# SLAVIC LEXICAL ASPECTS IN THE LIGHT OF MODERN LINGUISTIC THEORIES

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***Abstract***

*Comprehensive descriptions of lexical aspects, further on LAs (aka. Aktionsarten due to the work of Agrell in the beginning of the 20th century) appeared in the 1970s and 1980s and were developed by numerous theoretical linguists: Shelyakin, Avilova, Khrakovsky, Pikhlak, to name just a few.*
*Those descriptions are based on hand-collected material, and verbs with similar meanings were grouped according to the linguistic intuition of the authors. Taking into account recent developments of both language theories and computer technologies whose application allows conducting effective bootstrapping of those theories, we would like to shortly consider in this article several issues related to lexical aspects, namely:*
*1. How can the differentiation into Individual level and Stage level predicates proposed by Davidson and developed by Carlson reflect on the classification of lexical aspects?*
*2. How can their meanings be presented in a concise and consistent way with the help of some meaning representation language and contribute this way to a semantic dictionary of a natural language? How far can we go in applying the Petri nets' theory for the representation of different lexical aspects? (Is it only reduced to the phase-modifying group?)*
*3. How can such meaning components be extracted automatically?*
*We also propose a formalized meaning representation of some lexical aspects with the help of the basic predicate set proposed by Wojtasiewicz in 1975 and consider ways of expanding the power of the formalism to cover more lexical aspects present in Slavic languages.*

***Keywords***

*Lexical aspects (LAs), Aktionsarten, Slavic languages, Petri nets, basic predicates.*

## 1. LAS IN THE LINGUISTIC LITERATURE

There have been numerous discussions in the literature regarding the criteria for singling out Slavic lexical aspects [Khrakovsky, 1980]. On the one hand, since those categories are richly represented by morphological means, they are considered to be formal; on the other hand, they make up clearly distinct semantic groups. There is still no agreement among researchers regarding either the quantity of LAs in different Slavic languages or the criteria to differentiate between them.

Among the most comprehensive descriptions we can mention N. Avilova's [1976] and M. Shelyakin's [1972]. Avilova describes three basic groups of LA types (further divided into a total of 19 verb classes) with a semantic criterion as a starting point: temporal, quantitative and special-resultative ones. Shelyakin's description[1] also embraces three major groups (further divided into a total of 38 classes) and is based on grammatical aspectual characteristics of verbs contained in the groups: monoaspectual perfectives, monoaspectual imperfectives and biaspectuals. The lexical material in those two descriptions overlaps; moreover, each of them includes LAs not mentioned in the other work, which does not allow considering either of them complete. Even though the initial criteria are so different, the three groups in both

[1] According to Pikhlak [1980, 71–73].

classifications are very similar in content. In addition, further division in Shelyakin is based on semantic criteria, while Avilova also pays considerable attention to the formal derivational characteristics of LAs.

The mixture of classification criteria leads to differentiation of LA classes which is not always consistent. For example, Shelyakin's 2nd group includes a hypernormative-durative (*gipernormativno-dlitelnyi*) LA with *perespat'* "sleep too long" as an example, while his 3rd group includes an excessive-dimensional (*ekstsesivno-razmernyi*) LA with *pereperchit'* "put too much pepper" as an example. The two LAs have the same meaning of excessiveness, use the same formal means (prefix *pere-*) for derivation, and differ only with respect to formal transitivity. Other similar cases are numerous in this approach. Also, there is a problem as to where verbs like *otletat', otvoyevyvat'* should belong. They are imperfective, therefore they cannot belong to the 1st group; they are intransitive, therefore they cannot belong to the 3rd group; whereas according to their meaning, which corresponds to stopping doing something, they could belong to either of the two groups. Similarly, Avilova makes a somewhat artificial differentiation between a finitive (*finitivnyj*), e.g. *otgovorit'* "stop speaking" and completive (*zavershitelnyj*), e.g. *dogovorit'* "finish speaking" LAs, refering the former to the 1st group and the latter to the 3rd on the basis of the transitivity criterion, even though both describe phases of activities and the 1st group is announced as "temporal".

The above observations make us think about possibilities of a different configuration of criteria for LA classification. We will present below two formalisms that will be used later for meaning representation, some theoretical assumptions that could be helpful for differentiating LA relevant categories, discuss ontological restrictions and their correlation with LAs' formation, and finally, propose formal representations of selected LAs' meanings.

# 2. POSSIBLE FORMALISMS FOR LAS' REPRESENTATION

We will try further to present meanings of LAs, using in parallel two systems of notation: one, proposed by O. Wojtasiewicz [1975], is based on predicate calculus with a built-in set of basic predicates, the other one is a representation with the help of Petri [1962] nets.

