

Theses of Doctoral (PhD) Dissertation

**Approaches of cognitive linguistics and
ontologies in lexicographic sense delineation**

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1. Motivations and objectives of the dissertation

Sense delineation has been challenging for lexicographers who abstract senses from word uses and decide on splitting or lumping senses (Kilgarriff, 1998; 2005). Lexicographers have to present word meaning as a list of finite senses (Tóth, 2008) to help language users fulfill their operative, comprehension and knowledge needs arising from various para-lexicographical situations (Bergenholtz and Agerbo, 2018). Linguists, particularly cognitive linguists, have been studying the complexity of meaning, its conceptual base and fuzzy categories (e.g., Fillmore, 1975; 1976; Lakoff, 1987; Lakoff and Johnson, 1980; Langacker, 1999). Ontological approaches to meaning have been moving in a different direction. (Linguistic) ontologies mainly map categorized concepts to words (Speranza and Magnini, 2010). Lexicographic, cognitive linguistic and ontological approaches focus on meaning but have different assumptions, methods and objectives.

This dissertation is motivated by the significant contributions of cognitive linguistic theories and linguistic ontologies to studying meaning (Buitelaar, 1998; 2010; Dalpanagioti, 2018; 2019, Fuertes-Olivera

and Velasco-Sacristan, 2012; Ostermann, 2015). Also, the successful implementations of the Frame Semantics theory in the FrameNet database (Baker, Fillmore and Lowe, 1998) and the lexical-semantic relations in the WordNet database (Miller, 1998) have been a motivation to use the two databases in addressing the lexicographic challenge of sense delineation.

The study aims at reaching the following objectives:

- (1) Investigating the effectiveness of using the cognitive semantic approach proposed by Frame Semantics and implemented in FrameNet in meeting the challenge of sense delineation in dictionary-consultation experiments;
- (2) Exploring the effectiveness of using the lexical semantic information in WordNet for delineating senses in lexicography;
- (3) Examining the applicability of integrating lexicographic information from Oxford Learner's Dictionary, cognitive semantic information from FrameNet and sense relations from WordNet in the same lexicographic entry and

(4) Studying the usefulness of examples to the identification of word senses in Oxford Learner's Dictionary, FrameNet and WordNet

In eight chapters, this dissertation discusses meaning identification from lexicographic, cognitive and ontological perspectives. The introductory chapter states the problem and overviews current gaps in dictionaries. It also states the objectives and clarifies the chapterization of the dissertation. After the introduction, chapter two focuses on meaning as recorded in dictionaries. It addresses the uses, intended users, typology and structures of dictionaries. Chapter three discusses the contributions of lexical semantic information to meaning identification in lexical databases and ontologies. The WordNet database is addressed further because it is the most used linguistic ontology in lexicographic research. Chapter four focuses on the contributions of cognitive linguistics to sense delineation. It primarily focuses on the Frame Semantics approach to sense delineation because it has already been implemented in a database that can be used for lexicographic purposes, i.e., FrameNet. Proposing solutions for lexicographic challenges is usually supported by a comparison between

the conventional and modified entries or a user-based experiment. Therefore, this dissertation presents three experiments to support the theoretical arguments for using cognitive linguistic and ontological approaches in lexicographic sense delineation. The experiments compare the usability of lexicographic information in FrameNet, WordNet, and a monolingual learner's dictionary in dictionary-consultation contexts.

2. Overview of the methods

A total of 150 university students participated in the three experiments conducted in the dissertation. The first experiment was classroom-based and targeted 1st-year students at the Institute of English and American Studies, University of Debrecen. The experiment compared the sense delineation methods used in FrameNet, WordNet and Oxford Learner's Dictionary. Participants were divided into three groups and were asked to respond to time-measured decoding and encoding tasks. Participants received proper instructions with illustrative examples before starting the test.

Each group was exposed to a different entry type (based on the previously mentioned lexicographic resources).

