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# Towards Classifying Predicates Involving Change

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Scientific paper

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## Abstract

The paper discusses the semantic features of verbs of causal change which determine their realisation in text. The description framework is based on the frames from FrameNet and the shallow classification they provide in terms of verbs' semantics and the syntactic realisation of the corresponding configurations of frame elements. The classification covers four classes: 1) Verbs of change of physical integrity, shape, general condition and/or functionality; 2) Verbs of change of (measurable) inherent or acquired properties; 3) Verbs of creation; 4) Other verbs of change through processing or manipulation.

The main focus in the study is placed on the entity undergoing the change and the property which characterises the change. The analysis is supplemented with annotated examples from corpora.

**Keywords:** verb semantics, frame semantics, verbs of change, FrameNet, WordNet

## 1. Introduction

The main objective of this paper is to offer a description framework of the semantic properties of activity (dynamic) predicates involving change, with the main focus on the property which undergoes the change. For the purposes of this study, we understand *activity* in the widest possible sense,

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subsuming different types of dynamic predicates, which, under certain conditions may be interpreted as *activities* in the sense of Vendler (1967).

The description of verbs of change is based on several key semantic features – the lexical meaning of the verb and the semantic class it belongs to, the type of change (causal or inchoative), the property of the change (quantised or non-quantised change, scalable change or momentous change of a property or state), the frame elements describing the relevant semantic frame in FrameNet (Baker and Fellbaum 2009; Ruppenhofer et al. 2016). The study relies on well-known classifications of verbs and focuses on the verbs in the Princeton WordNet (Miller 1995) and the Bulgarian WordNet (Koeva 2021).

In the paper, we focus particularly on causative verbs of change in WordNet and the FrameNet semantic frames describing them, but the observations regarding the core frame elements are largely applicable to the inchoative counterparts of the respective frames. Moreover, we exclude large semantic classes such as verbs of motion, verbs of placing, verbs of emotional or psychological change, verbs involving animate objects, and some other classes which have their own specifics and warrant a separate study.

We analyse the property undergoing the change and the relevant semantic restrictions as grounds for the classification of the frames. Based on the outlined semantic features, a shallow classification within the semantic class of verbs of change is offered, aiming to cover the diversity within the class and to propose an approach to model their syntactic behaviour. As the classification is derived from the FrameNet frames, it groups together verbs with similar conceptual structure and syntactic properties. In particular, the shared invariant semantics of the predicates (in terms of the semantic frame they evoke) determines to a large degree the syntactic realisation of their participants. Our observations on the syntactic realisation of verbs of change are based on empirical material extracted from various corpora for English and Bulgarian.

The paper is organised as follows. After a brief discussion of the related works and the representation of verbs of change in lexical-semantic resources, we present a shallow classification of the verbs supplied with illustrative examples. The final section draws conclusions and raises some theoretical questions which outline directions for future work.

## 2. Related Work

Semantic classifications of predicates and the description of semantic relations between predicates and their arguments have been

undertaken within various theoretical approaches, based on: (a) verbs' syntactic properties and behaviour (Levin 1993; Pinker 1989; Goldberg 1994, etc.); (b) thematic structure (Chafe 1970; Longacre 1976; Van Valin and LaPolla 1997); (c) frame semantics (Fillmore 1982).

One of the most widely acknowledged and probably the largest-scale classification of English verbs has been proposed by Levin (1993). The author has divided verbal predicates into classes on the basis of their invariant semantics and the syntactic diatheses in which they participate. This work has served as a foundation for the description of English predicates in VerbNet (Kipper-Schuler 2005), a lexical-semantic resource presenting a shallow hierarchy of verb classes in the English language, the semantic roles describing the argument structure of the predicates from each class, the selective restrictions imposed on the arguments, their syntactic realisation, etc.

As exemplified by VerbNet, large-scale classifications of verbs (possibly along with other parts of speech) are devised as part of the semantic description of lexical units in semantic resources. WordNet (see next section) presents the lexis in a taxonomically organised semantic network whose nodes represent synonym sets. VerbAtlas (Di Fabio et al. 2019) enriches the description in the WordNet-inspired multilingual semantic resource BabelNet by assigning each synonym sets a frame corresponding to its prototypical predicate-argument structure described using semantic roles (along with relevant semantic restrictions defined over them).