## 2.1 Wojtasiewicz's basic predicates

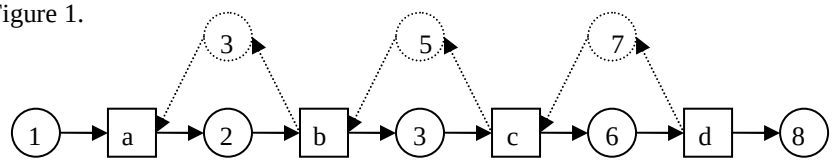
Wojtasiewicz suggests using twelve basic predicates which can serve as semantic primitives and whose combinations can represent meanings of natural language verbs. We will see later that one can do with just a few of them when trying to describe meanings of some LAs:
$P_0(x)$ and $P_i(x)$ describe states, where $P_0$ is a standard state (as seen by the speaker and preferably accepted as standard by the majority of the users of the language);
Trans(x,y) expresses the idea of change of state x into state y; by default x precedes y in time;
Ag(x,y) expresses the idea of agentivity (x does something and y is the result);
V(x,y,z) will be used for the estimation of a situation, where x is the evaluator, y is the situation of evaluation, z is the result (name) of the evaluation.
For the sake of the simplicity of the representation we will not specify here semantic types of activities (physical, social, etc.) as Wojtasiewicz himself does, and will use P for any basic state, but it might be worthwhile differentiating between them in the future.

## 2.2 Petri nets

The "alphabet" of Petri nets is even simpler as it consists of only three elements: states that last in time (represented by circles), timeless events that roughly correspond to moments (represented by squares) and arrows that connect them; the direction of arrows shows the temporal sequence of states and events. Temporal and modal situations are represented as combinations of states, events and arrows and sometimes grow into rather complex structures. The states and/or events that are in the focus of attention (e.g. state of speech) are highlighted.

The general frame for any event can be visualized with the help of Petri nets as is shown in figure 1, (cf. also the simple and composite models representing *growth* in [Koseska-Toszewa et al., 1996, 41–43], figures 11 through 14).

Figure 1.




Here it is represented as a process with the initial state (1), which has a beginning (a), development (2), reaches (b) a culmination state (3), then goes through a decline (6), dies out (d) and brings about a detectable resulting state (8) to either an agent or patient, sometimes seen as different from the original, sometimes perceived as similar to it. States (3, 5, 7) shown by dotted circles represent activities with higher degree of granulation, seen as iterations.

# 3. SOME THEORETICAL ASSUMPTIONS

## 3.1 Compositionality

We agree with Khrakovsky's approach [1980, 3–24], which is to define LAs as abstract meanings that can modify primary meanings of verbs, whereby those secondary meanings have to make up the basis for the universal typological classification of LAs. If we follow this assumption, we can consider verbs that are marked with respect to LAs as polypredicative, where the meaning of an LA corresponds to a "semi-notional" or a higher-order predicate (so-called phase or modal complicators, cf. [Zolotova 1998], quantifiers in the common sense of the word, etc.) with the meaning of the main verb as one of its arguments. Semi-notional components can modify the basic predicate or one of its aspects (arguments, consequent states, phases). The combinatorial capacities of complicators are restricted by the meaning of the original verb, as can be seen if the structure of the basis is represented in a formalized way. This allows us to record meanings of LAs and make them part of meaning representation in different types of dictionaries on an automatic basis. Such a treatment of LA-marked verbs may also allow reducing the quantity of LA types that in fact describe semantic qualities of derivational bases rather than of derivatives. For example, reciprocality in verbs with social interaction semantics: Rus. *pererugivat'sia* is treated as "distributive mutual" (*distributivno-vzaimnyi*) by Shelyakin and as "continuous distributive mutual" (*dlitelno-distributivno-vzaimnyi*) by Avilova. Information about mutuality is encoded in the meaning of the Rus. verb *rugat'sia* "quarrel" (at least one of its meanings which presupposes more than one participant). The mentioned LA can only be formed from that meaning, which means that declaring the mutuality part of the LA's meaning is redundant.

