From Syntax to Cognition:
Insights from Generative Linguistics

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Abstract:

Linguistics has undergone major development since Saussure's work, which initiated an epistemological break that shifted language studies from a historical perspective to a descriptive one. Chomsky later reoriented this field along a new methodological path grounded in the rationalist–mentalist tradition, elevating linguistic theory to a central position within the cognitive science—discipline concerned with the structures and products of the human mind.

This research aims to clarify the cognitive-scientific perspective on the nature and functioning of linguistic knowledge. It examines the principles underlying Chomsky's generative approach, particularly his attempt to model linguistic competence through formal and explicit representations. This shift has fostered new interdisciplinary bridges, expanding the theoretical and applied horizons of linguistic inquiry.

Keywords: linguistics; syntax; cognition; cognitive science; generative theory; Chomsky's theory.

Introduction:

Language represents both an expression of human mental activity and the central object of linguistic inquiry. Accordingly, it is only natural that linguistics should occupy a prominent position within the cognitive science—commonly referred to as the science of mind. This privileged position becomes particularly evident in the outcomes of linguistic research conducted in collaboration with other disciplines, most notably in the theoretical advances stemming from Noam Chomsky's transformational-generative framework. The influence of this model is especially apparent in studies of language acquisition, as well as in efforts to explain the nature and functioning of linguistic phenomena.

Beyond its significant contribution to the humanities, this linguistic framework has also provided a robust conceptual and theoretical foundation for applied research in diverse fields, including communication studies, computer science, and artificial intelligence. Through this interdisciplinary scope, linguistics has established itself not merely as a discipline devoted to the description of language, but as a key contributor to the scientific understanding of the human mind.

Within this context, the present study seeks to explore the relationship between linguistic theory and the cognitive science. It begins by defining the scope and

objectives of this science, outlining its core questions and methodological orientations, and examining how they conceptualize linguistic knowledge and its underlying mechanisms. The discussion then turns to generative theory and its interdisciplinary cognitive orientation, which draws upon insights from a variety of scientific paradigms. This orientation has profoundly shaped both the theoretical evolution of linguistics and its contribution to the development of an interdisciplinary model of cognitive research. Ultimately, this study aims to elucidate the ways in which generative linguistics enhances our understanding of human cognition. By emphasizing its rationalist and mentalist foundations, its adoption of formal methods inspired by the exact sciences, and its holistic concern with linguistic competence and universal grammar, the research underscores the central role of linguistic theory within the broader framework of the cognitive sciences.

1. Cognitive Sciences and Linguistic Knowledge

1.1. Cognitive Sciences: Definition and Scope

The term *cognitive science* refers to a set of interrelated scientific disciplines such as philosophy, linguistics, psychology, neuroscience, and others. Their common object of study is the human mind and the mechanisms through which it operates. As M. Imbert notes, cognitive science deals with intelligence in general, human intelligence and its biological basis, as well as its nature and manifestations in psychological, linguistic, and anthropological dimensions (Imbert,1992,p49). Similarly, D. Andler defines cognitive sciences as disciplines aiming to describe, explain, and, when appropriate, simulate the main dispositions and capacities of the human mind.

Cognitive science thus seeks to study the mechanisms of human, animal, and artificial thought: describing, interpreting, and modeling them. They are generally concerned with any system that processes information and possesses the ability to acquire, store, use, and transmit knowledge . The goal is to establish a comprehensive theory of mind by studying the biology of the brain and mental processes in an integrated way—bringing together contributions from multiple cognitive disciplines to better understand the mechanisms underlying knowledge, such as language, reasoning, memory, learning, perception, and consciousness. Understanding and explaining these processes ultimately means understanding

and explaining brain function itself (Ezzaher, 1997, p1). According to G. A. Miller, the main scientific fields that constitute cognitive science can be illustrated as follows (.Miller, 2003, p143):
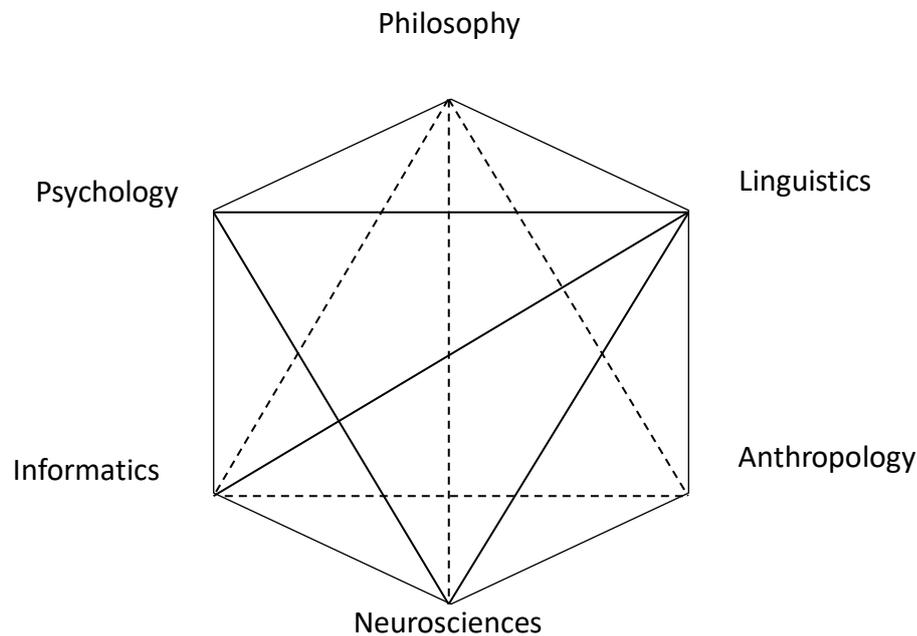
The solid lines in the figure represent the relationships that originally linked these disciplines when cognitive science first emerged, while the dashed lines indicate more recent connections that have developed as these sciences have continued to evolve and overlap.

