

Graph analysis of the dependency-based lexical structures

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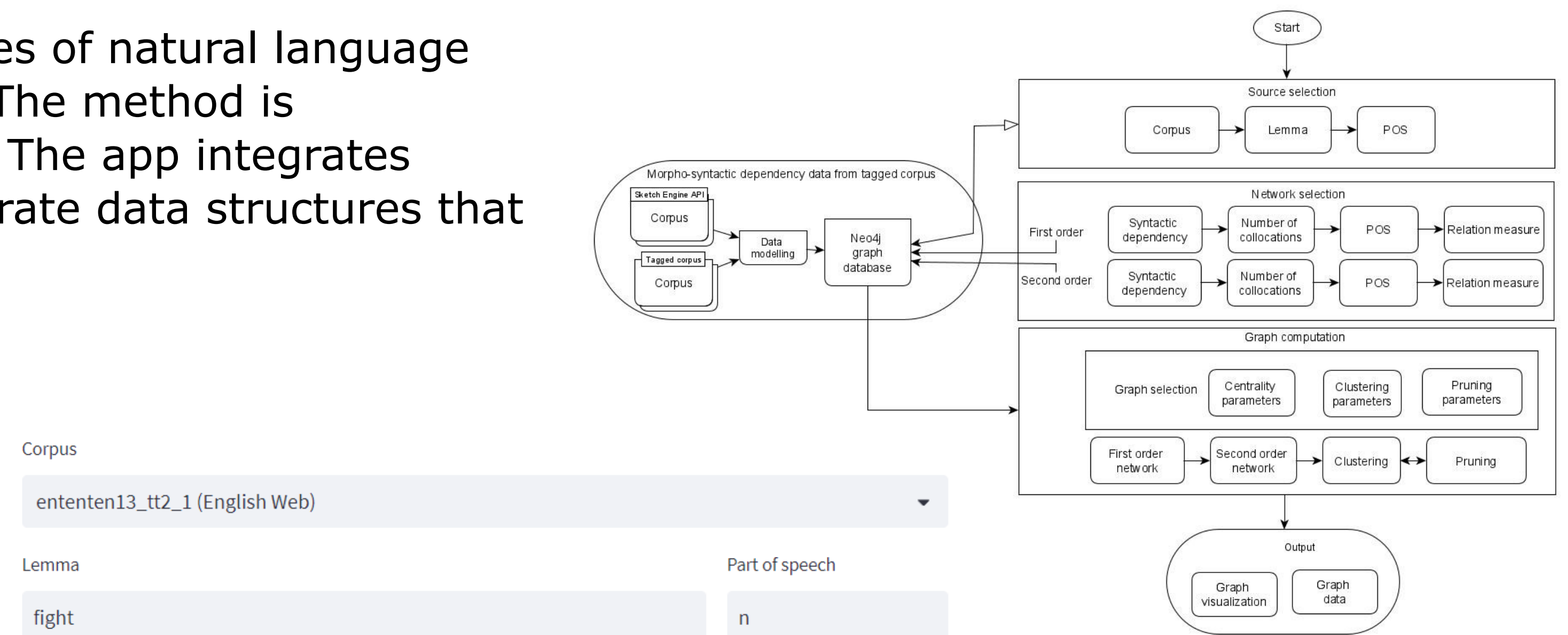
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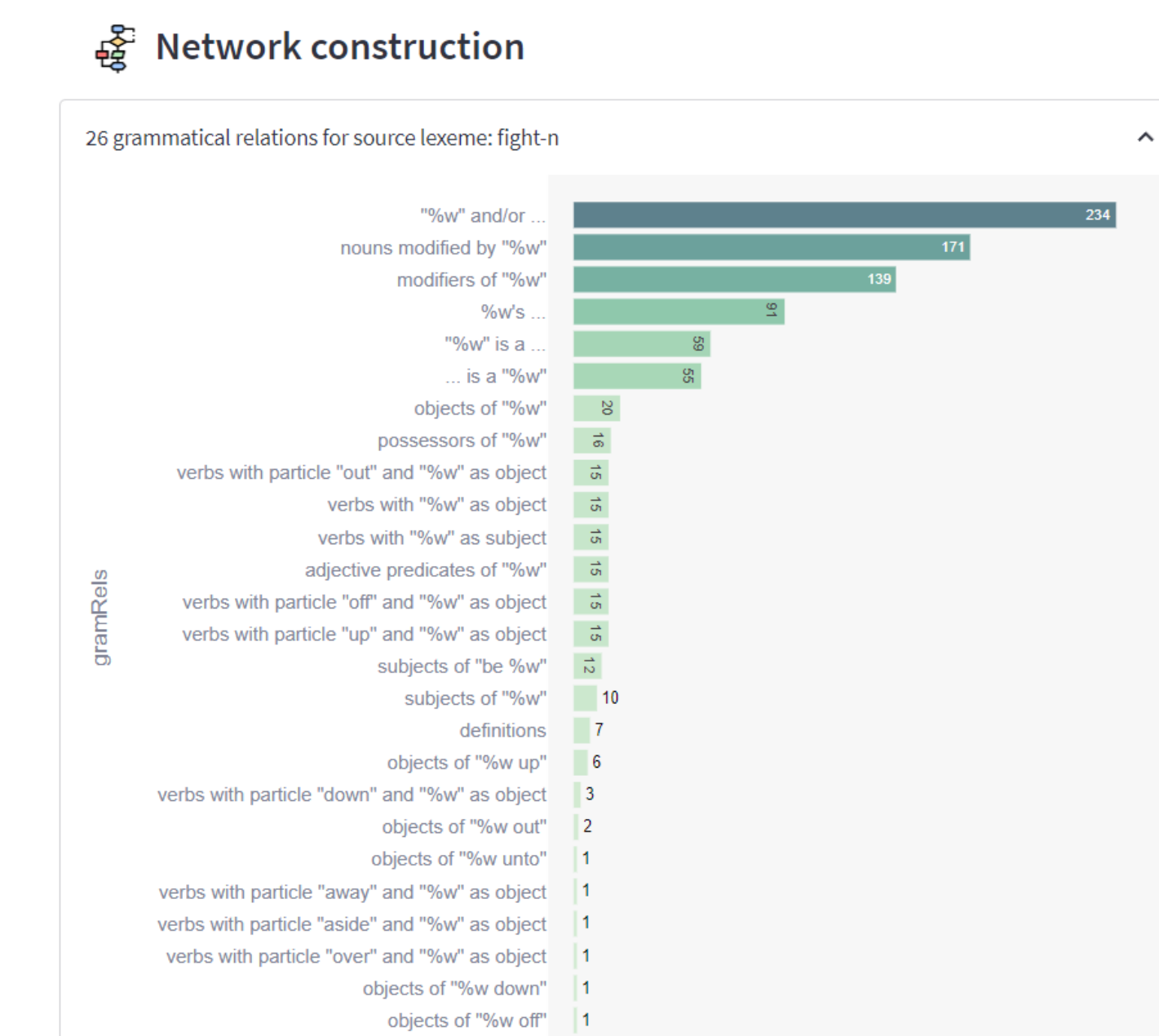
WG2, WG3

