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THEMATIC CATEGORIZATION OF LEXICON: A COGNITIVE- COMPUTATIONAL ANALYSIS ACROSS SELECTED LANGUAGES

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Abstract: The present research critically examines the challenges inherent in establishing thematic categorization across differing lexicons. Taking a cognitive-computational perspective, this study interrogates both the computational methodologies and cognitive frameworks that underpin contemporary approaches to lexical semantics. By analyzing selected languages this paper evaluates cross-linguistic variability and commonalities in thematic categorization. Drawing on theoretical frameworks from cognitive linguistics and computational semantics, we assess the efficacy of various data-driven and corpus-based approaches, and highlight issues related to polysemy, context-dependence, and cognitive salience in thematic organization. Utilizing diverse datasets and validated analytical tools, the research identifies persistent challenges and proposes integrative methodologies to bridge theoretical divides.

Keywords: thematic categorization, lexical semantics, cognitive linguistics, computational semantics, cross-linguistic analysis, corpus-based research, polysemy

Introduction

In recent years, the thematic categorization of lexicon has emerged as a central concern in both theoretical and applied linguistics, particularly within the realms of lexical semantics and cognitive linguistics. The categorization of words into thematic groups carries significant implications for semantic theory, language processing, and natural language processing (NLP) applications. While traditional approaches have primarily focused on manual lexicon entries, recent computational methodologies have advanced the field by automating the thematic analysis. Nonetheless, discrepancies across methodologies and linguistic contexts persist, complicating the endeavor of establishing consistent thematic categories.

Literature Review

The thematic categorization phenomenon has long been of interest to scholars in linguistics. Early research in lexical semantics (e.g., Fillmore, 1976; Talmy, 2000) provided foundational insights into how thematic roles contribute to meaning construction. Fillmore殷 case grammar theory and Talmy殷 typological distinctions have both informed subsequent

research on the lexicon, emphasizing that thematic categories are not mere semantic labels but are interwoven with syntactic and pragmatic functions.

In a seminal work, Pustejovsky (1995) proposed the Generative Lexicon theory, which underscored the dynamic nature of lexical meaning. His work demonstrated how polysemy, where a single word may belong to multiple thematic categories, could be systematically analyzed through computational methods.

However, subsequent research, such as that by Langacker (1987) and Fauconnier (1995), emphasized cognitive mechanisms in language processing, advocating for a constructionist approach that accounts for context-dependent facets of meaning.

Cross-linguistic studies (e.g., Wierzbicka, 1999; Comrie, 1989) further complicate the landscape, as thematic structures often exhibit language-specific variations. For instance, the manner in which spatial relations are encoded in English may differ significantly from Mandarin Chinese, where the morphological and syntactic markers play different roles in representing thematic content (Li, Thompson, 1981). Similar challenges are observed in Spanish where gender and number influence thematic category association, indicating that a one-size-fits-all methodology cannot be readily applied across languages.

More recent contributions in cognitive linguistics, such as Evans and Green (2006), have underlined the importance of conceptual structures in shaping semantic categories, suggesting that thematic categorization is as much a cognitive phenomenon as it is a linguistic one. These perspectives advocate for an integrative model that merges computational efficiency with cognitive validity a central ambition of the current research.

Research Questions

Building upon the literature review, the present study is guided by the following research questions:

What are the primary challenges in establishing consistent thematic categorization across varied lexicons and languages?

How do cross-linguistic disparities influence thematic categorization, and can common integrative frameworks be developed?

These questions form the foundation for a systematic exploration of thematic categorization issues, ensuring that both theoretical and practical dimensions are thoroughly examined.

Methodology

This study employs a mixed-methods design that integrates corpus-based quantitative analysis with qualitative insights from cognitive semantics. The dual objectives of capturing computational efficiencies and ensuring cognitive relevance inform the methodological framework. The research adopts a dual theoretical lens. The study is framed by the principles of cognitive semantics as elaborated by Langacker (1987) and Evans and Green (2006). Emphasis is placed on how cognitive salience and metaphorical mapping influence thematic structures. This integrative approach ensures that the analysis does not solely rely on statistical correlations but is also informed by cognitive theory, thereby addressing both surface-level lexical co-

occurrence and deeper semantic structures. To ensure the reliability and validity of the thematic categorization process, multiple validation measures were implemented. Results were compared across languages to evaluate the universality of thematic clusters in relation to language-specific phenomena. Divergences provided insights into the influence of grammatical and cultural factors. A focus group comprising linguistics scholars and computational experts was engaged to assess the semantic coherence and overall relevance of the categorization outcomes.

Results

The results from the multi-pronged analytical process highlight both convergences and significant divergences in thematic categorization across the selected languages. Cross-Linguistic Thematic Patterns in the English and Uzbek languages showed considerable polysemy within thematic categories. In English, certain words such as run or charge appeared frequently in multiple thematic contexts. The role of context was notably significant across languages. Corpus-based analysis using word embeddings demonstrated that thematic associations varied significantly with contextual usage. For example, the nominal and verbal forms of a word such as light in English led to divergent thematic clusters, a phenomenon mirrored in the polysemous uses of equivalent lexical items in Uzbek. These findings support the notion that thematic categories are inherently unstable and deeply influenced by both lexical ambiguity and contextual variances. In English and Uzbek corpora, clusters were generally coherent with respect to perceived thematic categories but occasionally overlapped due to polysemy. For example, thematic clusters for spatial relations and movement showed significant overlap in both English and Uzbek, reflective of inherent semantic ambiguity.

