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Knowledge Representation as Semiotic Mediation: Contributions of Peircean Theory to Knowledge Organization

Lucía Simón

Universidad de la República, Uruguay
Comisión Sectorial de Investigación Científica, Universidad de la República,

UruguayMario Barité

Universidad de la República, Uruguay

Abstract

This paper examines knowledge representation as a form of symbolic mediation within the field of knowledge organization. From a theoretical perspective, it explores the contributions of semiotics—particularly the theory of Charles S. Peirce—to understanding processes such as indexing, classification, and conceptual structuring. It argues that representation is not a passive reflection of reality, but an interpretive construction mediated by signs, inferences, and contexts of use. Within this framework, three contributions of Peircean semiotics are presented: the semiotic model of indexing (Jens-Erik Mai), indexing as an inferential process (Carlos Cándido de Almeida), and the pragmatic organization of knowledge domains (Torkild Leo Thellefsen and Martin Thellefsen). Taken together, these approaches allow knowledge organization to be understood as a dynamic, fallible, and situated process, whose effectiveness depends on conceptual coherence and alignment with communities of practice.

1.0 Introduction

Representation constitutes a central component of information science. It is not merely a set of procedures aimed at describing documents, but rather an intellectual operation that transforms knowledge into symbolic structures that can be shared, stored, reinterpreted, and retrieved. From this perspective, knowledge representation is a fundamental pillar of knowledge organization—as a specialized field of study—since the effectiveness and robustness of conceptual structures that enable the construction of shared meanings depend on its quality and coherence.

The notion of representation has been addressed from multiple theoretical traditions that offer complementary perspectives, including philosophy and semiotics, linguistics, and terminology. In philosophy, the problem of representation concerns the relationship between thought and reality; in semiotics, it concerns the ways in which signs mediate experience and produce meaning; and in linguistics and terminology, it concerns how language orders and structures knowledge.

In knowledge organization, all these dimensions converge, as representing is equivalent to symbolically organizing knowledge in order to make it accessible, retrievable, and useful. This paper presents the contributions of Peircean theory to knowledge representation.

2.0 Semiotics as a Contribution to Knowledge Representation

Knowledge representation is a central task in information science and is materialized through processes such as indexing, representation, and the translation of document content. These processes enable mediation between the production, dissemination, and retrieval of knowledge, and are fundamentally grounded in systems of signs—referred to here as "knowledge organization systems"—that allow meanings to be organized and stabilized.

In this sense, semiotics provides a particularly relevant theoretical framework, as it focuses on the study of signs and processes of signification. Representing knowledge ultimately involves operating with signs—both linguistic and non-linguistic—to transform complex contents into communicable and retrievable symbolic structures.

However, carrying out these processes requires theoretical foundations that go beyond purely mechanistic models. The mere extraction of terms or the simple application of techniques may be insufficient to capture the dynamics of signification. Processes of knowledge organization and representation are, in essence, processes of inference and meaning-making that require conceptual frameworks capable of accounting for the symbolic mediation involved. In the current state of technology, neither artificial intelligence nor automatic indexing techniques appear to have fully overcome this limitation, as they still face significant challenges in capturing contextual meaning, interpretive nuance, and domain-specific semantics.

Historically, the philosophical understanding of representation has evolved from a conception of passive reflection to one of active construction. In the Aristotelian tradition, knowledge was conceived as an accurate reflection of a preexisting order in reality (Aristóteles [ca. 350 B.C.E.] 1977); in contrast, the Kantian revolution proposed that the subject actively imposes mental structures on the chaotic multiplicity of phenomena (Kant [1781] 1998). With Kant, representation ceases to be a mirror and becomes mediation—an organized way of making sense of experience.

2.1 The Triadic Model of Charles Sanders Peirce

Knowledge organization systems—such as classifications, thesauri, or catalogs—are not neutral "mirrors" of reality. Rather, they are constructions mediated by theoretical principles and oriented toward practical purposes, a central idea of pragmatism that underpins practices in information science. These tools do not passively reflect the world; instead, they actively structure it according to specific purposes. It is within this framework that Charles Sanders Peirce's (1931–1958) work emerges as a comprehensive perspective for understanding processes of signification and representation.

Peirce thus appears as a key figure for information science, as his thought does not offer a set of isolated tools but rather an integrated theoretical framework that overcomes the limitations of purely linguistic or merely instrumental models.

