

Semi-Participants: LLMs, Activity Theory, and the Symbol Grounding Problem

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Abstract. This position paper critiques the semantic capacities of Large Language Models (LLMs), arguing that their token-based and relational architectures simulate fluency without genuine understanding. We claim that current LLMs lack the mechanisms for embodied, tool-mediated, and socially scaffolded practices necessary for meaningful participation. We offer a novel conceptualization of LLMs as *semi-participants* – artifacts that reproduce stabilized linguistic operations without participating in their socio-normative formation. Extending activity theory to hybrid systems design, we introduce “semi-participation” as a developmental stage in machine cognition. We propose embedding them within reflexive human-machine systems, where humans provide normative grounding and LLMs enhance collective sense-making. This framework avoids mistaking statistical correlation for understanding and calls for designing AI systems as participants in shared cognitive activity.

Keywords: Activity Theory, Enactivism, Large Language Models, Symbol Grounding Problem.

1 The Illusion of Understanding

The performance of Large Language Models (LLMs), including translation, summarization, code generation, and instruction following, which produce fluent, context-sensitive linguistic outputs, has reinvigorated debates about the nature of understanding in artificial systems (Millière & Buckner 2024, 2024a; Schüle 2025; Vaswani et al. 2017). These claims are backed by the complexity of attention architectures and the relational semantics provided by high-dimensional vector spaces, which constitute a form of emergent comprehension.

Yet, this linguistic fluency masks a critical deficit (Bender et al., 2021; Shanahan, Das & Turman 2025). When prompted with semantically trivial but physically counterintuitive questions, such as, “Is it possible to drink from a cup that lacks a bottom, but has its detached bottom affixed to the top instead?” (see Appendix 1) LLMs often fail, revealing a disconnection between syntactic competence and grounded conceptual knowledge.

This issue echoes earlier critiques of computationalism, including Searle’s “Chinese Room” argument (Searle 1980) and Dreyfus’s critique of symbolic AI (Dreyfus 1992), both of which highlight the limits of purely syntactic models in capturing semantic content. This paper contends that such failures are not peripheral but symptomatic of a fundamental architectural limitation that, however, still does not prohibit effective human-machine interaction. The appearance of meaning in LLM outputs stems from their vast capacity for pattern-matching and data memorization, not from genuine semantic grounding.

We reexamine the symbol grounding problem as a conceptual challenge concerning how meaning arises in any intelligent system (Millière & Buckner 2024; Shojaee et al. 2025). Our thesis is that current LLMs lack the generative conditions of meaning, particularly the embodied, socially-aligned, and tool-mediated activities that structure human cognition.

To develop this argument, we adopt a double perspective:

- 1) The enactive approach, which understands cognition as a dynamic process of sense-making emerging from an agent’s embodied interaction with its environment (Varela, Thompson & Rosch 1991; Di Paolo 2009; De Jaegher & Di Paolo 2007; Froese & Ziemke 2009);
- 2) Activity theory, or cultural-historical activity theory (Engeström 2001; Leontiev 1978; Vygotsky 1978; Shchedrovitsky 1957, 1962; Shchedrovitsky & Sadovsky 1964), which interprets cognition and language as emerging from historically and socially structured forms of practice, especially those involving labor, education, and tool use.

From the enactive approach, we borrow the idea that a meaningful action emerges through embodied action; from activity theory, we borrow the accent on a social practice. With this, we argue that signs are instruments of collaborative action, acquired through participation in shared activity. Language, from this standpoint, is not a set of abstract symbols to be mapped onto representations. It is a mode of action embedded in shared, socially regulated, and normatively structured activity. Meaning, therefore, emerges through participatory engagement with a shared world. Rather than disregarding LLMs as “stochastic parrots,” we locate them within an activity-based model of (gradable) participation – so they are not mere imitators, but partial agents in joint activity, even if they lack the capacities for transformation and norm-governed interaction.

In this sense, we disagree with Gubelmann (2024) that the symbol grounding problem is inapplicable to LLMs. While we acknowledge that any attempt at grounding through semantic consideration is misguided (since it implies a problematic internalist theory of meaning), and agree that it is conventional norms of language use that give meaning to linguistic expressions, we stress that the real grounding is unattainable if reduced to language only – especially taken apart from the practices it contributes to.

So what we claim is that language is a part of tool-mediated, institutionally instructed, and norm-governed activity; as activity theorists said, linguistic forms are components of a more complex structural whole, including, in addition to cognition, communication, and practical, object-oriented actions in coordination with other agents, steered by critical self-reflection and the ability to reassess one’s operational norms.

