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TOWARDS CONCEPTUAL FRAMES

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Abstract. The paper reports on the process of automatic mapping of the PDEV verb patterns to the WordNet sentence frames and subsequent manual validation of the verb patterns that were automatically assigned to the WordNet verb synsets. The validation resulted in the approval of 4,084 patterns, manual assignment of 1,568 new patterns and removal of 2,815 inappropriate patterns. The paper introduces the notion of Conceptual frame: a FrameNet Semantic frame the core Frame elements of which are specified for a set of semantic types. It is shown that the semantic types assigned to WordNet noun synsets define the sets of WordNet literals (lexical units) appropriate to express the core Frame elements.

Keywords: WordNet; semantic net; semantic frame

1. Introduction

A fundamental theory describing the semantic relations between lexical units is **Frame semantics** (Fillmore, 1977; Fillmore, 1982; Fillmore, 1985). Frame semantics explains the meaning of lexical units through their relation to a Semantic frame, a kind of conceptual prerequisite for understanding the meaning of a word (Fillmore 1985: 224), and motivates the Semantic frames through the relations of words used in a certain context. In widely accepted terminology it is said that *a lexical unit evokes a semantic frame relating to the specific concept to which it refers*. One of the examples which is often used to illustrate Frame semantics is the verb *sell,* a member of the Semantic frame **Commercial sell**: the verb *sell* is related to the situation of **Commercial sell** which also involves a seller, a buyer and goods and the specific semantic relations between the seller, the buyer and the goods.

The semantic resource FrameNet (Fillmore & Baker, 2000; Fillmore & Baker, 2010) defines Semantic frames and organises them in a network. Each Semantic frame consists of frame elements: *the various participants, props, and other conceptual roles involved in the semantic representation of a situation* (Fillmore & Petruck, 2003: 359). More than 1,224 Semantic frames (1,087 lexical frames) are described so far incorporating 13,640 lexical units, 10,542 Frame elements, 10,725 relations of Frame elements and 1,876 relations between Semantic frames, i.e., more general frames to more specific ones[1)]. For

example, the Semantic frame **Stimulate emotion** links the core Frame elements **Experiencer** (the one who reacts emotionally or psychologically to the Stimulus) and **Stimulus** (the event or entity which brings about the emotional or psychological state of the Experiencer). The Semantic frame **Stimulate emotion** organises also the following non-core Frame elements: **Circumstances** (the circumstances under which the Stimulus brings about the Experiencer); **Degree** (the degree to which the Stimulus brings about an emotion in the Experiencer); **Depictive** (a phrase which describes a state of the Experiencer); **Explanation** (the reason why the Stimulus causes the emotion in the Experiencer); **Manner** (the manner in which the Stimulus affects the Experiencer); **Means** (the means by which the Stimulus affects the Experiencer); **Result** (the result of the Stimulus affecting the Experiencer); **Time** (the time when the Experiencer has an emotion as caused by the Stimulus)[2].

The information in the FrameNet is derived by annotating sentences in a corpus. The annotation shows the syntactic realisation of Frame elements: phrase types and grammatical functions (Ruppenhofer et al., 2016: 7–8). The following annotated sentences are related to the Semantic frame **Stimulate emotion** and the verb *irritate*:

At theological college, near Oxford, [*NP* ***the docility of most of the wives of other students=Stimulus***] *IRRITATED* [*N* ***Anna=Experiencer***].

Nan showed no pleasure at the compliment – in fact Emily seemed to think [***pro it=Stimulus***] *IRRITATED* [*pro her*=***Experiencer***][3].