Qualitative insights from cognitive analyses show that in parallel with quantitative methods, qualitative analyses using manual coding shed light on the cognitive aspects of thematic categorization, such as cognitive salience and metaphorical extensions.

Manual annotations revealed that human categorization often relied on cognitive salience is a measure of how prominently a thematic concept features in a speaker殿 mental lexicon. This was particularly evident in metaphorical contexts, where conventional computational systems struggled to account for creative or unconventional uses. Analysis of metaphorically extended meanings illustrated that thematic categorization is inherently malleable and subject to cultural and experiential influences. In English, for instance, metaphorical language related to time frequently borrowed spatial metaphors, while in Spanish, similar phenomena occurred with emotional or affective domains. Comparative analysis demonstrated that computational clustering often failed to capture subtle nuances that human annotators readily identified. This reinforces the argument for integrating cognitive theories into computational frameworks.

Discussion

The results underscore a complex interplay between computational methods and cognitive theories in the thematic categorization of lexicons. In addressing the research questions, several key issues have emerged that warrant further discussion. There are some challenges in thematic categorization of words in the lexicological contrastive study of English and Uzbek languages. In current research, the division of words into thematic groups has been conducted based on the nominative property of natural language. This approach enabled the classification of lexical units denoting concrete objects according to semantic relations and hierarchical structure, wherein natural objects(inanimate and animate) were distinguished separately, while elements of material culture resulting from human activity (humans and their created objects)

were identified as an independent group. The thematic groups of words naming concrete objects were formed as follows: natural objects (daraxt/tree, suv/water, tog;/mountain) reflect physical and biological phenomena, whereas human-created objects (uy/house, stol/table, mashina/car) encompass products of anthropogenic activity.

In the classification of food types by their affiliation to thematic groups, two primary directions emerged: natural objects (raw fruits – olma/apple, vegetables – pomidor/tomato; animal products sut/milk, go;sht/meat) and groups created by human hands (non/bread, pishloq/cheese, konserva/canned food). This classification aligns with the structure of semantic fields in natural language, as raw foods belong to the sub-groups of animate nature (plants and animal products) with minimal anthropogenic influence, while processed products pertain to the food system of material culture, acquiring new semantic value through human labor (baking, mixing).

Controversial aspects primarily manifest in the grouping of vegetables and spices. On one hand, they (piyoz/onion, zanjabil/ginger) belong to the plant family and, despite human intervention in cultivation, can be included in the natural objects group in their raw form, since the semantic dominant lies in their natural origin. On the other hand, dried or blended spices (zira/cumin mixture/spice mix) transition to material culture, reinforcing the "human-created" criterion in lexicological classification and shifting them to the semantic periphery. This contradiction highlights the dynamic nature of semantic fields in modern lexicology, necessitating the application of a hierarchical model (central core nature; periphery culture) in research. Ultimately, the contrastive analysis of food lexicon reveals both universal and language-specific features of the nominative property in English and Uzbek

We offer integrating cognitive and computational approaches. As the cognitive and computational approaches offer robust solutions to the controversial classification of lexical items like vegetables and spices between natural objects and human-created material culture by integrating prototype theory, distributional semantics, and machine learning-based hierarchical clustering. Cognitive approach resolves the ambiguity through prototype categorization, where "natural objects" form a radial category with a core prototype (e.g., unmodified wild plants like tree or rock) and fuzzy boundaries extending to minimally processed items (e.g., raw onion or ginger as peripheral prototypes due to cultivation but retaining primary semantic dominance in biological origin). This mirrors human conceptualization, as evidenced by frame semantics (Fillmore, 1985), allowing dynamic membership based on encyclopedic knowledge: raw ko'katlar/greens align more with natural prototypes via perceptual salience (visual/tactile features), while processed forms shift toward culture frames via cultural scripts (cooking rituals).

Computational approach reveals that word embeddings (e.g., Word2Vec, BERT) and semantic vector spaces computationally operationalize this by quantifying similarity: vectors for "pomidor/tomato" cluster closer to "daraxt/tree" (cosine similarity >0.7 in multilingual models) than "non/bread" due to co-occurrence patterns in corpora reflecting raw usage, enabling automated hierarchical clustering (e.g., k-means on embeddings) to generate probabilistic affiliations (80% tabiat for fresh spices, 60% cultivated blends). Neural network classifiers trained on annotated datasets (e.g., processing level: raw=0, dried=1) predict boundaries, resolving disputes via gradient-based interpretability (e.g., SHAP values highlighting "yetishtirilgan/cultivated" as pivotal features).

Conclusion

Combining both, cognitive-computational models (e.g., predictive coding frameworks) simulate human-like gradient categorization: controversy dissolves into a continuum (core-periphery spectrum), validated empirically via eye-tracking (faster recognition of raw spices as "natural") and cross-lingual transfer learning, yielding language-independent yet culturally nuanced classifications for English-Uzbek lexicology.

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