FrameNet (Fillmore et al. 2003; Ruppenhofer et al. 2016, among others) is a lexical resource that couches the semantic and syntactic properties of lexical units in the apparatus of frame semantics (Fillmore 1982). It provides a robust conceptual description of lexical items in terms of the fragment of knowledge, or frame, they evoke when used in language.

A more detailed description of FrameNet and WordNet is presented in the next section, which elaborates on the verbs that are in the focus of this paper, namely verbs of change.

### 3. Verbs of Change in Language Resources

WordNet, also the Princeton WordNet or PWN (Miller 1995; Fellbaum 1998), is a large lexical database that represents comprehensively conceptual and lexical knowledge in the form of a network whose nodes denote cognitive synonyms (synsets) linked by means of a number of conceptual-semantic and lexical relations such as hypernymy, meronymy, antonymy, etc. Each synset is supplied with a gloss, possibly with usage

examples as well as with notes (if appropriate) on the grammatical, stylistic or other properties of the synset members. In addition to the Princeton WordNet, we use the Bulgarian WordNet, or BulNet (Koeva 2021), which is aligned with PWN at the synset level using unique synset identifiers.

WordNet provides a coarsely-grained semantic division in terms of a set of language-independent semantic primitives (semantic classes) assigned to all the nouns and verbs in the resource. The verbs fall into 15 groups, such as *verb.change* (verbs describing change in terms of size, temperature, intensity, etc.), *verb.cognition* (verbs of mental activities or processes), *verb.motion* (verbs of change in the spatial domain), *verb.communication* (verbs describing communication and information exchange), etc. Verbs of change in WordNet largely belong to the semantic class *verb.change*.

The causative verbs of change are predominantly organised in the WordNet subtree stemming from eng-30-00126264-v {*change, alter, modify*} ‘cause to change; make different; cause a transformation’ which covers 2,536 synsets. 46% of them are labelled as *verb.change*. However, some verbs of change fall into different semantic classes which specify their semantics (including the changing component) in a more concrete fashion, e.g. *verb.emotion* describes change in the emotional state, *verb.contact* covers change as a result of physical contact between objects, *verb.body* denotes change in the bodily experience or appearance, etc. A small group of relevant verbs are also found in the subtrees eng-30-01617192-v {*make, create*} ‘make or cause to be or to become’ and eng-30-01850315-v {*move, displace*} ‘cause to move or shift into a new position or place, both in a concrete and in an abstract sense’.

FrameNet (Baker et al. 1998; Baker 2008) is a lexical semantic resource that couches lexical and conceptual knowledge using the apparatus of frame semantics. Frames are conceptual structures that describe types of objects, situations, or events along with their components (frame elements) (Baker et al. 1998; Ruppenhofer et al. 2016). Depending on their status, the frame elements (FEs) are divided into core, peripheral, and extra-thematic (Ruppenhofer et al. 2016: 23–24). The core FEs, which would be the primary focus below, instantiate conceptually necessary components of a frame, which in their particular configuration make a frame unique and different from other frames.

FrameNet frames are organised into a hierarchical network, using a number of frame-to-frame relations (Ruppenhofer et al. 2016: 81–84). The following two relations (along with some others) determine the hierarchical internal structure of thematic verb classes: *Inheritance* – defined as a relationship between a parent frame and a more specific (child) frame, such

that the child frame elaborates on the parent frame, and *Using* (also called ‘weak inheritance’) – a type of relationship between two frames where the first one makes reference in a very general kind of way to the structure of a more abstract frame (used exclusively in instances where a part of the scene evoked by the child frame refers to the parent frame).

Verbs of change are covered by a shallow hierarchy of frames stemming from *Transitive action*, describing causative change, and *Transition to a state*, characterising non-causative change.

Our analysis relies on existing mappings between WordNet and FrameNet which assign FrameNet frames onto WordNet synsets (Leseva and Stoyanova 2020).

FrameNet also offers a set of annotated examples for lexical units evoking the corresponding frames (Ruppenhofer et al. 2016: 7–8). The annotation includes the verb, the frame elements and the syntactic components through which the frame elements are realised. The annotation provides information both about the explicit and the implicit frame elements (Ruppenhofer et al. 2016: 28–29). The empirically grounded linguistic generalisations about the syntactic realisations of frame elements are particularly valuable not only in the study of the target language (English) but as a point of departure for making observations cross-linguistically. We adopt the principles of annotation from the FrameNet annotated corpus and apply them in the annotation of examples in Bulgarian. A detailed conception of a FrameNet-modelled description of Bulgarian verbs is laid out in Koeva (2010, 2020).