The presented research aims to specify information about the compatibility of lexical units. For this purpose we need to determine the sets of lexical units with which a Frame element in a particular Semantic frame can be expressed in a sentence. The investigation is limited to the verbal lexical units and to the core Frame elements with the type Entity. We call Conceptual frame a Semantic frame the core Frame elements (from the type Entity) of which are specified for a set of semantic types describing the admissible lexical units. Thus, we can reformulate the aims of our research as follows: to enrich FrameNet Semantic frames into Conceptual frames. In practice this means to describe that the verb irritate is combined with an Experiencer which could be Human and a Stimulus which could be Anything. For example, the Experiencer of the Conceptual frame Stimulate emotion can be realised among others with the lexical units expressing subordinate concepts of the concept {person; individual; someone; somebody} 'a human being', such as: abortionist, allergist, angiologist, gastroenterologist, general practitioner, GP, house physician, resident, resident physician, intern, houseman, medical intern, specialist, medical specialist, surgeon, operating surgeon, sawbones, etc. On the other hand, there is no limitation for the lexical units with which the Frame element Stimulus of the Conceptual frame Stimulate emotion can be expressed.

The paper is organised as follows: first we present the motivation for the research and the methods applied combining automatic mapping and manual validation and annotation; further we briefly refer to our previous research and the obtained results; the core of the paper describes the manual validation of automatic mapping and analyses the results.

2. Motivation for the research

We exploit two widely known semantic resources: WordNet and PDEV (Pattern Dictionary of English Verbs) patterns with the CPA (Corpus Pattern Analysis) semantic types.

WordNet (Miller, 1995; Fellbaum, 1998) groups English nouns, verbs, adjectives and adverbs into sets of synonyms (synsets), each expressing a particular concept. The current number of defined synsets is about 117,000 [4]. Synsets are linked by means of conceptual relations. For example, verb synsets are arranged into hierarchies (trees); verbs at the roots of the trees express more abstract concepts while verbs top-down towards the leaves of the trees (called troponyms) express more specific concepts that denote the manner of doing something (Fellbaum, 1990; Fellbaum, 2002). The noun synsets are organised into hierarchies (trees) with the super-subordinate relation (hypernymy and hyponymy relations) which links more general concepts to specific ones (with the most abstract concepts being at the root of the tree(s) and the most specific concepts at the leaves of the tree(s)) (Miller, 1990). Verbs and nouns are grouped into more specific semantic classes (Miller, 1990; Fellbaum, 1990) describing their general meaning: noun.person, noun.animal, noun. cognition; verb.cognition, verb.change, etc. Each verb synset contains a list of Sentence frames illustrating the types of simple sentences in which the verbs in the synset can be used. The WordNet sentence frames represent information about the number of frame elements and brief semantic and syntactic description. For example, the verb *corrupt*, part of the synset {corrupt, pervert, subvert, demoralize, demoralise, debauch, debase, profane, vitiate, deprave, misdirect} 'corrupt morally or by intemperance or sensuality' is described with the sentence frames: *Somebody ----s somebody* and *Something ----s somebody*.

The main advantages of WordNet for semantic analysis are: a) a large amount of concepts organised in a semantic net; b) grouping of concepts in semantic classes according to their general meaning. A brief comparison between the fundamental approaches underlying FrameNet and WordNet shows that FrameNet describes the semantic knowledge about the type of event, relation, or entity and the participants (Frame elements) involved in it, while WordNet is focused on the description of the semantic relations between concepts.

The WordNet noun semantic classes can be further specified in order to describe more precisely the groups of words satisfying the verbs selectional requirements. A very appropriate means for this specification is offered by the PDEV framework (Hanks 2012) within which an ontology of semantic types is developed, where each semantic type refers to properties shared by a set of nouns (Cinkova & Hanks, 2010). For example, the PDEV CPA ontology contains semantic types such as [Movie] and [Movie_Part], relevant for the semantic description of verbs like {film, shoot, take} 'make a film or photograph of something'. The PDEV pattern [Human] ----s [Movie] | [Movie_Part][5)] represents the CPA semantic types of participants: [Human], [Movie] and [Movie_Part], which are relevant to distinguishing between different senses of these verbs. In comparison, in WordNet nouns like {movie, film, picture, moving picture, moving-picture show, motion picture, motion-picture show, picture show, pic, flick} 'a form of entertainment that enacts a story

by sound and a sequence of images giving the illusion of continuous movement' are classified within the more general semantic class: noun.communication which is also specified for nouns like {dissemination, airing, public exposure, spreading} 'the opening of a subject to widespread discussion and debate'. In some cases the PDEV patterns specify the concrete lexical units if the CPA semantic type consists of one member only, i.e. [Human] ----s cigarette | cigar | pipe.

