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SEMANTIC RELATIONS BETWEEN VERBS IN POLISH WORDNET 2.0

Abstract

The noun dominates wordnets. The lexical semantics of verbs is usually under-represented, even if it is essential in any semantic analysis which goes beyond statistical methods. We present our attempt to remedy the imbalance; it begins by designing a sufficiently rich set of wordnet relations for verbs. We discuss and show in detail such a relation set in the largest Polish wordnet. Our design decisions, while as general and language-independent as possible, are mainly informed by our desire to capture the nature and peculiarities of the verb system in Polish.

Keywords: wordnet, semantic relations, verbs, Polish

In most wordnets, nouns take centre stage. Verbs are a distant second when it comes to the size of the vocabulary and the repertory of semantic relations. It would also appear that applications of wordnets tend to revolve around the nominal part of the network. Among anything else, people seem to find it easier to classify entities (all that nouns denote) than situations (all that verbs represent in texts). The first release of Polish Wordnet, plWordNet 1.0, was no exception. Yet any non-trivial semantic analysis — and certainly any deep analysis — of natural languages can only benefit from a rich and carefully designed description of the verbal part of a wordnet.

There is a fundamental restriction on the nature of wordnet relations: they must stay within the confines of lexical semantics. Predicate-argument relations,

for example, are beyond the scope of a wordnet. It is a separate challenge to find the right granularity. There exist verb classifications with hundreds of classes; Levin's work (1993) is a classic example. That would be hard to generalise and even harder to encode manually in a large wordnet. On the other hand, we aim for a relation set large enough to cover, perhaps not always in a very subtle way, most of the lexical-semantic variety among verbs.

Another restriction is to do with language specificity. Typologically different languages appear to require slightly different relation sets; compare for example Princeton WordNet (Fellbaum 1998) and EuroWordNet (Vossen *et al.* 1998). For the needs of plWordNet 2.0, we have investigated the existing relation sets from the standpoint of Polish inflectional and derivational morphology, Polish lexicographic tradition and, no less important, the interplay between culture and language.¹

We present a system of lexico-semantic relations among verbs, designed to underlie the description of verbs in the Polish Wordnet. We propose a set richer than typically used in other wordnets, general enough to be applicable to similar languages, yet close to the Polish linguistic tradition.

To decide what granularity works best, we need clear criteria. Motivated by the lexicographic and semantic tradition, we have adopted several heterogeneous criteria, which we order by importance. A relation merits inclusion in plWordNet 2.0 if:

- it has appeared in the theory and practice of lexicography (so we do not invent new names unnecessarily);
- its instances are relatively frequent in the vocabulary (so we do not overburden the system for the sake of very rare phenomena);
- it plays a role in the general semantic and lexicographic reflection on the verb in Polish;
- it looks promising for the expected applications in automated processing of natural language;²
- it has been adopted in other wordnets (so portability between wordnets is possible).

As a starting point, we took the set of verb relations from plWordNet 1.0, summed up in Table 1.

For plWordNet 2.0 we propose a much richer set of relations. The list appears in Table 2. A detailed rationale and description follow in sections 3 and 4 of the paper.

¹The use of diminutives, for example, differs across languages, and so does the attitude toward obscenity.

²This is a prime consideration, but not at all easy to apply, given that it is users who decide how a wordnet will or will not be applied.

I. Purely semantic relations	II. Derivationally-motivated relations
Synonymy hyponymy and hypernymy* antonymy [◇] converseness [◇] entailment [◇]	relatedness [◇] pertainymy [◇] troponymy [◇]

[◇] marks a relation between lexical units, * between synsets.³

Table 1. Verb relations in plWordNet 1.0

1. Aspect

Aspectuality is key to the understanding how the verbal network of lexico-semantic relations is structured. Aspect divides Polish verbs into three groups: perfective, imperfective and bi-aspectual verbs; the latter are rare (Mędak 1997). We distinguish pure aspectual pairs from a relation which associates secondary aspectual pairs; this is covered by a *test of secondary imperfectivization*.⁴ An aspectual verb pair consists of a base word and its derivative, produced by affixes.

I. Purely semantic relations	II. Derivationally-motivated relations
Synonymy inter-register synonymy* hyponymy and hypernymy* meronymy and holonymy* complementary antonymy [◇] (proper) antonymy [◇] converseness [◇] state* processuality* causality* inchoativity* presupposition* preceding* fuzzynymy*	pure aspectuality [◇] secondary aspectuality [◇] derivationality [◇] cross-categorial synonymy [◇] iterativity [◇] role inclusion [◇]

Table 2. Verb relations in plWordNet 2.0

³According to Piasecki *et al.* (2009), a relation holds between two synsets if it holds between every two lexical units from these synsets.