Overall, based on the integrated framework of cultural-historical activity theory, we argue that LLMs should be introduced into human-machine systems (as their “semi-participants,” see below), with humans as external agents already semantically and pragmatically proficient – “reflexive organs” of these systems. With this, LLMs may learn to associate symbols not only with images or even multisensory data, but also with actions that have already been labeled and contextualized by humans in their cultural-historical activity.

This paper is structured as follows. Section 2 critiques tokenization for abstracting language from its operational context. Section 3 contrasts the static relational semantics of LLM embeddings with a dynamic, activity-based model of conceptual development. Section 4 connects enactivist accounts of sense-making with the activity-theoretic vision of tool-mediated cognition, introducing a distinction between *full* and *semi-participation*. Finally, Section 5 proposes a reorientation of formal methods for AI toward reflexive, activity-based models. We conclude that symbol grounding must be revisited as a socio-cognitive problem demanding hybrid solutions.

2 Tokenization and Its Limits: From Syntactic Segments to Tools in Action

The foundational step in LLM processing is tokenization, where linguistic expressions are decomposed into subword units using frequency-based methods such as Byte Pair Encoding (BPE) and WordPiece. Thus, the word “philosopher” might be segmented into semantically arbitrary tokens “ph”, “-ilos-” and “-opher,” each assigned a featureless numerical identifier. The model’s only access to the meaning of “philosopher” is through the statistical contexts in which this sequence of numbers appears. This process frames signs as syntactically tractable segments, but in doing so, it strips them of their function as tools within human action.

Tokenization may appear to be a neutral preprocessing step, but it relies on a representationalist ontology where meaning is decomposable into discrete placeholders for probabilistic prediction. Pragmatic and socio-historical dimensions of language are rendered architecturally irrelevant. By bypassing the operational histories through which signs acquire their semantic content, tokenization flattens the dynamic, semiotic richness of language into a static code.

This becomes evident when LLMs model procedural knowledge. Consider the prompt “How to boil water?” (see Appendix 2). The model may generate a grammatically correct sequence – e.g., “pour water,” “place it on a heat source,” “wait until it boils,” etc. – but it lacks access to understanding what “boiling” entails sensorimotorically, the physics of heat transfer, how safety norms governing the action should be followed, and how all this fits into broader culinary or scientific practices. By contrast, human cognition treats this prompt as entailing normatively scaffolded and situated boiling as a practice (Gambarotto & van Es 2025). As shown in the Table 1 below, the contexts available to humans and LLMs are fundamentally different.

Table 1. Comparing LLM vs. human contexts for understanding “to boil water.”

LLM Contexts	Human Contexts
Textual co-occurrence with words like “kettle,” “stove,” “recipe,” “tea.”	Embodied: the feeling of a pot’s weight, the sight of steam, the sound of bubbling.
Statistical association with procedural instruction formats.	Normative: safety rules (“don’t touch the hot surface”), cultural norms (how to make tea properly).
Proximity in vector space to tokens like “simmer,” “heat,” and “liquid.”	Tool-mediated: the affordances of a specific stove, kettle, or pot. Social: Learning from a parent, collaborating on a recipe, conducting a scientific experiment.

The activity theorist Georgy Shchedrovitsky, for instance, distinguishes symbolic replacement in formal systems and operational substitution in collective activity (Shchedrovitsky & Sadovsky 1964). For him, a sign acquires meaning not by pointing to a referent but by becoming a stabilized substitute for a specific action within a socio-historically situated task. Meaning, thus, is not intrinsic to the sign nor derived from reference, but arises, in this context, through its integration into normative, feedback-sensitive, and developmental action. He borrowed an example from the acquisition of arithmetic concepts in children. These concepts are not given as ready-made formulas, but emerge through the transition from actions with objects to recognition of recurrent patterns, verbalization, and, finally, reflection based on trial and error.

The sign “boil” is not a static container or a label of content (here, a physical process) but gains its meaning through its functional role within activities of cooking or chemical experiments. The sign coordinates a set of embodied routines, constraints, and expectations. This aligns with enactivist arguments that cognition emerges from adaptive coordination with the environment, structured by affordances and norms (Varela, Thompson & Rosch 1991; Di Paolo 2008); Piaget’s (1971) genetic epistemology, where cognitive structures emerge through accommodation and assimilation in action; Lakoff’s and Johnson’s (2008) theory of embodied metaphors, which posits that meaning is grounded in recurrent sensorimotor interactions and their integration into cultural practices.

