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Beyond binary opposition: philosophical reflections on a multi-level Language cognitive model from an embodied constructional perspective

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Through the analysis of the bio-linguistic approach represented by Chomsky and the social cognitive approach represented by Tomasello, the paper finds neither theory is sufficient to fully explain current linguistic phenomena. This paper explores philosophical questions about the nature of language, especially new thoughts against the backdrop of AI language model development, and then establishes the Embodied Constructional-Cognitive Model (ECCM). The ECCM transcends this binary opposition, constructing three interconnected levels: the Cognitive-Constructional Level (CCL) processes language information based on general cognitive abilities; the Representational Integration Level (RIL) explains how language constructions are formed through embodied experience and integrated into the cognitive system; the Social-Interactive Level (SIL) focuses on the process by which language acquires complete meaning in the social dimension. The model proposes that language is essentially a multi-level cognitive tool formed through bodily experience and ecological construction, functioning to reduce environmental uncertainty and maintain the stability of self-symbols. This integrative theoretical framework has important implications for understanding the uniqueness of human language ability and the limitations of AIGC systems.

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Introduction

The evolution of philosophy can be viewed as a continuous process of self-reconstruction. The 20th century, an era of dramatic change in linguistic and cognitive theories, accelerated this reconstruction process. This acceleration is mainly reflected in two aspects. Firstly, highlighting the major breakthroughs and turning points in 20th-century philosophy, philosophical historians use the linguistic turn to describe this process, which not only becomes the dominant paradigm of the humanities in the 20th century, but is also viewed as a re-establishment of the foundation of philosophy, and a marker of the periodization of philosophical history. For example, both Dummett (1981 and 1991) and Habermas emphasize the key position of the linguistic turn in the development of philosophy (Habermas and Cooke 2000). Dummett (1991) believes that the linguistic turn marked the formation of the analytic philosophy tradition, while Habermas (2023) regards it as the beginning of post-metaphysical thought. Secondly, the 20th century witnessed the fluctuations in the core areas of philosophical traditions, such as metaphysics, ethics and logic, while various emerging philosophical branches rapidly developed, covering different cultures, ethnicities, fields and disciplines. In this context, the philosophy of language long occupied a dominant position among various philosophical branches. Rorty's book *The Linguistic Turn* (1992) centrally reflects this trend, demonstrating how linguistic analysis becomes the main method for philosophical problems. From Frege, Russell and Wittgenstein to the logical positivists, and then to key figures such as Quine, Davidson and Strawson, the philosophy of language underwent a shift from the application of modern logical tools to language games and speech act theory (Brandom 2010). However, the 1980s and 1990s witnessed an important paradigm shift. The philosophy of mind, with the help of emerging interdisciplinary fields such as cognitive science, neuroscience, computational science and AI, gradually replaced the central position of the philosophy of language. This change reflects a shift in philosophical focus from linguistic analysis to issues of consciousness, cognition and AI, embodying an active response of philosophy to contemporary social and technological developments, as well as changes in human cognition.

The core position of language in epistemology and philosophy of mind originates from the inherent tendencies of philosophy, which focus on the role of language in cognition and the mind, aiming to decipher the linguistic code of thought. The relationship between linguistic forms and philosophical thinking involves bidirectional interaction and synchronous evolution. The prominence of the linguistic turn in 20th-century philosophy primarily stems from the endogenous problems and methodological developments within philosophy itself. The philosophy of language is inextricably linked to the operation and laws of language and thought. Without the achievements of modern science, it would not differ substantially from the pure speculation and partial empirical observations of ancient thinkers. As Devitt (2006) points out, speakers' linguistic intuitions do not fully reflect the information provided by linguistic competence, and thus should not be considered the primary evidence for grammatical research. Therefore, if philosophers lack the necessary foundations in language science, their understanding of the essence, structure and acquisition of language may be limited to unexamined intuitions or speculative preferences, thereby affecting the accurate understanding of thought and ideas.

However, with the development of cognitive science, neuroscience and artificial intelligence, the core focus of language in the 21st century has shifted from pure grammatical analysis to a more integrative perspective. The theoretical tension between Chomsky's biolinguistic approach and Tomasello's social-cognitive approach has become particularly significant in the face of the remarkable achievements of large language models (LLMs). While these AI systems can generate grammatically correct and pragmatically appropriate language, they may lack true language understanding, prompting deeper reflection on the nature of language. Torres-Martínez's (2024a) embodied essentialism argues that current AI systems, despite producing grammatically correct output, lack embodied grounding and cannot truly understand the world through bodily experiences and conscious states. This insight prompts us to reexamine the nature of language: is language purely a computational process, or is it essentially a cognitive tool constructed through bodily experience? This paper argues that understanding language ability requires a new framework that transcends the binary opposition between biolinguistic and social-cognitive perspectives, thus proposing the Embodied Constructional-Cognitive Model (ECCM). The ECCM emphasizes that language ability is rooted in embodied experience and ecological interaction, conceptualizing language as both an abstract representational system in the brain and an adaptive tool formed through human bodily interaction with the environment. This dual nature functions to reduce environmental uncertainty and maintain the stability of self-symbols. This model integrates computational perspectives with social functional perspectives, arguing that language is a cognitive tool formed through bodily experience and ecological niche construction. Language enables humans to reconstruct reality—a process originating from biological memory and adaptation to uncertain environments, aimed at confirming the Self-as-symbol (Torres-Martínez 2024b).