⁴In Polish: *test wtórnej imperfektywizacji*. The English term *secondary imperfectivization testis* used by Młynarczyk (2004), the imperfectives derived via suffixation from the perfectives are called *secondary* and the imperfectivization is called *secondary imperfectivization* (Ramchand 2008: 1691–2; van Hout 2008: 1743; Pereltsvaig 2007: 1127; Nikolova, Jarema 2004: 351, 353–4, 359).

The test is as follows:

- X is PERFECTIVE, Y is IMPERFECTIVE.
- X and Y are an aspectual pair.
- X has no imperfective derivatives other than possibly Y.
- The semantic difference between the two is only in aspect.

Pairs such as *napisać* ‘write_{perf}’ — *pisać* ‘write_{imperf}’ pass this test (the form **napisywać* would be incorrect), *pisać* and *napisać* have almost the same meaning except the aspect. The test fails for pairs such as *przepisać* ‘copy_{perf}’ — *pisać* (there is another derivative: *przepisywać* ‘copy_{imperf}’, there is also some inconsistency of meanings). Pairs of the first type are called *pure aspectual* pairs, while the other type are called *secondary aspectual* pairs⁵ or *lexico-aspectual pairs* (Laskowski 1998: 167). Among secondary aspectual pairs we also list associations of perfective verbs, such as accumulatives, distributives, delimitatives, with their derivational bases; they pass the test of secondary imperfectivisation, but differ semantically more than only in aspect.

Aspect is a key feature in the system of verb relations in plWordNet 2.0. Most relations are constrained to verbs of the same aspect. The exceptions are meronymy/holonymy, inchoativity and distributivity (see the respective sections for details).

Domains for nouns, verbs and adjectives assumed in plWordNet 1.0 have been borrowed, with slight modifications, from WordNet 1.5 (where they correspond to the so called “lexicographic files”). Domains were not interpreted semantically in plWordNet 1.0. They played an ancillary role, in particular to facilitate assignment of work to linguists.

For the needs of the verbal part of plWordNet 2.0, we introduced a new set of domains based on the typology of verbs proposed by Laskowski (1998: 152–166).⁶ His categorization seems better to fit the specific features of Polish. He divides Polish verbs into classes according to *situations*⁷ denoted by them: *states*, *activities*, *events*,⁸ *accidents*, *actions*,⁹ *processes* and *acts*¹⁰ (Laskowski 1998: 155–

⁵It is worth noticing that pure aspectual pairs pass the test of secondary imperfectivization, while secondary aspectual pairs do not.

⁶Laskowski’s typology is an adaptation of Vendler’s categorisation to the characteristic features of Polish (Stawnicka 2009).

⁷The term *situation* is widely used in contemporary linguistics (Comrie 1989: 13; Dahl 1985: 27). «In discussing aspect, it is often necessary to refer to the differences between states, events, processes, etc. (...). However, while ordinary nontechnical language provides, with a limited amount of systematisation, a metalanguage for these various subdivisions, it does not provide any general term to subsume them all. In the present work the term ‘situation’ is used as this general cover-term, i.e. a situation may be either a state, or an event, or a process» (Comrie 1989: 13).

⁸States, activities and events are *imperfectiva tantum*.

⁹Actions and accidents are *perfectiva tantum*. They denote *punctual situations*. «It should be noted that the crucial point here is that punctual situations do not have any duration, not even duration of a very short period. Thus a punctual, by definition, has no internal structure of a situation, then clearly punctuality and imperfectivity will be incompatible. (...) punctuality is a valid linguistic category» (Comrie 1989: 42). The idea is identical with Laskowski’s understanding of punctuality (Laskowski 1998: 163–5).

¹⁰Processes and acts are telic verbs (Laskowski 1998: 161). «The term ‘telic situation’ corre-

6). In a slight modification of his typology, we introduce *distributives*, *delimitatives*, *accumulatives* etc. as a separate class of dynamic + change of state + atelic + non-momentary verbs (Wróbel 1998).

Domains are still an auxiliary tool for linguists, but we now correlate them more directly with the wordnet structure. Some lexico-semantic relations are associated with specific selected domains; for example, pure aspectuality is reserved for actions and processes (telic verbs), and *perfectiva tantum* and *imperfectiva tantum* link via secondary aspectuality (cf. Laskowski 1998: 167).

2. Semantic similarity relations

The first group of relations between verbs are those which capture various kinds of semantic similarity. Those are: synonymy, inter-register synonymy, hyponymy, hypernymy and cross-categorical synonymy. They are differentiated by several criteria, notably by aspect and domain.

