

Modeling Metaphorical Meaning Networks in English And Uzbek (Based on Graph Theory and Frames)

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Abstract: This article explores the methodological significance of the synthesis of graph theory and frame semantics in modeling metaphorical meanings within cognitive linguistics. The central idea of the study is based on the description of metaphor as a multilayer conceptual network (graph), abandoning traditional lexicographic classifications. The article reinterprets the concept of metaphorical equivalence through the models of "node neighborhood" and "spreading activation". On the example of English and Uzbek, the asymmetry between the source and target domains, the functional functions of core and bridge nodes, and the semantic weight (w) of edges are analyzed. Based on the FrameNet architecture, metaphor is justified as a structural projection of one frame onto another. The results of the study show that the graph model is an effective tool for identifying cognitive disparities between agglutinative Uzbek and analytic English, creating new analytical opportunities for the fields of translation theory and natural language processing (NLP).

Keywords: Graph theory, frame semantics, conceptual metaphor, FrameNet, nodes and edges, spreading activation, Uzbek language, cognitive modeling.

Introduction: In modern cognitive linguistics, many studies recognize that traditional lexicographic and semantic classifications are insufficient to fully understand the nature of metaphor. Lakoff and Johnson, defining metaphor as a conceptual system, present it as the core of human thinking. Metaphor is not a word combination, but a mechanism for projecting one conceptual domain onto another. However, these projections are interconnected, multi-layered, and distributed asymmetrically across languages. This complexity cannot be captured by a simple list or hierarchical tree, and a network model becomes necessary here, that is, a simple lexical list or equivalence in the form of "word A = word B" is not enough. The list only puts individual units side by side; the network shows which neighboring nodes a unit is connected to, by what weighted edges, in which frame, and with what cultural constraints. The formula $G = (V,$

$E)$, the basic model of graph theory, offers great methodological opportunities when applied to comparative linguistics for this very reason: V is taken as the set of nodes, and E is taken as the set of relations between nodes.

Semantic maps in linguistics are also often understood as graphs: meanings are viewed as nodes, and transitions or proximity between them as edges. However, this general principle needs to be further developed in the modeling of metaphorical meanings. This is because metaphor embodies a two-layered action: on the one hand, a conceptual transfer occurs between the source domain and the target domain; on the other hand, this transfer does not operate with individual words, but with the entire frame, that is, the situation, actors, roles and their mutual relations. Thus, to compare metaphorical equivalence, it is necessary to compare not only nominative units, but also their

framing neighborhood and location in the network.

LITERATURE ANALYSIS

The graph approach is especially effective in showing asymmetry between two languages. Meanings concentrated around a single central node in one language may be divided into two or more independent centers in the second language. Or, conversely, several semantic directions that are separated as separate lexical units in English may be concentrated in a single cultural node in Uzbek. Therefore, instead of the concept of "equivalent word", it is appropriate to put forward the concept of "nodes with a corresponding degree of neighborhood".

The second pillar of this approach is frame semantics. Fillmore explains meaning through a knowledge scene – a frame: the meaning of a word is understood together with the type of situation that calls it, the composition of participants and the scenario. The FrameNet architecture developed by S. Baker, C. Fillmore and J. Lowe defines more than 1000 frames in English, and for each frame, frame elements (Frame Elements), lexical units representing the frame (Lexical Units) and relationships between frames (Frame-to-Frame Relations) are specified. Therefore, while graph theory gives the formal topology of meaning elements, frame semantics gives the internal semantic structure of that topology. When the two are combined, metaphor is seen as a structural projection of one frame onto another. Lakoff and Johnson show this systematicity in their theory of conceptual metaphor, emphasizing that metaphor is not a random, but a systematic mapping between concepts.

As Barabási has pointed out, the presence of hub nodes in complex networks determines the entire functioning principle of the network. The same is true for metaphorical networks: some concepts become the collision point of countless metaphorical edges, acting as a "conceptual center". On this basis, comparing metaphorical networks between English and Uzbek allows us to solve two problems. First, it is determined which metaphorical projections are universal (present in both languages) and which are language-specific (lacunar). Second, through the analysis of network density and hub nodes, the clustering mechanisms arising from the agglutinative morphology of the Uzbek language differ from the analytical syntactic branching

of English.

RESULTS

The justification for this choice is that traditional comparative semantics usually studies the equivalence relation "word $\leftrightarrow$ word", ignoring the semantic information lost in the transition from one language to another. However, as Z. Koveches has shown, metaphorical equivalence is a manifestation of a deep asymmetry in the network structure of conceptual systems in two languages. Therefore, the presented graph models are of practical importance in the field of translation theory and natural language processing (NLP).

