

sciforum-209481: Semantic field theory in the context of large language models

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The analysis and conclusions presented here are still in development. The text proposes a theory of the semantic field as a superior instance of knowledge retention and articulation. This goal is achieved by unifying approaches from diverse research areas: philosophy of knowledge, linguistic semantics, and computational theory, within a single ontological framework.

The aforementioned concepts, considered in the context of the emergence and development of LLMs, certainly include the concepts of meaning and knowledge. From a semantic perspective, they are directly related. Saeed, the author of a well-known semantics textbook, writes: "Semantics is the study of meaning communicated through language". On the other hand, he adds that "a person's linguistic abilities are based on the knowledge they possess" (Saeed, 2016). In this way, through language and its inherent context, it connects the domains of meaning and knowledge. In this context, the meanings are rather technical and auxiliary in nature, stipulating that "linguistic abilities" which certainly include the ability to communicate, are based on knowledge. This knowledge becomes the universal foundation of linguistic acts, including those (communicative) in which meanings emerge. Therefore, there is a rather clear connection between knowledge and meanings; language use connects the levels of knowledge and meaning.

Language appears here as a pragmatic component, interpreted as its use, that is, the phase that de Saussure calls parole, speech, the actual act of linguistic expression. Saeed also stipulates that he is referring to a specific kind of linguistic knowledge.

Semantics understood in this way has a vast literature, using various approaches, e.g., pragmatic (Austin, Searle), logical and formal (Russell, Wittgenstein), cognitive (Lakoff, Langacker), structural (de Saussure, Greimas), etc.

Meaning production procedures have traditionally been viewed as language-based and, therefore, also as articulations of knowledge. A dramatic impetus in this area was provided by large language models (LLMs), which involve the programmatic (technical) generation of meanings linked into complex structures that emerge as knowledge artifacts. These artifacts can then be assessed using various tools, such as rankings or tests. In this way, LLMs provide evidence that meanings and knowledge, at least in part, rely on language as their ontological foundation.

This does not rule out the possibility of other, nonlinguistic systems that could play a similar role. On the other hand, the possibility of other, analogous, language-based procedures cannot be ruled out either. This means that the cognitive processes of generating meaning and knowledge need not be identical or similar to the procedures underlying LLM, a tempting, if unjustified, possibility in light of the explicit nature of LLM procedures. LLMs may be one way to harness the semantic and epistemic power inherent in language.

The author, seeking a solution to the problem posed at the beginning, i.e., an adequate tool for capturing the processes of knowledge retention and articulation in language, initially relied on Michel Foucault's concept. This work resulted in the concept of discursive space, in which he proposed discourse as a unit of knowledge. This concept interpreted knowledge as the effect of discourses running along specific trajectories in a dynamical space.: "knowledge is a set of discourses contained in an n-dimensional manifold that can be interpreted locally as a discursive space" (Maciag, 2022). This definition, in the context of a semantic field, refers to stabilized insights, not to the field itself. In order to also capture nonlinguistic situations of knowledge articulation, the concept of discourse was generalized by replacing it with the concept of gnoseme. This concept primarily introduces the idea of a dynamical space traversed by gnosemes, in spaces that constitute an overarching, appropriately defined manifold.

However, the emergence of LLMs provided an example of knowledge articulation based on an explicit algorithmic procedure. This transparency was limited by the specificity of this procedure, resulting from the nature of artificial neural networks. Using this procedure involved replacing the discourse with a token, which served as a natural unit of meaning. This allowed for avoiding the arbitrariness of discourse defined by the procedure of particularistic social analysis (hermeneutic, analog). This procedure of discourse delimitation was replaced by a complex statistical classification (objectivized, digital) of tokens.

In this way, the previous idea of perceiving the process of meaning formation as the articulation and retention of knowledge was reconstructed and preserved, while primarily retaining the proposed analytical approach. It is based on the idea of the dynamic nature of this process and uses conceptual tools to describe it, such as trajectories, dynamical spaces, manifolds, etc. The result of this approach was “a concept of knowledge as a set of gnosemes, whose ontological form is the computational trajectories of vectors representing tokens, which are semantic signatures. These trajectories traverse all computational spaces of the LLM, distinguished as autonomous computational areas” (Maciag, 2026).

However, the approach proposed in the aforementioned article, although it offered a semantic and even epistemic interpretation of the operation of LLMs, did not provide a number of answers. Above all, it did not explain the mechanism of inference, a key property of semantic processes in language, that is, the dynamic connections between individual units of meaning. It also lacked an explanation for the ambiguity of units of meaning, as well as its dynamics, dependent on the environment created by other/all such units. It also failed to address the process of meaning emergence or its source. Instead, a coherent semantic and epistemic interpretation of a local, one-time computational process was proposed.

These problems are solved by introducing a superior instance of retention and articulation of meaning, and therefore of knowledge. This is the semantic field. It lies behind semantic phenomena, such as words or tokens. It is prior and more general in nature.