2.1. Synonymy

Synonymy in plWordNet 2.0 is constrained to verbs of the same aspect, belonging to the same domain. It is close to semantic identity, but we do not interpret the

sponds to the term 'accomplishment' used, for instance, by Vendler (1967: 102). The term 'telic' was apparently introduced by Garey (1957) (Ancient Greek τέλος 'end')» (Comrie 1989: 44).

identity condition as *absolute synonymy*, which is rare in language (Gouws 1996: 118–120; Lyons 1995: 60–3). We want to narrow the term *synonymy* to cover pairs of words with the same denotation but possibly different connotation, pairs whose stylistic registers coincide or differ insignificantly. Synonymy so defined resembles both absolute synonymy and near-synonymy (Svensén 2009: 214–5).

Our tests for the relation only partially guarantee that those conditions — close similarity of denotation and register — are fulfilled. As in the case of nominal synonymy in plWordNet (Piasecki *et al.* 2009), the most important criterion is the placement of the pair of synonymous verbs in the network of lexico-semantic relations.¹¹ It is crucial whether the verbs share hypernyms and hyponyms.

2.2. Inter-register synonymy

Inter-register synonymy relaxes one condition on synonymy: stylistic registers of such inter-register synonyms differ significantly. The reference to this difference is a consequence of the basic requirement that synonyms in plWordNet be identically connected to the network of synset relations. Verbs in different registers cannot meet this requirement. If a verb has several synonyms and inter-register synonyms, they all have the same hypernym, but those synonyms and inter-register synonyms must have different hyponyms. The significant difference in the stylistic registers results in different directions of the hyponymic links. Inter-register synonyms of a verb are differentiated from its co-hyponyms¹² by the fact that co-hyponyms have different denotational meaning while inter-register synonyms vary only in their pragmatic meaning — in stylistic register value. Tests for inter-register synonymy defined in plWordNet 2.0 cover this difference.

- X and Y do not significantly differ in their registers
- to X_{inf} is to Y_{inf}
- to Y_{inf} is to X_{inf} .

Similarly to synonymy, inter-register synonyms must have identical aspect and the same domain.

2.3. Hyponymy/hypernymy

Synonymy, the phenomenon which underlies synsets, determines locally the nodes of the network of relations. It is hypernymy and its flip side, hyponymy, which are responsible for defining the skeleton of the whole network. Hypernymy can, in fact, be seen as a more fundamental wordnet relation. Mutual hyponymy is a plausible restatement of both synonymy and inter-register synonymy, the latter to the extent of the difference in registers.

Identification of hyponymy for verbs is significantly more difficult than for nouns. Wordnet designers often deny its independent existence or usefulness in

¹¹The placement is the set of synset relations — other than derivationally motivated relations — in which the given verb participates.

¹²«The set of terms which are hyponyms of the same superordinate term are **co-hyponyms**, e.g. flute, clarinet, trumpet» (Crystal 2003: 222).

the system of lexico-semantic relations among verbs (Fellbaum 1998). It is claimed that verbal hyponymy is always encompassed by forms of entailment. We have decided to retain hypernymy and hyponymy, following the practice of plWordNet 1.0 (Piasecki *et. al.* 2009). Naturally, we need a reliable test:

- to X_{inf} is to Y_{inf} in a special way, somehow

(Wordnet entry authors are instructed to seek expressions of “special way” in adverbial phrases of manner.) The test is structured as a classical definition:¹³ *definiendum* / linking expression / *definiens*, the latter further divided into *genus proximum* (GP) and *differentia specifica* (DS).

The expression *in a special way, somehow* describes generically the manner in which an activity is performed or a situation occurs. The expression is meant to activate in the mind of a linguist a *differentia specifica* for the activity which the verb represents. The structure of the test can be illustrated by the following dictionary entries:

- $\text{biec} \ll [\text{posuwać się}]_{GP} [\text{naprzód za pomocą szybkich ruchów nóg, szybkich skoków}]_{DS} \gg$ (USJP¹⁴)
run $\ll [\text{move}]_{GP} [\text{forward by means of quick movement of legs, quick jumps}]_{DS} \gg$
- $\text{przemaalowywać} \ll [\text{malować}]_{GP} \text{ coś } [\text{po raz drugi, na inny kolor}]_{DS} \text{ lub } [\text{malować}]_{GP} \text{ coś } [\text{powtórnie, w inny sposób}]_{DS} \gg$ (USJP)
repaint $\ll [\text{paint}]_{GP} \text{ something } [\text{for the second time, in a different colour}]_{DS} \text{ or } [\text{paint}]_{GP} \text{ something } [\text{once again, in a different way}]_{DS} \gg$

A hyponym and its hypernym must have the same aspect. This means that verbs are divided into two separate hypernymy hierarchies: perfective and imperfective. They are interlinked by the aspectuality relation. Bi-aspectual verbs can belong to both sub-hierarchies.

A hyponym and its hypernym must also belong to the same domain.

¹³ «The classical definition formula (...) is used to explain the meaning of a word or phrase by reference to a generic term (GENUS PROXIMUM) and at least one distinguishing feature (DIFFERENTIA SPECIFICA)» (Hartmann, James 2001: 6).