#### 4. Methodology

In order to collect the dataset for analysis, we rely on the existing mapping of FrameNet frames to WordNet synsets. The methodology is based on the following steps.

1) We select a set of FrameNet frames which describe verbs of change such that: a) evoke causative frames inheriting from the abstract frame *Transitive action*; b) the change occurring in the affected entity involves a particular attribute of the entity (Patient or other), thus excluding very generally-specified frames such as *Cause change*. Other exceptions are also made, as specified in the Introduction.

At this step we have identified 40 FrameNet frames inheriting directly or indirectly from *Transitive action*. The internal organisation of the specified sets of frames is illustrated in the classification in the following section.

2) We select synsets to which any of the analysed frames are assigned, resulting in a total of 239 synsets covering 569 verbs in English and 925 verbs in Bulgarian (the greater number is mostly due to the fact that aspect is a lexical property of the verbs and both the perfective and the imperfective members of the aspectual pairs are included as separate literals in the synset).

3) We compile a set of examples collected from corpora by performing automatic extraction and manual selection based on the relevance of the instances, followed by manual annotation. The annotation includes identification of frame elements and labelling them with the relevant syntactic category (NP.Ext, NP. Obj, PP, AdvP, etc.). The examples and annotations for English are borrowed from the FrameNet corpus.

The analysis focuses in particular on the affected entities and their properties with the further aim of defining classes with similar semantic characteristics and syntactic realisation in terms of the morphosemantic features of the verb and the configuration of frame elements (valency frames) it appears with.

In some cases where there is no frame in FrameNet that describes the studied verbs (usually groupings of synsets in a WordNet tree), we define such a frame with its corresponding frame elements and relations. Some of these frames, labelled with an asterisk, are integrated in the classifications presented in Figures 1 – 4.

## 5. Classification of Frames Representing Verbs of Change

Below we attempt to classify the causative verbs of change in terms of the characteristic features of the entities affected by the change and the property which is subjected to change or the state that occurs as a result of the change. The most general distinction in this respect is between 1) frames that involve affecting a Patient in such a way as to change its physical integrity, shape or (general state of) functionality, including its going out of existence, or causing it to acquire or lose some property essential for its functioning; 2) frames that involve a change of an inherent measurable property or state of the Patient; 3) frames describing creation, i.e., change that results into an Entity coming into existence through an act of the Agent; and 4) frames describing other causative types of change.

### 1. Verbs of change of physical integrity, shape, general condition and/or functionality

The frames characterising this class of verbs inherit from *Transitive action* and in general include as frame elements an Agent (alternatively, a

non-human Cause) and a Patient. The invariant situation involving a change of physical integrity, shape, general condition and/or functionality may also include either an explicit or implicit elaboration on the resulting state at which the situation ends, usually described in terms of a new state of the Patient and the shift in its existential or functional properties.

Figure 1 shows the set of the frames subsumed in this class. Some of them are related to a (reversible or irreversible) change in the physical integrity or general condition of an object (e.g., *Cause to fragment*, *Destroying*, etc.), including change in shape (e.g., *Reshaping*, *Manipulate into shape*), damage without destruction (e.g., *Damaging*, *Render nonfunctional*), etc.<sup>2</sup>

Verbs of change of physical integrity, shape, general condition and/or functionality	
Cause to fragment	An <b>Agent</b> suddenly and often violently separates the <b>Whole patient</b> into two or more smaller <b>Pieces</b> .
Destroying	A <b>Destroyer</b> or <b>Cause</b> affects the <b>Patient</b> negatively so that the <b>Patient</b> no longer exists.
Grinding	A <b>Grinder</b> or <b>Grinding cause</b> causes a <b>Patient</b> to be broken into smaller pieces.
Damaging	An <b>Agent</b> affects a <b>Patient</b> in such a way that the <b>Patient</b> ends up in a non-canonical state.
Reshaping	A <b>Deformer</b> deforms a <b>Patient</b> so that it undergoes a change from its canonical or original shape into the <b>Configuration</b> , a new shape.
Manipulate into shape	An <b>Agent</b> manipulates a <b>Theme</b> so that it ends up in a particular shape or configuration denoted by a <b>Resultant_configuration</b> .
Arranging	An <b>Agent</b> puts a complex <b>Theme</b> into a particular <b>Configuration</b> , which can be a proper order, a correct or suitable sequence, or a spatial position.
Corroding caused	The <b>Patient</b> , an inorganic item, undergoes a chemical process caused by another entity, which renders it less useful, desirable or stable.
Cause to rot	A <b>Patient</b> , which is an organic substance, undergoes the natural process of decay due to a <b>Cause</b> (or <b>Agent</b> ).
Rejuvenation	The action of an <b>Agent</b> or the occurrence of a <b>Cause</b> returns an <b>Entity</b> to an earlier state of vigor and strength.
Render nonfunctional	An <b>Agent</b> or a <b>Cause</b> affects an <b>Artifact</b> so that it is no longer capable of performing its inherent function.
*Cause chemical reaction	An <b>Agent</b> or a <b>Cause</b> causes the occurrence of a chemical reaction in or on a <b>Patient</b> which leads to its change.
*Cause change of appearance	An <b>Agent</b> or a <b>Cause</b> changes the external features of the <b>Patient</b> which changes its appearance and may influence its functionality.

