Aspectual Morphology of Russian Verbs in Fluid Construction Grammar
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Abstract

Aspect is undoubtedly the most capricious grammatical category of the Russian language. It has often been asserted as a mystery accessible only to native speakers, leaving all the others lost in its apparently infinite clutter. Recent work in cognitive linguistics has tried to bring order to the seeming chaos of the Russian aspectual system. But these approaches have not been operationalized so far. This paper demonstrates how the aspectual derivation of Russian verbs can be handled successfully with Fluid Constructional Grammar, a computational formalism recently developed for the representation and processing of constructions. **Keywords:** Fluid Construction Grammar; Russian aspect.

Introduction

Russian aspect is notorious for its complexity. Traditional analysis organizes Russian verbs according to a paired imperfective vs. perfective distinction, but this only offers partial explanations and requires a large list of “exceptions” to account for the characteristics of the verb system. These problems have cast doubt on whether there is a system underlying the conceptualization of Russian aspect. And consequently, Russian and other Slavic languages are typologically often classified as an idiosyncratic group in terms of their aspectual behavior.

However, a promising approach to this issue has emerged within cognitive linguistics, particularly in the work of Laura Janda (2004). She motivates Russian aspect with metaphors grounded in embodied experience and has argued that Russian has in fact a “highly constrained and well-motivated” structure of aspectual verb clusters that goes well beyond the distinction between perfective and imperfective (Janda, 2007, p. 608). She therefore proposes a novel way of classifying Russian verbs using a more intricate interaction between semantic distinctions than assumed so far.

However, no operationalization exists yet of this hypothesis, indeed most proposals from cognitive linguistics remain stuck in verbal description without formalisation. Nevertheless, we believe that operationalization is a crucial step in the empirical research process because it is the only way to demonstrate the validity, completeness, and coherence of a proposed linguistic system. The main contribution of this paper is to offer an operationalization of Russian aspect based on the analysis developed by Janda (2004, 2008) and to show that Fluid Construction Grammar (FCG), a computational grammar formalism recently developed to allow the bi-directional processing of grammatical constructions (Steels, 2004; Steels and De Beule, 2006), is adequate to capture this analysis. As part of this effort, we found that an additional dimension had to be added to Janda’s analysis based on the well-known notion of Aktionsart.

The next section briefly describes the proposal of Janda and the extension with Aktionsart. Then we briefly report on the formalisation and implementation effort. Since the linguistic structures of the provided examples are quite elaborate, we can only sketch here the outline of the solution and give some examples. The interested reader is invited to look at the complete demonstration of the examples at www.fcg-net.org/aspect/. In the conclusion, we discuss the next steps to be undertaken.

Linguistic Background

Russian verbs can be roughly divided into ‘simple’ verbs, consisting of a stem, suffix and ending, e.g. чит-а-ть\(^1\) (‘read’), цип-а-ть\(^1\) (‘pinch’), and ‘complex’ verbs, which are derived from the latter by the addition of aspectual markers, e.g. by prefixation пере-чить\(^p\) (‘re-read’), вы-щипать\(^p\) (‘pinch out’). Simple verbs typically describe activities and are imperfective (indicated by an index \(i\), e.g. резать\(^i\) (‘cut’)). In this paper, we focus on how the addition of a prefix changes the aspect of simple verbs into Perfective (indicated by an index \(p\), e.g. на-резать\(^p\) (‘cut’), пере-резать\(^p\) (‘cut off’), по-резать\(^p\) (‘cut for a while’) etc. Russian has nineteen verbal prefixes that productively form Perfective (Krongauz, 1998). There is also a perfectivising suffix -ну- leading to such forms as реза-ну-ть\(^p\) (‘cut once’).

This study draws upon a theory developed by Janda (2004, 2008), postulating that the lexical meaning of verbs dictates their aspectual behaviors because different types of events and their relationship to time are conceptualized in different ways. This necessitates a distinction among (at least) four different types of Perfective: Natural, Specialized, Complex and Single Act Perfectives (Figure 1) – each with different semantic and morphological behavior. For instance, the verb щипать\(^i\) (‘pinch’) describes an activity that can be completed, which is why it can derive a Natural Perfective об-щипать\(^p\) (‘pinch’) (upper right corner in Figure 1). Other verbs lacking this component in their meaning cannot form Natural Perfective, e.g. пахнуть\(^i\) (‘smell’).