The test examined five words belonging to three parts of speech. *Appear.v*, *tell.v*, *level.n*, *development.n* and *fair.a* are the five chosen words. The criteria for including words in the study were as follows. First, each word must have at least five senses in the three language resources. This condition was challenging in FrameNet's incomplete database. Therefore, the second criterion was having at least an initial entry (e.g., containing the definition and the frame evoked by the lexical unit, even if the valence description was absent) for each word sense in FrameNet. Otherwise, the word would be excluded from the experiment. The third criterion was sharing a comparable number of senses in the three language resources so that entry length could be similar for the three groups. Overall, the tested entries contain from six to ten senses. All entries must have at least one sense that is saliently shared among the three resources so that the test questions can be unified for the three entry types. Finally, a signpost must precede senses in Oxford Learner's Dictionary entries.

Lexicographic entries used in the experiments have been designed explicitly for the purposes of this study. The target word has been replaced by an obsolete English

word from the *Compendium of Lost Words* (Dziemianko, 2016). Lost words in the *Compendium of Lost Words* are not present on web pages or online dictionaries. Therefore, it is improbable for learners to encounter them. The *Compendium of Lost Words* includes more than 400 words from the *Oxford English Dictionary* that are not currently used in English. Therefore, neither googling nor looking up the disguised word would retrieve results. Disguising the headword guarantees students' reliance on the provided entries to answer the questions in each test. Also, grammatical, morphological and semantic information in the entries has been removed so that participants would solely rely on the delineated senses in the responses.

The second experiment targeted first and second-year students at the same higher education institute. The second experiment divided participants into two groups. The target group consulted a hybrid entry which contained information from the previously tested lexicographic resources, whereas the control group consulted entries based on the *Oxford Learner's Dictionary* only. The hybrid entry cited the delineated senses from the FrameNet database, simplified the name

of frames by replacing them with sense signposts from dictionaries and included hypernyms and hyponyms from the WordNet database.

The two groups were asked to answer the same encoding and decoding questions. Seven words (*blow.v*, *break.v*, *cool.a*, *case.n*, *full.a*, *strong.a*, and *sound.n*) were added to the five previously tested. The same method of disguising the target words was applied to this experiment. A strict application of the criteria for selecting words (mentioned in the first experiment) was relatively challenging for the second experiment. The realization of the differences in the sense delineation methods was more salient with the expansion of the sample words than in the first experiment. In addition, the incomplete database of FrameNet imposed further challenges.

The first two experiments focused on the senses delineated by each language resource. The last experiment explored the delineated senses and the examples used to represent them. Participants in the third experiment were 4th and 5th-year students at the same institute. They were divided into four groups and were asked to respond to sense selection, synonym selection,

and sense applicability judgment tasks. Each group examined a single entry type (FrameNet-based, WordNet-based, Oxford-dictionary, hybrid entry). The selection of test words in the third experiment was more challenging than the previous two experiments because of its focus on the role of example sentences. In addition to the challenges already mentioned in the first and second experiments, word senses in the third experiment must have at least one example sentence to be mentioned in the modified entry. For each target word, four senses must have at least two example sentences so that one can be used in the entry while the other can be used in the test. The selected target words in the three language resources must meet these conditions. Therefore, six words from the second experiment were excluded for lacking examples in one or more databases. For instance, *blow.v* had no examples in FrameNet. Also, *cool.a* and *level.n* have an insufficient number of examples in WordNet. The third experiment included the following words: *appear.v*, *development.n*, *full.a*, *sound.n*, *strong.a* and *tell.v*.

Designing the entries followed the same steps detailed in the first and second experiments regarding disguising the

target word, removing grammatical, morphological and phonological information, and maintaining the definition and the signpost or the frame name. Entries in the third experiment required adding one example sentence to each word sense. Example sentences were processed manually and automatically to select the examples used in the entries and questions. During the preprocessing stage, the first step was excluding incomplete sentences (which were most frequent in the WordNet database, followed by Oxford Learner's Dictionary and FrameNet). Second, the examples were manually scrutinized to expand any acronym or abbreviation. The third step was creating corpora for the examples of the six words based on the source of the examples (FrameNet, WordNet or Oxford Learner's Dictionary). The 18 corpora were uploaded to Sketch Engine to be processed automatically. The Good Dictionary Example (GDEX) measure, proposed by Kilgarriff et al. (2008) and implemented in Sketch Engine, was used to choose the best candidates from the corpora. GDEX assigns a score to each sentence based on the length of the sentence, the position of the target word in the sentence (e.g., in the main clause, towards the end of the sentence), the frequency of the

words in the sentence, frequent use of pronouns and anaphors and the completeness of the example (i.e., full sentences are preferred to fragments). GDEX scores range from 0 to 1. Sentences, which have the highest GDEX score, were selected as the best candidates for inclusion in the third experiment.