1.2 The Nature of Linguistic Knowledge and the Mechanisms of Its Functioning:

An intelligent being acquires information from the surrounding environment through the senses—such as hearing, sight, and touch—and then subjects it to processes of classification, organization, and storage according to a mental plan that ensures connections between stored data when it is later retrieved. This process requires the existence of a faculty through which the representation of the environment becomes flexible and adaptable to new circumstances, allowing knowledge of things and entities to change its internal structure in accordance with cognitive and practical strategies dictated by the situation (Zanād, 2010, p16).

This faculty resides in the mind. Cognitive science seeks to describe how the mind processes the information it receives, and it does so by examining two fundamental capacities. The first is perception, the cognitive mechanism responsible for receiving and encoding linguistic and non-linguistic input. The second is production, which depends on the retrieval and use of this stored information in communication and linguistic performance. Through the study of these processes, cognitive science aims to explain the mental operations that accompany language use—operations that reveal

essential aspects of the speaker's cognitive abilities, including the systems involved in both linguistic and non-linguistic behavior (Munʿim, 2009/2010, p10). In the domain of language, any speaker possesses a system of knowledge that is mentally represented and physically instantiated in the brain. Understanding the mind therefore requires investigating the abstract properties of the operations carried out by the brain— properties that linguistic modeling is uniquely suited to uncover. Through such modeling, the cognitive structures and mechanisms underlying linguistic competence become accessible to scientific inquiry (Ibid, p10).

Psycholinguistic researchs highlight a fundamental correspondence between the processes of speech production and comprehension. A comprehensive account of language functioning therefore requires an integrative framework that jointly considers perceptual and productive mechanisms. Within this perspective, developing models that unify the full range of linguistic capacities—including both perception and production—constitutes a central objective of psycholinguistic inquiry. Such models shed light on the cognitive structures underlying linguistic competence and provide a theoretical basis for understanding how these capacities interact to support the flexible, adaptive, and context-sensitive use of language across communicative settings (Ferrand, 2000, p228).

2.The Generative–Transformational Theory and Its Cognitive Contributions:

2.1. The Mentalist and Rationalist Orientation:

Chomsky's earliest attempts to model language involved applying formal mathematical logic to reformulate American structuralist theory—specifically, the *immediate constituent theory*—as presented in his seminal work *Syntactic Structures* (Chomsky, 1957) (Al-Hajj Saleh,2007, p10). This work marks the emergence of the mentalist school (Al-Waʿar,1988, p85) and its first stage within the framework of the generative–transformational theory.

 The generative approach goes beyond the mere description of linguistic phenomena to their explanation and rationalization. It adopts an introspective and deductive method focused on the potential output of speakers rather than an empirical inductive one centered on attested utterances(Ibid, pp114-115). Structuralism, notably through Saussure's assertion that "the reality of language lies within itself more than in its history" (Al-Massadi,1986, p120). succeeded in shifting linguistics from historical-comparative inquiry to the study of the structural properties of language itself, conceived as a hierarchical system. Structuralist linguists thus described speech empirically and objectively, analyzing it in terms of the distribution and position of its units.

While some structuralists were influenced by psychological studies and others by social approaches, leading to different theories of language acquisition, Chomsky redirected the field through a new methodology aligned with the rationalist mentalist current. As Peirce summarized, linguistics, in its broadest sense and in light of its remarkable development, holds a distinguished place among "the studies of the mind's achievements and products." (Jakobson, 2002, p46). Chomsky sought to establish a linguistic theory of this kind—one that examines linguistic action in its relation to thought and mind (Ghalfan, al-Mallakh and Ismaʿili ʿAlawi, 2010, p12.).

2.2. Pursuing an Explanatory Scientific Method in the Manner of the Exact Sciences:

Chomsky drew upon his diverse intellectual background—encompassing grammar, mathematics, philosophy, and logic—to lay the epistemological foundations for a scientific linguistic theory characterized by precision, objectivity, and explanatory power. Explanation, in fact, is a major criterion for the value of a theory in the exact sciences, yet it was largely excluded from the taxonomic approaches of European and American structuralism, which rejected both hypothesis and interpretation.