## 3.2 Quantization

Developing the idea expressed in [Derzhanski 1995] about the **quantity**-related nature of the perfective aspect in Slavic languages, we can say that ways of expressing the "quantity of an event" also constitute one of the basic semantic criteria for differentiating LAs. Quantity can be expressed as the objective **duration** of an activity (it is normally measured against other anthropologically significant/relevant activities, preferably such whose duration can be with some approximation treated as standard, like the duration of the perception or the human life). According to this criterion a semelfactive is opposed to an "unquantified" activity of the kind or its iterative correlate. Another relatively **objective** way to "measure" an activity is its **result** or, in more general terms, the consequence of the activity, a record of the change of state of the affected object. The **estimation** of this result by the speaker is a **subjective** way of measurement.

Phases of activities can be singled out as well, as is usually done. Treating them as aspects of the quantity of an activity or as combinations of quantity and the expected result of this activity is compatible with the understanding of LAs declared above as quantity specification of events and allows a relatively uniform treatment of LAs without opposing those LAs to the rest of the LA system. This should lead to further reduction of basic types.

## 3.3 Standard duration issues and units of measurement

In his work on a universal typology of LAs, Khrakovsky [1980, 11] argues against considering the primary meanings of verbs while describing Aktionsarten, saying that this unavoidingly leads to inconsistency. At the same time, he mentions the necessity of deeper studies of the combinability of certain lexical semantic classes of verbs with LA meanings and, further, the combinability of LAs among themselves.

Khrakovsky [1980, 14] proposes the idea of "quanta" to refer to the standard duration of actions denoted by verbs which are the basis for LA derivation. This helps him to roughly differentiate between moments and states (*Sergey prygnul s kryshi* "Sergey jumped from the roof" and *Nikolay pisal pis'mo* "Nikolay was writing a letter"). We can observe a parallel between those quanta on one side and events and states in Petri nets on the other, with the significant difference that according to Khrakovsky the quality of the standard duration is encoded into the basic lexical meaning of a verb, while according to the Petri nets' perspective, whether an activity is seen as an event, a state or their combination is a matter of predication and discourse. Even though we are inclined to reject the idea of quanta as an absolute measurement criterion, temporal qualities like standard duration (to be more cautious we can say it is represented within some period compatible with the listener's expectancy) seem to matter as far as the combinatorial preferences of LAs are concerned. However, we will treat them not as absolute qualities but as qualities that are comparable in their duration to some standard units.

Let us consider for instance the temporal qualities of Russian verbs like *uznat', vyt', vizzhat', spat', jest', zhyt'* "learn (find out), howl, scream, sleep, eat, live". The realizations of the actions denoted by those verbs are limited in duration due to ontological reasons. A popular grouping of predicates based on relative duration was proposed by Davidson [cf. Carlson 1977] and includes Individual level (also "lifetime", [Musan 1997]) and Stage level predicates. The two categories demonstrate different grammatical behaviour, although the border between them is sometimes blurred. In the case of mental verbs like "learn" we can talk about a minimal perception unit (popularly referred to as a "moment"). The duration of "screaming" and "howling" is restricted by the physiological characteristics of breathing and ability of holding one's breath. Due to those physical characteristics such predicates are more tightly correlated with speech verbs and the phenomenon of speech itself as a significant grammatical concept. The duration of sleeping is normally related to the night period and can be measured in hours. Although the duration of sleep oscillates in time depending on both species and concrete individuals—representatives of a species, it still has some reasonable (i.e., predictable) limits.

A superficial examination of lexical material compatible with different LAs from the point of view of absolute standard duration allows differentiating among predicates those perception-related, speech-related and lifetime-related. All of them, as well as the rest, can and normally are measured by solar system-related units but due to the relative stability of their duration they can be used as immediate reference units. Those are predefined and are treated as default in natural language, and other realized events represented in natural language can be mapped to those standards.

Among the restrictions we can observe the following ones: perception-oriented predicates can be modified into iterative and semelfactive LAs, while lifetime predicates are not quantified that way at all; for the intermediate Stage level predicates, derivation of semelfactives has a casual character, belongs to the oral discourse and is not normally recorded in dictionaries: Ukr. *zvyakny meni* "give me a ring", Rus. *cherkni mnye pis'metso* "*have a write of a little letter to me".