Every linguistic act leads to a situation that can be called the excitation of a field. The field is excited in a certain way, which is the result of the historical process of shaping the field during its social development. LLMs can reconstruct this internal field structure primarily through the mechanism of attention, and this is acquired through training. Humans accomplish this in a single act of utterance, the result of many years of (and still ongoing) learning to speak. The utterance of a word actualizes the internal structure of the field and reveals it. Humans realize this process unconsciously, during the process of articulation; in LLMs, this is extended in trajectories traversing computational spaces.

The structure of the field exists as a disposition, a historically shaped readiness to form a specific arrangement into a momentary structure capable of articulation. However, the field is mobile, meaning it responds nonlinearly, gradually, chaotically, and contradictorily, a result of training based on spontaneous and uncontrolled texts taken from the real world. The repeatability of its dynamics exists, but it is constantly violated and exists only to a certain extent. Without repeatability, we would not be able to communicate, and LLM would not generate coherent responses. On the other hand, the semantic coherence and epistemic value of the utterance are not necessarily unambiguous and stable.

This approach represents a fundamental shift in the ontology of semantic events. Semantic units, such as words or tokens, although they possess a hard, object-like representation, are merely field reactions suspended in motion, which we have tentatively called excitations. Gnosemes, observed, for example, as words, are field creations devoid of substance. This mechanism enables a feedback effect; the field is changed in its inferential structure by each act of its use, speaking. This effect is consistent with Foucault's intuitions, e.g. (Foucault, 1969). At such a point, the field stabilizes and becomes visible, although this moment simultaneously represents the loss of its dynamic variability and is thus merely a frozen photograph of a state that, in the context of the field's dynamism, has ceased to exist. This state of stability is observed as the actual emergence of meaning in intelligible utterances, without regard to the technical procedure used to identify them, i.e., human cognitive effort or the LLM algorithm.

The field, which potentially exists as infinite, is concretized (stabilized) through local insights and is therefore not practically operationally accessible in its entirety, but only in local parts. In practice, there is no access to the entire field but only to field-stabilizing insights, which are

realized as excitations. By excitation of the field, we understand the emergence of meaning, which we perceive as a meaningful whole, a gnossem that materializes as a token, a word, a discourse. Insights, i.e., the use of tokens, words, and discourses, conversely shape the field through the use of emerging gnossemes, which arrange themselves into local structures, resulting in a reconstruction of the field, not necessarily desirable or justified.

The field has no metric dimensions, while the images of insights, i.e. the practical uses of gnossemes, for example, their trajectories across computational spaces in large linguistic models, stabilize and concretize, subject to the rigors of computability. The field is dimensionless, though internally ordered, though this order is unstable and fluid.

Meanings considered in the context of language always appear within sets of sense units, such as utterances or texts. The field maintains in a state of potentiality the relations connecting the elements of these sets, as well as others concerning those sense units that are not directly activated. By preserving the structure of meanings, the field enables the actualization of these relations through the process of being activated in different places/elements of the same field.

Semantic field theory draws on a range of concepts from various authors. Quantum field theory undoubtedly provides primary inspiration, from which it differs in certain key respects (such as the historical and social variability of gnossemes). The idea of a semantic field in the context of language was introduced by Jost Trier, Günther Ipsen, Walter Porzig, and Leo Weisgerber in the 1920s and 1930s. Ferdinand de Saussure's contribution plays a significant role. However, contributions from the philosophy of language, such as the thought of Ludwig Wittgenstein, as well as the French poststructuralist school, such as Michel Foucault, Jacques Derrida, and Gilles Deleuze, should also be considered, concluding this very selective and incomplete list.

LLMs are a groundbreaking and unprecedented tool that allows us to observe the process of articulating meaning as the result of a specific computational process. The proposal to treat token trajectories as units of meaning remains valid, but these trajectories are merely materializations resulting from the excitation of a field, according to an order hidden within it. These materializations merely articulate a certain state of the field.

LLMs can become areas of indirect experimental research in the semantic field. An example of such research, stemming from the assumption that the meaning of a semantic unit, such as a word, is historical, local, and social, is establishing this meaning not as a fixed dictionary entry, but as a dynamic trajectory dependent on the model, or more precisely, its textual training corpus. Such an approach can simultaneously account for apparent errors or so-called hallucinations as properties of the semantic field, as well as the social fact that the meaning of the same token (word) differs across social and historical contexts.

Semantic field theory, for example, opens up the possibility of a new and fundamental type of social research. Semantic field theory leads to the conclusion that the field itself is differentiated or that there are many fields characteristic of various types of social communities: linguistic, ethnic, racial, gender, etc., based on their own semantic fields as the foundations of knowledge. This directly implements the intuition of Teun van Dijk (Dijk, 2013), who used the term epistemic community, as well as the concept of knowledges (plural), proposed by Maciag. The study of the topography of semantic fields would therefore become the study of the topography of social knowledge, in the sense proposed by Foucault, i.e. the study of social phenomena and processes on a scale and precision unattainable so far.

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