If after a modification by a prefix the verb describes an activity with a potential completion, Specialized Perfectives can be formed, e.g. вы-щипать\(^p\) (‘pinch out’), от-щипать\(^p\)
Specialized Perfective
(prefixes)
Natural Perfective
(prefixes)
Complex Act Perfective
(prefix po-)
Single Act ... 'pinch out'

phasized. It is, however, not always the case that there is one
fixes, which encode exactly what feature of an activity is em-
('work for a while'). Aktionsarten bridge the gap with pre-
po-rabotat~
time span – delimitative Aktionsart, e.g.

it can highlight either the beginning of an activity leading to
Act Perfective combines an activity with temporal limits, so
limit to the corresponding activity - po-

able to get Complex Act Perfective, e.g by setting a temporal
be formed if it is possible to extract a single cycle from a
repeated activity, e.g. цип-ну-ть (‘pinch once’).

Our efforts to operationalize these aspecual behaviors
showed that Janda’s analysis needs to be expanded with
an explicit implementation of Aktionsart (Forsyth, 1970) in
order to separate between the different temporal semantics
within a single Perfective type. For instance, the Complex
Act Perfective combines an activity with temporal limits, so
it can highlight either the beginning of an activity leading to
an ingressive Aktionsart, e.g. за-работатъ (‘start work-
ing’), its ending phase – terminative Aktionsart, e.g. от-
работать (‘stop working’), or just a notion of a limited
time span – delimitative Aktionsart, e.g. по-работать (‘work for a while’). Aktionsarten bridge the gap with pre-
fixes, which encode exactly what feature of an activity is em-
phasized. It is, however, not always the case that there is one
single prefix for each Aktionsart.

Operationalizing Aspect in FCG

We operationalized Russian aspect in Fluid Construction
Grammar (FCG) (Steels, 2004; Steels and De Beule, 2006).
FCG is currently the only computational implementation of
construction grammar which can handle both production and
parsing. FCG is a unification-based grammar formalism that
uses feature structures for representing linguistic knowledge.
A feature structure contains a set of units, a set of features
or slots for each unit, and values for these features. The
units might correspond to lexical items, morphemes, words,
or phrases. Features are both related to syntactic aspects, for
example the form constraints associated with a unit or its syn-
tactic categories, and to semantic aspects, for example, the
associated meaning, the referent identified by the unit, the se-
monic categories, etc.

General Architecture

In line with cognitive linguistics, FCG represents all linguis-
tic knowledge in a uniform way, namely as constructions that
map some aspects of meaning into some aspects of form and
back (Goldberg, 1995; Croft, 2005). The proposed construc-
tions can nevertheless be organized into four sets according
to their functionality: There are lexical constructions which
map lexical stems to their meanings, semantic constructions
which recategorise meaning in terms of semantic categories
(within certain syntactic contexts), mapping constructions
which map abstract semantic structures to abstract syntactic
structures, and syntactic constructions which work out and
refine syntactic categories (within certain semantic contexts).
The latter include morphological constructions. The follow-
ing subsections provide examples of these various construc-
tions using the verb щипать (‘pinch’) as example (see Fig-
ure 1). It falls out of the scope of the present paper to explain
all technical details of FCG and the reader is therefore not
expected to understand the FCG examples given here in full
detail. Nevertheless these examples are useful as illustrations
and as proof that the whole system has successfully been im-
plemented.

Lexical Constructions  Lexical constructions couple for a
particular word its meaning with a string acting as the lexical
stem. In production, the construction triggers when a particu-
lar meaning is detected as target meaning and then creates a
new unit (using the J-operator; De Beule and Steels, 2005),
which has particular semantic categories, for example a base-
type and a potential for perfectivisation, a particular string as
lexical stem, and additional syntactic categories like the part
of speech. In parsing, the same rule triggers when a certain
lexical stem is detected in the utterance and then creates a
new unit for this word with the same syntactic and semantic
information and the relevant meaning.

The lexical entry for щипать (‘щипать’, ‘pinch’) (techni-
cally for its stem щип- because the rest depends on conjugation)
is as follows:
The semantic pole of this rule contains features for meaning, referent and sem-cat (stands for semantic category), and the syntactic pole has form and syn-cat (syntactic category) features. The lexical entry states that the meaning of нищать is ‘pinch’, the referent is the event itself, sem-cat declares it as an event with a certain potential. The metaphor plays an important role because it implements the constraints encoded in the lexical semantics of the verb, i.e., which aspctual forms it can derive. We saw in the derivational diagram (Figure 1) that нищать can form all four Perfective types. So, it includes the potential to become completable-culminating by forming Natural Perfective, completable-specializing for Specialized Perfective, non-completable for Complex Act Perfective and singularizable for Single Act Perfective. The syntactic side defines a string “scip” as a form of the stem and its syn-cat states that it is a verb as a part of speech (pos).