The three experiments were conducted using Psytoolkit (Stoet, 2017), an online toolkit for cognitive and psychological experiments and surveys. It offers precise time measurements for each test item (time is measured in milliseconds). The web-based toolkit can be used for free to design, launch and analyze questionnaires and experiments. It stores multiple baseline psychological and cognitive experiments. The toolkit can be used to build customized surveys. Several types of questions are available such as radio questions, equivalent to multiple-choice questions. Radio questions allow participants to select a single choice. For check questions, ticking several options is allowed. Text questions allow participants to provide a short text in their responses. Psytoolkit provides several options to upload a photo, video or audio before or after the question.

After data collection, results are downloadable in separate spreadsheets, one for the answers and another for the time each user spends on each question. Also, an individual plain text file for each response is downloadable.

Statistical tests (Pearson correlation, one-way ANOVA and Post Hoc Tukey tests) are used to validate or reject the hypotheses of each experiment. Cronbach's Alpha was used to measure the reliability of each question.

3. The main findings of the dissertation

The theoretical discussion in the first chapters showed how the field of lexicography changed in the past decades due to the increasing reliance on corpus and computational tools. It also clarified how the new techniques of gathering lexicographic information have led to the creation of novel types of dictionaries (e.g., crowdsourced, aggregators, portals). However, there is room for improving lexicographic practice. Using different approaches to address a lexicographic challenge can be helpful to dictionary makers and users. The cognitive linguistic literature showed how applying

several cognitive-semantic theories could enhance the detection and presentation of polysemous word senses.

The three experiments in this dissertation show the influence of adopting theoretical approaches to sense delineation on the students' encoding and decoding performance and perplexity levels. They also show the gaps in the tested lexicographic resources as regards the selection of example sentences.

Comparing the students' performance in the three groups in the first experiment showed the superiority of the FrameNet system to WordNet and the Oxford Learner's Dictionary. Students in the FrameNet group showed the best encoding and decoding performances, the lowest perplexity levels, and spent the shortest time on the consultation. Accuracy of sense selection was measured through the total number of correct sense choices among participants in each group. The three groups provided significantly different responses when it came to the accuracy of sense selection, according to the one-way ANOVA test ($F= 4.089$, $P= 0.0211$). The result is significant at $P < 0.05$. The time of sense selection also significantly differed across the three groups ($F= 3.58$, $P= 0.033$).

In the second experiment, the target group performed relatively better than the control group. This advocates the effectiveness of integrating lexicographic information from different resources despite the complexity of the task. Also, the second experiment highlighted the significant role of the conventional lexicographic signposts if compared to the complexity of frame names. There was a significant difference between the accuracy of sense selection of the target group and the control group, according to the one-way ANOVA test ($F=7.8055$, $P=0.00454$). The result is significant at $P<0.05$.

The third experiment unveiled the drawbacks of the three resources when it comes to providing example sentences. The group consulted the Oxford dictionary entries performed slightly better than the two groups consulted the FrameNet-based and the hybrid entries. The WordNet showed the lowest performance in all tasks in the third experiment. According to the ANOVA test, intergroup variations in the sense selection task were statistically significant for nouns ($F=10.964$, $P<.00001$) and verbs ($F=10.554$, $P<.00001$).

It was evident that the one-to-one mapping between word senses and word uses is unattainable in various cases.

Meaning extension, fuzzy meaning categories, and diversity of profiles within the same conceptual base further complicate the process of delineating senses. This was most reflected in the students' judgment of the applicability of multiple senses to the same test sentence.

The FrameNet database showed a degree of systematicity that was missing from the Oxford Learner's Dictionary and other dictionaries. The delineation of senses based on the valence patterns, annotated corpus examples and, more importantly, evocative frames guaranteed a more justifiable sense delineation and differentiation.