It is claimed that each PDEV pattern can, in principle, be plugged into a FrameNet Semantic frame[6] and some PDEV patterns already contain links to the FrameNet Semantic frames. To summarise, PDEV is close to FrameNet in its representation of the semantic knowledge: both semantic resources are based on real corpus examples and encode the core frame elements. Further, the PDEV patterns decode particular (fine-grained) semantic types of frame participants. However, the number of PDEV patterns is relatively small and the CPA ontology could be expected to be further enlarged with new members.

3. Mapping WordNet with CPA and PDEV patterns

In our previous work, we have presented an effort to enrich WordNet information through the assignment of the CPA ontology to WordNet noun synsets (Koeva et al., 2018) and the assignment of PDEV verb patterns to WordNet verb synsets (Koeva et al., 2019). This work was performed using a combination of a manual setup and an automatic assignment based on the setup. The 253 CPA semantic types were first mapped by human annotators to one or more WordNet noun synsets, adhering to the following principles:

– The highest appropriate WordNet synset (in the relevant hypernym tree) is chosen;

– If necessary, more than one synset is selected;

– All available PDEV verb patterns containing the CPA semantic types were observed, validating against the chosen synset hyponyms.

As a result, 199 CPA semantic types were mapped to 1 WordNet noun synset, 39 semantic types – to 2 synsets, 12 semantic types – to 3 synsets, 2 semantic types – to 4 synsets, and 1 semantic type – to 5 synsets. Based on the assumption that synsets inherit the semantic type of their hypernyms, an automatic assignment was done using the manual mapping of the CPA semantic types to WordNet synsets, assigning synsets the same semantic classes as their hypernyms. This resulted in a total of 171,359 assignments to 82,114 WordNet noun synsets[7].

Continuing the effort to expand WordNet on verb compositionality, PDEV patterns were assigned to WordNet verb synsets. The automatic assignment process used a form of translation, where PDEV patterns were translated to WordNet sentence frames using a set of manually curated "translation" rules. As PDEV patterns often include alternative and optional participants, some patterns were translated to several sentence frames. The automatic assignment of PDEV patterns to WordNet verb synsets was then based on the following two conditions:

– The verb of the PDEV pattern is present in the synset.

– At least one of the PDEV pattern translations is present in the WordNet synset list of sentence frames.

So far, the PDEV covers in total 3,220 of the 13,767 WordNet verb synsets. As a result of the assignment, 2,904 of 4,048 unique PDEV patterns were assigned to 2,593 of the 3,220 WordNet verb synsets covered by PDEV, totalling 6,899 automatic assignments.

4. Validation of results of automatic mapping

Our hypothesis is based on the assumption that the literals (as members of synsets) can be interchangeable, thus a pattern which is applicable to one of the literals can be applicable to all the other literals. We have manually checked the PDEV patterns assigned, taking into account the following factors: the sense of the verb (synset); the semantic class of the verb synset; the WordNet sentence frames assigned to each synset; the usage examples. We assume that:

(1) The automatically assigned PDEV patterns have to be true with respect to the sense of the verb synset, e.g., the automatically assigned pattern [Human] *hails taxi | cab* is not valid for {acclaim; hail; herald} 'praise vociferously'.

(2) The PDEV patterns participants should be defined with the appropriate types in the CPA hierarchy ([Animal], [Dog], [Bird], [Human] are within the [Animate] hierarchy).

(3) The PDEV patterns assigned should be applicable to all the verbs (literals) in a synset – this is hampered by the incomplete data, as not all literals have been assigned patterns from PDEV.