ConGraCNet: is a method for exploring lexical semantic structures of natural language utilizing graph-based analysis of syntactic dependency relations. The method is implemented as the ConGraCNet web app (emocnet.uniri.hr/congracnet/). The app integrates various computational tools and technologies to extract and integrate data structures that reflect the relationships between words and concepts.

	Construction type	Syntactic Properties	Cognition type	Semantic Properties
I)	Existential	[NT+ existential verb]	Is-ness	The entity exists as an object.
II)	Attribution	[ADJ ^{modifier} +NT]	Property	What are the salient properties attributed to the emotion?
III)	Apposition	[NT ^{modifier} +N V]	Modifier	What are the salient entities and events modified by the emotion?
IV)	Figure spatial	[NT ^{Figure} +Preposition]	Spatial, (temporal, causal)	What are the spatial/logical/causal relations when coded as figure?
V)	Ground spatial	[Preposition+NT ^{Ground}]	Spatial, (temporal, causal)	What are the spatial/logical/causal relations when coded as ground?
VI)	Thematic processual	[Verb+NT ^{object}]	Processual argument structure	What processes can you (conceptually) do with the emotion coded as object?
VII)	Agentive processual	[NT ^{Subject} +Verb]	Processual argument structure	What processes (can you conceptualize) an emotion can do when coded as subject?
VII)	Coordinated	[NT and/or N]	Association, near synonym, antonym	What are the conceptually related concepts?



Corpus: ententen13_tt2_1 (English Web)
 Lemma: fight
 Part of speech: n
 fight-n Frequency: 1148195 Relative frequency (per million): 59.5134788431695



Grammatical relation 1: (fight-n)-[gr1]-[f]

modifiers of "sw"
 nouns modified by "sw"
 verbs with "sw" as object
 verbs with "sw" as subject
 "sw" and/or ...
 adjective predicates of "sw"
 "sw" is a ...

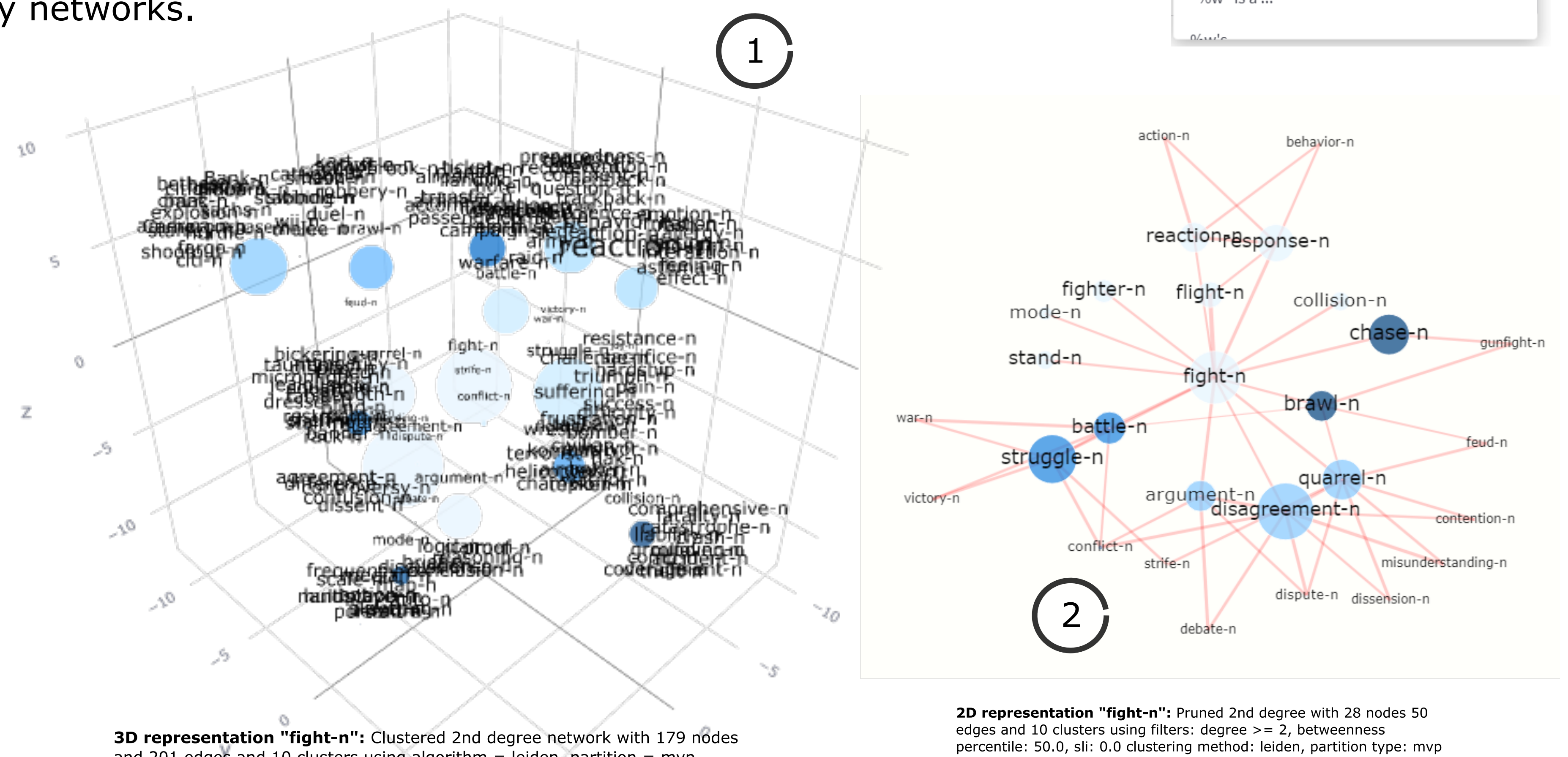
Grammatical relation 2: (fight-n)-[gr1]-[f]-[gr2]-[fof]