The integration of philosophy of language and linguistic philosophy

Philosophy of language and linguistic philosophy both focus on language as their core object, exploring the essence, functions and characteristics of human language, but with significant differences in their research focus. Philosophy of language traditionally concentrates on issues such as the nature of language, meaning, reference and truth conditions (Lycan 2018), while linguistic philosophy emphasizes the philosophical investigation of methodology, theoretical foundations and conceptual analysis of linguistics as a science (Scholz et al. 2021). However, they are not entirely distinct, and have influenced each other throughout their historical development and currently form an interconnected research system with linguistics. Although philosophy of language does not directly take language as its research object, knowledge about language constrains the grasp of its true object (i.e., the things expressed and depicted by language). It is worth noting that this field faces a dual challenge. Firstly, despite philosophy of language and linguistic philosophy emerge as the philosophical responses to the independent development of linguistics, a unique phenomenon exists where researchers can engage in philosophical discussions of linguistics without conducting substantial linguistic research (Kripke, 1980). This phenomenon is not only present in linguistic philosophy, but also prevalent in other philosophical branches (Pigliucci 2017). Secondly, over the past four decades, semantic research has become increasingly technical, forcing philosophers to adjust their approach to thinking about meaning and theories of meaning. Although formal semantics was initially developed by philosophers, many philosophers today are no longer familiar with its technical details. These two aspects reflect the disconnect between philosophy of language and linguistic practice, while highlighting the necessity of interdisciplinary dialogue. This interconnection between language, thought and society is further explored in recent studies (Wu and Cheng 2020; Wu et al. 2022; Wu et al. 2023; Yang et al. 2024).

In the study of linguistic philosophy, although the theories of Chomsky and Tomasello exhibit significant differences, they present important commonalities in some basic understandings. Firstly, both scholars recognize that language research goes beyond the understanding of language itself, viewing it as a key pathway to explore the essence of the human mind (Chomsky 2006; Tomasello 2005). As Davidson (2001) emphasizes, language research is essentially an in-depth exploration of the nature of human thought. This view highlights the core position of philosophy of language in cognitive science and philosophy of mind. Secondly, both Chomsky and Tomasello consider language acquisition as crucial for understanding the essence of language (Chomsky 2010; Tomasello 2010). This consensus has driven developments in philosophy of language regarding language acquisition theory, deepening Quine's (2013) philosophical reflections on language learning. Additionally, Chomsky and Tomasello jointly oppose the simple reduction of language to behaviorist or purely empiricist explanations (Chomsky 1997; Tomasello 2005). This stance provides an important critical perspective for philosophy of language, echoing Lakoff 's critique of the traditional Western philosophical view of language (Lakoff et al. 1999), emphasizing the complexity and multi-dimensionality of language. It is worth noting that the research methods of both scholars involve multiple fields such as linguistics, cognitive science, psychology, biology and philosophy (Chomsky 2000; Tomasello 2019). This interdisciplinary approach reflects different scientific methodologies in language research traditions (Chapman 2023), indicating that the study of language and cognition requires multi-disciplinary integration. However, there are significant differences in Chomsky and Tomasello's views on linguistic philosophy, and the diversity of linguistic theories provides multiple perspectives for understanding the essence of language (Hornstein 2018). In recent years, with the rapid development of fields such as cognitive science, neuroscience and AI, the research paradigm of linguistic philosophy has constantly evolved (Hinzen 2022). In this context, this paper argues that the differences between these two theoretical orientations are not irreconcilable oppositions, but rather reflect complementary perspectives on understanding the nature of language. Especially against the backdrop of contemporary AI language model, we urgently need a more integrated theoretical framework to study multi-dimensional human language ability. The ECCM is based on this need, explicitly adopting a constructional cognitive perspective and emphasizing the embodied nature of language. This model constructs three interconnected and hierarchically progressive structures: the Cognitive-Constructional Level (CCL), the Representational Integration Level (RIL) and the Social-Interactive Level (SIL). The CCL processes linguistic information based on general cognitive abilities such as statistical learning and analogical reasoning, challenging the assumption that a specialized language module is necessary; the RIL, as the core of the model, explains how language constructions are dynamically formed through usage frequency and bodily experience, and integrated into the cognitive system; the SIL focuses on the process through which language acquires complete meaning in social dimensions such as shared intentionality, normativity and cultural accumulation. In an era of rapid AI development, this multi-level theoretical framework embodying an embodied cognitive perspective has important implications for understanding the uniqueness of human language ability and the limitations of AI systems.

Challenges to Chomsky's biolinguistics from an embodied cognitive perspective

In the development of linguistic philosophy, Chomsky's generative theory fundamentally reshapes the understanding of language and mind, adopting a distinctive Cartesian approach to philosophical issues (Boeckx and Benítez-Burraco 2014). This intellectual framework incorporates the systematicity of linguistic structure from Katz and Fodor (1962), and repositions the philosophy of language as linguistic philosophy, with its core emphasis on advancing the Cartesian tradition within modern scientific inquiry (McGilvray 2012). Chomsky's biolinguistics integrates discoveries from natural sciences, particularly in viewing language as a distinctive mental faculty (Chomsky 2015; Chomsky 2017). This framework rejects behaviorism and purely evolutionary explanations of language, instead developing a distinctive rationalist approach that draws on evidence from evolutionary biology, anthropology, psychology and neuroscience, while preserving the fundamental Cartesian separation of mind and matter (Boeckx and Grohmann 2013). Through this approach, Chomsky challenges empiricist philosophy and inherits the rationalist tradition by demonstrating its compatibility with rigorous scientific investigation. Chomsky's development of Cartesian rationalism manifests in three key areas: the biological basis of reason, scientific methodology and the study of mind as a distinct substance (Collins 2004; Chomsky 2006).