As far as objectively measured standard duration is concerned, it can be demonstrated by the examples of a continuous semelfactive (*protyazhenno-odnoaktnyi*) *provyt'* "give a long howl" and an intensive semelfactive (*intensivno-odnoaktnyi*) *vzvizgnut'* "give a short scream", as differentiated by Shelyakin. It seems worthwhile to use a more finely granulated and preferably objective temporal reference for the differentiation of actions and their respective lexicalizations. The recording of the situation in Wojtasiewicz's notation would be as follows:

$P_{i\,t'}(x) \wedge P_{0\,t}(x) \wedge (t'>t)$[2]
$P_{i\,t'}(x) \wedge P_{0\,t}(x) \wedge (t'<t)$

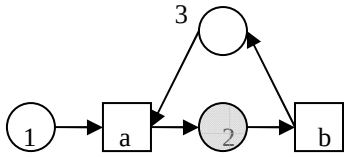
Apart from generally acknowledged ontological restrictions on durations that have a systematic character, there are situational ones, where it is the speaker who decides about the standard in each particular situation. Hence, it seems reasonable to introduce a speaker's will into a description, whose meaning can be expressed with the help of the V(alue) predicate (cf. 4.3.2). As both in the case of an objective and subjective standard some evaluation takes place, we may consider the concept of a standard state $P_0$ to be a shortcut in Wojtasiewicz's formalism. Since Petri nets do not include either the concept of a standard state or a concept of value, a representation with their help will need introducing parallel states that will be mapped on the main states to show differences in duration (cf. 4.3.2).

# 4. BASIC SEMANTIC TYPES OF LAS

## 4.1 The iterative component

The general scheme for iterations could be represented as follows (fig. 2). The highlighted circle (2) corresponds to the state "on" that turns into state "off" (3) in a cycle, similar to switching a light "on" and "off".

Figure 2.



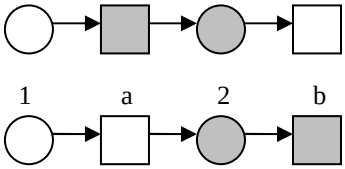

In some Slavonic languages pure iteration is a fairly common phenomenon: Pol. *jadać*::*jeść, pijać*::*pić, czytywać*::*czytać, grywać*::*grać* "eat from time to time::eat, drink from time to time:: drink, read from time to time:: read, play from time to time:: play"; Rus.: *hazhivat', zhivat', yedat'* "go, live (do), eat from time to time" (multiple or *mnogokratnyye* according to Avilova).
While Petri nets present a simple way to express iterations, the rules of Wojtasiewicz's notation demand a more complicated formula, e.g.: $(P_t^1(x) \wedge P_t^2(x) \wedge \ldots \wedge P_t^n(x)) \wedge (t^1<t^2<\ldots<t^n)$.

## 4.2 Indicating a phase

In the cases of both inceptive (beginning) and terminative (end) LAs we deal with a change of state that is expressed as Trans(x,y) predicate in Wojtasiewicz's notation. Below are examples of verbs with opposite phase meanings:
Trans(¬(P(x)),P(x)) *zasnut'* "fall asleep"
Trans(P(x), ¬(P(x))) *prosnut'sia* "wake up"
In both cases the state of sleeping is in the focus of attention, but different phases of sleeping are described. In both cases, it is a change from a vigilant state to a sleeping state or vice versa. Hence, we need to show both those states but accentuate the state of sleeping. We could do this by means of adding the negation operator to the state opposite to the main state, as the negated state is always marked with respect to the asserted one.
Since particular parts of a process are in the focus of attention, we can make the resulting state "invisible" and, abstracting from iterations for the moment, will map the inceptive and the terminative LAs respectively to the general frame in the following way (a) is the event of beginning, (b) is the event of ending, state (1) is initial, state (2) represents activity in progress):

[2] Here and further on, t and t' are temporal indices of the states $P_i$ and $P_0$, while "< "is the relation of precedence.

Figures 3 and 4.




A further differentiation of inceptives can be based on their formal (prefixes) and semantic (dictionary definitions) characteristics. Since most prefixes are polysemic, we had chosen the semantic criterion to start with, but further differences of a morphological character brought some interesting insights as well.

### 4.1.1 The invariant inceptive

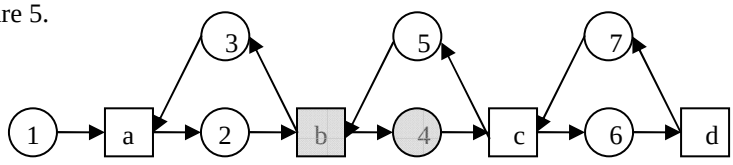
The group of the so-called inceptive[3] verbs was selected from the dictionary of the Ukrainian language (*Slovnyk ukrainskoyi movy*, hereafter SUM) on the basis of the inclusion of the verb *pochynaty* "begin" in their definitions. The selection consists of 1018 verbs. They can be further divided into three major groups according to the prefix used to derive them (*za-*, *po-* and *roz-*) and are characterised by different compatibilities with derivational bases and the resulting meaning of the whole as well as different degrees of complexity of their structure, as some are combinations of a phase meaning with other kinds of LAs, such as iteration or intensiveness. Further semantic differentiation is needed as the same verbs happen to combine with more than one of the mentioned prefixes, still preserving their phase semantics.