Peirce introduces a conception of the sign known as the "triadic" model, which provides new elements for thinking about representation. In contrast to the "dyadic" model of Ferdinand de Saussure ([1916] 1945), focused on the relationship between signifier and signified, Peirce proposes a structure composed of three elements: representamen, object, and interpretant. Each sign (representamen) refers to an object, but acquires meaning only through the interpretant, that is, the effect it produces in the mind of the interpreter. This dynamic constitutes a process of continuous semiosis, in which each interpretation gives rise to new representations. In this sense, the sign is not a static entity.

Peirce's semiotics also incorporates three categories that permeate all experience: Firstness, Secondness, and Thirdness. Firstness—associated with the sign or representamen—refers to pure quality and possibility; Secondness—associated with the object—refers to existence and fact; and Thirdness—associated with the interpretant—refers to law or mediation. It is this latter category that allows representation to be understood as a relational phenomenon: there is no knowledge without mediation, without signs that establish connections between experience and understanding.

Given the breadth and complexity of Peirce's proposal, this paper presents a general synthesis of his notion of the sign and outlines the three branches into which he divided semiotics: speculative grammar, pure logic, and speculative rhetoric.

- Speculative grammar refers to the general theory that studies the nature of signs and the conditions under which something can function as a sign.
- Pure logic refers to the theory of the conditions of truth of signs and their reference to objects. It studies the forms of inference: abduction (hypothesis formation), deduction (analysis of consequences), and induction (generalization from cases).
- Speculative rhetoric concerns the conditions under which signs generate other signs and thus promote the development of knowledge; it is closely linked to pragmatism and continuous semiosis.

From this perspective, Peirce's thought is particularly useful for knowledge organization insofar as it places emphasis on the process of representation rather than on the represented object. Signs are not mere substitutes for the world, but instruments for thinking and communicating. In documentary practice, classifications, thesauri, and catalogs are not reflections of reality but conceptual systems constructed by communities of practice for specific purposes. In this sense, the information professional acts as an interpreter who mediates between document content and users' cognitive needs.

Thus, Peirce's framework links thought, language, and action. Knowledge representation, understood from this perspective, is an interpretive practice in constant evolution. Its value does not lie in exact correspondence with reality, but in its capacity to function in specific contexts, thereby enabling communication. In this sense, knowledge organization exemplifies a mediating function, conceived not merely as a classificatory system but as a practice of symbolic mediation.

2.2 Contributions to Information Science from a Peircean Perspective

As noted above, the central tasks of knowledge organization—such as indexing or the construction of classification systems—are fundamentally processes of interpretation, representation, and sign production. Three contributions of Peircean semiotics to information science are presented below, articulated according to its three branches: speculative grammar, pure logic, and speculative rhetoric.

2.2.1 Speculative Grammar: The Semiotic Model of Indexing (Jens-Erik Mai)

One of the pioneering contributions integrating Peircean semiotics into information science was developed by Jens-Erik Mai (1997), who formulated a "semiotic model of indexing" to describe the process of subject analysis. His innovation lies in understanding indexing as a chain of semiosis, in which each stage produces an interpretant that generates the next representamen.

Mai decomposes the process into four elements, each conceived as a Peircean sign:

- Document: the initial sign, carrying a set of ideas and knowledge, classified as an "Argument."
- Subject: the first interpretant, a mental sign derived from document analysis, conceived as a "dicisign symbol."
- Subject description: the synthetic formulation that stabilizes the subject within the system's language.
- Subject entry: the final sign, translated into documentary language (e.g., descriptor, subject heading).

The strength of this model lies in showing that indexing is not merely a mechanical operation, but a process in which different types of signs are linked through successive interpretations. However, its main limitation—identified by Almeida (2015)—is its focus on classifying resulting signs without adequately addressing the cognitive and inferential processes that generate them. This limitation led to the expansion of the approach toward pure logic.