Based on Cartesian mind-matter dualism, Chomsky's language theory deepens the understanding of language ability through modern scientific methods (Berwick and Chomsky 2016). He attributes humans' innate ability to acquire language to an evolutionary physiological function—the language faculty, a view that provides theoretical support for language as a distinct mental system (Chomsky 2014). Chomsky further strengthens the biological foundation of language by introducing the distinction between the faculty of language in the broad sense (FLB) and in the narrow sense (FLN). FLB encompasses the internal computational system, sensory-motor system and conceptual-intentional system, while FLN specifically refers to the internal computational system, with its core being the merge (Hauser et al. 2002). This operation not only makes discrete infinity in structured expressions possible, but also demonstrates the unique computational properties of mental systems. However, against the background of embodied cognition theory, this insistence on mental distinctiveness has sparked in-depth discussions about the nature of language: is language a cognitive ability derived from bodily experience, or a relatively independent mental system? From the perspective of embodied cognition, language is not merely a computational process in the brain, but a cognitive tool formed through bodily experience and ecological niche construction. Language ability is rooted in purposeful biological agency, forming consciousness and language understanding through multi-scale physical world experiences (Torres-Martínez 2024a). Torres-Martínez (2024c) further proposes a predictive human language model, directly challenging the core assumptions in traditional linguistics and pretrained transformer research, emphasizing the decisive role of bodily experience in language understanding and generation. Therefore, language should not be viewed as a module isolated from other cognitive processes, but understood as a dynamic product of interaction between the body and environment.

While Chomsky's computational model demonstrates explanatory power in formal language structures, it appears insufficient for the relationship between language and meaning. A purely computational biological framework struggles to explain the social pragmatic dimensions of language, as biolinguistics disregards the meaning dimension in language (Taylor 2016; Brandom 2019, Enfield 2024). Hole and Ahmad (2021) also challenge Chomsky's central processing model, arguing that cognitive representations are multi-perspective distributed structures. This aligns with the embodied constructional theory, suggesting that language representations may also be formed through the collaborative work of multiple cortical columns,

rather than being products of a single central language module. Embodied cognition theory considers language constructions as a triadic relationship of form, function and intelligent agency. Language constructions encode embodied information through specific Constructional Attachment Patterns (CAPs), which reflect perception-driven reconstruction of reality rather than merely abstract computational rules (Torres-Martínez 2024b). Therefore, the meaning of language constructions comes not only from their formal structure, but also from bodily experience and environmental interaction.

While LLMs ostensibly demonstrate human-like language abilities, they remain essentially statistical learning models, echoing Chomsky's earlier assertion that language acquisition cannot rely solely on statistical learning (Yang et al. 2017; Coopmans et al. 2024). Although LLMs can achieve combinatorial creativity and exploratory creativity, they struggle to reach transformational creativity (Franceschelli and Musolesi 2024). This stems from AI's lack of embodied foundation, its inability to truly understand the world through bodily experience, resulting in language output that lacks genuine semantic depth, while formally correct. Although AI may surpass humans in computational ability, the human central nervous system (CNS) provides emotional experiences and ethical understanding—core dimensions of truly mastering language, rather than mere formal operations (William Stewart 2024). These views highlight the crucial role of embodied experience in language, and challenge the adequacy of purely computational theories. The ECCM incorporates Chomsky's insights on language systematicity, while considering the opposition between biolinguistics and embodied cognition theory. The ECCM acknowledges the biological foundations of language without reducing it to a specialized language module, and it recognizes language's formal rules but emphasizes that these rules originate from bodily experience and social interaction. Within this framework, language ability is no longer viewed as a module isolated from other cognitive processes, but understood as a complex system rooted in general cognitive abilities, bodily experience and social interaction. Language is a reconstruction of subjective embodied reality and stance, achieved through effect-oriented action planning and affordance mapping. Language is not merely formal structure, but also encodes how subjects understand and construct the world through bodily experience. Moreover, the relationship between neuroscience and AI is bidirectionally convergent rather than unidirectionally inspirational, and thus language ability requires transcending single theoretical frameworks to adopt multidimensional research methods (Gershman 2024).

Tomasello's shared intentionality: social cognition and embodied foundations of language