Figure 1. Verbs of change of physical integrity, shape, existence and/or functionality.

<sup>2</sup> The frames labelled with a \* are newly created by us in order to describe the conceptual structure of well presented classes of verbs in WordNet.

The frames represent in different detail the properties of the Patient after it transitions into a resulting state. For example, while both *Cause to fragment* and *Grinding* describe change of the integrity of the Patient, the second frame is more specific in terms of the result (smaller pieces). The lexical units evoking the frame *Grinding* are usually associated with a specific manner of performing the change (e.g., *flake, grind, grate, crush, mush*) (ex. 1). The frames *Corroding caused*, *Cause to rot* and *Rejuvenation* describe change in the general condition of the Patient due to physical, chemical or other processes; while for the first two frames the change is associated with a deterioration in the Patient's general condition, the third one is implicitly associated with the recovery of a former better condition. The end state of the Patient in *Reshaping*, *Manipulate into shape* and *Arranging* is associated with a particular Configuration – shape or structure (ex. 2). Other frames describe change in the capacity of the Patient to perform its intended purpose, e.g. frames such as *Render nonfunctional*, or a change in the integrity which also leads to loss of functioning ability such as *Damaging* (ex. 3). In all cases the Patient is realised as the direct object of the verb.

(1) **Grinding; Core FEs:** Grinder | Grinding cause, Patient

[ ]GRINDER:CNI **Смелете** [бисквитите]WHOLE\_PATIENT:NP.Obj [на ситни трохи]RESULT:PP.

[ ]GRINDER:CNI **Grind** [the biscuits]WHOLE\_PATIENT:NP.Obj [into small crumbs]RESULT:PP.

(2) **Reshaping; Core FEs:** Deformer | Cause, Patient, Configuration

[Тя]DEFORMER:NP.Ext **разточи** [тестото]PATIENT:NP.Obj [на тънки кори]CONFIGURATION:PP.

[She]DEFORMER:NP.Ext **rolled out** [the dough]PATIENT:NP.Obj [into thin sheets]CONFIGURATION:PP.

(3) **Damaging; Core FEs:** Agent | Cause, Patient

[Силен удар]CAUSE:NP.Ext **може да повреди** [системата за автоматичен фокус на телефона]PATIENT:NP.Obj.

[A strong blow]CAUSE:NP.Ext **can damage** [the automatic focusing system of the mobile phone]PATIENT:NP.Obj.

Part of the verbs in this group describe a typically instantaneous transition between an initial and a result state (*break, burst*), while others

denote a gradual incremental change (*grind, rot, corrode*), etc. Even though the particular verbs are associated with a change in the integrity of the affected entity, the semantic, syntactic and aspectual properties vary according to the predicate.

## 2. Verbs of change of (measurable) inherent or acquired properties

The frames in this group involve an induced change of (measurable) properties, in particular a change in an inherent attribute of the affected entity or the acquisition of a certain property (entailed from the entity's attributes). The inherent properties may refer to the: magnitude of a context-specific attribute, e.g. *increase, raise*, etc., number (*multiply*) physical size or dimension (*expand, lengthen*), intensity (*heighten, deepen*), temperature (*cool, warm*), consistency (*thicken, thin*), phase (*melt, freeze*), colour (*brown, silver*), taste (*bitter, sweeten*), etc.