This activity-based understanding of meaning challenges the referential and compositional assumptions behind token-based AI models, as well as the attempts to ground them in representations: the semantic capacity depends on situated participation in normatively structured activity, not on formal symbol manipulation alone. This critique does not dismiss formal methods but highlights their limitations when posited as a comprehensive model of cognition. We criticize the conceptual framing and not the architecture per se, and suggest that to approach genuine cognition, formalisms should be reconnected with developmental and operational contexts from which they are abstracted.

3 Relational Semantics vs. Relational Pragmatics

LLMs model meaning through relational semantics: a token’s significance is defined by its vector’s proximity to other vectors in a high-dimensional space. The vector for “boil” is located near those for “kettle,” “steam,” or “saucepan,” reflecting statistical patterns of co-occurrence in the training data. While powerful for prediction, this static, spatial representation of meaning lacks a developmental or operational account of how concepts emerge, evolve, and transform through use. It can represent that “aubergine” and “courgette” appear in similar textual contexts. However, it still cannot reconstruct the multimodal experiential knowledge that allows a human to differentiate them as distinct objects with unique properties.

Shchedrovitsky’s content-genetic logic offers an alternative perspective grounded in relational pragmatics (Shchedrovitsky 1957, 1962). Rejecting the formal-semantic idea of content and sign as fixed and separable, he instead proposed that conceptual forms emerge from cumulative and tool-mediated actions. A sign’s meaning is derived from its function as a substitute for an operation within a developing system of human activity. This approach parallels Marx’s value-form analysis, where economic value is not an intrinsic property of a commodity but manifests through the structural relations of exchange mediated by money. By analogy, conceptual meaning is not found in co-occurrence patterns but must be reconstructed through its normative and operational role within practice (Gambarotto & van Es 2025). As Stewart claims, social forms and cognitive forms co-evolve (Stewart 2014).

Additionally, static embeddings do not account for conceptual change, norm conflicts, or misalignment between agents – moments central both to activity theory and enactivist views on sense-making. Though they may capture regularities in past linguistic usage, they lack a mechanism for the conceptual transformation that generates novelty in human cognition, where signs are repurposed as tools, not merely processed as tokens. In this sense, they are not *participants* in conceptual development, but rather *reproducers of past* regularities.

The limitations of relational semantics, thus, are not only technical but ontological: they presuppose that meaning can be exhausted by the statistical relations among signs. Once the semantic field is reduced to correlations within a static vector space, the possibility of norm negotiation, breakdown, and repair disappears. To move beyond this, one needs to shift from modeling relations among symbols to modeling relations among agents – that is, to the problem of *sense-making* and, consequently, to the distinction between full and partial participation, which we develop in the next section.

4 Grounding Through Sense-Making: Semi-Participants and Full Participants

Efforts to solve the symbol grounding problem in LLMs assume that associating tokens with multimodal data – e.g., images, audio, or sensorimotor inputs – is sufficient to simulate understanding (Bisk et al. 2020; Radford et al. 2021; Alayrac 2022). Vision-language models such as Google’s PaLM-E (Driess et al. 2023), for instance, extend this by connecting linguistic commands to machine behavior, translating symbolic prompts into coordinated robotic actions. However, as Bender & Koller (2020) note,

mere co-occurrence or correlation between symbols and perceptual data is not equivalent to cognition.

It means that to understand is not to align, but to engage in what the enactive cognition scholars name sense-making, i.e., the reflexive, norm-governed, and self-adjusting coordination of activity within a social and material world.

Multimodal models can execute a mechanical sequence for tasks such as “boiling water.” Nevertheless, they cannot inhabit the social and normative context of this action: teaching a child to do so safely, improvising a recipe with a chef, or creating a new culinary method. Their logic remains one of *instruction-following*, not of *norm-formation*, even though they may generate an appropriate procedural script (“fill the kettle,” “turn on the stove,” “wait for boiling”). This distinction exposes a deeper limitation. These models lack a *reflexive* dimension through which meaning becomes negotiated, contested, and stabilized across interactions.