¹⁴USJP — Dubisz, S. (ed.). *Uniwersalny słownik języka polskiego*[Universal Dictionary of the Polish Language], electronic version 0.1, PWN.

2.4. Cross-categorial synonymy

Synonymy need not be restricted to lexemes of the same part of speech. Some linguists extend it to pairs of words belonging to different parts of speech (Apresjan 2000: 54–55). According to some scientists, the deep semantic structure is not differentiated with respect to parts of speech; this claim was first formulated by Russell (1940).

We recognize *cross-categorial synonymy*, in compliance with the wordnet tradition. The relation links, among others, verbs with:

- gerunds — names of actions, processes and states created in a regular, systematic way by suffixes *-anie*, *-enie*, *-cie*,¹⁵
- imperfective adjectival participles created from imperfective verbs by the suffix *-ąc*,
- adjectives derived from state verbs (e.g., *żyć* ‘live’ > *żywy* ‘alive’).

3. Semantic contrast relations

Relations of semantic contrast encompass all types of semantic word associations characterised by some element of semantic opposition. Associations of this type — following Lyons — have been grouped in plWordNet 2.0 into three lexico-semantic relations: complementary antonymy, proper antonymy and converseness (Lyons 1977: 279–280).

We distinguish two types of antonymy. All instances of antonymy must pass a test of the form:

- $X \Rightarrow \sim Y$.

Complementary antonymy also requires a test of the form (Lyons 1995: 401):

- $\sim X \Rightarrow Y$.

Such generic tests, however, are too crude. An unrestricted statement “If she/it X, then she/it does not Y” holds for pairs not linked by antonymy (Lyons 1981: 154–5). One example should suffice:

If she eats, then she does not sleep.

While clearly one does not eat in one’s sleep, there is no clear opposition here, nor is there ontological closeness between eating and sleeping. In our test, opposition is overtly marked with the adverb *przeciwnie* ‘contrariwise, conversely’ (Cruse 1997: 257). Thus:

- Does she/it X? On the contrary, she/it Y.

Semantic proximity is ensured by this condition:

¹⁵*Nomina actionis* created in irregular derivational processes (i.e., without affixes *-anie*, *-enie*, *-cie*) are also described in plWordNet by cross-categorial synonymy, although «they are often semantically irregular» (Grzegorzczkowska, Puzynina 1998: 393–8).

- X and Y share a hypernym or a holonym.

Lexical converseness,¹⁶ a specific relation of semantic opposition, relies on the exchange of verb arguments: expressions built on converses become synonymous when one exchanges the actants of predicates (Apresjan 2000: 241–65). For example, the multiword predicate *wchodzić w skład (czegoś)* ‘be a part (of something)’ opens two argument positions (*A* is a part of *B*). It is the converse of the predicate *składać się (z czegoś)* ‘consist (of something)’. Indeed: *B* consists of *A* = *A* is a part of *B*.

In plWordNet 2.0, we systematically describe only two-argument converses. That is because the difficulty of applying the test in practice increases as the number of argument exchanges grows. Three- or five-argument converses, by the way, seem very infrequent (Apresjan 2000: 250–1).

Both antonyms and converses must have the same aspect and belong to the same domain.

4. Meronymy/holonymy

Troponymy in WordNet 3.0 covers verb pairs which can equally well be seen as meronyms (Fellbaum 1998). In fact, troponymy and verb meronymy seem to coincide to a large extent. In plWordNet 1.0, troponymy was meant to link selected aspectual pairs (Piasecki *et al.* 2009). We have extended the number and definitions of aspectual relations in plWordNet 2.0, so troponymy for a subclass of aspectual pairs is no longer adequate or necessary. Instead, we have introduced a verb relation of meronymy, a natural extension of the system of noun meronymy and holonymy onto verbs. There are two subtypes: *sub-situation* and *accompanying situation*.

Entities which are not monolithic can be perceived as consisting of smaller parts, element, components etc. We apply this inclusion perspective and analysis to *situations* described by verbs. We perceive situation *S* as potentially consisting of constituent situations co-existing or temporally included in *S*. Native speakers, in virtue of hearing the given verb, prominently and permanently perceive some situations as accompanying *S*. We use here the term *situation* in the sense given to it by Laskowski (1998: 155–6; see also Comrie 1989: 13; Dahl 1985: 27): ‘a denotation of a given verb phrase’.

Meronymy and holonymy of sub-situation associate a composite situation and its component. There is “temporal inclusion” between the component and the whole. While this is a simplified view of temporal dependencies — see Allen (1983) for a thorough analysis — it is sufficient for our purposes.

Meronymy and holonymy of accompanying situation accounts for a “primary” situation, represented by the holonym, typically supplemented by another situation, represented by the meronym.