Although the FrameNet database is totally different from monolingual learners' dictionaries and was not intended for learners' use, the results of the first experiment proved the effectiveness of the database in presenting word senses to learners of English as a Second Language (ESL). FrameNet's annotated examples are one of the most important components of the database, but their usability for lexicographic purposes is questionable. They are long, lexically and structurally complex and hard to link to the senses they are supposed to represent. In several cases, complete knowledge about the frame, its

frame elements, and the type of frame elements (e.g., sentient, physical object) are necessary to assign the correct sense to its corresponding sentence. It is evident that the FrameNet examples need manual processing before their use in any classroom context.

The FrameNet database would benefit from integrating the Frame Semantic approach with other cognitive linguistic approaches. Langacker's approach succeeds in capturing the similarities and differences between related words and word senses, given their shared conceptual structure and the various ways of construing this conceptual base. Also, Lakoff's Conceptual Metaphor Theory could fix the dissociations between related Lexical Units in FrameNet. The advances in other cognitive linguistic approaches and theories would enhance the coherence and usability of the database.

WordNet provided the most fine-grained sense distinctions if compared to other lexicographic resources. The hierarchical structure of the WordNet database contributes to placing such distinctions within a larger context and justifies, in several cases, the separation of apparently similar word senses. Different hypernyms,

antonyms or arguments of the same word usually indicate different senses that should be placed in different synsets in the database. Again, the plausibility of the motivations for sense delineation and differentiation in WordNet should be complemented with user-oriented experiments if the database is to be used in lexicographic practice. The fine-grained meaning distinctions considerably prolonged the consultation process. The WordNet database seems not to acknowledge the fuzzy categorization of or account for polysemy. The negative consequences of listing such distinctions in meaning were clear in the third experiment.

The new advances in the lexicographic field can provide solutions to make the best of the diversity of the resources available for language learners. The crowdsourcing technique, for instance, could help FrameNet lexicographers simplify the phrasing of frame names which are one of the obstacles to using the database by ESL learners. Also, using the aggregator model would facilitate the integration of multiple lexicographic information from conventional dictionaries and databases (such as FrameNet and WordNet) without

the need to map each word sense to its parallel sense in the different resources.

However, changing a lexicographic resource's content or interface is not enough to make it usable by the target group. The target dictionary users should have the necessary skills to use and understand the information in a lexicographic resource. Therefore, professional lexicographic training at schools and higher education institutions is a necessity. Tóth, Márkus and Pődör (2022) explored how lexicography and dictionary didactics are taught in the university education of English teachers in Hungary. They argued that lack of knowledge about quality dictionaries at the beginning of the learning process results in learners' inability to select the right sources of information from the vast number of websites. They examined the practice of some Hungarian higher education institutions in teaching and training lexicography. They reported that a specialized course is occasionally organized for students, but lexicography and dictionary didactics are not typically taught in a more focused form. Students have a low appreciation of dictionaries, consider print dictionaries obsolete, and use free online dictionaries. The most used dictionaries

reported in that study were a bilingual dictionary (Magay-Ország) and a monolingual learner's dictionary (Oxford Advanced Learner's Dictionary).

It is essential to teach language learners about meaning and dictionaries before expecting them to use dictionaries effectively. Participants in the three experiments showed their reliance on machine translations offered by *Google Translate*, for instance, more than on institutionalized dictionaries. Moreover, informing learners about the infinite meaning possibilities of a word as opposed to the obligatory finite list of senses in dictionaries would enhance learners' effective use of dictionaries. Therefore, integrating some basic assumptions about meaning in cognitive linguistics into the lexicographic curricula is highly recommended.