The FrameNet project is important because it has brought frame semantics to a computer-processable form. In it, lexical units are assigned to specific frames, frame elements are displayed, and annotated with corpus examples. In subsequent interpretations, metaphor is also recognized as an inter-frame relationship. In a situation where metaphorical meaning is formed, a lexical unit corresponding to the target frame is allocated, and a metaphorical relationship is established between the frames. This principle is especially important for comparative research, that is, it allows us to determine which frames metaphorical units in Uzbek and English activate, which nodes these frames bring closer together, and where they differ. The main task of comparative research of metaphorical meaning is to determine the systematic structure of language units in the network. In this case, graph theory provides a formal template, frame semantics provides a meaningful structure, and the FrameNet database provides ready-made conceptual tools for annotation and modeling. It is the synthesis of these approaches that makes it possible to substantiate the fact that metaphorical meaning networks in Uzbek and English are of an unequal nature.

Within the framework of this study, the metaphorical network for each language is obtained as follows:

$G_L = (V_L, E_L, w_L, f_L)$ where L is the language (Uzbek or English), V_L is the set of conceptual nodes, E_L is the edges between them, w_L is the semantic weight of the edges, and f_L is the marking function indicating which frame each node belongs to. In this model, a node is more like a conceptual center activated by it than a lexeme itself. For example, units such as face, table,

wedding are recognized as core nodes that go beyond the boundaries of a simple lexical heading and unite many phraseological, axiological and pragmatic layers around themselves. Therefore, the value of units such as face, table, wedding is assessed not only based on dry lexical meaning, but also through the active frame, collocation and complex of cultural scenarios that move within them.

An edge represents a relationship based on specific cognitive laws, rather than a random connection between nodes. In this respect, at least four different types of edges can be distinguished:

The first type is the metaphorical projection edge. It reflects the structural correspondence transferred from the source frame to the target frame;

The second type is the phraseological reinforcement edge. In this, one node enters into regular contact with another node through certain phrases and patterns;

The third type is the edge of derivational densification. In the Uzbek language, artificial and formal variants formed around a single nucleus complete the semantic cluster;

The fourth type is the pragmatic-axiological edge. It indicates the combination of a certain unit with evaluative layers such as respect, prohibition, sacredness, or social obligation. It should be noted here that the metaphorical network, along with cognitive properties, also carries cultural and social significance.

In addition, at this point it is necessary to understand the concept of edge weight. One concept is not associated with another concept with the same strength in all situations. For example, the connection of the node bread with food and its connection with holiness are not the same. In Uzbek discourse, the latter is often manifested with a greater axiological load. Similarly, although the food and money/livelihood aspects of the node bread are important in English, they are activated differently in the everyday evaluative field. Therefore, the edge weight $w(e)$ is interpreted not as a strict statistical number of corpus frequency, but as a sum of functional centrality, phraseological stability and cultural load within the frame.

The graph approach has its own scientific advantage in explaining the mechanism of the spread of metaphorical meanings. According to the spreading

activation model of A. Collins and E. Loftus, when a node in semantic memory is activated, nodes close to it are also activated to a certain extent. A similar process is observed in metaphor perception: as a result of the activation of a certain node in a text or speech, logic is not limited to a narrow range of lexical meanings, but also directly activates the system of frames, roles, and evaluative layers adjacent to it. This process can be expressed in a simplified form by the following formula:

$$a_{t+1}(v_i) = \lambda a_t(v_i) + \sum_j w_{(ji)} a_t(v_j),$$

where $a_t(v_i)$ is the activation at time t , λ is the retention coefficient, and $w_{(ji)}$ is the weight of the influence from the neighboring node. This formula is used as an explanatory model rather than a mathematically rigorous calculation: the important point is that the metaphor activates not only a single center, but also neighboring frames located around the center.

The characteristic of directionality in the metaphorical network is also of particular importance. As J. Lakoff and M. Johnson noted, metaphors in most cases move from the source domain to the target domain: in conceptual pairs such as time - resource, discussion - battle, thought - food, the direction of structural transfer is strictly one-way. Thus, while recording the interrelationship, the edge clarifies the important question of which frame serves to illuminate the other. In this case, the directed edge is expressed by the source - target formula. For example, the transition from the conceptual center of the eye to such lower frames as control, attention, hope and perception proves the branching of a single core in different directions. The transition from the English node weight to the concepts of responsibility or burden is a clear example of the transfer of physical weight -> social obligation.

CONCLUSION

In network architecture, nodes are classified differently according to their hierarchical status. Within the framework of the study, three main types of nodes are distinguished. The first is the core node: it acts as a strong center that combines many edges and attracts surrounding semantic layers. The second is the bridge node: it is considered an intermediate connecting point that provides a seamless transition between two independent frames or clusters. The third type is the peripheral node: it is an auxiliary element that is

activated only in certain situations and does not directly affect the overall centrality of the network. For example, if the eye appears as a single core node in Uzbek, in English this conceptual function is shared between the eye and face units. In English, the concept of table plays the role of a bridge node between everyday household relationships and formal agreement frames. The concepts of wedding and wedding clearly demonstrate how different points the center of cultural significance is located in different languages.

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