The *za-* group is the most numerous one and can be divided into two groups due to the linguistic nature of their derivational basis. The first group comprises verbs that are derived from **deadjectival** states like *zasynity*, *zazelenity* "become blue, become green" and so-called **Individual-level** predicates like *zagovoryty*, *zadyhaty* "start speaking, start breathing" (if understood literally, without adverbial modification of an intensivity of action), those are quite few and they comprise the **inchoative** group, their representation scheme can be considered the invariant inceptive, as above. The second group includes verbs that are derived from those with sensoric perception semantics, mostly **sounds** produced by nature, humans (including speech) and animals, but also **light** perception, and those characterizing the **way** of movement of humans (*zashkandybaty* "start walking unevenly, with difficulty"). From the point of view of human perception, such predicates denote actions with a high frequency of repetition of single similar acts, so those verbs often derive semelfactive correlates like *stuknuty*, *blysnuty* "knock, blink". They can also be categorized as "**vibrating**" verbs (cf. 4.1). Comparing the morphologically expressed iterativity (suffix *-iv*) with the lexical one ("vibrating" verbs) we can say that the standard duration criterion is here deciding about the level of expressing this concept.

### 4.1.2 Complication with intensiveness

The *roz-* group is different from the previous two because the beginning concerns here not the activity itself but its intensiveness, see fig. 5 below. The initial state is the activity itself (2), but it is its peak (4) that is in the focus of the speaker's attention. Such an activity presupposes the decline stage, but is not result-oriented either. The derivational bases for the *roz-* group are the same as for *za-*, selection 2), hence the difference is structural and not conventional (cf. ***za****smiyatysya* and ***roz****smiyatysya*). To follow the previously used metaphor, this category can be considered as characterizing the "**amplitude**" of vibrations.

Figure 5.

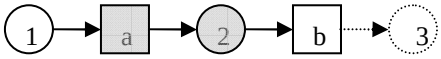



[3] Here we treat inceptives as a category which signals the beginning of an activity and includes both inchoatives and ingressives (see Avilova 1975 for the differentiation and Kotsyba 2004, 2006a for some further considerations).

## 4.3 Focusing on result

The *po-* group includes basically human (independent) movement verbs and thus partially overlaps with the *za-* group. They may include the same bases (***po****shkandybaty*, ***za****shkandybaty*, both meaning basically "start to walk unevenly, slightly limping"), which brings about the question of the difference in the meanings of such derivatives and about prefix compatibility limits for derivational bases. As compared with the "granulated" *za-* group, the *po-* group presents movement as a uniform activity, which automatically refocuses the listener's attention to other parts of the whole process, makes it more "result-oriented", often purely through the negation of the preceding state: "he has left, therefore he is not here any more" and this way is probably the closest correspondent of grammatical meanings like Present Perfect in English. Their meaning can be represented as a development towards the result (3) in comparison to the inceptive invariant:

Figure 6.




An interesting fact is that phase correlates of those verbal types will be different.
Cf. *poshkandybaty*::*doshkandybaty* "he reached some destination point of his journey", *zashkandybaty*::*vidshkandybaty* "he walks no more".

### 4.3.1 Explicating the reason for terminating an activitity: an intended telicity

Another important question connected with phase modifications of a predicate and the quality of LAs is the reason why an activity was interrupted—is it a natural end, when an expected result has been achieved for the subject of an activity, or was the interruption evoked by some external factors?

The *vid-* group is symmetrical to *za-* and has a **backward** temporal orientation as compared to the *do-* group (see figure 3). Verbs like *vidsluzhyty*, *vidtantsiuvaty*, *vidzhyty* (in one of its meanings), *vidbuty(sia)* "to have done one's military service, to have danced (as much/long as one could), to have lived (enough), to have taken place/to have occurred" accentuate the end of a (repeated) activity and the activity itself. Other cases of measurement depend on concrete realization in the discourse and are related to different kinds of results.

The result-oriented group differs from the above one in that the attention of the speaker is focused on the state that comes after reaching the end of the activity. Moreover, since the terminated activity interests the speaker no more, there is always an (at least partially) parallel process that is affected by that activity and receives its own development afterwards. This makes representation schemes more complex again.
The result can be formally expressed by stating that the affected participant of the activity has been "used up". The **distributive** LA (or **cumulative** according to Avilova) expresses this situation when the affected participant is a group.

