There is a historical connection between imperfectivity and genericity. The imperfectivizing suffix -va-, used in the formation of some imperfective verbs, developed from the marker of iterativity, frequency, or genericity, and it is synchronically homonymous with the marker for genericity -va-.

## 7 Concluding Remarks

The analysis of the verbal prefixes na- and po- as expressing extensive measure functions, and hence yielding quantized verbs, is compatible with the view that perfective verbs as a whole class are semantically quantized. Nevertheless, the essentially derivational nature of verbal prefixes and the observation that their semantic contribution cannot subsume the semantics of perfectivity precludes the treatment of prefixes as markers of perfective aspect. By measuring various aspects of events denoted by verbs, prefixes play an important role in the structuring of events. At the same time, due to their measurement and quantificational content, verbal prefixes belong to a subclass of A-quantifiers and pose a number of difficult questions for the theory of quantification in general. In this paper I have addressed only a very limited range of measurement functions of the accumulative prefix na- and the attenuative po- in Russian. Among the many issues that the present analysis opens up, let me here mention five.

First, it has been proposed that the domain of measurement and quantification of verbal prefixes is restricted by the thematic argument structure of verbs to which prefixes are attached, as stated in (29). For example, if the argument structure of a verb to which na- is attached contains an Incremental Theme argument, na- will be exclusively linked to it, as in examples in (27). However, other prefixes show different preferences. For example, the distributive prefix po- in Czech simultaneously quantifies over the parts of an andividual and the parts of an event (see Filip

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provides an extensive argument for this position. An intensional analysis of the progressive is also advocated in

and Carlson, 2000). For various distributivity operators in general, this is suggested by Lasersohn (1998). This poses the following question: Which prefixes select only the individual argument, which only the event argument, and which simultaneously both the event and individual arguments for their semantic effects?

There are also many cases in which the situation is not as clear cut. For example, a sentence like (9b/26) can be interpreted as meaning that Ivan covered a long Path on each of the numerous occasions on which he took a walk in the park. How would we represent meanings like 'to cover a long Path on numerous occasions', for example? The possibility of na- simultaneously functioning as a measure over the domain of Path entities *and* pluralities of events is not captured in the proposed logical forms (23) and (28) in section 4. And what exactly is measured in events expressed by naplákat'sja[P] 'to cry a lot'? Is it the temporal trace associated with the denoted event and/or the amount of tears, for example? How do we determine the measurement domain(s) of a given prefix? In some cases it may not be possible or even relevant to determine which entity or entities exactly are measured. English vague quantifiers like *a lot, a little, more, most* and *much*, for example, seem to exhibit a similar behavior, as Partee (p.c.) observes. What needs to be explored is whether they can stay indeterminate with respect to their domains of quantification, and how we can determine their domains of quantification in particular contexts.

Second, given that we can find combinations of two or more prefixes on a single verb the following questions arise: What are the admissible combinations of prefixes on one and the same verb? What are the scopal properties of measurement and quantificational prefixes in such combinations and in isolation? What are the admissible combinations of quantificational and measurement prefixes on the same verb?

Third, it has been observed above (see examples (21), (33)) that vague measure prefixes are compatible with vague adverbial and determiner quantifiers with which they semantically overlap. What are the similarities and differences between vague measure prefixes like na- and po- and comparable vague adverbial quantifiers like němnógo, němnóžko, málo 'a little', mnógo 'a lot', dólgo '(for a) long (time)', for example?

Fourth, lexical A-quantifiers are distinguished by their selectivity with respect to the kinds of quantificational and measurement meanings they encode, how they conflate various measurement and quantificational meanings, and how they combine measurement and quantificational meanings with non-quantificational ones. Among the non-quantificational meaning components, spatial and temporal ones are especially prominent. For example, the accumulative prefix na- in Russian typically involves the temporal component of 'gradual accumulation of a (large) quantity of x', 'gradual covering of a (long) Path', and the like. What are the constraints on

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Portner (1998).

the conflation of the quantificational, measurement and non-quantificational meanings within one monomorphemic lexical A-quantifier?