modifiers of "sw"
 nouns modified by "sw"
 verbs with "sw" as object
 verbs with "sw" as subject
 "sw" and/or ...
 adjective predicates of "sw"
 "sw" is a ...

Syntactic Dependencies in ConGraCNet: The ConGraCNet methodology takes a systemic approach to exploring the syntactic-semantic constructions in natural language. It utilizes graph theory to represent emergent semantic properties of lexical nodes within layers of syntactic dependency networks.

Lexical Tasks: Dependency graphs can be used for various lexical tasks.

- Identifying conceptually similar lexemes using the "conj" relationship.
- Clustering lexical meanings into semantic domains by identifying clusters of semantically related concepts.
- Identifying polysemic structures of a lexeme by analyzing the relationships between different meanings of a lexeme.
- Identifying category label for a semantic domain by analyzing the hypernym or categorial relationships of the concepts in the domain.



Community 1: fight-n, flight-n, response-n, collision-n, fighter-n, mode-n, stand-n, reaction-n, action-n, behavior-n
 Corpus-based labeling of community 1: fight-n is related to FIGHT-N, RESPONSE-N
 WordNet hypernym-based labeling of community 1: fight-n is related to synsets MANNER.N.01, SUPPORT.N.10

Community 2: argument-n, quarrel-n, disagreement-n, debate-n, dispute-n, dissension-n, misunderstanding-n, contention-n
 Corpus-based labeling of community 2: fight-n is related to ARGUMENT-N, PART-N
 WordNet hypernym-based labeling of community 2: fight-n is related to synsets DISPUTE.N.01, DISAGREEMENT.N.03

Community 3: battle-n, struggle-n, conflict-n, war-n, victory-n, strife-n
 Corpus-based labeling of community 3: fight-n is related to STRUGGLE-N, BATTLE-N
 WordNet hypernym-based labeling of community 3: fight-n is related to synsets CONFLICT.N.01, MILITARY_ACTION.N.01

Community 4: chase-n, brawl-n, feud-n, gunfight-n
 Corpus-based labeling of community 4: fight-n is related to BANK-N, HUNT-N
 WordNet hypernym-based labeling of community 4: fight-n is related to synsets FIGHT.N.02, PURSUIT.N.01

5. Propagating sentiment values and properties on a set of semantically similar concepts from a sparse sentiment dictionaries.

6. Calculating sentiment value for semantic domains by analyzing the weighted relationships between concepts in a cluster.