Tomasello's academic research spans multiple fields including philosophy, social sciences and natural sciences, systematically investigating the origins and evolution of language, cooperation, cognition, thinking and morality. Through comparative cognitive studies, Tomasello (2019) presents profound criticism of Chomsky's Universal Grammar. His shared intentionality not only emphasizes the central role of social cognition in language development, but also reveals how linguistic ability is rooted in more fundamental cognitive and social capabilities. Regarding language evolution, Tomasello (2022a) suggests that its developmental path moves from goal-orientation to social norms. This evolution involves not only abstract cognitive representations, but also human embodied experience and ecological interaction. Tomasello (2022b) builds on Vygotsky's sociocultural theory, emphasizing that higher cognitive functions, as human-specific functions, stem from the ability to create and internalize social behavioral habits. He proposes a Vygotskian hypothesis: the unique forms of human cognition and sociality emerge in individual development solely through human-specific sociocultural activities. Neuroscientific findings reveal significant differences in brain regions involved in social cognition and normative judgment between humans and other primates (Hare and Woods 2021). These differences reflect unique human embodied cognitive structures that enable humans to transcend direct perceptual experience, and construct abstract social norms and value systems. Although Tomasello's shared intentionality relates to phenomenological intentionality, it does not directly derive from the latter. The deep-level shared intentionality process is not Chomskyan linguistic representation and computation, but rather the foundation of human cognitive and social forms (Tomasello 2019; Krupenye and Call 2019; Heyes 2020). O'Madagain and Tomasello (2022) elaborate on the social ontological basis of this concept, emphasizing that shared intentionality involves not only cognitive representation, but also reason-giving and cultural accumulation. Tomasello (2023a) proposes that the essence of human thinking's uniqueness lies in its distinct integration of metacognitive abilities and social cognition. Compared to great apes, this integration enables humans to form perspectival cognitive representations and recursive thinking. While gorillas possess basic metacognitive and social cognitive abilities, only humans can combine these capabilities to form complex understandings of their own and others' mental states (Tomasello 2019 and 2023c). Tomasello (2023b and 2023d) further distinguishes three levels of intentionality: having intentions, understanding intentions and understanding communicative intentions. From an embodied constructional perspective, these three levels reflect a progressive process from basic sensorimotor experiences to advanced symbolic representations, demonstrating how bodily experiences gradually transform into abstract cognitive abilities. The early stage's joint goals and joint attention create "second-person" thinking, a thinking mode formed through direct bodily interaction and shared perceptual experiences, while the objective-reflective-normative thinking of modern humans builds on this direct experience, constructing abstract cognitive structures that transcend individual embodied experiences through cultural accumulation and linguistic symbol systems (Li and Tomasello 2021). Ultimately, different human cultures develop distinct sets of specific cognitive skills (Johnson 2021). Due to the ratchet effect in cumulative cultural evolution, culture-specific cognitive skills and thinking types are derived, revealing deep connections between human agency and cognitive development (Tomasello 2024). This paper argues that this integration process is deeply rooted in embodied experience, through interaction between the body and the environment, humans not only form an understanding of their own and others' mental states, but also construct complex symbol systems to represent these understandings. Unlike the traditional Turing test that emphasizes deception ability (Pantsar 2025), the embodied constructional perspective emphasizes that language and thinking abilities should be evaluated in real social interactive environments.

Regarding human morality, Tomasello views morality as a specialized form of cooperation, evolving from sympathy and fairness, with language playing a key role in the formation and transmission of norms (Li and Tomasello 2021). The unique social motivations and moral emotions that distinguish humans from other great apes, such as "you>me" sympathy, "you=me" fairness and "we>me" collective commitment, drive the formation of cultural and group-minded objective moral systems. Morality, cooperation and language all originate from embodied understanding of how the world works, being products of both phylogenetic and ontogenetic natural history. The emergence of complex social organizations (such as law and religion) reflects

the evolution of multi-layered moral systems (Tomasello 2019 and 2023c). The cognitive evolution from individual to collective intentionality relies on language as a form of social action, integrating shared intentionality, common purposes and the coordination of attention and action (Tomasello 2024). Through comparative cognitive research, Tomasello confirms that language is not an independent abstract grammatical system as Chomsky claims, but is deeply embedded in social cognition and embodied experience. This view aligns closely with the CCL of ECCM, emphasizing that language processing depends on general cognitive abilities rather than a specialized language module. This paper argues that one of the core propositions of the ECCM is that language ability is rooted in embodied experience and ecological interaction. Tomasello's language evolution path from goal-orientation to social norms forms a natural mapping with the three-tier architecture of ECCM. The primary stage of joint goals and joint attention corresponds to the basic cognitive abilities of the CCL; the intermediate stage of shared intentionality corresponds to the representational integration process of the RIL; and the objective-reflective-normative thinking in advanced stage corresponds to social interaction and norm formation of the SIL. This mapping relationship indicates that the ECCM successfully captures the natural progression of language ability development.

Integration path from an embodied constructional perspective: ECCM

Chomsky and Tomasello represent two paradigms in contemporary linguistic philosophy: the biolinguistic approach and social-cognitive approach. The former emphasizes the biological foundations and computational properties, reducing language ability to a highly formalized computational system; the latter highlights the social nature and cultural accumulation, emphasizing that language is rooted in more fundamental cognitive and social capabilities. With the emergence of LLMs, reexamining these theoretical frameworks has become particularly necessary. Empirical research in language acquisition and processing indicates that a single theoretical framework struggles to fully explain the complexity of linguistic phenomena (Dąbrowska 2020). The development of scientific theories often requires dialogue and fusion between different paradigms (Christiansen and Chater 2016). Tomasello's research approach involves not only abstract cognitive representations, but is also rooted in human embodied experience and ecological interaction. This perspective forms an interesting contrast with current LLMs. Although these models demonstrate remarkable generative capabilities, they can achieve linguistic behavior through large-scale data training without presupposing detailed internal language mechanisms, yet they show fundamental limitations in understanding language meaning. LLMs lack embodied foundations, making it difficult to truly understand language meaning (Torres-Martínez 2024a). Unlike the traditional Turing test that emphasizes formal language abilities, the embodied constructional perspective argues that language and thinking abilities should be evaluated in real social interactive environments (Pantsar 2025). This position reflects that language is not merely the result of symbol manipulation, but a dynamic cognitive tool constructed through human bodily experience and environmental interaction. True language ability is manifested not only in formal operations, but also in the construction of meaning and functional realization in social interaction.