Fifth, different types of quantificational and measurement meanings can be differentiated according to whether they are encoded in affixes or verbal roots/stems. Slavic verbal prefixes typically encode meanings that are associated with quantification by means of adverbials in English, for example. Verbal roots and stems encode meanings that are associated with D-quantification, specifically by determiner quantifiers that are insensitive to the count-mass distinction[30]: e.g., *all (the), the, part of*, *some, not all*. Verbal roots and stems inherently encode meanings that characterize the categories of grammatical aspect: namely, meanings like 'totality' associated with perfective aspect, and 'partitivity' with imperfective aspect. Assuming a homomorphism between the lattice structure associated with the Incremental Theme argument and the lattice structure associated with the event, this has an effect on the interpretation of Incremental Theme arguments of perfective verbs comparable to that of determiner quantifiers like *all* or some totality expression like *a/the whole (portion) of*, while Incremental Theme arguments of imperfective verbs are interpreted as involving some notion of partitivity comparable to *part of*, *some,* for example (see Filip, 1993/99). Naturally, the question then arises: What are the generalizations on the distribution of quantificational and measurement meanings in affixes and in verbal roots/stems in a given language and cross-linguistically?


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[30]This distribution of quantificational and measurement meanings into verbal roots/stems, on the one hand, and prefixes, on the other hand, in Slavic languages seems to be compatible with Bach's (1995:19) observation for Haisla: "Affixes can encode meanings of the sort associated with adverbial quantification in English and similar languages. Meanings associated with determiners or generalized quantifiers are restricted to roots and stems".

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# Appendix

(1)   Definition of a part structure $P$ (Krifka, 1998:199):

$P = \langle U_P, \oplus_P, \leq_P, <_P, \otimes_P \rangle$ is a part structure, iff

a.   '$U_P$' is a set of entities, individuals, eventualities and times: $I_P \cup E_P \cup T_P \subset U_P$

b.   '$\oplus_P$' is a binary **sum operation**, it is a function from $U_P \times U_P$ to $U_P$.
   (It is idempotent, commutative, associative.)

c.   '$\leq_P$' is the **part relation**: $\forall x,y \in U_P [x \leq_P y \leftrightarrow x \oplus_P y = y]$

d.   '$<_P$' is the **proper part relation**: $\forall x,y \in U_P [x <_P y \leftrightarrow x \leq_P y \wedge x \neq y]$

e.   '$\otimes_P$' is the **overlap relation**: $\forall x,y,z \in U_P [x \otimes_P y \leftrightarrow \exists z \in U_P [z \leq_P x \wedge z \leq_P y]]$

f.   **remainder principle**: $\forall x,y,z \in U_P [x <_P y \rightarrow \exists! z [\neg [z \otimes_P x] \wedge z \oplus_P x = y ]]$

(2)   

| simple imperfective V | prefixed perfective V | |
|---|---|---|
| | attenuative po- | accumulative na- |
| rabótat'[I] 'to work' 'to be working' | po-rabótat'[P] 'to do a little / some work' | na-rabótat'sja[P] 'to have worked enough', 'to have tired oneself with work' |
| plákat'[I] 'to cry' 'to be crying' | po-plákat'[P] 'to cry a little, for a while', 'to shed a few tears' | na-plákat'sja[P] 'to cry a lot', 'to have a good cry' |
| sidét'[I] 'to sit' 'to be sitting' | po-sidét'[P] 'to sit for a while' | na-sidét'sja[P] 'to sit long enough' |
| kričát'[I] 'to yell', 'to scream' 'to be yelling' 'to be screaming | po-kričát'[P] 'to cry out a few times' | na-kričát'sja[P] 'to scream a lot', 'to have tired oneself with screaming' |

(3)   Examples:  Tests for distinguishing perfective verb forms from imperfective

| **present tense forms** | **future tense forms** |
|---|---|
| **IPF** Zakryváet[I]    dver'. close. 3SG.PRES door.SG.ACC (i)   'He is closing a/the door.' (ii)   'He closes a/the door.' | Búdet    zakryvát'[I]  dver'. will.3SG    close    door.SG.ACC (i)   'He will close a/the door.' (ii)   'He will be closing a/the door.' |
| **PF    Zakróet**[P]    dver'. close. 3SG.**PRES** door.SG.ACC 'He **will close** a/the door.' | *__Búdet__    **zakrýt**[P]    dver'. *will.3SG    close.INF door.SG.ACC |

| present tense forms | future tense forms |
|---|---|

**IPF** Ivan guljáet[I] .     Ivan búdet gulját'[I].
Ivan walk.3SG.PRES     Ivan will.3SG walk
'Ivan walks.' / 'Ivan is walking.'     'Ivan will walk.' / 'Ivan will be walking.'

