

## PSYCHOLINGUISTICS AND LANGUAGE PROCESSING

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**ABSTRACT.** The aim of this article is to trace the evolution of the most important theoretical and experimental approaches to language processing, from the early 1960s, which witnessed the emergence of psycholinguistics as a separate field of study, to the more advanced methods constituting the methodological infrastructure of current research in the field. Combining two disciplines, namely psychology and linguistics, *psycholinguistics* originally attempted to identify the ways in which lexical items and syntactic rules are stored in the mind, as well as the role played by memory in the process of discourse perception and text interpretation. More recently, however, the interest has expanded not only towards issues pertaining to discourse processing, but also towards the manner in which readers' schemata based on background knowledge and readers' inferences about a text may help them create mental representations of the narrative world.

**Keywords:** *cognitive processes, internalised grammar, word recognition, working memory, sentence processing, text interpretation.*

**ZUSAMMENFASSUNG.** Ziel dieses Artikels ist es, die Entwicklung der wichtigsten theoretischen und experimentellen Ansätze zur Sprachverarbeitung, aus den frühen 1960er zu verfolgen, von der Entstehung der Psycholinguistik als eigenes Studienfach bis zu den weiter fortgeschrittenen Methoden, die die methodische Infrastruktur auf dem Gebiet aktueller Forschung bilden. Durch die Kombination von zwei Disziplinen, nämlich Psychologie und Linguistik, versuchte Psycholinguistik ursprünglich die Wege, auf denen die lexikalischen Einheiten und syntaktischen Regeln im Kopf gespeichert sind, sowie die Rolle, das Gedächtnis im Prozess der Wahrnehmung und der Diskurs Textinterpretation spielt, zu identifizieren. Neulich hat sich jedoch das Interesse nicht nur auf Fragen der Diskurs Verarbeitung, sondern auch gegenüber der Art und Weise, in der die Leser Schemata basierend auf Hintergrundwissen und Leser Rückschlüsse auf einem Text ihnen helfen mentale Repräsentationen der Erzählung auszubauen.

**Schlüsselwörter:** *kognitive Prozesse, internalisierte Grammatik, Worterkennung, Arbeitsgedächtnis, Satzverarbeitung, Textinterpretation.*

An essential part of understanding a language consists in constructing or identifying the appropriate syntactic structure for each utterance or sentence created or perceived. Sentence processing is an automatic, fast and apparently effortless cognitive

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process, but it is also a process extremely difficult to study directly. Moreover, any theory of sentence comprehension and production based exclusively on linguistic theories is doomed to failure. Noam Chomsky's realisation that the special properties of language require special processing mechanisms contributed to the emergence of psycholinguistics as a separate field of study in the early 1960s. But, as Garrett (2007: 805) explains, psycholinguistics "did not spring full born from a bed of behaviourism in 1960". Combining two disciplines, namely psychology and linguistics, this new field of scientific inquiry originally attempted to identify the ways in which lexical items and syntactic rules are stored in the mind, as well as the role played by memory in the process of discourse perception and text interpretation. More recently, however, the interest has expanded not only towards issues pertaining to discourse processing, but also towards the manner in which readers' schemata based on background knowledge and readers' inferences about a text may help them create mental representations of the narrative world.

In his *Reflections on Language*, Chomsky (1976: 139) argues that the speedy development in the case of language acquisition must be aided by the existence of an "**initial** state of the mind" which, following processes of maturation under the influence of the environment, turns into a "**steady** state of the mind" characterised by two important elements: (1) a system of expectations and beliefs regarding the behaviour and the nature of objects, and (2) a system of language. Chomsky (1976: 144) adds that what people usually label as 'knowledge of a language' is, actually, one of the cognitive components of this "steady state", namely an internalised grammar of the generative transformational type that derives the sentences' surface structures from the deep structures called initial phrase markers. This grammar comprises a set of rules governed by general principles that guide the interpretation of both the initial phrase markers and the surface structures (Chomsky, 1976: 150). Since the language users' internalised grammar has the form of generative rule systems which, despite being finite, have an infinite output and are, thus, able to account for linguistic creativity as well, psycholinguists and cognitive psychologists aiming to solve the puzzle of sentence processing must not only **describe the intrinsic competence** of the language users, be they speakers, listeners, readers or writers, but also **provide an explicit analysis of their contribution**.

As early as 1965, in his *Methodological Preliminaries*, relying on Humboldt's theory of language as based on a system of rules able to determine the way in which users can both generate and interpret an infinitude of sentences, Chomsky attempted to draw attention to the concept of "underlying competence as a system of generative processes" (Chomsky, 1965: 4). Arguing against the idea that word order merely mirrors the so-called *natural order of thoughts*, Chomsky stated that only a grammar of the generative type can own the proper tools required for explicitly assigning structural descriptions to sentences, for accurately describing the language users' intrinsic linguistic competence, as well as their contribution during the process of linguistic performance. The goal is to identify what the users are actually able to do

with the language, not simply what they might report about their linguistic knowledge, because the mere fact that a speaker “has mastered and internalised a generative grammar” means neither that he is aware of the rules of this grammar, nor that he can be made aware of them, so “his statements about his intuitive knowledge of the language” may not be accurate (Chomsky, 1965: 8). To paraphrase Leibniz’s words on thoughts and ideas, words that perfectly apply to linguistic knowledge as well, we can say that there are innate general principles that form the soul and the connection of our thoughts; “they are as necessary thereto as the muscles and sinews are for walking, although we do not at all think of them”. When we use language we constantly lean upon these innate principles, but it is extremely difficult “to distinguish them and to represent them distinctly and separately”; consequently, “one possesses many things **without knowing it**” (emphasis ours).

