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EDITED AND REVIEWED BY
Greig I. de Zubicaray,
Queensland University of Technology, Australia

*CORRESPONDENCE
William Matchin
matchin@mailbox.sc.edu

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# Editorial: Syntax, the brain, and linguistic theory: a critical reassessment

William Matchin[1]*, Simona Mancini[2,3], Jixing Li[4] and Emiliano Zaccarella[5]

[1]Communication Sciences and Disorders, University of South Carolina, Columbia, SC, United States, [2]Basque Center on Cognition, Brain and Language, Donostia-San Sebastian, Spain, [3]Ikerbasque, Basque Foundation for Science, Bilbao, Spain, [4]Behavior and Social Sciences, City University of Hong Kong, Kowloon, Hong Kong SAR, China, [5]Neuropsychology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Lower Saxony, Germany

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Editorial on the Research Topic
Syntax, the brain, and linguistic theory: a critical reassessment

## Introduction

Theoretical syntax no longer plays as prominent a role in neurolinguistics as it used to. A prominent issue is that linguistic theory often has been applied directly to neuroscience (Figure 1, left), but rather should be filtered through a well-articulated processing model (Figure 1, right). The papers in this volume pave the way for a renewed and productive relationship between linguistic theory and neuroscience in the study of syntax and the brain.

## "Words" are not separable from syntax

A major insight that has guided recent research on the organization of syntax in the brain concerns the tight relationship between syntactic structure and the lexicon. Krauska and Lau review cross-linguistic evidence both from non-European languages such as Iniktitut, Vietnamese, and Hiaki, as well as English and Dutch, illustrating that the concept of the lemma familiar from psycholinguistic research (e.g. Levelt, 1989) is untenable. They propose an alternative model of syntax and the brain in which the posterior temporal lobe generates both what we colloquially call "words" and "sentences". Gonering and Corina provide a comprehensive review of constructionist and generative syntactic theories and neuroscience research on syntactic processing, and advocate for a theory in which syntactic processing is widely distributed in a dual-stream architecture: a ventral stream for processing nouns and attributive modifiers, and a dorsal stream for processing verbs and relational modifiers (cf. Bornkessel-Schlesewsky and Schlesewsky, 2013). Finally, Matchin points out that lexical items have both syntactic and semantic properties, a consensus across many linguistic theories. Therefore, spatial overlap between lexicality (e.g. word > nonword) and syntactic effects (e.g. complex > simple structures) in functional neuroimaging studies does not provide evidence supporting an inseparability of syntax and semantics in the brain.

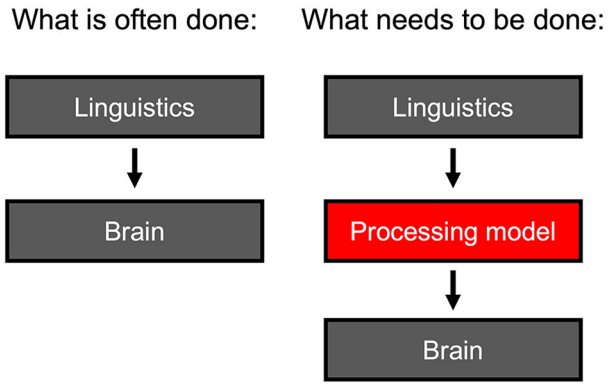


FIGURE 1
**Left:** some neurolinguistic work has attempted to directly apply linguistic theory to neuroscience, which has led to many pitfalls. **Right:** the approach we advocate here, in which linguistic theory is integrated with an adequate processing model, which will enable more meaningful results and the development of more effective neurocognitive models.

## Syntactic deficits in patient populations are best explained by a combination of linguistic and domain-general deficits

Linguistic structure is clearly relevant to language disorders: agrammatism and cognitive impairments due to Alzheimer's disease can both be meaningfully characterized in part as a reduction in syntactic complexity. However, it is also critical to incorporate insights from cognitive domains outside of linguistics. Based on the results of Ivanova et al., deficits in working memory may explain some of the major declines in syntactic complexity yet preserved syntactic well-formedness in Alzheimer's disease. Faroqi-Shah claims that a combination of deficits to linguistic structure, speech articulation, and processing capacity may all contribute to the classic pattern of agrammatic speech commonly seen in nonfluent aphasia. Interestingly, Faroqi-Shah's framework takes a plausible middle-of-the-ground approach to agrammatism, differing from theories which focus primarily on deficits from a specific module of syntax derived from linguistic theory (e.g., Grodzinsky, 2000) and differing from theories which eschew any targeted linguistic deficit, but rather a more general processing issue (Kolk, 1995; Fedorenko et al., 2023).

## Abstract linguistic structure is critical to online processing

It is common to dismiss the abstract structures that are postulated by some linguistic theories. However, the papers contributed by Greco et al. and Yamaguchi and Ohta indicate that these structures are essential for explaining language processing behavior. Specifically, Greco et al. illustrate the necessity of hierarchical structure to surprisal effects, above and beyond surface-based statistics based on specific words and parts-of-speech. Yamaguchi and Ohta investigated one issue that has often been contentious within the psycholinguistic literature: the extent to which putative phonologically null elements, or empty categories, exert effects on sentence processing similar to overt pronominal elements. They found evidence that the structures containing these putative null elements behave like structures with real reflexive pronouns, and also that multiple distinct types of empty categories must exist, converging with the predictions of syntactic theory.

## Defining the relation between linguistics and neuroscience

One of the pitfalls in previous and current research on the syntax-brain relationship is the failure of sufficient imagination in considering how language might be implemented in the brain, and problematic, unexamined assumptions concerning *how* language is processed and *how* that processing relates to brain activity, echoing influential comments by Poeppel and Embick (2005). Călinescu et al. comprehensively review functional neuroimaging on syntax, pointing out the inadequacy of many experimental paradigms in identifying what they claim to. Coopmans and Zaccarella discuss three concepts from syntactic theory: the distinction between competence and performance, the autonomy of syntax, and the abstract nature of syntactic representations, arguing that they are often incorrectly interpreted as applying to online language processing rather than as representational descriptions, or vice versa. Both papers assert that some of the confusion in neurolinguistics may stem from a misunderstanding or misapplication of concepts from linguistics. Uriagereka pushes at the edges of inquiry, suggesting a novel mathematical approach to decomposing syntactic features into an algebraic form. This decomposition may provide a greater opportunity to find a neural correlate of linguistic processing in the form of punctual and distributed representations than is currently evidenced in neurolinguistic research.

## Conclusions

The papers in this volume are far from providing confident answers to the questions we posed in this Research Topic. However, they are inspiring in their breadth and their common cause of bringing to light the valuable and significant contributions of syntactic theory, when interpreted carefully, keeping in mind how syntax should be processed algorithmically in real-time, to neurobiology. They should provide a valuable starting point for new researchers looking to enter the field, either linguists who are curious about the brain or neurolinguists looking for theoretical grounding for their work.

## Author contributions

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Publisher's note



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