Linguistic patterns focus on observable language forms and usage regularities, which are surface features that LLMs can master through statistical learning, while theory of mind for language involves how language is rooted in bodily experience and subjective consciousness, constituting an understanding and reconstruction of reality. The theoretical dispute between Chomsky and Tomasello mainly focuses on linguistic patterns, while the development of AI technology has proven that focusing solely on this level is insufficient to explain the nature of language. Unlike traditional paradigms, ECCM no longer views language as a binary choice between abstract systems or social tools, but conceptualizes it as a multi-level cognitive ecological system with cognitive, embodied and social dimensions simultaneously. This multi-dimensional perspective allows the ECCM to avoid the reductionist tendencies of traditional theories and not simplify language to pure social construction. Construction Grammar provides a promising framework for understanding both the cognitive foundations and social functions of language. Constructions are defined as form-meaning pairings, and can be extended as emergent clusters of lossy memory traces that match human high-dimensional conceptual space based on shared form, function and context (Goldberg 2019:7). This definition criticizes innate language-specific mechanisms and emphasizes form-meaning pairing, meaning unpredictability, conceptual representation and frequency determinacy. Diessel's (2019) grammar network theory demonstrates how language structures are shaped by usage, emphasizing the need to explore the co-selection and interaction within lexicon, grammar and meaning/function based on authentic corpora, which echoes Tomasello's emphasis on social-cognitive foundations. Hoffmann (2022) reveals the potential of constructions as interfaces between cognition and social interaction through systematic analysis of meaning-form combinations. In recent years, Construction Grammar research has shown diverse trends in construction network connectivity (Hilpert and Flach 2022) and multimodal constructions (Fisher 2021), providing empirical support for the dynamic and embodied nature of constructions. Based on these research developments, ECCM aims to comprehensively explain the cognitive and social functions of language through multi-level construction networks and embodied mechanisms. ECCM views language as a representational system of embodied experience, emphasizing its unique role in reducing environmental uncertainty and supporting human cognition and social interaction. This model does not rely on specialized language modules or complex computational operations, but reveals the nature of language through dynamic embodied cognitive structures. ECCM further extends the concept of constructions, viewing them as perception-driven reality reconstruction tools rather than static language units. This extension lays the theoretical foundation for the three-tier architecture of ECCM: Cognitive-Constructional Level (CCL), Representational Integration Level (RIL), and Social-Interactive Level (SIL), concretizing the role of language as a dynamic cognitive tool.

CCL: general cognitive abilities supporting language processing. Within the ECCM, the CCL is conceptualized as a general cognitive system that supports language construction processing, rather than a specialized language module. This level consists of three closely related core elements that work together to form the cognitive foundation of language processing. The first core element of CCL is the general cognitive computational mechanism, including basic cognitive abilities such as working memory, attention allocation and pattern recognition. Working memory is responsible for temporary storage and processing of language information, enabling us to maintain coherence in conversation. Attention allocation mechanisms guide us to focus on key features in language input while filtering irrelevant information. Pattern recognition abilities allow us to identify regularities and structures in language, laying the foundation for constructional

recognition. These general cognitive mechanisms collectively support online processing and long-term storage of constructions through controlling information processing, guiding attention resource allocation and identifying language patterns. Statistical learning ability constitutes the second core element of CCL, enabling language users to extract probabilistic regularities from language input, such as word co-occurrence frequencies or sentence pattern structures. This ability aligns with Construction Grammar's emphasis on usage frequency effects (Diessel 2019) and provides a theoretical basis for LLMs to produce grammatically correct output through statistical learning. Through statistical learning, language users can naturally acquire language rules from experience, without relying on a specialized language faculty hypothesis. Analogical reasoning is the third core element of CCL, supporting generalization and innovative use of constructions. This mechanism enables language users to create new linguistic expressions based on known constructions. For example, language users can associate *give me X* with similar contexts to create new expressions like *give me a chance*. This echoes findings on construction creativity in Construction Grammar (Goldberg 2019) and provides a cognitive explanation for language productivity and creativity.

The synergistic operation of these three elements enables CCL to efficiently process language units of varying constructionality levels. In this regard, the gradient notion of constructionality has special significance for the conceptualization of CCL. Ungerer (2023) argues that constructions are not discrete binary categories, but dynamically vary on a continuum from weak constructionality to strong constructionality. For example, single lexical items like *dog* exhibit weak constructionality, with meaning primarily derived from the lexical item itself, while complex idioms or fixed expressions like *the more, the better* exhibit strong constructionality, with overall meaning exceeding the sum of its components. This gradient view highly aligns with the cognitive flexibility emphasized by CCL, indicating that language processing relies on general cognitive abilities capable of recognizing and adapting to different levels of constructionality, rather than preset language-specific mechanisms. The statistical learning and analogical reasoning in the CCL jointly explain how constructionality dynamically adjusts with usage frequency and contextual changes. For instance, expressions that initially function as simple lexical combinations may gradually acquire stronger constructionality through repeated use, forming fixed expressions with specific meanings. This dynamic process demonstrates that language knowledge is not statically stored, but continuously reconstructed through use. The three core elements of CCL each contribute to supporting the constructionality continuum: statistical learning extracts regularities from usage frequencies, identifying patterns of constructionality changes; pattern recognition in general cognitive mechanisms lays the foundation for different levels of constructionality; while analogical reasoning drives the dynamic development of constructionality, enabling language users to creatively use and understand new constructions. These three elements mutually support each other, forming an integrated processing system.