These final words offer an essential insight into the correct understanding of Chomsky’s notion of internalised grammar, especially since most of the attacks directed against the renowned linguist’s generative-transformational theory were grounded in his interchangeable use of the terms ‘knowledge of grammar’ and ‘internalised grammar’. This constituted, for some critics, a serious terminological problem, since the two terms are not synonymous and, therefore, should not be employed as if they were in free variation. According to Stich, for instance, Chomsky’s assertion that generative grammar can account for the language users’ internalised knowledge is unsubstantiated: “My own view is that the notion of competence is explanatorily vacuous and that attributing knowledge of grammar to a speaker is little more plausible than attributing knowledge of the laws of physics to a projectile whose behaviour they predict.” (Stich, 1972, quoted in Katz 1985: 143). On the one hand, since *knowledge* is synonymous with *awareness*, *understanding*, and *familiarity*, being defined as “the psychological result of perception and learning and reasoning” (WordNet 3.0), the term obviously refers to something we *acknowledge* and are *conscious of*. It is undoubtedly true that, just like a projectile is unaware of the laws of physics, so a speaker is not aware of grammar rules. However, it is not absurd to state that language users are endowed with an ‘internalised grammar’, which is not learned but innate, nor is it absurd to claim that the laws of physics are part and parcel of the design procedure employed in the construction of the projectile. Thus, we might say that due to the existence of this ‘internalised grammar’ the speaker is able to acquire and process language, just like the projectile is able to reach its target due to the existence of the laws of physics on the basis of which it was designed. Consequently, “[k]nowledge of the laws of physics is not necessary for the projectile to reach its target – and from this we cannot conclude that the laws of physics do not exist –, as knowledge of a grammar is not necessary for the speaker to understand and produce grammatically correct sentences – and this does not mean that there is no such thing as an ‘internalised grammar’.” (Preda, 1999: 142). Furthermore, it is precisely these laws that enable the projectile to function and to reach its target, just as it is the ‘internalised grammar’ that enables humans to acquire and to process language.

Fodor (1981, in Katz 1985: 154) points out that both in the case of ‘competence theories’ and in that of ‘performance theories’ there is a psychological element involved. The former account for “facts about the behaviours and capacities of a speaker/hearer by reference to *properties of his internalized grammar*”, while the latter account for “facts about the behaviours and capacities of a speaker/hearer by reference to *interactions between the internally represented grammar and other aspects of the speaker/hearer’s psychology*” (emphasis ours). Chomsky and Miller (1963: 269-361) explained that theories of linguistic competence described the knowledge that a language user could access during processing, whereas theories of linguistic performance had to take into account the way in which the limits of the cognitive system could guide to systematic patterns in performance. Using these theories as a starting point, a few psycholinguistic theories explain the phenomena involved in the human processing of language by resorting to working memory.

Canice Grant (2005: 26-27) begins her analysis of sentence processing by referring to a quote from Searfoss, Readence and Mallette’s book entitled *Helping Children Learn to Read*: “The basic task of readers is similar to the task of a prospector. Just as the prospector picks away at the surface to discover the gold hidden underneath, readers dig away at the surface structure, searching for and demanding meaning.” Grant points out that this analogy is justified by the existence of theories that draw on the process of “subconsciously picking away at a sentence” in order to gain access to its meaning. Since sentences are used as part of communicative activities, sentence processing is meant to foster sentence comprehension, which requires more than just lexical processing, as the meanings of words and phrases are interwoven into the fabric of the text. Thus, it has been argued that listeners and readers rely, at first, on word recognition and, then, must interpret the respective word meanings function of the context in which they were used. Given the fact that sentences are often ambiguous in isolation, it is not only the linguistic context that needs to be taken into account, but the situational and the social context as well. Judith Greene (1995: 21) shows that even the interpretation of a very common utterance, such as *He gave her a ring* may vary significantly, depending on the situational and on the linguistic context. Thus, the sentence means one thing if preceded by *Daniel begged Jane to marry him* and quite another if it appears following *Daniel needed to speak with Jane*.

Moreover, *conversational conventions* play an essential role in achieving the desired goal of communication, as do *performative constructions*, which belong to the realm of pragmatic analysis. Thus, an interrogative structure such as *Will you turn the lights on?*, a statement like *It is rather dark in here.*, an imperative construction like *Turn the lights on!* and a tag question such as *It’s getting dark, isn’t it?* may all be used to perform the speech act of requesting that the lights be switched on. However, in order for the action to be carried out by the addressee, he or she must be cognizant of the social context conventions at work in our society and able to perceive the speaker’s intentions.