The invariant situations conceptualised by the relevant frames are described in terms of a configuration involving the following core frame elements (Figure 2): a sentient entity (an Agent) or possibly a non-human Cause that brings about the change in the affected entity and the affected entity itself (an Item, Patient or other, depending on the way it is affected). An explicit or more frequently implicit initial value (or state) at which the situation begins and a resultant value/state at which it ends may also be expressed. The change between the two may be construed as a (gradual) path along a multi-valued scale (ex. 4). The frame elements associated with the two end values/states are peripheral for the frames, i.e. not conceptually necessary, as they are dependent on the attribute. The attribute itself is usually not conceptualised as a separate frame element and is only implied through the properties of the affected entity; in the case of deadjectival verbs it is incorporated by the verb (ex. 5). The attribute is conceived as a core frame element only in the frame *Cause change of position on a scale*, which conceptualises a scalar change with a property that is specified in the context.

This prototypical schema may be elaborated across frames through specific configurations of core frame elements; consider, for instance, the correspondences between pairs of frame elements in (ex. 4) and (ex. 5): the Attribute is specified as (physical) Dimension and Value 1 and Value 2 are construed as Initial size and Result size, etc.

(4) **Cause change of position on a scale; Core FEs:** Agent | Cause, Attribute, Item

[Компанията]<sub>AGENT:NP.Ext</sub> **увеличи** [приходите]<sub>ATTRIBUTE:NP.Obj</sub>  
 [от 20]<sub>VALUE\_1</sub> [на 25 милиона]<sub>VALUE\_2</sub>.  
 [The company]<sub>AGENT:NP.Ext</sub> **raised** [its income]<sub>ATTRIBUTE:NP.Obj</sub>  
 [from 20]<sub>VALUE\_1</sub> [to 25 million]<sub>VALUE\_2</sub>.

(5) **Cause expansion; Core FEs:** Agent | Cause, Item

[Властите]<sub>AGENT:NP.Ext</sub> **разшириха**<sub>DIMENSION:INC</sub>  
 [пътя]<sub>ITEM:NP.Obj</sub> [с 1,5 метра]<sub>SIZE\_CHANGE [от 2]INITIAL\_SIZE [на 3,5 метра]RESULT\_SIZE.</sub>  
 [The authorities]<sub>AGENT:NP.Ext</sub> **widened**<sub>DIMENSION:INC</sub> [the road]<sub>ITEM:NP.Obj</sub> by [1.5 meters]<sub>SIZE\_CHANGE [from 2]INITIAL\_SIZE [to 3.5 m]RESULT\_SIZE.</sub>

Unlike the frames discussed in the previous section, the frames describing situations of acquiring a certain property usually do not entail a fundamental change in the form, integrity, function, etc. of the affected entity, or at least it retains its essential characteristics or chemical composition. The result of the state associated with the acquired property may be but is not necessarily a temporary (and/or possibly reversible) one (*dry/wet, sharp/dull*) (ex. 6). While the property that is obtained is not intrinsic to the affected entity, its acquisition is enabled by the traits it possesses; for instance, the Patients in the frame *Cause to be wet* need to be porous but not hollow objects.

(6) **Cause to be dry; Core FEs:** Agent | Cause, Dryee

[Извлечената отрова]<sub>DRYEE:NP.Ext</sub> **се изсушава** [до кристално вещество]<sub>RESULT:PP</sub>  
 [ ]<sub>AGENT:INI.</sub>  
 [The poison extract]<sub>DRYEE:NP.Ext</sub> **is dried** [to a powder]<sub>RESULT:PP</sub> [ ]<sub>AGENT:INI.</sub>

The classification of the frames involving change in a scalar property is illustrated in Figure 2. A substantial number of the verbs evoked by these frames are derived from adjectives denoting the particular property (ex. 6). The occurring change is construed as associated with a transition on a scale defined by the set of possible values of the property. In their typical interpretation, the predicates describe a process of change in a property inherent in or acquired by an entity that has a duration over time and is perceived as incrementally occurring<sup>3</sup>.

<sup>3</sup> The particular parameter that is used to measure the scale of the change is underlined in the frame's definition.