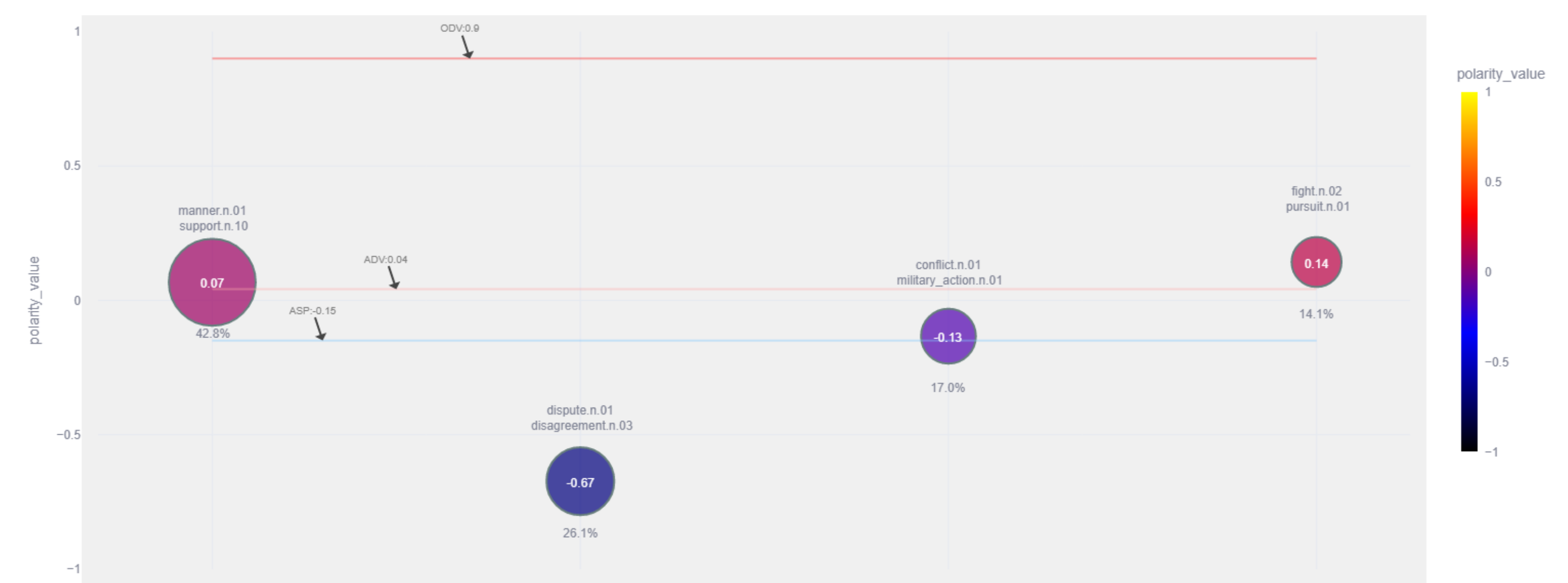
SenticNet 6

SenticNet 6 ODV: Original Dictionary Value for ** fight-n **

label	polarity_value	polarity_label	moodtags	semantics	introspection
0 fight-n	0.9	positive	[#joy, #eagerness]	[joyful, happy, eager, proactive, smile]	0.9

SenticNet 6 ADV: Assigned Dictionary Value for ** fight-n ** based on the 15 friends and 5 friends of friends graph of "sw" and/or ... in ententen13_tt2_1.

	label	polarity_value	introspection	temper	attitude	sensitivity
sli	fight-n	0.041739	0.003661	-0.022569	-0.029626	0.199703
pagerank	fight-n	-0.090316	-0.112458	-0.047033	0.016243	0.003989
degree	fight-n	-0.082507	-0.106934	-0.044000	0.011750	0.015987
weighted_degree	fight-n	-0.091723	-0.120747	-0.043156	0.012385	0.010597
betweenness	fight-n	0.261891	0.275981	-0.039180	-0.010934	0.389058



Future Research Directions: employing deep graph learning techniques to enhance the performance and incorporate more complex graph structures to further improve the accuracy, efficiency and diversity of tasks.

References:
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 Perak, B., & Ban Kirigin, T. (2020). Corpus-based syntactic-semantic graph analysis: Semantic domains of the concept feeling. *Rasprave*, 46(2), 957-996.
 Perak, B., & Kirigin, T. B. (2022). Construction Grammar Conceptual Network: Coordination-based graph method for semantic association analysis. *Natural Language Engineering*, 1-31.