Here is the core test for meronymy, the sub-situation type:

1. The situation represented by *X* is part of a typical situation represented by *Y*.

¹⁶The term *converseness* is widely accepted among linguists (Crystal 2003: 109).

2. From the fact that she/it *X*, we can conclude that she/it *Y*.

Condition (1) ascertains a part/whole dependency. Condition (2) narrows it down by requiring that the dependency be obligatory. If both conditions hold for a verb pair, the sub-situation must be part of the primary situation: it is not possible for a native speaker to think about the sub-situation and not to think about the primary situation. Let us consider an example:

skręcać «(o pojeździe) zmieniać kierunek jazdy» (USJP)
turn «(of a vehicle) change the direction of motion».

This is a sub-situation meronym of:

jechać «(o pojeździe) poruszać się»
run «(of a vehicle) move».

That is because, when applied to vehicles, *skręcanie* ‘turning’ is a typical constituent of *jechanie* ‘running’.

The test for holonymy, the sub-situation type, is analogous:

1. The situation which *Y* represents is an integral part of the situation which *X* represents.
2. From the fact that she/it *X*, we can conclude that she/it *Y*.

A good example is *jeść* ‘eat’ — *przetykać* ‘swallow’. While it is true that *przetykanie* ‘swallowing’ can be part of processes other than eating, such as *picie* ‘drinking’, we cannot imagine anyone eating without swallowing.

An accompanying situation is not a necessary part of the primary situation, but the two may co-exist. For example, *chrapanie* ‘snoring’ accompanies *spanie* ‘sleeping’.¹⁷

The test for meronymy is as follows:

- The situation which *X* represents accompanies (may meaningfully accompany) the situation which *Y* represents.
- From the fact that she/it *X*, we can conclude that she/it *Y*.

The test for holonymy is symmetrical. Meronyms and their holonyms need not have the same aspect or belong to the same domain.

5. State relation

Semantic similarity relations (synonymy, inter-register synonymy and hypernymy) together with semantic opposition relations (antonymy and converseness), aspectuality and meronymy are not enough to describe the rich semantics of verbal

¹⁷It would appear that snoring only happens in sleep, as witnessed by this dictionary definition: *chrapać* «wydawać podczas snu świszczący, charkotliwy dźwięk, zbliżony do brzmienia głosek: chr» *snore* «emit, during sleep, a wheezy, hoarse sound, similar to the sound: chr» (USJP).

lexemes. It is necessary to extend this basic set of *lexical functions*¹⁸ with additional relations. One of the proposed new relations is called *state, being in state*. In Karolak's theory of aspect, predicates of state are semantically simple: they share the meaning 'being in state' (Karolak 1996/2001: 576).¹⁹

Our state relation links *state verbs* (Laskowski 1998: 154) which represent static situations (or *states*, Vendler 1957: 152) with adjectives and nouns which describe this state. For example, *władać* ('to rule') means «*być panem, władcą* ('to be a ruler')»; *czzerwienić* («*mieć czerwony kolor, odróżniać się od tła czerwonym kolorem; czzerwienić się*, 'to have red colour, be discriminated from the background by red colour, to redden' (USJP)») means «*być czerwonym* 'to be red'»²⁰. In Polish there are denominal and deadjectival transposition derivatives²¹ which resemble our statives (the derivatives are called stative formations, see Wróbel 1998: 570, 575–6). Note that we do not limit the stative relation to morphosemantically related words.

6. Process, cause and inchoativity relations

Processives, verbs which denote spontaneous change of state or any dynamic situation, belong to *accidents* (perfective) and *processes* (perfective/imperfective) [note the typo] (Laskowski 1998: 155–6). The process relation connects verbs with nouns and adjectives. As in derivational *processual formations* (Wróbel 1998: 570–1, 576–7), processives can be paraphrased by the word *stać się/stawać się* 'become':

- *zaczzerwienić się* 'to redden (*perf.*)' = *stać się czerwonym* 'to become red' (V — Adj);
- *chamieć* '≈ to become a boor (*imperf.*)' = *stawać się chamem* 'to become a boor (*imperf.*)' (V–N).

Although parallel to the phenomena present in word formation, *process* is not necessarily a derivational relation. Consider synonyms of *cham* 'boor' — we will find many in plWordNet, for example, *wieśniak* 'peasant' or *gbur* 'lout'. They could be used in the definition of *chamieć* instead of *cham* (become *gbur*, *wieśniak*).

In the Polish vocabulary, processives must be very common: *stawać się* is a key word in SWJP²² definitions (first rank among verbs — Piotrowski 2001: 148), and USJP employs the words *stawać się* and *stać się* in definitions 710 times and 976 times respectively.