Chomsky's framework rests on the principle that "every theory relies on a limited number of observations and seeks to explain the observed phenomena and predict others through general laws expressed in hypothetical conceptual terms—as in the case of the electron or mass." (Ibid, p18).

2.3. Directing Linguistic Inquiry Toward the Speaker's Knowledge of Language

The generative-transformational school succeeded in shifting linguistic study from the investigation of the infinite manifestations of language to the study of its finite underlying rules. For Chomsky, language is not a physiological behavior reducible to stimulus–response mechanisms (Mu'min,2005, p195), as in Skinner's behaviorist theory—which Chomsky famously and rigorously criticized—but rather a uniquely human, creative faculty. Humans can produce and comprehend an infinite number of sentences, including those never previously encountered, by relying on implicit phonological, morphological, syntactic, and semantic rules.

Chomsky refers to this underlying capacity as linguistic competence, distinguishing it from performance (Chomsky , 1965, p4), which is the actual use of language in concrete situations. Every human naturally acquires a language and can use it in various contexts, relying on their implicit knowledge of its rules—their linguistic competence. Ideally, performance should reflect this competence and develop in parallel with it. However, performance is subject to numerous non-linguistic factors that may cause deviations from grammatical norms, leading to variations among individuals and even within the same individual across different situations and topics.

Consequently, Chomskyian linguistics focuses on *competence* rather than *performance*, excluding the latter from its core inquiry because it is prone to interference and irregularities. Chomsky explicitly states that The fundamental concern of linguistic theory is the ideal speaker-listener, in a completely homogeneous speech community, who knows his language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention or interest, and errors (Ibid, p12).

2.4. From Particular Grammar to Universal Grammar

In addressing questions concerning the nature, acquisition, and use of linguistic knowledge, Chomsky emphasizes the need to move from focusing on behavior or its products to examining the mental/neurological states that underlie it (Chomsky, 1993, p54). The generative theory posits that humans possess an inherent *linguistic competence* and distinguishes between two levels:

- **Innate competence**, inherited as an intrinsic component of the human mind, preceding any linguistic experience. The theory assumes that this competence includes a set of universal principles facilitating the acquisition of specific languages—constituting what is termed Universal Grammar (UG).

- **Acquired competence**, which develops through exposure to linguistic data in social experience (Zanād, 2010, p49), and is referred to as particular grammar.

While Universal Grammar guarantees the human capacity for language acquisition and readiness to understand and use any human language, particular grammar enables individuals to acquire specific languages, each characterized by its own lexical and syntactic properties.

The transition from universal principles to particular grammars is explained by the presence of parameters—variables with unmarked values—that become specified through the interaction between UG principles and the linguistic input in the surrounding environment. Variations in this input across linguistic communities result in different parameter settings, accounting for cross-linguistic diversity despite shared underlying principles.

In his early work, Chomsky focused on particular grammar, seeking to construct a generative model capable of producing all grammatical sentences of a language and, ideally, applicable to all languages. He formalized grammatical rules using the concept of transformation, which distinguished his approach from descriptive structuralism. According to this concept, every sentence has two levels of representation: a deep structure reflecting the speaker's implicit grammatical knowledge, and a surface structure realized in actual speech. Transformational rules map sentences from the deep to the surface level.

Chomsky later focused on identifying the mechanisms that realize linguistic competence across languages, emphasizing the invariant principles underlying Universal Grammar that govern linguistic functioning in all human tongues. He developed what he termed the Minimalist Program, which seeks economy in grammatical design by reducing formal mechanisms to their simplest and most efficient form.

Within this framework, language is viewed as a cognitive system that stores and processes information, consisting of a lexicon and a computational system. The lexicon system provides lexical items, while the computational manipulates them to generate sentences (Ibid, p56). Due to the computationally effective nature of the Minimalist Program, numerous linguistic studies have developed computational models for sentence processing that incorporate syntactic constraints analogous to those proposed by the program (Rahali, 2008, p68).

Conclusion

Throughout its development, the generative-transformational school has progressively refined its treatment of linguistic phenomena. Chomsky's linguistic theory has evolved through successive stages, each reflecting greater conceptual sophistication and adaptability, in pursuit of an optimal formal representation of human linguistic knowledge.

The theory has engaged with advances in cognate disciplines—such as cognitive science, biology, and computation—and has progressively expanded its scope. It offers a theory of the *nature*, *acquisition*, and *use* of linguistic knowledge and has laid the groundwork for a grammatical theory that models language as a cognitive system with computational properties.

From generating particular grammars to uncovering universal principles shared across all languages, generative theory has made linguistics an interdisciplinary field—one that integrates insights from diverse theoretical traditions and has given rise to new domains of inquiry, notably *computational linguistics*.

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