Verbs of change of measurable physical parameters	
Cause change of position on a scale	An <b>Agent</b> or a <b>Cause</b> affects the <u>position</u> of an <b>Item</b> on a <u>scale</u> (the <b>Attribute</b> ) to change it from an initial value ( <b>Value 1</b> ) to an end value ( <b>Value 2</b> ).
Cause proliferation in numbers	An <b>Agent</b> (or inanimate <b>Cause</b> ) affects a <b>Set</b> so that the <u>number of entities</u> that make up the <b>Set</b> changes from an <b>Initial number</b> to a <b>Final number</b> .
Cause change of consistency	An <b>Agent</b> or <b>Cause</b> changes the <u>consistency</u> of a <b>Patient</b> from its <b>Initial state</b> to a <b>Result</b> (within the same phase).
Cause change of phase	A <b>Cause</b> or <b>Agent</b> causes a <b>Patient</b> to undergo a change of <u>phase</u> .
Cause temperature change	An <b>Agent</b> or a <b>Cause</b> changes the <u>temperature</u> of an <b>Item</b> .
Cause change of strength	An <b>Agent</b> causes a <b>Patient</b> to be more <u>strong</u> , often resulting in something that is more secure and safe.
Cause expansion	An <b>Agent</b> or non-human <b>Cause</b> causes an <b>Item</b> to change its <u>physical size</u> .
Cause to be dry	An <b>Agent</b> or <b>Cause</b> causes a <b>Dryee</b> (either a surface or an entire entity, inside and out) to become <u>dry</u> .
Cause to be wet	An <b>Agent</b> or <b>Cause</b> causes a <b>Patient</b> to become <u>wet</u> with a <b>Liquid</b> (a liquid or a gas).
Cause to be sharp	An <b>Agent</b> or <b>Cause</b> makes a <b>Patient</b> <u>sharper</u> or <u>duller</u> .
*Cause change of color	An <b>Agent</b> or <b>Cause</b> makes a <b>Patient</b> change its <u>Color</u> .
*Cause change of taste	An <b>Agent</b> modifies the <u>taste</u> of some <b>Food</b> by adding spice or flavour, usually making it more palatable.
*Cause change of intensity	An <b>Agent</b> or a <b>Cause</b> affects the <u>intensity</u> of some <b>Attribute</b> of an <b>Item</b> to change it from an initial value ( <b>Value 1</b> ) to an end value ( <b>Value 2</b> ).

Figure 2. Verbs of change of (measurable) properties.

### 3. Verbs of creation

A set of principles can be derived for the consistent semantic description of verbs of creation as implemented in FrameNet through semantic frames. The generalised situation described by these predicates includes an Agent (a sentient participant) and a Created entity (an artifact). The semantic subclassification within the class (presented in Figure 3) is based on the type of the Created entity and, therefore, on the type of the process of creation and other elements of the situation (e.g. whether there are Components / Ingredients involved).

Creation verbs are typical incremental theme predicates (Dowty 1991), i.e. the change occurring as part of their meaning is measured out incrementally by the extent to which the entity undergoing the change is affected, that is, as a homomorphism from parts of the object to parts of the event (Krifka 1992). In this respect they differ from the verbs in the previous section, where the change is measured out along a multi-valued scale defined by a gradable property of the affected entity (lexicalised by the verbs).