¹⁸A lexical function is a mapping between lexical spaces $f: L \rightarrow L$ (Mel'čuk, Polguère 1987; Apresjan 2000: 54). We identify here lexico-semantic relations with lexical functions.

¹⁹Karolak's point of view is complementary with Laskowski's typology of situations (states — non-states). «The distinction between states and dynamic situations is one that seems reasonably clear intuitively, and in practice one finds a large measure of agreement between individuals who are asked to classify situations as static or dynamic, and similarly between languages that have overt correlates of the static/dynamic distinction» (Comrie 1989: 48; see also: Dahl 1985: 28–9).

²⁰Another meaning of *czzerwienić* is 'to become red' (USJP).

²¹Derivatives without any loss or change of the meaning of the base.

²²SWJP (1996) — Bogusław Dunaj (ed.). *Słownik współczesnego języka polskiego*, Warszawa.

Causatives belong to *acts* and *actions* in Laskowski's typology (Laskowski 1998: 155–6): they denote dynamic, intentional and telic situations. In our system, however, a causative could refer to unintentional telic and punctual situations as well (*accidents* and *processes*). For instance, *spowodować* 'to cause' has two interpretations in the following contexts:

- intentional interpretation —
Jan spowodował ogólne zamieszanie swoją prowokacją;
 'Jan caused general confusion (with) his provocation_{instr}'
- unintentional interpretation —
Rozłam Słowiańszczyzny spowodował najazd mongolski w roku 1223.
 'Split (of) Slavdom_{gen} caused Mongolian invasion in year 1223.'

The **cause** relation is of great significance in semantics (Frawley 1992: 158–170). It is a form of entailment (Pustejovsky 2001: 24; Gutiérrez-Rexach 2003: 267). Causativity is one of the lexical functions in the Sense $\Leftrightarrow$ Text Model (Apresjan 2000: 57–8).

In dictionary definitions, the relation is usually signalled by the verbs (*s*)*powodować* / *sprawi(a)ć* 'cause' (perf. and imperf.). For example, in SWJP these words are key words (*powodować* 2nd rank among verbs, *sprawić* 5th rank — Piotrowski 2001: 148). In USJP, *powodować* was used 494 times, *spowodować* 602 times, *sprawić* 202 times, *sprawić* 202 times. In wordnets, causation sometimes has its own relations (Fellbaum 1998: 83–84; Vossen *et al.* 1998: 94, 96).

We associate causatives with other verbs, adjectives and nouns. Examples follow:

- *zabić* 'to kill (perf.)' = *spowodować, że ktoś umrze* 'to cause that someone dies' (V — V);
- *suszyć* 'to dry (imperf.)' = *powodować, że coś schnie* 'to cause that something is drying' (V — V);
- *zmniejszać* 'to reduce the size of something (imperf.)' = *powodować, że coś staje się mniejsze* 'to cause that something shrinks' (V — Adj);
- *ukoronować* 'to crown (perf.)' = *spowodować, że ktoś stanie się królem* 'to cause that someone will become king' (V — N).

Deadjectival and denominal verbs could be paraphrased as follows:

X-ować to (s)*powodować, że ktoś/coś staje się* Y_{ADJ} (lub Y_N)
 'to X is to cause that someone/something becomes Y_{ADJ} (or Y_N)

Causative formation in Polish morphology has similar paraphrases (Wróbel 1998: 571–3, 577), but our class is broader, and it is purely semantic.

Inchoativity is claimed to be a kind of action (*Aktionsart*, Karolak 2001: 638). Perfective inchoatives denote *acts* and *accidents* (Laskowski 1998: 167–9), their secondary aspectual pairs ('*zaczynać*') should belong to *activities* and *events*. We do not distinguish between inceptive («the beginning of action» Bright 1992: 145)

and inchoative verbs («entrance into state» Bright 1992: *ibid.*). Both inceptive and inchoative verbs are called inchoatives (Crystal 2003: 36, 229) and describe either entering into a state or beginning an action. *Incep*, a lexical function in the Sense $\Leftrightarrow$ Text model (Apresjan 2000: 58), contains both inchoative and inceptive relations. In USJP, verb *zacząć* appears 224 times, *zaczynać* — 117 times. Examples:

- *zapalić się* ‘to light (perf.)’ = *zacząć się palić* ‘to start burning’ (V — V);
- *zasypiać* ‘to fall asleep (imperf.)’ = *zaczynać spać* ‘to begin to sleep’ (V — V).

7. Presupposition and preceding

The relations of *processuality*, *causality* and *inchoativity* refer to associations among situations which involve some aspect of *causing* and *making*. *Presupposition* and *preceding* express the backward-going dependency between a situation represented by the given verb and a situation whose occurrence is a kind of precondition. Both differ according to the level of necessity of the precondition. *Presupposition* makes the precondition mandatory if there is to be a meaningful interpretation of the given verb (Allan 2001: 204; Gutiérrez-Rexach 2003: 102 i 105)²³. The precondition must occur regardless of the negative polarity of the sentence with the given verb, that is to say, we cannot use the given verb meaningfully in an affirmative or negative sentence if the presupposition is not fulfilled (see examples below).