**PF** Ivan **NA-guljáetsja**[P] po górodu.     Ivan **budet** \***NA-gulját'sja**[P] po górodu.
Ivan **ACM** -walk. 3SG.PRES.REFL around town     Ivan will.AUX \***ACM**-walk.INF.REFL around town
'Ivan **will walk** a lot all around the town.'

## Phasal verbs

    a. Načnet[P] / načináet[I] zakryvát'[I] dver'.
       start. 3SG / start.3SG close.INF door.SG.ACC
       'He will start closing a/the door.' ('He starts / is starting closing a/the door.')

    b. Načnet[P] / načináet[I] \***zakrýt'**[P] dver'.
       start.3SG / start.3SG \*close.INF door.SG.ACC
       'He will start closing a/the door.' ('He starts / is starting closing a/the door.')

    c. Načnet[P] / načináet[I] gulját'[I].
       start.3SG / start.3SG walk.INF
       'He will start walking.' / 'He starts or is starting walking.'

    d. Načnet[P] / načináet[I] \***NA-gulját'sja**[P].
       start.3SG / start.3SG \***ACM**-walk.INF.REFL
       'He will start walking a lot.' / 'He starts or is starting walking a lot.'

## Present time reference in the present tense ('right now' test)

    a. Ivan <u>tepér'</u> zakryváet[I] / \***zakrýt'**[P] dver'.
       Ivan <u>now</u> close.INF / \*close.INF door.SG.ACC
       'Ivan is right now closing the door.'

    b. Ivan <u>tepér'</u> guljáet[I] / \***NA-gulját'sja**[P].
       Ivan <u>now</u> walk.3SG.**PRES** / \***ACM**-walk.3SG.**PRES**.REFL
       'Ivan is right now taking a walk.'

(4)     Definition of the 'Gradual Patient' thematic role (Krifka, 1986, 1989, 1992):
       $\forall P[GRAD(P) \leftrightarrow UNI\text{-}O(P) \wedge MAP\text{-}O(P) \wedge MAP\text{-}E(P)]$

    a. Mapping to objects
       $\forall R[MAP\text{-}O(R) \leftrightarrow \forall e,e', x\ [R(e,x) \wedge e' \leq e \rightarrow \exists x'[x' \leq x \wedge R(e',x')]]]$
       [Example: *drink a glass of winee;* every part of a drinking of a glass of wine
          corresponds to a proper portion of the glass of wine]

    b. Mapping to events
       $\forall R[MAP\text{-}E(R) \leftrightarrow \forall e,x,x'[R(e,x) \wedge x' \leq x \rightarrow \exists e'[e' \leq e \wedge R(e',x')]]]$

[Example: *drink a glass of wine*; every proper portion of the glass of wine that is drunk corresponds to a part of the drinking]

c. Uniqueness of objects
$\forall R[\text{UNI-O}(R) \leftrightarrow \forall e,x,x'[R(e,x) \wedge R(e,x') \rightarrow x=x']]$
[Example: *drink a glass of wine*; it is not possible for one event to have two different object tokens, x=x', subjected to it]

Krifka (1998) argues that we need stricter relations than mapping to events and mapping to objects, namely mapping to subevents and mapping to subobjects. The latter are defined as follows (Krifka, 1998:211-212):

a'. Mapping to subobjects
$\forall x \in U_P \ \forall e, e' \in U_E \ [\theta(x,e) \wedge e' <_E e \rightarrow \exists y[y <_P x \wedge \theta(y,e')]]$

b'. Mapping to subevents
$\forall x,y \in U_P \ \forall e \in U_E \ [\theta(x,e) \wedge y <_P x \rightarrow \exists e'[e' <_E e \wedge \theta(y,e')]]$

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