In SUM's definitions this feature is explicated as *(pro) vsih abo bagatioh* "(about) all or many". The cautious "many" can be explained by a situational specification of the universum and in fact corresponds to the universal quantifier—in natural discourse, unrestricted universal quantification is quite rare and tends to be associated with encyclopaedic knowledge.

In Wojtasiewicz's notation we can include the universal operator for such cases. This notation also demands specification of the subject as opposed to the object of the activity.
$\forall x$ (Ag(y, Trans(P(x), $\neg$P(x)))) Rus. *perebili (vseh)*, "(all (of them)) have been killed, massacred", with a universally quantified object (Avilova).
$\forall x$ (Ag(x, Trans(P(x), $\neg$P(x)))) Rus. *perezhenilis' (vse)*, "(all (of them)) have got married", with a universally quantified subject.

In Petri nets we can use a common scheme for cases of both distributive subject and distributive object and differentiate further between them if such a need arises.[4]

Figure 7.

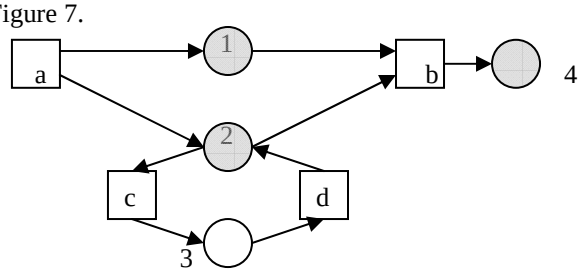



Figure 7 represents the cumulative (Avilova) LA where the "object" is expressed in units of some standard measurement, like kilometres (2) in Rus. *nabegal 10 kilometrov* "he has run 10 kilometres". Since the division into units is purely conventional, the activity itself (1) is seen as uniform. State (4) corresponds to the result of the whole activity, namely, having run 10 kilometres.

Figure 8.

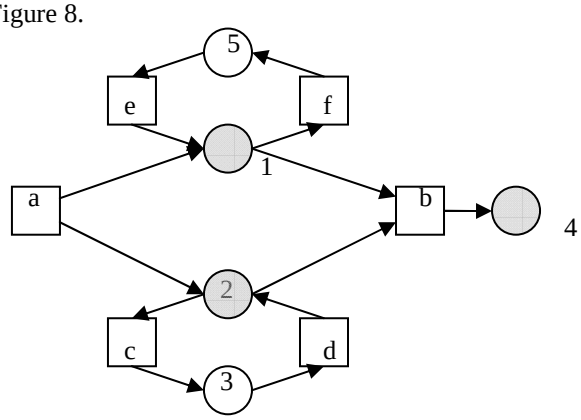



Figure 8 concerns the distributive LA proper. Objects exist as separate entities in nature, hence the activity of affecting those objects is granulated (represented as a cycle (1-f-5-e)) and the limits of the parts are defined by the limits of the objects (2) in a given universum (2-c-3-d): cf. Rus. *kot perebil vorobiev* "the cat has killed (all) the sparrows".

### 4.3.2 Axiological complications: an acquired telicity

The assessment element within the semantic structure[5] of LAs is connected with different **degrees of saturation** and is usually rendered in definitions with the help of lexemes like "too long, too much, a little bit, with undesirable consequences, just enough", etc. Let us consider the following pair of expressions:
Rus. *On prospal (tri chasa)* "sleep as long as (three hours)"
*On pospal (tri chasa)* "sleep as long as (three hours)"
They are presented in [Pikhlak] as perdurative and delimitative respectively and seem to differ with respect to the estimation of their quantity by the speaker. The estimation is a follow-up saying that the time spent on activity P could have been managed in a more efficient way.

[4] Some interesting parallels to the phenomenon of ergativity can be drawn here as distributivity in fact concerns only one of the arguments.
[5] It is worthwhile mentioning that even though the evaluation component is used for differentiating the meanings of those two LAs [Pikhlak 1980], it is not too rigid. E.g. saying *on **po**spal* we more naturally mean "a little", but a sentence *on horosho pospal* in the meaning "a lot" is plausible. On the other hand, *on **pro**spal* is more naturally compatible with *tselyh tri chasa* "as much as three hours", but a sentence like *on prospal tol'ko tri chasa*, even being marked, is still grammatical.