Compared to traditional I-language theory, CCL has several distinct advantages. CCL demonstrates greater universality, aligning with evidence of how general cognitive abilities support language processing. CCL demonstrates great parsimony, avoids assumptions about complex language modules, and explains the developmental continuity of language abilities, which highly aligns with the usage-based perspective of Construction Grammar. This view of language processing based on general cognitive abilities is supported by recent neuroscience research. Mahowald et al. (2024) point out that human language processing involves different neural mechanisms that formal language abilities correlate with specific language networks, while functional language abilities involve broader cognitive networks. These findings indicate that language processing can indeed be decomposed into general cognitive processes. By integrating Ungerer's gradient notion of constructionality with general cognitive mechanisms, CCL explains precisely how language units are processed and represented at the cognitive level, providing a theoretical perspective for understanding the nature of human language ability and the capabilities and limitations of AI language systems. This cognitive foundation enables the ECCM to explain the entire language use process from simple lexical processing to complex social interaction.

RIL: embodied foundations and dynamic integration of constructions. RIL is the core level of the ECCM, focusing on explaining how language constructions are formed through bodily experience and usage frequency, and integrated into the cognitive system. This level captures the transformation process from concrete bodily experiences to abstract symbolic representations, revealing the embodied nature and dynamic state of language representations. The RIL conceptualizes constructions as distributed multi-perspective representational systems, rather than the result of a single central processing. Language representations are considered to be formed through the collaborative work of multiple cortical columns, with each column providing different perspective representations of the same language construction (Hole and Ahmad 2021). Through this distributed representation, RIL explains how language units can simultaneously possess flexibility and stability, highly consistent with current neuroscientific findings of distributed processing in the brain. The primary characteristic of the RIL is the hierarchy and dynamicity of construction networks. Construction networks present a hierarchical structure from concrete to abstract, with lower-level concrete constructions (such as fixed expressions) interconnecting with higher-level abstract constructions (such as syntactic patterns), forming dynamic cognitive networks. Language structures are found to emerge spontaneously based on usage frequency and cognitive processing, rather than pre-encoded fixed rules (Divjak and Milin 2023). This emergent property resembles the capabilities demonstrated by LLMs, suggesting that complex language systems may originate from the interaction of simple components rather than intricately designed complex rules. The second core characteristic of RIL is the unification of statistical and conventional properties. Constructions simultaneously demonstrate statistical effects of usage frequency and conventionalization, with frequently used expressions gradually acquiring specific functions, showing how statistical learning can lead to the formation of conventionalized meanings (Diessel 2019). Therefore, language abilities acquired through large-scale data learning suggest that statistical patterns and language rules may be different aspects of the same phenomenon. This understanding effectively reconciles the theoretical opposition between formal rules and usage frequency. The third core of RIL is meaning construction based on bodily experience. Language meaning derives not only from form-function pairings, but is also rooted in the subject's bodily experiences and conscious states. Unlike traditional semantics that views meaning as relationships between symbols or referential relationships, the ECCM proposes that meaning is essentially formed through embodied reconfiguration, through which subjects purposefully filter and organize environmental stimuli mediated by bodily experience, and it's a process that depends not only on perceptual experience, but is also regulated by the subject's conscious states, emotional experiences and biological purposefulness. For example, the concept of *anger* is not merely an abstract symbol, but a complex

experiential pattern constructed through specific facial expressions, muscle tension, heart rate changes and other bodily states. The three levels of intentionality understanding—having intentions, understanding intentions and understanding communicative intentions—provide a cognitive mechanism for RIL, demonstrating the progressive process from basic sensorimotor experiences to advanced symbolic representations (Tomasello 2023a). For instance, children first experience *giving* through bodily actions, then associate this experience with language input, and finally form stable construction representations. This process reveals how language understanding is rooted in bodily experience, and explains why AI systems lacking bodily experience have fundamental limitations in understanding language meaning.

In the RIL, constructions encode embodied information through CAPs, which reflect not only form-meaning correspondences but also perception-driven reconstructions of reality (Torres-Martínez 2024b). For example, constructions expressing path encode bodily experiences of reaching goals through physical space movement, demonstrating how abstract language originates from concrete bodily experiences. This view emphasizes constructions as adaptive tools serving to reduce uncertainty in the environment. The RIL emphasizes the dual representational properties of constructions: formal representations are constrained by cognitive processing mechanisms, reflecting the biological foundations of representations; while meaning representations are deeply rooted in social interactive practices, reflecting the cultural dimension of representations. It is at the RIL that these two forms of representation are integrated, constituting complete language expressions. Meanwhile, constructions are not static isolated units but form complex networks through multiple dynamic connections (Hoffmann 2022). These connections are manifested both at the formal level (such as grammatical associations) and at the meaning level (such as semantic associations), constituting the multi-dimensional network structure of language. The RIL particularly emphasizes the dynamic adaptability of this network, constructions constantly adjust through frequency-driven emergent processes to adapt to the changing needs of cognition. For instance, when certain expressions are repeatedly used, related constructions gradually solidify and automate in the RIL, forming mental habits (Petré and Anthonissen 2020). This mechanism explains how language representations dynamically evolve in individual cognitive systems, and provides a cognitive foundation for understanding language change. As the hub of the ECCM, RIL establishes a crucial bridge between the CCL and the SIL through the embodied foundations, dynamic integration and distributed representation of constructions. The general cognitive abilities provided by the CCL transform into specific construction representations in the RIL, while the construction representations provide the foundation for social communicative functions in the SIL. Through this bridging function, the RIL explains how language is both a cognitive phenomenon and a social phenomenon, both rooted in bodily experience and adapted to social interaction needs.