To evaluate such architectures, we turn to the notion of *zero semantical commitment* (Z-condition), which asserts that a system can be said to *ground* symbols only if it develops its semantics autonomously, without relying on pre-installed or externally supplied meaning (Taddeo & Floridi 2005). Under this criterion, existing multimodal and embodied architectures fall short. Their semantics are not generated *de novo* but are *inherited* from vast human-curated datasets. Learning, in this sense, remains supervised by humanity at large as a form of large-scale *semantic parasitism* based on already existing human interpretive frameworks.

Nonetheless, emerging approaches to *self-training* in text-only LLMs offer a partial path toward Z-compliance. In these setups, a model recursively generates multiple candidate continuations for a prompt and evaluates them using its own internal criteria of coherence or relevance, sometimes through reinforcement learning on its own outputs, or through self-reward mechanisms that simulate preference evolution.

Recent developments – such as OpenAI’s o1 model (OpenAI 2024), Anthropic’s Constitutional AI (Bai et al. 2022), and DeepSeek R1 (Guo et al. 2025) – present early attempts to embed limited self-alignment and preference revision into large-scale models. These systems approximate internal feedback mechanisms by generating and evaluating their own outputs under normative prompts; yet, they still operate within fixed, human-defined evaluative frameworks. This iterative self-evaluation serves as a primitive form of *environmental feedback* within the “text world,” allowing the model to stabilize internal representations that are not explicitly encoded in human-labeled data.

This recursive self-assessment, however, should not be mistaken for *reflexivity*. Self-evaluation, whether performed in autoregressive loops or in reinforcement learning, concerns optimization within a predefined objective function, so it is procedural and bounded by parameters that remain externally determined. *Reflexivity*, by contrast, means the capacity to revise or reinterpret those very objectives and to reconfigure one’s mode of operation in light of norm conflicts, errors, or emergent meanings. Where self-evaluation adapts within a frame, reflexivity transforms the frame itself, and it is this latter capacity that distinguishes full participants in cognitive activity from merely semi-participant agents.

These autoregressive self-training loops may produce what could be termed *proto-sense-making*: a minimal simulation of reflexivity in which the model adjusts its symbolic landscape through recursive engagement with its own outputs. Although these

systems still depend on pretraining corpora, they exhibit the emergence of autonomous semantic drift, that is, an incremental shift toward a regime in which meaning arises through *self-modelling and world-modelling* rather than external supervision. In this transitional text-based space, LLMs can be regarded as *semi-participants*: agents capable of limited, self-regulated participation in symbolically constructed environments, but still lacking embodied and normative grounding.

The enactivist approach defines cognition as a process of ongoing regulation and coordination between an agent and its environment (Di Paolo 2008; De Jaegher & Di Paolo 2007). In this view, meaning is *co-enacted* in social interaction that is not reducible to transmitted data. Cognitive agents are contributors to emergent activities whose normative structure they both shape and are shaped by. Cognition, thus, is scaffolded by socio-material contexts that collectively extend, support, constrain, and reproduce understanding (Baggio 2025; Clark 2005; Gallagher & Crisafi 2009).

This brings us to a distinction between a full participant and a semi-participant:

1. A *full participant* engages in a shared practice by co-creating, negotiating, and repairing the semantic norms that organize that practice. They demonstrate reflexivity: the ability to reconfigure their own behavior in response to misalignment, conflict, or breakdown.
2. A *semi-participant* manipulates the symbolic traces of that activity (e.g., its linguistic descriptions), but remains outside its embodied or normative dynamics. They remain syntactically competent but semantically ungrounded.

Current LLMs exemplify the second category. They can associate “boil” with “steam” or “heat,” but cannot engage with the social or material contexts that give these associations their meaning. Their implicit theory of cognition begins with syntax and considers activity as derivative. In contrast, activity theory (Leontiev 1978; Vygotsky 1978) posits that cognition is *produced through activity*, i.e., the participation in historically structured, tool-mediated forms of labor and cooperation. Meaning is not encoded but *enacted*.

For artificial systems to evolve from semi- to full participants, they must acquire reflexive capacities: the ability to modify their own operational structures in response to conflict, novelty, or normative pressure. Human reflexivity, as Schön (1983) describes it, entails revising one’s practices through self-observation within a shared, purpose-oriented environment, and this corresponds not only to *self-correction* but to *meta-learning applied to frameworks of interaction*: models that learn how to learn norms, not just patterns.

This reflexivity could be implemented in *hybrid* human-AI systems, where humans provide the normative grounding and machines serve as *sense-enablers* – agents that augment, stabilize, and extend collective cognition without claiming independent normativity, and not *sense-makers* in a strong sense. Within these systems, meaning emerges as “socially grounded” and dynamically co-constructed. Syntax itself, rather than being pre-given, would be seen as the *stabilized residue of successful norm-governed interaction*.