Greene (1995: 21-23) explains that the interpretation of the words “THE POLICE LIVE AT THE ALBERT HALL” (featuring on a poster) relies heavily upon the reader’s background knowledge. Choosing correctly between the two possible scenarios (namely, on the one hand, that a famous pop music group is going to deliver a live performance at the Albert Hall and, on the other hand, that “members of the constabulary inhabit that vast building”) is **not** just a matter of linguistic knowledge. Therefore, cognitive theories of language are needed to account for the relationship between “purely linguistic knowledge of a language and general knowledge about the world” and to describe exactly how these different kinds of knowledge are represented in memory. Consequently, psycholinguists and cognitive psychologists have the challenging task of establishing not only whether our knowledge of grammar rules is represented as “a special syntactic component in memory” but also how our understanding of social conventions is organised “so as to constrain our utterances to make sense.”

To understand a sentence, listeners and readers have to retain a large amount of information, covering the words they encounter, the order in which they appear, their syntactic category, the relations among them, etc. Not only the role, but also the limitations of working memory powers are probably best evinced by the processing of embedded structures such as the following sentence, for instance: **The rat the cat the dog hated chased fell into the trap.** In this case, the string of words could be more explicitly uttered by making use of relative pronouns as introductory words for the defining relative clauses:

The rat *that the cat which the dog hated chased* fell into the trap.

Although they are grammatical, complex embedded structures are often ambiguous and, thus, highly challenging for the human processor, if not almost impossible to understand at first. It is only natural for processing time to lengthen in the case of complex structures, and, according to specialists in psycholinguistics, if comprehension fails in cases such as the one mentioned above, this occurs because each of the initial noun phrases must be held in working memory until the location of its appropriate predicate is detected, but more than two such noun phrases usually exceed the capacity of most people’s working memory.

Both the assumptions of the researchers and the research methodology have undergone important changes since the 1960s, especially in what concerns the importance awarded to the role of the brain’s structure and functions in language processing. Garrett (2007: 807) points out that, besides the competence-performance issues, some other significant shift in perspective have marked the first twenty years of psycholinguistic research: if Fodor et. al. (1974) focused on the relation between grammar and the processing of language, Clark and Clark (1977), as well as Foss and Hakes (1978), gave less prominence to the grammatical aspects. However, all three works featured issues such as language development, word recognition, speech processing and parsing. More recent works also include essential aspects

concerning production processes, language pathology, neuroscientific insights, bilingualism and computational modelling.

In the area of lexical processing, the interest centred on ambiguity and its resolution on the basis of contextual constraints, as well as on semantic priming and the workings of memory systems. The investigation of the mental lexicon, for instance, centred on form-driven versus meaning-driven theories, with William Marslen Wilson's "cohort theory" attempting to take into account the role of contextual clues as well. The focus of more recent psycholinguistic research shifted to the role of conceptual and memory systems, a distinction being made between the representation of form-related information and that of meaning-related information (with not only semantic, but also pragmatic overtones). One of the most acute issues in contemporary psycholinguistics is whether "there is a principled difference between the linguistic lexicon and the general memory systems that record experience with words" (Garrett in Gaskell, 2007: 808).

As far as the investigation of parsing is concerned, there has been a significant evolution from early 1960s research, characterised by a "static structural focus", to more recent approaches acknowledging the essential issue of "real-time" or "on-line" sentence processing (Garrett in Gaskell, 2007: 810). Fodor's 1983 analysis of modularity, William Marslen-Wilson and Lorraine Tyler's 1982 experimental approaches to on-line processing, especially in the case of utterances displaying lexical and/or structural ambiguity, were accompanied by research based on computational linguistics, with a focus on syntactic ambiguity, and with a special interest in temporary syntactic ambiguity (particularly the so-called "garden-path phenomena"). As Garrett (2007: 810) explains, although reaching a consensus on the convoluted issue of ambiguity resolution was impossible due to the "intrinsic variability in human performance", this was one of the most prolific periods in the study of language. What followed was an expansion of investigation techniques which, at the end of the 1980s and the beginning of the 1990s, relied on electrophysiology and eye-movement monitoring techniques, later improved by free-field eye-pointing assessments and brain imagery testing. Nevertheless, shows Garrett (2007: 811), the above mentioned methods of observation "in concert with more traditional behavioural measures, widened the empirical stream without much deepening it".

Still, all these different types of investigation have not been carried out in vain, because as a result of the various theoretical excursions and practical experiments there sprang some significant evidence regarding

- the remarkable swiftness that characterises the process of combining various bits of information during speech processing,
- the time-related and memory-related constraints on information processing,
- the existence of specialised linguistic sub-systems,
- the use of different computational systems for the processing of sentence form and, respectively, of sentence meaning, and
- the necessity to integrate comprehension theories with production theories.

Moreover, shows Garrett (2007: 815), although, in time, the global measures of language processing were replaced by more specific methods, able to account for temporal aspects of sentence processing, dual task measures and self-paced reading have survived, in their subsequently improved versions, of course, and have been essential in the development of novel more advanced methods that constitute the methodological infrastructure of current research in the field.

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