Dictionaries and databases

<https://www.oxfordlearnersdictionaries.com/>

<https://framenet.icsi.berkeley.edu/fndrupal/>

<http://wordnetweb.princeton.edu/perl/webwn>

Compendium of Lost Words accessible through
<https://phrontistery.info/clw.html>

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List of publications related to the dissertation

Foreign language international book chapters (1)

1. **Abdelzaher, E.:** Cognitive Linguistics and Digital Lexicography.
In: The Routledge Handbook of Cognitive Linguistics / edited by Xu Wen and John R. Taylor,
Routledge, New York, 568-584, 2021, (Routledge handbooks in linguistics) ISBN:
9781138490710

Foreign language scientific articles in Hungarian journals (1)

2. **Abdelzaher, E., Tóth, Á.:** Defining Crime: A multifaceted approach based on Lexicographic
Relevance and Distributional Semantics.
Argumentum (Debr.). 16, 44-63, 2020. EISSN: 1787-3606.
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Foreign language scientific articles in international journals (3)

3. **Abdelzaher, E.:** A classroom-based study on the effectiveness of lexicographic resources.
LEXI. 9 (2), 139-174, 2022. ISSN: 2197-4292.
DOI: <http://dx.doi.org/10.1558/lexi.22164>
4. **Abdelzaher, E.:** An Investigation of Corpus Contributions to Lexicographic Challenges over the
Past Ten Years.
Lexikos. 32, 162-179, 2022. ISSN: 1684-4904.
DOI: <http://dx.doi.org/10.5788/32-1-1714>
IF: 0.375 (2021)
5. **Abdelzaher, E.:** Comparing Frame Membership, WordNet-Based Similarity and Distributional
Similarity.
Computational Linguistics in the Netherlands. 10, 5-17, 2020. ISSN: 2211-4009.





List of other publications

Foreign language scientific articles in international journals (8)

6. **Abdelzاهر, E.:** Compiling a cognition-based thematic monolingual lexicon.
CogLS. 4 (2), 313-329, 2021. ISSN: 2213-8722.
DOI: <http://dx.doi.org/10.1075/cogls.00007.abd>
7. **Abdelzاهر, E.:** Lexicon-based Detection of Violence on Social Media.
Cogn. Semant. 5 (1), 32-69, 2019. ISSN: 2352-6408.
DOI: <http://dx.doi.org/10.1163/23526416-00501002>
8. **Abdelzاهر, E.:** The Systematic Adaptation of Violence Contexts in the ISIS Discourse: A Contrastive Corpus-Based Study.
Corpus Pragmatics. 3 (2), 173-203, 2019. ISSN: 2509-9507.
DOI: <http://dx.doi.org/10.1007/s41701-019-00055-y>
9. **Abdelzاهر, E.,** Essam, B. A.: Weaponizing words.
JLP. 18 (6), 893-914, 2019. ISSN: 1569-2159.
DOI: <http://dx.doi.org/10.1075/jlp.18048.abd>
IF: 1.628
10. **Abdelzاهر, E.,** Elghamry, K., El-Attar, A. A.: A Corpus-based Arabic Valency Dictionary: The Case of Fighting Verbs.
Egyptian Journal of Language Engineering. 4 (1), 20-28, 2017. ISSN: 2356-8216.
11. Essam, B. A., **Abdelzاهر, E.:** Approaching "lost love" theme in two culturally different poems: A cognitive linguistic analysis.
J. Comp. Lit. Aesthet. 38 (1-2), 33-48, 2015. ISSN: 0252-8169.
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Int. J. Appl. Ling. Eng. Lit. 4 (4), 62-76, 2015. ISSN: 2200-3592.
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International Journal of English Language and Translation Studies. 2 (3), 14-22, 2014. ISSN: 2308-5460.

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A PhD értekezés alapjául szolgáló közlemények

Idegen nyelvű, külföldi könyvrészletek (1)

1. **Abdelzاهر, E.:** Cognitive Linguistics and Digital Lexicography.
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Idegen nyelvű tudományos közlemények hazai folyóiratban (1)

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Idegen nyelvű tudományos közlemények külföldi folyóiratban (3)

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További közlemények

Idegen nyelvű tudományos közlemények külföldi folyóiratban (8)

6. **Abdelzaher, E.:** Compiling a cognition-based thematic monolingual lexicon.
CogLS. 4 (2), 313-329, 2021. ISSN: 2213-8722.
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A közlő folyóiratok összesített impakt faktora: 2,003

**A közlő folyóiratok összesített impakt faktora (az értekezés alapjául szolgáló közleményekre):
0,375**

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Debrecen, 2023.03.29.