In this approach, progress in grounding cannot be measured solely by the richness of multimodal data, but by the depth of participatory integration. A genuinely grounded AI would not simply map tokens to pixels or sounds, but *co-produce* new semantic norms through iterative engagement in *socially meaningful* tasks. Developing such

systems requires embedding formal architectures *within activity-centered frameworks* that can model reflexivity, value sensitivity, and collective sense-making.

We thus propose reframing symbol grounding not as a mapping problem but as a practice problem – *grounding through participation*. Current LLMs remain semi-participants, but through self-training, recursive self-evaluation, and integration into human-machine reflexive systems, they may begin to approach the threshold of full, sense-making participation.

5 Conclusion

Mainstream AI research often begins with formal systems that abstract away the conditions of their emergence. This methodological framing treats concepts as stable, pre-existing units for manipulation or prediction. However, as enactivism and activity theory demonstrate, conceptual structures are inseparable from the socio-material processes that create and sustain them. Formalization is the *outcome*, not a foundation of activity.

This critique does not intend to dismiss formal methods entirely: these approaches, from symbolic logic to vector embeddings, are undoubtedly useful but have limitations if considered as the sole means of simulating understanding and cognition. We propose designing systems that can model not just the execution of an instruction, but the process by which meanings are formed, contested, and repaired, as in simulation of norm negotiation in training environments or the integration of sociotechnical feedback in model evaluation. This proposal can be instrumental in shifting the focus from “can LLMs understand?” to “how can we design systems that support understanding as a collective, shareable activity?”

Developing this requires collaboration between computer scientists, philosophers, and cognitive scientists. With this, they can transform the critique provided in this paper into a concrete prospect for future interdisciplinary research.

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Appendix

1. <https://chatgpt.com/share/6907b9d6-27c0-8006-aea7-97ed0f2df4c6>

Prompt: Is it possible to drink from a cup that lacks a bottom, but has its detached bottom affixed to the top instead?

ChatGPT: That depends on how you define “possible.”

If we interpret “drink from” in the physical, functional sense—actually getting liquid from the cup into your mouth—then no, it’s not possible in the ordinary way.

A cup without a bottom can’t hold liquid; it will flow straight out. Even if the original bottom is glued to the top, the vessel’s geometry now blocks access from above while still offering no containment below. So it ceases to be a usable cup—more like an inverted lid-ring sculpture.

However, conceptually or philosophically, you could “drink” from it in a figurative or performative sense—for example, as a commentary on futility or inversion of function (as in certain Dadaist or conceptual artworks). The object *looks* like a cup, yet negates its purpose; so one might say it’s a “cup you cannot drink from,” echoing paradoxes like Magritte’s *Ceci n’est pas une pipe*.

In short:


Practically: No, it can't serve as a functional drinking vessel.

Conceptually: Yes, you can "drink" from it symbolically—as a gesture or statement about broken utility or reversed expectations.

2. <https://chatgpt.com/share/68fa416d-b2b4-8004-a1f2-da9fad3ddda8>

Prompt: How to boil water?

ChatGPT: Boiling water is simple, but let's go step by step and think of it both practically and conceptually:

 **Practical steps**

Pour water into a pot, kettle, or other heat-resistant container.

- If you want to drink it, use clean, fresh water.
- Don't fill it to the top – leave some space so it doesn't spill when bubbling.

Place it on a heat source.


- On a stove: turn the burner to high.
- In an electric kettle: close the lid and turn it on.

Wait until it boils.

- First, you'll see small bubbles on the bottom.
- Then, the water will move more vigorously – large bubbles rise to the surface.
- That's boiling: it happens at around 100 °C (212 °F) at sea level.

Use or turn off.

- Turn off the heat once boiling starts.
- Carefully pour the hot water for your intended use (tea, cooking, sterilizing, etc.).

 **Conceptual view**

Boiling water means changing its state from liquid to gas.

When you heat it, the molecules move faster.

At a certain temperature, they gain enough energy to escape into the air as vapor.

This is why you see steam – it's water in gaseous form.

You could say:

Boiling is the threshold where matter transforms its mode of existence – from cohesive liquid to liberated vapor.

Would you like me to explain how to boil water safely for drinking (sterilization) or why it boils at 100 °C next?