2.2.2 Pure Logic: Indexing as an Inferential Process (Carlos Cándido de Almeida)

Subsequent theoretical developments, particularly in the work of Carlos Cándido de Almeida (2015), argue that indexing cannot be understood solely in terms of sign classification, but must be analyzed as a full inferential process governed by Peirce's pure logic. In this perspective, the indexer acts as a researcher who formulates hypotheses, analyzes their consequences, and tests them against both the community and documentary languages. Thus, indexing is structured through three forms of inference:

Table 1 Types of inference in the indexing process

Types of inference	Nature of indexing	Peircean category	Process stage
Abduction	Formulation of a hypothesis about the document's content.	Firstness (possibility)	Creation
Deduction	Analysis of the logical consequences of assigning a subject; exploration of conceptual relationships.	Secondness (reactive generality)	Analysis
Induction	Testing, adjustment, and validation of the hypothesis through documentary languages and community use.	Thirdness (continuity, habit)	Comparison

Source: Almeida et al. (2013). The "Process stage" column is the author's own addition.

From this perspective, indexing ceases to be conceived as a mere "translation" between documents and documentary languages. Instead, it is understood as a fallible, creative, and self-correcting procedure that resembles the scientific method. The information professional is no longer a mechanical executor of rules but engages in discovering meaning through a matrix of inferences.

2.2.3 Pragmatism: The Semiotic Organization of Knowledge Domains (Torkild Leo Thellefsen and Martin Thellefsen)

Peirce's influence also extends to the organization of entire knowledge domains. The work of Torkild Leo Thellefsen and Martin Thellefsen (2004) proposes a "semiotic organization of knowledge," grounded in pragmatism and in Peirce's own theory of interpretive habits (Peirce 1998). Thellefsen and Thellefsen critique traditional classification methodologies for imposing universal structures that are external to the internal dynamics of scientific and professional fields. To address this, they introduce several key concepts:

- Knowledge domain: a scientific or professional community with shared goals, practices, and terminology; knowledge is relative to this domain.
- Fundamental sign: a core concept that structures and organizes a domain's conceptual network.
- Significance-effect: the capacity of a concept to convey a large amount of information to an interpreter with adequate collateral experience.
- Pragmatic method: a procedure for identifying the fundamental sign through analysis of the practical consequences of concepts and expert consensus.

This approach recognizes that concepts are not static entities but evolving interpretive habits. In this sense, the inductive phase of indexing—where representations are tested and validated against system languages and expert use—is also the space in which professionals contribute to consolidating these habits and, therefore, to the conceptual evolution of the domain.

In summary, these three contributions show how Peircean semiotics enables knowledge organization to be understood as a deeply interpretive process: speculative grammar explains the structure of signs; pure logic models inferential processes; and pragmatism connects these practices with the evolving dynamics of domains and communities.

3.0 Concluding Remarks: Knowledge Representation as Semiotic Mediation

The analysis presented in this section supports the claim that semiotics provides a key framework for understanding knowledge representation in information science. In particular, the triadic and dynamic conception developed by Charles Sanders Peirce conceives signs as essential mediators in the organization of thought and the construction of shared meanings.

From this perspective, knowledge representation is not limited to a set of technical procedures, but rather constitutes a practice of symbolic mediation that articulates language, thought, and interpretation within specific social and institutional contexts.

Saussure's perspective highlights the structuring role of language and its function in organizing thought, offering a formal understanding of how sign systems delimit and stabilize concepts. From this viewpoint, knowledge organization systems can be understood as conventional systems that operate through internal and differential relations.

Peircean semiotics, however, broadens this perspective by explicitly incorporating the relation to the object, the role of the interpreter, and the processual nature of signification. The notion of continuous semiosis, together with the categories of Firstness, Secondness, and Thirdness, allows representation to be conceived not as a finished product but as an evolving interpretive practice.

The contributions of Peirce, as developed in contemporary information science, translate this philosophical framework into operational models applicable to indexing,

classification, and domain organization. Speculative grammar provides tools for analyzing sign structures; pure logic models inferential processes; and pragmatism links these practices to the evolving dynamics of epistemic communities.

Taken together, these contributions allow knowledge representation to be understood not as a mere descriptive technique, but as a practice of symbolic mediation that articulates language, thought, and action. From this perspective, knowledge organization emerges as a theoretical-practical field in which the quality of representation systems depends on conceptual coherence, interpretive capacity, and alignment with the cognitive and social contexts in which they operate.

Statement on the Use of AI Tools

Generative artificial intelligence tools were used exclusively for translation and language/style editing support during the preparation of this manuscript. The authors take full responsibility for the content, arguments, and conclusions presented in this paper.

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