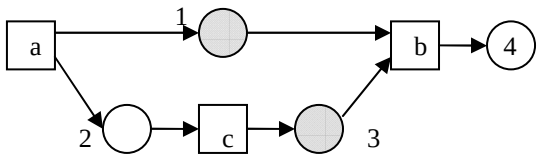
The perdurative aspect is grouped by Shelyakin separately from cases like *prospat' pojezd* "oversleep the train" although there is a lot of similarity between the two cases and we can treat the latter as a development of the former, where the consequence of awakening too late is added. Other examples are: Rus. *perespat'* "sleep too long"; *doplyasat'sia* "dance oneself into trouble"; *prihvornut'* "become a little ill". The last one is formed with the use of the semelfactive pattern but the LA meaning receives a metaphorical development of insignificance connected with "allegedly" short duration.

The **speaker** sets admissible limits for a particular realization of a predicate connected to either some more or less objective standards or his will that is defined by a concrete situation, and later checks it against those limits. This allows us to represent the given aspect of meaning as the optative modality (the description given below is taken from Koseska-Toszewa 1996). When it is realized with the backward temporal orientation, it expresses the meaning of the irrealis modality.

As far as the degree of saturation is concerned, we can consider the following cases:

**Verbs with the prefix *nedo-*** that form the incompletive, or *nedostatochno-normativnyi* LA according to Shelyakin (see figure 9): Rus. *On nedospal* "he has underslept". In SUM definitions[6] such cases are regularly presented with the help of differently expressed negation: adverbial modifiers like *ne povnistyu, nedostatnyo, nepovnoyu miroyu, menshe, nizh potribno chy mozhlyvo, ne do kintsya* "not completely, not to the full, less than is needed, not to the end" (most numerous cases), the negative particle *ne* "not" with telic verbs: *ne dosyahaty, ne vysyplyatysya* "not to reach, not to sleep one's fill", or lexically through words with negative semantics: *bad, to be tough of hearing.*

Figure 9.



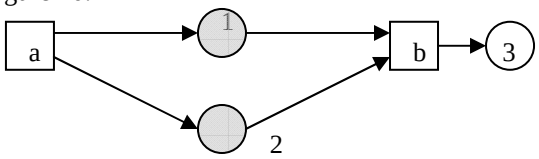

(1) represents the speaker's will concerning the main activity of sleeping (2) that was interrupted (c); another highlighted state is "not sleeping" (3) that is undesirable from the point of view of (1) and until (b) (1) holds.

In Wojtasiewicz's notation the concept of evaluation is expressed in a simplified version by setting the value of a situation as higher than 0 (w>0) or comparing it to the value of another situation with the same agent:
x PREFERS y to z: $\exists t,t' \exists w,z\ V_t(x,y_{t'},w) \wedge V_t(x,\neg y_{t'},z) \wedge (w>z) \wedge (t<t')$.
We can use this script to represent different degrees of saturation with use of temporal indices. In the case of the incompletive it can be as follows:
$\exists t,t',t'' \exists w,z\ Trans(P_t(x),\neg P_{t'}(x)) \wedge V_{t'}(y, P_{t''}(x),w) \wedge V_{t'}(y, \neg P_{t''}(x),z) \wedge (w>z) \wedge (t<t'<t'')$

**Verbs with the prefix *vy-*** that form the category whose meaning is close to the intensive-reinforcing (*intensivno-usilitelnyj*) LA (see figure 10): Rus. *On vyspalsia* "he has had enough sleep (no more sleep is necessary, he does not look drowsy)". The internal drive of the agent is exhausted, which leads to a natural end of the activity. Definitions of verbs with the prefix *vy-* in SUM include semantic components like: *doskhochu, vdovol, tsilkom zadovolnyayuchy potrebu u chomus'* "enough, as much as one wants, completely satisfying one's need in something".

[6] Since the formal expression of degrees of saturation seems to demonstrate a high level of regularity, while there is some variability of expressing their semantics in definitions, we shall use a morphological criterion for these LAs' identification.

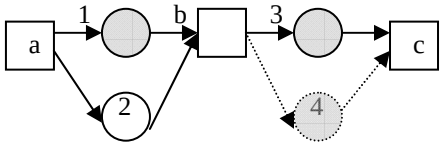
Figure 10.




In figure 10, the end (b) of the "sleeping" state (2) coincides with the one of the "willing" state (1).
In Wojtasiewicz's notation the situation can look as follows:
$\exists t,t' \exists w,z \; Trans(P_t(x),\neg P_{t'}(x)) \wedge V_{t'}(y, \neg P_{t'}(x),w) \wedge V_{t'}(y, P_{t'}(x),z) \wedge (w>z) \wedge (t<t')$

**Verbs with the prefix *na*-** that form the satiative LA (see figure 11): Rus. *On naspalsia* "he has had enough sleep (even more sleep could be bad)". Apart from the meaning of saturation, similar to the LA above, definitions in SUM often include (mostly implicit) elements with pejorative semantics.