In fact, it is rather rare for patterns to be automatically assigned to more than two literals in a synset, and if they coincide, it is usually with respect to the type of participants (for example, {yelp; yip; yap} were assigned the patterns [Dog] *yelps*, [Dog] *yaps*), and at most with transitive verbs such as [Human] *watches* [Event], [Human] *sees* [Event]. There is variation with respect to the prepositions introducing a participant (this usually matches the PP participant in WordNet frames) but for our purpose we assume that patterns with different prepositions are in fact different. In addition, the patterns do not seemingly hold for all the literals, e.g., of all three literals in {accept; consent; go for} 'give an affirmative reply to; respond favorably to', *Somebody ----s something*, there are patterns assigned only to {accept}, while the participant of {consent} is introduced with 'to' (possible frames would be *Somebody ----s PP, Somebody ----s to INFINITIVE*). Thus, in the future new patterns can be added or an existing pattern can be changed (for example, the assigned PDEV pattern [Human 1] *adopts* [Human 2] to the synset {adopt; take in} 'take into one's family' can be modified to cover animate entities: [Human] *adopts* [Animate]). We also observe whether the patterns are valid with respect to the usage examples because there are cases where the participants even in the WordNet frames do not match.

Below, we will discuss a couple of different scenarios.

4.1. Invalid PDEV pattern assignments. The issue with overgeneration of patterns is a result of the translation rules where *Someone* was automatically mapped to [Human] and *Something* – to Non-human. Therefore, the verb {blow} 'play or sound a wind instrument' with a WordNet sentence frame *Somebody ----s something* was assigned 9 PDEV patterns ([Human] | [Device] *blows* [Vapour] | [Stuff] | [Physical_Object] *Direction*; [Human] *blows* ([Musical_Instrument])*;* [Human] | [Road_Vehicle] *blows horn*; [Human] *blows whistle*; [Human] *blows bubble*; [Human] | [Device] *blows hole* *Location*), from which we have validated only two: [Human] *blows* ([Musical_Instrument]) and [Human] | [Road_Vehicle] *blows horn*.

Some of the assigned PDEV patterns have to be deleted as they do not correspond to the sense expressed by the respective synset. To {explode} 'destroy by exploding', two patterns were assigned: [Human] | [Institution] *explodes* [Bomb], and [Human] | [Concept 1] *explodes* [Concept 2], but only the first one is validated.

In other cases, the validation is based also on the usage examples, e.g., with {edit; cut; edit out} 'cut and assemble the components of', two usage examples – "edit film" and "cut recording tape" – is found which correspond to [Human] *edits* [Movie] | [Recording] | [Broadcast], but not to [Human] *edits* [Document].

Another scenario allows for the adaptation of patterns by adding participants if the synset sense allows it. For example, in some cases the sense can be applicable to both [Human] and [Animal] participants, but PDEV patterns with only [Human] were assigned, as in {disembowel; eviscerate; draw} 'remove the entrails of' with the pattern [Human 1] *disembowels* [Human 2] but a usage example of "draw a chicken", which points to further inclusion of [Animal] participant. Another such example is with the five PDEV patterns assigned to {absorb; suck; imbibe; soak up; sop up; suck up; draw; take in; take up} 'take in, also metaphorically', in correspondence with the WordNet sentence frame *Something ----s something*, but a usage example (*She drew strength from the minister's words*) points to an additional [Human] participant.