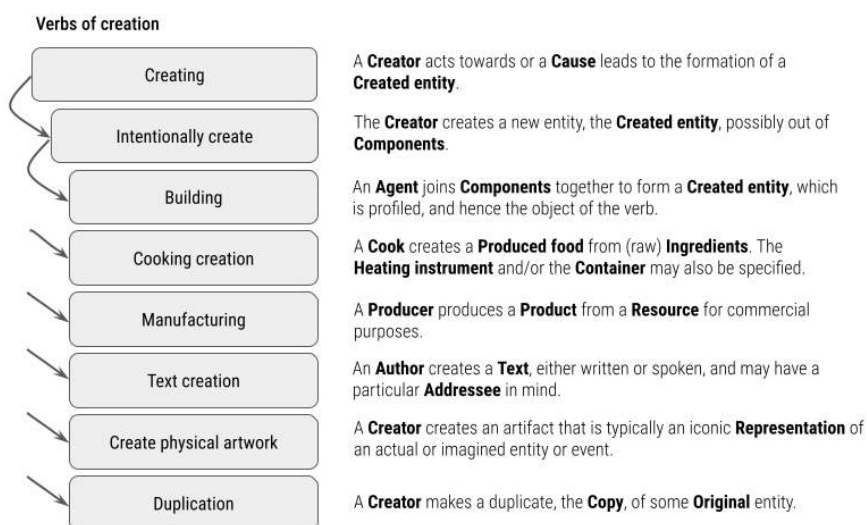


Figure 3. Verbs of creation

The scalability (incrementality) of the frame element Created entity is an essential semantic feature which to a great degree determines the syntactic realisation of the verb and the frame elements. The frames in Figure 3 are all characterised by an incremental Created entity coming into being but differ in terms of the type of the entity: *Building*, *Manufacturing* and *Create physical artwork* are associated with a physical object; for *Cooking creation* the Created entity (Produced food) has the special function to serve as food; *Text creation* involves a spoken or written text product; in the *Duplication* frame the Original and the Copy can be a physical object, text, image, etc. In all these cases the Created entity is associated with an assumed scale of existence along which the process of its creation proceeds incrementally, according to the defined homomorphism: in *Building* the progress of the situation is measured by the layers of components or the parts of the entity along any of the 3D axes (ex. 7), in *Cooking creation* it corresponds to the stages of the food's readiness from raw to fully cooked (ex. 8), etc.

(7) **Building; Core FEs:** Agent, Created entity, Components

[Te]<sub>AGENT:NP.Ext</sub> **строили** [кулата]<sub>CREATED ENTITY:NP.Obj</sub> [етаж по етаж]<sub>MANNER</sub>.

[They]<sub>AGENT:NP.Ext</sub> **built** [the tower]<sub>CREATED ENTITY:NP.Obj</sub> [floor by floor]<sub>MANNER</sub>.

(8) **Cooking creation; Core FEs:** Cook, Produced food

[ ]COOK:DNI **Изпичате** [два блатата]PRODUCED\_FOOD:NP.Obj [до зачервяване]DEGREE:PP.  
 [You]COOK:CNI **bake** [two cake layers]PRODUCED\_FOOD:NP.Obj [until golden brown]DEGREE:PP.

4. **Verbs of change through processing or manipulation**

The frames included in this category involve processing or manipulation leading to a change in the affected entity and the bringing about of a new state without altering the entity's structural integrity or essential traits and functions, e.g. *roast, grill, toast (Apply heat), shave, comb (Grooming)*. The change may also involve the acquisition of novel properties as a result of some treatment, e.g. *dye, galvanise, enrich (Processing materials)*<sup>4</sup>.

## Verbs of other types of change through processing and manipulation

Apply heat	A <b>Cook</b> applies heat to <b>Food</b> , where the <b>Temperature setting</b> of the heat and <b>Duration</b> of application may be specified.
Processing materials	An <b>Agent</b> alters some <b>Material</b> in some useful way by means of some chemical or physical <b>Alterant</b> .
Grooming	An <b>Agent</b> engages in personal body care by grooming either a <b>Patient</b> or a <b>Body part</b> .

Figure 4. Verbs of change through processing or manipulation

In general, many of the verbs evoking these frames, also specify an incremental change corresponding to the degree to which the object is affected (ex. 9 and 10).

(9) **Apply heat; Core FEs:** Cook, Food, Container, Heating instrument, Temperature setting

[ ]COOK:DNI **Варите** [яйцата]FOOD:NP.Obj [5 минути]DURATION:NP.  
 [You]COOK:NP.Ext **boil** [the eggs]FOOD:NP.Obj [for 5 minutes]DURATION:PP.

(10) **Grooming; Core FEs:** Agent, Patient, Body part

[Той]AGENT:NP.Ext **си беше избръснал** [брадата]BODY\_PART:NP.Obj [само наполовина]RESULT.AdvP.  
 [He]AGENT:NP.Ext **has shaved** [his beard]BODY\_PART:NP.Obj [only halfway]RESULT.AdvP.

<sup>4</sup> The list of frames belonging to this class is non-exhaustive and reflects the current stage of our research. The membership of some frames may be revised in the future, as needed.

## 6. Conclusions

The subclassification of the frames describing the verb lexis involving change according to the properties of the affected entity enables us to study more closely the semantic and syntactic behaviour of the respective verbs within and across the defined subclasses, including the syntactic realisation and morphosyntactic features of the affected entity, the aspectual interpretation of VPs headed by the studied verbs and their compatibility with *in-/for*-temporal phrases (used as telicity diagnostics), among others. It has been well-known that even within the class of incremental verbs there is an internal division in terms of the aspectual interpretation of VPs (Krifka 1992, Filip 2008), and that many predicates specified as non-strictly incremental may alternate between a telic and an atelic interpretation (cf. for instance Kratzer 2004), a feature typically associated with scalar verbs and uncharacteristic for strictly incremental verbs. This shows that the nature of the affected entity (and the type of change affected upon it), is closely tied to and may shed light on the semantic, syntactic and aspectual properties of the predicates. To the best of our knowledge, a thorough within- and cross-categorical study of the different classes of verbs has yet to be undertaken for Bulgarian.