The *preceding* relation treats the precondition as desirable. It holds in many situations, native speakers consider it natural, but it is not mandatory.

The properties of presupposition dictate the following tests:

[Presupposition X presupposes Y]

- *Jeżeli stwierdzamy, że X-ował, oznacza to, że musiał wcześniej Y-ować.*
‘If we state that she/it X_{past} , it means that she/it must have earlier $Y_{pastParticiple}$ ’.
- *Jeżeli stwierdzamy, że nie X-ował, to też oznacza, że musiał wcześniej Y-ować.*
‘If we state that she/it not X_{past} , it also means that she/it must have earlier $Y_{pastParticiple}$ ’.
- *Prawdziwość stwierdzenia, że wcześniej Y-ował jest warunkiem koniecznym, aby sensownie stwierdzić, że X-ował czy też nie X-ował.*
‘The truth of the statement that “she/it must have $Y_{pastParticiple}$ before” is

²³ «Another important respect in which words can be related is through entailment and presupposition. Although there is no complete agreement on how to define these relations, one fairly established distinction is the following. An expression A semantically entails an expression B if and only if every situation that makes A true, makes B true. On the other hand, A semantically presupposes B if and only if both (a) in all situations where A is true, B is true, and (b) in all situations where A is false, B is true» (Pustejovsky 2001: 24). Presupposition offers an opportunity to formulate an alternative definition of *inchoativity*: according to ter Meulan (ter Meulan 1995: 19–20) inchoatives are the only verb class which does not have any presupposition.

a necessary precondition for saying meaningfully whether she/it X_{past} or not X_{past} .

For example, *umrzeć* ‘to die’ presupposes *żyć* ‘to live’ because in order to die someone must have earlier lived (to not die also presupposes to have lived earlier).

The *preceding* relation is based on a similar scheme of dependency, but the element of necessity is weakened. *Preceding* is based on the sense of typicality of a precondition for the given verbs for native speakers. For example, *tańczyć* ‘to dance’ is in the *preceding* relation with *ruszać się* ‘to move’. There are different forms of dancing, so moving is not necessary for dancing, but most native speakers will initially point to moving as a precondition of dancing. *Preceding* can be informally described as a naïve form of presupposition or improper form of presupposition. This is expressed in the test:

[**Preceding** Y is in the *preceding* relation with X]

- *X nie presuponuje Y* ‘X does not presuppose Y’
- *Jeśli ktoś/coś X-uje, to wcześniej Y-ował oraz istnieje tylko kilka Z, które mogą zastąpić Y w tym teście.*
‘If she/it X_{pres} , then ‘she/it Y_{past} previously and there are only a few verbs Z which can replace Y in this test.’

For example:

- *wstać* ‘to stand up’ and *siedzieć* ‘to sit’ are not derivationally linked,
- *wstać* does not presuppose *siedzieć* — it is not necessary to sit for standing up,
- but when we hear that someone has stood up, we find very likely a situation in which she was sitting before; there are other verbs like *leżeć* ‘to lie’ which can replace Y.

The *preceding* relation in its idea as a ‘naïve’ version of presupposition is close to the fuzzynymy relation: the association is weak. In contrast with fuzzynymy, however, we know the direction of this dependency and the temporal relations too.

8. Iterativity

This relation encompasses the phenomenon of iterativity encountered in the lexical meaning of verbs. The relation has a derivational character.

(1) It can link pairs of imperfective verbs such that one of them, which expresses an iterative meaning, is derived by suffixation from the other (Wróbel 1998: 549). For example, *pisać* ‘to write’ (*imperf.*) has a derivative *pisywać* ‘ $\approx$ to write a little from time to time’ (*imperf.*); *grać* ‘to play’ — *grywać* ‘ $\approx$ to play a little from time to time’ (*iterative*).²⁴

²⁴ «We must distinguish *strict* iteratives, derived from their imperfective bases, and *morphological* iteratives, which need not be derived from imperfectives» (Amse-de Jong 1974: 83).

(2) It can also link imperfective derivatives of *perfectiva tantum*, that is to say, *secondary imperfectives*, with their derivational bases (Laskowski 1998: 167–9; Kucała 1966): *zakochać się* ‘to fall in love’ (*perf.*) > *zakochiwać się* ‘to fall in love from time to time’ (*iterative*), *znaleźć* ‘to find’ (*perf.*) > *znajdować* ‘to find many times’ (*iterative*).

Our tests for iterativity take advantage of the sense of the phrase *wiele razy* ‘many times’:²⁵

- *X-ować to wiele razy Y-ować*
‘to X is to Y many times’.