In many cases, wrong PDEV patterns are assigned to the syntactic frame, since the WordNet sentence frame does not specify the type (semantics) of possible participants. Sometimes, this is related to the metaphorical or idiomatic meaning of the verb. The sense of {repair; resort} 'move, travel, or proceed toward some place' was assigned the PDEV patterns: [Human] *repairs* [Artifact]; [Human] | [Institution] *repairs damage to* [Artifact]; [Human] | [Institution] | [Activity] *repairs damage to* [Abstract = Relationship] | [Abstract_Entity]; [Human] *repairs* [Body_Part]. Elsewhere, PDEV patterns different to the assigned ones were applicable to a verb as the metaphoric sense imposes other restrictions. The verb {fire} 'drive out or away by or as if by fire' with usage examples "The soldiers were fired", "Surrender fires the cold skepticism" can only have one PDEV pattern [Human 1] | [Institution] *fires* [Human 2] (*from* [Human_Role]) (and not the other assigned ones such as [Inanimate] | [Stuff] *fires* [Machine]; [Anything] *fires* !Human's! [Psych]; [Anything] *fires* [Human], and [Event] | [Human 1] *fires* [Human 2] | [Emotion] (up)).

The PDEV patterns can also be enriched when the encoding of the participants as

Somebody, Something, PP, etc. is not exhaustive, and transitiveness is not systematically followed. For example, the verb {crop; browse; graze; range; pasture} 'feed as in a meadow or pasture' were automatically assigned the pattern [Animal] *browses* (*Location*), but we have added two more patterns: [Animal] *browses on* | *upon* [Stuff], and [Animal] *browses* [Stuff].

4.2. Changes to patterns. In 930 synset instances, we have added the respective PDEV patterns as a result of the following assumptions:

1. The WordNet sentence frame participant *Somebody* was automatically matched to the PDEV participant [Human] but it can also be matched to [Human_Group], [Body_Part], [Self]. In some cases, *Somebody* can be matched to [Institution], [Business_Enterprise]. For example, the verb {brand; trademark; brandmark} 'mark with a brand or trademark' with frame *Somebody ----s something* was assigned only the PDEV pattern [Human] *brands* [Animal] (*with* [Visible_Feature]), while we added the pattern [Business_Enterprise] *brands* [Artifact] ([Name]). Here, the pattern [Human 1] | [Institution] *brands* [Human 2] (*with* [Artifact]) can also be valid if we assume that in certain context [Human] can be also branded. In some contexts, an entity – Action, Activity, Eventuality – can be associated with a Human, therefore the participants can be expanded, e.g., {afflict} 'cause great unhappiness for; distress', with the frame *Something ----s somebody*, can be expanded with the pattern [Human 1] *afflicts* [Human 2] additionally to [Eventuality] *afflicts* [Human] | [Institution] | [Location].

2. We also assume that prepositional participants – PP in WordNet sentence frames and participants introduced by prepositions such as for, with, on, unto, etc. – and participants expressed via *Direction*, *Location*, etc. may match (mind that *Direction*, *Location*, etc. can be expressed by a PP or an adverbial). For example, when no match was found for the verb {stroll; saunter} 'walk leisurely and with no apparent aim' with a frame *Somebody ----s PP,* we have manually assigned the PDEV pattern [Human] *saunters* *Direction*.

3. A participant cannot be used with some verbs, and they can be removed from the pattern, as with {abort} 'terminate a pregnancy by undergoing an abortion', with the frame *Somebody ----s*, and assigned pattern [Human] | [Animal] | [Fetus] *aborts*. We have assigned an additional pattern: [Human 1] | [Animal 1] *aborts* [Fetus] | [State_of_Affairs], where [State_of_Affairs] = Pregnancy, but [Fetus] is to be removed.

4. There are instances of divergence between the WordNet verb sense and WordNet sentence frames and usage examples which helped us with the validation. For example, the verb {affect; impress; move; strike} 'have an emotional or cognitive impact upon' has only one frame *Something ----s somebody*, but there is *Somebody* in the usage examples "This child impressed me as unusually mature", "This behavior struck me as odd". Therefore, we assigned the patterns: [Eventuality 1] | [Entity 1] *affects* [Human] | [Animal] | [Eventuality 2] | [Entity 2]; [Human] *affects* [Attitude] | [Emotion]; [Anything] *impresses* [Human] | [Institution] (*with* [REFLDET][8] Property]); [Human] *impresses*; and [Artifact] *impresses*.