Furthermore, as the semantic representation in terms of frames and the selectional restrictions defined for frame elements are to a great degree language-independent, this conceptual framework enables the carrying out of contrastive research both into the universal and the language-specific parameters of semantic description, syntactic expression and aspectual properties. The proper encoding of the semantic properties of the entity undergoing the change, in particular its incrementality, as well as the semantic properties of other relevant frame elements, may facilitate the study of the aspectual classes of verbs and, moreover, may enable the transfer of information to other low-resourced languages lacking such lexical semantic resources.

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## Ка класификацији предиката активности који означавају промену

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### Sažetak

Основни циљ овог рада је да понуди оквир за опис семантичких својстава предиката активности (динамичких предиката) који означавају промену, са примарним фокусом на својство које трпи промену. У овом раду активност се схвата у најширем могућем смислу и укључује различите класе динамичких предиката.

Опис глагола промене заснива се на неколико кључних семантичких карактеристика и обухвата лексичко значење глагола и семантичку класу којој припада, тип промене (узрочна или инхоативна), карактеристике промене (квантна или не, постепена или тренутна), као и релевантне елементе семантичког оквира у *FrameNet*-у (Baker and Fellbaum 2009; Ruppenhofer *et al.* 2016). Студија се базира на семантичким класификацијама глагола које су претходно чврсто успостављене у принстонском *Wordnet*-у (Miller 1995), као и у бугарском *Wordnet*-у (Koeva 2021).

На основу издвојених семантичких карактеристика биће понуђена и тзв. „плитка” класификација глагола промене, са циљем да се обухвате бројне различитости унутар класе и предложи адекватан приступ моделирању њиховог синтаксичког понашања. Класификација је заснована на оквирима из *FrameNet*-а, који групишу глаголе на основу сличних концептуалних својстава и сличног синтаксичког понашања. Сматра се да семантичка својства предиката у великој мери одређују његову синтаксичку реализацију тако што евоцирају одређени семантички оквир, те конфигурацију елемената унутар оквира, као и модус њихове (морфосинтаксичке) експресије.

Наши налази засновани су на аутоматски издвојеним и мануелно одабраним илустративним примерима из бугарског и енглеског језика. Примери и анотација за енглески позајмљени су из корпуса *FrameNet*, док су бугарски ручно анотирани. За оба језика подаци су допуњени примерима из других корпуса, уколико је то било потребно.

**Анотирани пример:**

FRAME: Cause\_expansion; Default: [causal gradual change]  
[Universitetat]<sub>AGENT</sub> postoyanno **razshirya** [uchastieto si v kulturniya zhivot]<sub>ITEM</sub>.  
[The University]<sub>AGENT</sub> constantly **expands** [its participation in the cultural life]<sub>ITEM</sub>.

FRAME: Cause\_temperature\_change; Default: [inchoative gradual change]

[Plamnaloto i litse]<sub>ITEM</sub> **se ohladi** [ot ledenata voda]<sub>CAUSE</sub>.  
[Her flushed face]<sub>ITEM</sub> **cooled** [by the chill water]<sub>CAUSE</sub>.

У раду су истражени универзални аспекти концептуалног знања који омогућавају пренос семантичких и синтаксичких информација унутар различитих језика и ресурса. Конфигурација елемената оквира који одређује понашање глагола (евоцирано одређеним оквиром) независна је од језика, као што су то и семантичка ограничења која детрминишу њихову селекцију.

Констелације елемената оквира које добијају синтаксичку експресију међусобним комбиновањем елемената (тзв. „валентни обрасци”, у терминима *FrameNet-a*) махом су валидне и важе у различитим језицима, као што је потврђују подаци за енглески и бугарски. Такође постоји и јасна кореспонденција између синтаксичких категорија и синтаксичких функција елемената унутар семантичких оквира у ова два језика.

Уз то, на основу емпиријске грађе из корпуса анализирана су и специфична својства, као и разлике у синтаксичком и семантичком опису између енглеског и бугарског. Размотрени су случајеви у којима се у ова два језика на различит начин, или на различитим синтаксичким позицијама реализују одређени елементи семантичког оквира. Добијени налази могу бити од значаја и за друге словенске језике који показују уочене граматичке посебности.

**Кључне речи:** глаголска семантика, семантика оквира, аспектуалне класе, предикати активности, глаголи промене