Figure 11.

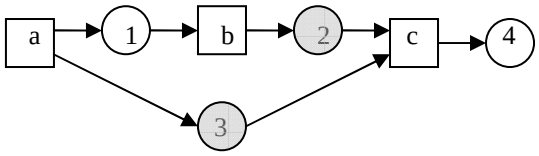



In figure 11, the part (a-1-b, a-2-b) corresponds to figure 10, while (3) denotes the negation of the speaker's will (1), the dotted (4) is a hypothetic continuation of sleeping (2) that is parallel to the speaker's disapproval of it.

A representation with use of Wojtasiewicz's notation:
$\exists t,t',t'' \exists w,z \; Trans(P_t(x),\neg P_{t'}(x)) \wedge V_{t'}(y, \neg P_{t'}(x),w) \wedge V_{t'}(y, P_{t''}(x),z) \wedge (w>0), (z<0) \wedge (t<t'<t'')$

**Verbs with the prefix *pere*-** that form the excessive LA (see figure 12): Rus. *On perespal* "he has had more than enough sleep". Definitions in SUM include semantic elements like *zanadto, dovgo, dovshe, nizh slid* "too, too long, longer than is needed" on the regular basis.

Figure 12.




The situation here is opposite to the one from the one in figure 9: (1) represents the speaker's will concerning the main activity of sleeping (3) which holds no more (2) after (b), while (3) still lasts.
A representation according to Wojtasiewicz will be as follows:
$\exists t,t',t'' \exists w,z \; Trans(P_t(x),\neg P_{t''}(x)) \wedge V_{t''}(y, P_{t'}(x),w) \wedge V_{t''}(y, \neg P_{t'}(x),z) \wedge (w<z) \wedge (t<t'<t'')$

## 5. CONCLUSION

The presented results allow us to make the assumption that Slavic lexical aspects serve by and large to turn originally atelic predicates into telic ones (without taking into account the distributive groups that initially and necessarily include a direct object).
Telicity is encoded into the lexical meaning of a derivational basis as possible consequences (more or less objective) for the participants of the situation denoted by it. Realization of atelic predicates, with fewer arguments, also turns out to bring unexpected results, and the function of some lexical aspects is to conceptualize those results. Most verbs that are the base for derivation are intransitive. Even those that are transitive (examples from Avilova) have intransitive correlates (transitivity is derived).

Avilova was concerned with word formation factors and morphonological restrictions on LA derivation, which brought a quite distinct difference between the resultative and the quantative (according to her) groups. Some of the restrictions stated by her have an occasional character (like an accentuated root of a word which disallows secondary imperfectivization). As we decide to abstract ourselves from the transitivity concept and treat LAs as a quantity specification of events, we can regroup them according to the ways of expressing this quantity mentioned earlier.

On the other hand, the differentiation of lexical bases according to ontological limitations of duration is important as it brings about combinatorial restrictions. Thus perceptually oriented predicates can be modified into iterative and semelfactive LAs, while lifetime predicates are not quantified in that way.

It must be noted that even in such a comprehensive dictionary as SUM, not all potentially plausible verbs with additional lexical aspectual marking are represented. A learner of the language might thus consider the word as nonexistent. But the rules that govern the appearance of such derivatives belong to language competence, so even if they might be perceived as occasionalisms, they still belong to the language system and consideration of this fact might be worthy in automatic language processing. Many verbs that do appear in SUM can be hardly found in real discourse or have negligible frequency (examples of their usage are extremely rare in dictionaries). Some of the verbs sound quite artificial (*dosmiyatysia* "finish laughing" in the terminative meaning) and might be considered results of lexicographers' zeal more than natural language units.

This way, aspectual coercion is lexicalized or anticipated on the systemic level of the lexicon in the Slavonic languages much more as compared to most Western European ones, but still its full potential is evoked only in the sphere of discourse.

As for the ways of formalizing the (invariant) meanings of lexical aspects, we can say that both Petri nets and Wojtasiewicz's predicate calculus have sufficient power of expression to describe them. Petri nets seem to be a more elegant and economic way of meaning representation, while Wojtasiewicz's notation contains some redundant patterns. We have included into the latter patterns with universal quantifier and iteration schemes. The choice of a representation system would depend on the particular needs of further research.

## ACKNOWLEDGEMENT

The author would like express her gratitude to Violetta Koseska-Toszewa and Ivan Derzhanski for reviewing the draft of the article and suggesting some valuable solutions.

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