5. Different literals in a synset may be matched to different PDEV patterns. The synset {tittup; swagger; ruffle; prance; strut; sashay; cock} 'to walk with a lofty proud gait, often in an attempt to impress others' is matched to two patterns with two literals: [Human] *prances* (*Direction*), [Human] *sashays* *Direction*, which differ in respect to the optionality of the *Direction* participant.

6. Subsumption in the CPA hierarchy: The CPA semantic type of a participant may be subsumed under another semantic type, as in the case of the verb {brandish; flourish; wave} 'move or swing back and forth' which has the frame *Somebody ----s something* and usage example "She waved her gun" with automatically assigned patterns: [Human] *brandishes* [Weapon]; [Human] *brandishes* [Physical_Object]. In the CPA hierarchy, [Weapon] is a subtype of [Physical_Object], [Inanimate]. Moreover, there is another verb {brandish} 'exhibit aggressively', with the same frame and automatically assigned patterns, and a usage example "brandish a sword", would be more suitable for the [Weapon] participant.

7. PDEV patterns matching with some verbs were not identified at all, as with the verb {crown} 'put an enamel cover on' where the appropriate pattern was neither assigned, nor matched and another pattern was assigned: [Human] *crowns* [Body_Part].

4.3. Results in Numbers. The manual validation and correction had the following effect:

1. Total number of WordNet verb synsets covered by PDEV: 3,220
2. Confirmed assignments:
    a. Synsets with fully confirmed pattern assignments: 1,488
    b. Confirmed pattern assignments for all synsets: 4,084
3. Manually added assignments:
    a. Synsets to which new patterns were manually assigned: 930
    b. Manually assigned patterns in total for all synsets: 1,568
4. Automatic assignments, removed at validation:
    a. Synsets from which automatically assigned patterns were removed: 1,143
    b. Removed automatically assigned patterns from all synsets: 2,815

The manually validated PDEV patterns were added to the XML version of the Princeton WordNet verb synsets used for this study and are publicly available under the CC by license: http://dcl.bas.bg/PWN_PDEV/.

5. Analysis of results

The analysis of results shows that in most cases the number of participants in the WordNet sentence frames coincides with the number of participants in the PDEV patterns. Consider, for example, the synset {breathe, take a breath, respire, suspire} 'draw air into, and expel out of, the lungs', the root of a WordNet tree with 21 verb synsets. All synsets within the tree are assigned WordNet Sentence frames with one or two members: *Somebody ----s*; *Somebody ----s something*, or the combination of both. 15 out of the 23 synsets were assigned PDEV patterns and all except one of them have one or two

members. The main difference between encoding semantic and syntactic information in the PDEV and in the WordNet concerns the granularity of the semantic description with the more granular semantic types in PDEV. The differences can be compared in the following example (synsets and the definitions of their senses are given first (the hierarchy of the hypernyms and hyponyms are shown), the WordNet sentence frames are presented on the left below them, and the PDEV patterns – on the right:

{breathe, take a breath, respire, suspire} 'draw air into, and expel out of, the lungs'

Somebody ----s	**[Human] | [Animal] ----s**
Somebody ----s something	**[Human] | [Animal] ----s in [Human] | [Animal] ----s air | dust | gas | [Vapour] (in)**

{breathe}

WordNet synset does not exist	**[Fish] breathes (through gills)**

{breathe}

WordNet synset does not exist	**[Cetacean] ----s**

{respire} 'breathe easily again, as after exertion or anxiety'

Somebody ----s	**PDEV pattern is not assigned.**

{choke} 'breathe with great difficulty, as when experiencing a strong emotion'

Somebody ----s	**[Human] | [Animal] ----s (to death) (on [Physical_Object]) | (on fumes)**

{hyperventilate} 'breathe excessively hard and fast'

Somebody ----s	**PDEV pattern is not assigned.**

{hiccup, hiccough} 'breathe spasmodically, and make a sound'