SIL: social functions and meaning construction of language. SIL is the top level of the ECCM, focusing on the meaning construction function of language in social interaction and its cultural evolutionary process. This level transcends individual cognitive categories, and places language within a social ecosystem framework, revealing how language acquires complete meaning and functions through social interaction. The primary characteristic of the SIL is shared intentionality. The foundation of language is not only individual cognitive abilities, but also uniquely human shared mental capabilities. Language users achieve mutual understanding and coordination of intentions through communicative activities, jointly constructing shared meaning spaces. In collaborative tasks, when community members use constructions like *let's do it together*, they not only transmit information, but also activate cognitive frameworks of joint commitment, facilitating the coordination of collaborative behavior. This social foundation embodies the unique function of reason-giving, considered a cognitive characteristic that distinguishes humans from other species (O'Madagain and Tomasello 2022). This language use based on shared intentionality explains why AI systems lack genuine social cognitive abilities and cannot participate in the construction of shared intentional spaces. The second core of the SIL is normativity. Language use involves not only form-meaning correspondence, but also adherence to social norms. Language has important moral functions, embodying uniquely human moral emotions such as sympathy, fairness and collective commitment, and its use is necessarily constrained by social norms (Li and Tomasello 2021). For example, polite request constructions like *would you mind…* not only convey the semantic content of requests, but also reflect the social norms of speech acts. Social interaction influences the long-term evolution of language structures through normative constraints, with language variations often guided by community values and norms (Trinh 2024). This normative characteristic explains why pure statistical learning models, while able to mimic language forms, struggle to grasp the normative requirements. The third core of the SIL is cultural accumulation. Language constructions, as cultural tools, carry and transmit group cognitive experiences and value systems. Language users acquire language knowledge accumulated by predecessors through social learning and constantly innovate in use, driving the evolution of the language system (Tomasello 2023a). The specific cognitive skills and thinking types created by different cultures are considered products of this cultural accumulation (Johnson 2021). This cultural accumulation is related to the ratchet effect of cognitive and language evolution, where cultural learning allows cognitive innovations to accumulate rather than each generation starting anew.

The SIL particularly emphasizes the synergistic relationship between individual grammar and community grammar. Language knowledge contains both shared components, such as general cognitive abilities and shared contextual information, as well as individual differences, such as language knowledge variations caused by educational background and social relationships (Petré and Anthonissen 2020). Individual language knowledge does not exist in isolation, but has organic connections with shared knowledge. For example, innovative expressions by individuals may spread to the entire language community through social interaction, forming new shared constructions. Conversely, community language norms continuously shape individual language use. This bidirectional interaction explains why language has both stability and constant innovation. At the SIL, language is viewed as a component of the social ecosystem, with its meaning and function dynamically evolving in community use. True language ability can only be verified in real social interactions rather than traditional formal tests (Pantsar 2025), explaining why AI systems lack the ability to participate in social ecosystems. The SIL also focuses on the deep connection between human agency and language use. Language not only passively reflects the environment and social relationships, but also serves as an active tool for constructing cognitive and social reality (Tomasello 2024). Through language, humans can reconstruct reality, reduce environmental uncertainty and maintain the stability of the Self-as-symbol (Torres-Martínez 2024b). This proactivity originates from uniquely human agency, and is the foundation of true language understanding and creative use, while

AI systems lack genuine agency and subjectivity. As the top level of the ECCM, the SIL understands the basic abilities of the CCL and the construction representations of the RIL within a sociocultural framework through dimensions such as shared intentionality, normativity and cultural accumulation. Through this integrated perspective, the ECCM comprehensively reveals the multi-level nature of language: it is both a cognitive tool and a social practice; it has both biological foundations and cultural accumulation; it embodies both individual creation and reflects social norms. This comprehensive framework not only provides new perspectives for understanding human language ability, but also reveals the fundamental limitations of current AI systems in true language understanding.

In terms of methodology, the ECCM requires a multi-level research strategy corresponding to its three-tier structure. First, at the CCL, formal analysis and neurocognitive methods need to be combined to study how general cognitive abilities support language processing. Language processing networks show significant overlap with general cognitive processing (Mahowald et al. 2024), providing important clues for the cognitive mechanisms of construction processing. Research at this level should focus on how general cognitive mechanisms such as statistical learning and analogical reasoning support the processing of language units at different levels of constructionality, and how constructionality dynamically adjusts with usage frequency and context. Second, at the RIL, corpus analysis and computational modeling need to be integrated to study how language constructions are formed through bodily experience and usage frequency. Studies at this level should examine how distributed multi-perspective representational systems are formed, and how the hierarchy and dynamicity of construction networks spontaneously emerge based on usage frequency and cognitive processing. Particularly in AI age, such research can help understand the construction learning capabilities and limitations demonstrated by LLMs, especially their performance in unifying statistical and conventional properties. Third, at the SIL, social cognitive experiments and longitudinal tracking studies need to be employed to examine the meaning construction function of language in social interaction and its cultural evolutionary process. Research should focus on how dimensions such as shared intentionality, normativity and cultural accumulation influence language use. Meanwhile, the synergistic relationship between individual grammar and community grammar, as well as the dynamic evolution of language as a component of the social ecosystem, are also focal points at this level. This comprehensive research method helps to validate the theoretical predictions of the ECCM.

