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THE PROBLEM OF ISOMORPHISM BETWEEN LANGUAGE AND LOGIC

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Abstract

This article discusses the issue of isomorphism, one of the fundamental problems in the relationship between language and logic. The study examines the impact of semantic ambiguity and polysemy on both language and logical systems.

Keywords

language, logic, isomorphism, semantic ambiguity, polysemy.

The concept of isomorphism serves as an important methodological tool in explaining the complex relationship between language and thought. Isomorphism (from the Greek *isos* – equal, and *morphe* – form) refers to the complete or partial correspondence between the components, relations, and structures of two or more systems [7:403]. Within the linguo-logical approach, isomorphism is used to identify correspondences between linguistic units (words, sentences, syntactic constructions) and logical units (concepts, judgments, and inferences). Theoretically, if language and logic are interpreted as isomorphic systems, then each syntactic model should correspond to a logical model, the deep structure of language should be built on the same basis as logical structure, and the gap between thought and its expression should be minimized. However, this approach is not always confirmed by empirical linguistic data. The dynamic, contextual, and multilayered nature of natural language makes it impossible to equate it completely with logic, which is a strictly formal system.

The problem of isomorphism between language and logic emerged within the framework of classical logic and analytic philosophy. In particular, Gottlob Frege sought to reveal the true semantic structure of language through logical analysis. According to his view, natural language represents only a surface form, while the underlying logical structure differs from it [2:32–35]. Later, Ludwig Wittgenstein, in his *Tractatus Logico-Philosophicus*, explained the relationship between language and reality through the concept of “logical form.” According to him, propositions are

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logical models of reality; therefore, a certain degree of isomorphism exists between them [3]. In the mid-twentieth century, Rudolf Carnap [1:3] and Alfred Tarski [8] continued the logical modeling of language through formal semantics. They treated language as a formal system and attempted to provide a scientific foundation for the idea of isomorphism [1:3].

However, the development of generative grammar, particularly through the work of Noam Chomsky, led to the interpretation of the internal structural regularities of language as an independent object of scientific inquiry [5:251]. While this approach did not deny the relationship between language and logic, it demonstrated that grammatical structures cannot be completely reduced to logical structures.

One of the most important aspects of the problem of isomorphism is the identification of contradictions between natural language and formal logic. Semantic issues occupy a special place in the study of the relationship between language and thought. In particular, semantic ambiguity and polysemy are regarded as major reasons why language cannot fully correspond to logical models. These phenomena are therefore considered significant factors limiting the isomorphism between language and logic.

Semantic ambiguity refers to the lack of a single, definite meaning in a linguistic unit (a word, phrase, or sentence), making it open to multiple interpretations. This phenomenon often arises when contextual information is insufficient or when structural ambiguity occurs. For example, in the sentence “The students saw the teacher,” the relationship between the participants is clear (students → teacher). However, in a more complex construction such as “The man I saw is reading a book,” the circumstances under which the man was seen remain unspecified. Semantic ambiguity creates difficulties for logic because logical systems require clear and unambiguous expressions.

Polysemy, by contrast, refers to the phenomenon in which a single word possesses several lexical meanings [6:15]. This phenomenon develops naturally as language evolves. For example, the Uzbek word *bosh* (“head”) has numerous meanings, including: (1) the part of the body above the neck; (2) intellect or mind; (3) leader or chief; (4) a person of higher rank; (5) principal or major; (6) the most important or leading element; (7) first or foremost; (8) a person; (9) an individual animal counted as livestock; (10) the top part of an upright object; and several other meanings [4:332–335].

The example of *bosh* demonstrates that its original nominative meaning (“the upper part of the body”) has generated numerous secondary meanings through

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metaphorical and metonymic extensions. For instance, the meaning "leader" emerged through the conceptual model "head of the body → head of a system," while the meaning "first" developed on the basis of spatial orientation. Polysemy thus reflects the cognitive nature of language. In categorizing reality, human cognition forms systems of central and peripheral meanings. The various meanings of *bosh* are not random but are connected through a common conceptual core involving such semantic components as "upperness," "centrality," "control," and "beginning." This allows polysemy to be interpreted within the framework of conceptual metaphor theory.

Therefore, polysemy is not a sign of disorder within the language system but rather a consequence of the economical and associative functioning of human cognition. Nevertheless, from the perspective of logical systems, polysemy constitutes a problematic phenomenon. According to the principles of formal logic, every sign should possess a single, precise meaning (the principle of univocity). Natural language, however, is characterized by the opposite model: "one form → multiple meanings." This leads to semantic ambiguity and interpretative variability. Consequently, polysemy serves as one of the strongest arguments against the complete isomorphism of language and logic.

Natural language functions through context, meaning that interpretation is determined by the communicative situation. Logic, on the other hand, seeks to eliminate contextual dependence and relies on a system of formal symbols. As a result, while polysemy enhances the communicative flexibility of natural language, it creates serious limitations for formalization.

Although semantic ambiguity and polysemy are closely related concepts, they are not identical:

Features	Semantic Ambiguity	Polysemy
Nature	Uncertain interpretation	Multiple meanings
Cause	Insufficient context	Language development
Result	Two or more possible interpretations	Several lexical-semantic variants
Impact on Logic	Problem of interpretation	Violation of semantic precision

According to the theory of isomorphism, complete correspondence between language and logic requires that each linguistic unit correspond to a single logical unit and that each meaning be expressed unambiguously. However:

• semantic ambiguity allows one sentence to be translated into several logical formulas;

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• polysemy enables one linguistic unit to correspond to different logical units.

As a result, isomorphism is either disrupted or can function only partially.

Semantic ambiguity and polysemy are inherent features of natural language and do not conform to the strict requirements of logical systems. Therefore, the isomorphism between language and logic cannot be considered complete; rather, it is limited and partial in nature. Taking these phenomena into account, modern linguistics interprets language not as a rigid logical model but as a multilayered and context-dependent system.

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