Somebody ----s	**PDEV pattern is not assigned.**

{sigh, suspire} 'heave or utter a sigh; breathe deeply and heavily'

Somebody ----s	**PDEV pattern is not assigned.**

{wheeze} 'breathe with difficulty'

Somebody ----s	**[Human] ----s**

{yawn} 'utter a yawn, as from lack of oxygen or when one is tired'

Somebody ----s	**[Human] | [Animal] ----s**

{snore, saw wood, saw logs} 'breathe noisily during one's sleep'
Somebody ----s **[Human] | [Dog] ----s,**
Somebody ----s something

{exhale, expire, breathe out} 'expel air'
Somebody ----s **[Human] | [Animal] ----s**
Somebody ----s something

{snort} 'make a snorting sound by exhaling hard'
Somebody ----s **[Human] | [Animal] ----s**

{blow} 'exhale hard'
Somebody ----s **[Human] ----s (*Direction*)**
Somebody ----s something

{pant, puff, gasp, heave} 'breathe noisily, as when one is exhausted'
Somebody ----s **PDEV pattern is not assigned.**

{puff, huff, chuff} 'blow hard and loudly'
Somebody ----s **[Human] | [Animal] ----s**
[Human] ----s,

{insufflate} 'blow or breathe hard on or into'
Somebody ----s something **PDEV pattern is not assigned.**

{inhale, inspire, breathe in} 'draw in (air)'
Somebody ----s **PDEV pattern is not assigned.**
Somebody ----s something

{aspirate} 'inhale (air, water, etc.}'
Somebody ----s something **[Human] ----s cavity | tube**
[Human] ----s [Liquid]

{sniff, sniffle} 'inhale audibly through the nose'
Somebody ----s **[Human] | [Animal] ----s**

{snuffle, snivel} 'snuff up mucus through the nose'
Somebody ----s **Human] ----s**

{snuff} 'inhale (something) through the nose'
Somebody ----s something **[Human] ----s [Artifact]**

{puff, drag, draw} 'suck in or take (air)'
Somebody ----s [Human] ----s cigarette | cigar | pipe
Somebody ----s PP

{huff, snort} 'inhale recreational drugs'
Somebody ----s something [Human] ----s [Drug]

The PDEV patterns mediate the mapping of the semantic information in FrameNet and WordNet. The FrameNet information about the core Frame elements of the Semantic frame **Breathing** corresponds with the semantic information presented at the PDEV patterns and the WordNet sentence frames: **Agent** (the Agent's breathing causes the motion of the Air) and **Air** (Air is the substance that the Agent causes to move). The lexical units that evoke the Semantic frame **Breathing** are: *blow, breathe, exhale, expire, gasp, huff, inhale, inspire, insufflate, pant, puff, respire, sigh, suspire*.

We assume that if a given FrameNet Semantic frame is linked through the mediation of the PDEV pattern to a WordNet synset, the corresponding Conceptual frame can be enriched with the information about the semantic types of the participants.

Agent = [Human] | [Animal] ----s (Air = air | dust | gas | [Vapour] (in))
Agent = [Fish] ----s (through its gills)

The granular semantic types assigned to WordNet noun synsets define the sets of WordNet literals appropriate to express the core Frame elements. For example, the semantic type [Fish], mapped to the synset {fish} 'any of various mostly cold-blooded aquatic vertebrates usually having scales and breathing through gills', is inherited by hyponyms such as: *groundfish, bottom fish, barracoota, snoek, shad, herring, sardine, salmon, trout, whitefish, sea bass, snapper*, etc. Each of these lexical units can express the core Frame element Agent in the Conceptual frame: **Agent = [Fish] ----s (through its gills),** i.e. ***a salmon* | *a barracoota* | *a herring breathes through its gills.***