9. Semantic roles

Thematic roles — a classic example of semantic roles — associate verbs and nouns those verbs govern. The paradigm is best exemplified by Fillmore’s classic paper (1968). Wordnets operate with very different theoretical assumptions, but — to a limited extent — the idea of semantic roles is useful in lexico-semantic networks (Vossen *et al.* 1998: 101–2). We added semantic roles to the group of derivational relations. It is well known that semantic roles influence the word formation process (Grzegorzczkowska, Puzynina 1998: 378–383; Laskowski 1973). If the meaning of a verb is somehow included in a noun, we call it a *role* (Polish *rola*): *nauczyciel* ‘a teacher’ < *nauczać* ‘to teach’. If the meaning of a noun is somehow included in a verb, we talk about *role inclusion* (Polish *zawieranie roli*): *pompować* ‘to pump’ < *pompa* ‘a pump’. Note that *role* and *role inclusion* are not mutual inverses. In this paper we only deal with *role inclusion* — the *role* is bound to noun, not to a verb. Instead of talking about deverbal nouns, let us present denominal verbs.

Following a scheme proposed for Polish by Wróbel (1998: 578–583), we distinguish such sub-relations of *role inclusion*:²⁶

Instrument — this sub-relation captures very productive word-formation procedure. The relation links nouns denoting the means of action, instruments with their verbal derivatives (*solić* ‘to salt’ < *sól* ‘salt_N’; Wróbel 1998: 579).

Product — this sub-relation connects nouns referring to products of actions with their verbal derivatives (*adresować* ‘to write a name or address on an envelope, to address’ < *adres* ‘an address’, *portretować* ‘to make a portrait’ < *portret* ‘portrait’; Wróbel 1998: 579–80).

Patient — this sub-relation associates patients denoting concrete objects with their verbal derivatives (*skalpować* ‘to scalp’ < *skalp* ‘a scalp’; Wróbel 1998: 581).

Location and time — the *role inclusion* relation associates names of places and moments or periods with verbs derived from them (*garażować* ‘to keep in a garage’ < *garaż* ‘a garage’, *nocować* ‘spend a night’ < *noc* ‘night’; Wróbel 1998: 581).

Test expressions activate the semantic base of a predicate which is built into the verb (the noun’s meaning):

²⁵ «At this stage, we may introduce the term (...) ‘iterative’ to refer to a situation that is repeated (e.g. a series of coughs)» (Comrie 1989: 42).

²⁶ We exclude the *involve an agent* relation from other „involvements”. The relation is a derivational branch of nominal relations (Wróbel 1998: 575–6).

- Y jest narzędziem, którym się X-uje ‘Y is the instrument with which one Xs’
- Y jest wytworem/rezultatem czynności Y ‘Y is the product/result of X_{gerund}’
- Y jest pacjensem czynności X ‘Y is the patient of Xing’
- Y jest miejscem, w którym się Y-uje ‘Y is the place where someone/something Xs’
- Y jest czasem, na który wskazuje czynność Y ‘Y is the time when someone/something Xs’

Znaczenie Y jest zawarte w X ‘The meaning of Y is involved in X’.²⁷

10. Derivativity i fuzzynymy

We have identified, and named *derivativity* and *fuzzynymy*, several distinctive types of semantic association not covered by any of the preceding, more specific relations. Both derivativity and fuzzynymy have been left underspecified on purpose. The former links a derivative with its derivational base. In plWordNet this link always represents some semantic information. Collected instances of derivativity will be the subject of further research, because we do not exclude the possibility of introducing into plWordNet new lexico-semantic relations based on derivation.

Fuzzynymy has been present in plWordNet from the beginning. Its introduction follows the practice of EuroWordNet (Piasecki *et al.* 2009: 34–5). The role of fuzzynymy is similar to that of derivativity: we register under its name all cases that signal close semantic association, but cannot be classified as any of the specific (but non-derivative) lexico-semantic relations.

11. Concluding remarks

The plWordNet relation system has been expanded to capture more lexical connections. The expansion went into two directions: derivational and purely semantic. We replaced relatedness and pertainymy (adopted in plWordNet 1.0) with more specific relations: *cross-categorial synonymy* and *aspect*. To describe pure semantic pairs, we turned to the derivational relations *state*, *causation* and *process*, known from linguistic papers. *Cross-categorial synonymy*, *process* and *causation* enabled us to link verbs with other parts of speech. *Aspect*, *meronymy* and *inter-register synonymy* become prominent relations, because they help restructure shallow hyponymic trees into deeper hierarchies.

We expect that the set of lexico-semantic relations will be well suited to the specificity of the Polish language.

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²⁷The last statement means that the sense of a derivational base is a part of the meaning of the derivative (not on the contrary).

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