The definitions of language in traditional language theories appear insufficient when explaining the capabilities and limitations of current AI language models. Through multi-level architecture, ECCM clearly distinguishes between the formal features, representational content and functional realization of language. Formal features can be acquired through statistical learning, explaining why LLMs can produce grammatically correct output. Representational content is rooted in embodied experience, explaining why AI systems have limitations in truly understanding meaning. Functional realization depends on social interaction, explaining why AI struggles to truly participate in human social practices. This distinction avoids the theoretical defect of simplifying language to a single dimension. ECCM redefines language as a multi-level cognitive tool formed through bodily experience and ecological construction, emphasizing that language is not only a formal system or communication medium, but also a cognitive adaptation for humans to understand and reconstruct reality. This definition both acknowledges the pluralistic nature of language, and provides a theoretical foundation for understanding the uniqueness of language ability. By emphasizing the embodied nature of language, the ECCM provides clear criteria for understanding the essential differences between human language and AI language capabilities: true language understanding necessarily involves the integration of embodied experience, rather than merely simulating formal patterns. Human language ability involves not only statistical learning and pattern recognition (CCL), but also depends on the representational system formed through bodily experience (RIL) and meaning construction in social interaction (SIL). Thus, true language ability necessarily includes cognitive processing ability, embodied representation ability and social interaction ability. Current AI systems, while making significant progress at the CCL, still have fundamental limitations at the RIL and SIL.

New directions in philosophy of language in AIGC era

In the AI age, philosophy of language faces new opportunities and challenges. Through analysis of Chomsky's biolinguistic approach and Tomasello's social cognitive approach, this paper considers the essential characteristics and limitations of AI language capabilities from multiple dimensions. The ECCM offers a multi-level perspective for these considerations.

First, in terms of language essence, the rationality embodied in AI has non-original meaning. The rational reasoning contained within AI is based on human creative processes, while the rational inference ability possessed by humans, as human essence, has originality. Although generative AI may surpass humans in data processing speed and computational ability, it is necessary to distinguish between original rational thinking ability and intelligence formed based on human creation (Grossmann et al. 2023; Wang et al. 2023a). From the perspective of the ECCM, AI lacks the analogical reasoning of the CCL and the embodied representation of the RIL, which prevents it from achieving true linguistic creativity, despite excelling at the purely computational level.

Second, in terms of language understanding and processing, current AIGC overcomes challenges in accuracy of language comprehension and humanlike expression, but algorithmic logic still lacks nuanced consideration of deeper linguistic and contextual implications, such as values and ethical aspects, which may lead to inaccuracies and misunderstandings in the evolution of cultural genes (Wu et al. 2023). This aligns with the SIL in the ECCM, since AI systems lack a foundation of shared intentionality and cannot truly understand the normative dimension of language use. Meanwhile, algorithmic bottlenecks exist, replicating cultural differences from the original human cultural databases into AI-generated culture, and insufficient or improper training may lead to errors contradicting human common sense (Bubeck et al. 2023; Chen and Zhang 2024). This reflects that language is not merely a computational process, but a cognitive tool formed through bodily experience and ecological construction (Torres-Martínez 2023 and 2024a).

Third, regarding language interaction, research shows that AI-generated messages more readily make recipients feel heard, and in some ways AI is more adept at detecting emotions than humans (Yin et al. 2024). This phenomenon can be explained through the form-meaning representation of the ECCM. AI systems can effectively simulate features at the formal level of language, but lack true understanding based on shared intentionality in the SIL.

Fourth, from the perspective of cognitive complexity, AIGC has become an important analytical tool for multi-modal data (Grossmann et al. 2023; Wang et al. 2023b). While AI demonstrates advantages in computational ability, memory capacity etc., it still shows deficiencies in deep language understanding and creative thinking (Luo et al. 2024). AI systems perform excellently

in formal language abilities, but are deficient in functional language abilities (Mahowald et al. 2024), reflecting that AI systems lack the bodily experience foundation of the RIL and the social interaction abilities of the SIL.

Fifth, regarding the relationship between technology and philosophical reflection, technological development can deepen our understanding of world details and specific aspects, but overall comprehension of the world remains inseparable from philosophy. In the process of perceiving the world, scientific specialization and philosophical holistic understanding can develop in parallel, without mutual exclusion. Science primarily operates according to its own functions and develops by inertia; whether it moves toward a humanized society or toward negative outcomes requires constant attention. In this process, value guidance becomes indispensable, primarily provided by philosophy. AIGC has already produced comprehensive and profound impacts on socioeconomic development, making its inherent ethics particularly crucial (Marcus and Davis 2019). Considering Tomasello's (2023c) views on unique human social motivations and moral emotions, we must consider how AI can handle language tasks involving value judgments, while lacking these fundamental capabilities. This is particularly significant given that AIGC possesses certain uncertainties, uncontrollability and complexity (Wu et al. 2023). The SIL analysis of the ECCM reveals that language is not only a tool for information transmission, but also a carrier of social norms and cultural values, providing direction for AI ethics research.

Conclusion and outlook

In the era of AIGC, this research transcends traditional binary opposition thinking. ECCM integrates the latest findings from linguistics, cognitive science, philosophy and AI, embodying the interdisciplinary nature of philosophy of language. On one hand, the multi-level architecture of ECCM requires researchers to adopt multi-dimensional research methods, integrating different approaches such as neurocognitive research, corpus analysis, computational modeling and social interaction research to comprehensively grasp the complex nature of language. On the other hand, the embodied constructional perspective emphasizes the importance of combining experimental methods with theoretical reflection, encouraging researchers to test philosophical hypotheses through empirical research, and to guide empirical exploration through philosophical thinking. This interdisciplinary dialogue is currently crucial for solving complex language problems, and also represents the future direction of philosophy of language.

Data availability

The research does not involve the analysis or generation of any data.

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