6. Conclusions and future work

We presented the automatic mapping of PDEV patterns to the WordNet verb synsets and its manual annotation, which resulted in the validation of 4,084 patterns, assignment of 1,568 new patterns and removal of 2,815 inappropriate patterns. The results of the presented research enriched the semantic information in WordNet with more granular semantic classes for the noun synsets and more precise sentence frames for the verb synsets. Some WordNet verb synsets that are not enriched with the PDEV patterns can be automatically assigned such after further analysis of the dependencies of the inheritance of the PDEV patterns in

the hypernymy – hyponymy WordNet paths. For others, manual annotation of sentence frames with appropriate semantic types will provide additional information about the compatibility of lexical units. Further, some of the semantic information in FrameNet and WordNet can be combined via semi-automatic construction of Conceptual frames.

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NOTES

1. https://framenet.icsi.berkeley.edu/fndrupal/current_status [15 September 2019].
2. https://framenet.icsi.berkeley.edu/fndrupal/luIndex [15 September 2019].
   Among the lexical units that activate this Semantic frame are the verbs: abash, aggravate, aggrieve, agonize, alarm, amaze, anger, annoy, antagonize, appeal, arouse, astonish, astound, baffle, beguile, bewilder, bewitch, boggle, bore, calm, captivate, charm, cheer, comfort, conciliate, confuse, console, crush, dazzle, delight, demolish, depress, destroy, devastate, disappoint, discomfit, disconcert, discourage, dishearten, displease, distress, disturb, embarrass, embitter, enchant, encourage, engage, enrage, entertain, enthrall, exasperate, excite, exhilarate, fascinate, faze, flabbergast, floor, flummox, fluster, frighten, frustrate, fulfill, gall, gladden, grate, gratify, harass, hearten, humiliate, impress, incense, infuriate, interest, intimidate, intrigue, irk, irritate, kill, let down, madden, mollify, mortify, mystify, nettle, nonplus, offend, outrage, pacify, perplex, perturb, petrify, placate, please, puzzle, rankle, rattle, reassure, repel, revolt, rile, sadden, satisfy, scare, shake, shame, shock, shocker.n, sicken, sober, solace, soothe, spook, stagger, startle, stimulate, sting, stir, stun, stupefy, surprise.n, surprise, terrify, thrill, tickle, torment, traumatize, trouble.n, trouble, unnerve, unsettle, upset, vex, vexation. n, worry, wound, wow.
3. https://framenet.icsi.berkeley.edu/fndrupal/luIndex [The annotated examples are 20 in September 2019].
4. https://wordnet.princeton.edu [15 September 2019].
5. https://old.datahub.io/dataset/260d2e3e-1ff3-4c5e-bd11-9238ead750d5 [15 September 2019]
6. https://nlp.fi.muni.cz/projects/cpa/ [15 September 2019]
7. The resulting data is available online: http://dcl.bas.bg/PWN CPA/ [15 September 2019]
8. [REFLDET] – reflexive possessive determiner.

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ЗА КОНЦЕПТУАЛНИТЕ ФРЕЙМОВЕ

Резюме. Статията представя работата по автоматичното съотнасяне на глаголните рамки от Речника на глаголни рамки за английски (Pattern Dictionary of English Verbs – PDEV) и изреченските рамки, приписани към глаголите в УърдНет (WordNet), както и последващата ръчна проверка на автоматично приписаните рамки. В резултат на проверката са потвърдени 4084 автоматично приписани рамки, 1568 рамки са допълнително приписани, а 2815 рамки са премахнати. Статията въвежда понятието *концептуална рамка* – семантичен фрейм по модела на ФреймНет, чиито ядрени фреймови елементи са асоциирани с множество от семантични типове. Семантичните типове според класификацията в Корпусния анализ на рамките (Corpus Pattern Analysis – CPA), приписани на съществителните в УърдНет, дефинират множества от лексикални единици в УърдНет, които удовлетворяват изискванията на ядрените елементи на глаголните фреймове.

Ключови думи: УърдНет; семантична мрежа; семантичен фрейм

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