Semantic Constructions Semantic constructions translate parts of the meaning which are not directly expressed by lexical items into semantic categories that then will be mapped onto syntactic features of the utterance, such as morphological markers and word order. We argue that Russian aspect involves two semantic categories. The first one, according to Janda (2004), is based on the metaphor that “Perfective is a discrete solid object” and “Imperfective is a fluid substance.” Without this opposition it is not possible to distinguish between, e.g., the two forms нищать ('pinch') and обнищать ('pinch') or between перенищать ('pinch to exhaustion') and шем-перенищать ('pinch to exhaustion'), which differ only in how the event is “viewed” as a fluid substance or a solid object. The second shade of meaning encodes the semantic category of Aktionsart, which, simply stated, refers to the phase in which the action finds itself. For instance, the perfective derivatives of жить ('live'), such as за-жить ('begin to live'), по-жить ('live some time'), от-жить ('stop living'), прожить ('live for a certain amount of time'), all belong to the Complex Act Perfective type, but differ in Aktionsart, which is ingressive, delimitative, terminative, and totalizing, respectively.

Here is an example of a semantic rule that maps an event viewed as solid-object into a perfective semantic aspect. The Aktionsart remains undetermined so far because the solid-object-view is compatible with many event-types, and is therefore filled in with a logic variable (?event-type).

```lisp
(define-lex-entry pinch
 (define-lex-entry pinch
  ((?top-unit
    (tag ?meaning
      (meaning (== (pinch ?event))))))
  ((?new-unit ?top-unit)
   ?meaning
   (referent ?event)
   (sem-cat
    (==1 (base-type ?event event)
         (potential ?event
          (completable-culminating
           completable-specializing
           non-completable
           singularizable)))))))

(<->
  (define-sem-rule solid-object-sem
   ((?top-unit
     (tag-only ?meaning
      (meaning
       (== (event-view ?event solid-object)
            (event-type ?event ?event-type))))
    (sem-subunits (== ?event-unit))
    (syn-cat (==1 (pos verb))))
   ((?event-unit ?top-unit)
    ?meaning
    (sem-cat
     (==1 (sem-aspect ?event perfective)
          (sem-actionsart ?event ?event-type)))))

An analogous semantic construction has to be created associating a “fluid substance” view with the semantic category of imperfective.

Mapping Constructions The mapping constructions map abstract semantic categories onto abstract syntactic categories. Roughly speaking, semantic aspect (Perfecrive/Imperfective) and semantic Aktionsart are translated into their corresponding syntactic counterparts depending on the semantic and syntactic context, particularly the potential of the verb. For instance, the delimitative Aktionsart can be expressed only within the Complex Act Perfective, so that the relevant mapping construction has to verify that the corresponding semantic aspect is Perfective, the syntactic aspect is Complex Act Perfective, and the verb is actually able to derive this form, meaning that its potential includes non-completable. Here is an example of a mapping rule that implements this constraint:

```
(define-con-rule delimitative-con
  (((?event-unit
    (referent ?event)
    (sem-cat
     (==1 (potential ?event (== non-completable))
          (sem-actionsart ?event delimitative)
          (sem-aspect ?event perfective))))
  (syn-cat (==1 (pos verb))))))

Analogous rules for other Aktionsarten are needed, e.g. ingressive Aktionsart requires a Complex Act Perfective, semelfactive Aktionsart requires the Single Act Perfective, and includes both non-completable and singularizable potentials because only non-completable events are singularisable, etc. for the other Aktionsarten.
Syntactic Constructions  Syntactic constructions complete the meaning/form relation by specifying the surface forms (here in particular morphological markers) of abstract syntactic categories (like Perfective or delimitative Aktionsart). Here is an example of the rule for the prefix по- (‘po-‘):

```lisp
(define-morph-rule po-prefix-morph
  (\(?\verb-unit\)
   (\(\text{syn-cat} \Rightarrow 1 (\text{syn-aspect complex-act-perfective})\))
   (\(\text{syn-actionsart delimitative})\))))
<--> ((?top-unit
   (\(?\verb-unit\))
   (\(\text{tag-parts}\))
   (\(\text{prefix-form}\))
   (\(\text{form} \Rightarrow (\text{string} ?\prefix-unit "po-"))\))
   (\(\text{meets} ?\prefix-unit \?\verb-unit\))
   (\(\text{syn-cat} \Rightarrow 1 (\text{pos verb}))\))
   (\(?\verb-unit\)))
   (\(?\verb-unit\))
   (\(\text{suffix-form}\))
   (\(\text{form} \Rightarrow (\text{string} ?\suffix-unit "-a")\))
   (\(\text{meets} ?\suffix-unit \?\verb-unit\))
   (\(\text{syn-cat} \Rightarrow 1 (\text{pos verb}))\))
   (\(?\verb-unit\)))
   (\(\text{ending-form}\))
   (\(\text{form} \Rightarrow (\text{string} ?\ending-form "-t")\))
   (\(\text{meets} ?\ending-unit \?\verb-unit\))
   (\(\text{syn-cat} \Rightarrow 1 (\text{pos verb}))\))
   (\(?\verb-unit\)))
)
```

The rule states that the prefix ‘po-’ can be used by the delimitative Aktionsart within the Complex Act Perfective type, such as in попрыгать (‘jump for a while’), попнуть (‘walk for a while’), подержать (‘hold for a while’) etc. Other prefixes and a perfectivizing suffix -a- have similar morphological rules, bringing together syntactic aspect, Aktionsart, and the form of the marker. Additionally, the morph rule attaches other infixes such as suffix -a- and infinitive ending -t (we are neglecting conjugation) and establishes the ordering prefix-stem-suffix-ending of the verb pattern.

Producing  Let us go through an application of these rules to see how everything works. We will focus on the utterance пощипать (‘pinch a while’) whose meaning is ‘pinch-event viewed as a solid object and having a limited time span’. Figure 2 presents the initial feature structure in production: on the semantic side the top unit consists of the meaning, the syntactic pole is empty so far.

The first phase in production is the unification of the semantic pole of the construction with that of the linguistic structure that the speaker has to build. Lexical constructions are applied first, so we are searching whether parts of the meaning to be expressed can be captured by lexical items. This is the case for the verb ‘pinch’, which has as meaning: (pinch ?event). Because in production the unification operates on the semantic side, the top unit of the lexical rule for ‘pinch’ unifies with the top unit of the initial feature structure and subsequent application of the J-operator creates the new unit for the found word, moves a tagged meaning to it and makes it a child unit of the top unit declaring some of its semantic features such as referent and sem-cat. In the merging phase, everything in the syntactic pole of the rule new to the current coupled feature structure is added to its syntactic pole. The resulting linguistic structure is shown in Figure 3.

The next step in production is the application of the semantic constructions. Here, the “solid-object-sem-rule” incorporates the notion that the event of a kind of event-type is (metaphorically) viewed as a solid object. Exactly those meanings were still left in the top unit of the linguistic structure, so the unification of the semantic poles can occur by binding ?event-type to delimitative and given the coherence of other semantic features (i.e. there is a subunit of the top describing an event, its sem-cat includes an event as base-type and the particular event as a referent). After the unification, the J-operator removes the tagged meaning from the top unit, inserts it to the meaning of the event unit and adds the corresponding sem-cat of semantic aspect and Aktionsart. The
merging process does not add any information to the syntactic pole because it was already integrated there by the lexical construction. In the resulting linguistic structure, the semantic side of the top is empty, so all the meaning was absorbed either by the lexicon or by the semantic categorization (see Figure 4).

Now it is the turn of the mapping constructions to take action and enhance the syntactic pole of the feature structure with syntactic categories of the language, which later become visible though morphology. The aim of the construction “delimitative-con” is to translate the semantic Perfective aspect and delimitative Aktionsart into the syntactic categories of Complex Act Perfective and delimitative Aktionsart given the proper potential of the verb, in this case to become visible though morphology. The current feature structure in the merging phase (see Figure 5).

The only major difference is that the various types of constructions are applied in a different order: lexical constructions still come first, but are immediately followed by the morphological rules. This is necessary because these two rule types provide the syntactic information that is required to map constructions for determining a verb’s semantic Aktionsart and aspect. Finally, after the mapping construction has been applied, the semantic constructions can integrate the grammatical aspect with the inherent Aktionsart of the verb.

**Discussion**

This paper focused on the notoriously difficult domain of Russian aspect, examining how the necessary lexical and grammatical rules could be operationalized using a construction grammar approach. The analysis was primarily based on
the work of Janda (2004, 2007, 2008), who has argued that the potential for participating in aspect is part of the lexical definition of the verb. Experiments in operationalizing this analysis showed however that the notion of Aktionsart had to be incorporated as well in order to properly handle prefixes. In this paper, only a small example was shown due to space limitations, but the whole system has been operationalized and www.fcg-net.org/aspect/ shows more examples for: "пить" - "выпивать" - "выпивать" - "попытывать" (diagram in Figure 1).

From the viewpoint of construction grammar, one of the most important points of the present paper is that the set of constructions needs to be subdivided into different subsets (lexical, semantic, mapping, and syntactic constructions) and the example of Russian aspect has shown how it is to be done and that it effectively works in a bi-directional system (parsing and production) without changing the definition of the constructions themselves. The division into different types of rules is also helpful to organise the learning process that is the target of our current research. Lexical constructions can be learned independently of the complex aspect system, aspect markers can be learned first in an ad hoc way, and then the more abstract and more difficult to learn categories can be acquired.

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References


