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When linguistic dogma rejects a neuroscientific hypothesis

Kazanina and Tavano argue that delta-band oscillations cannot be involved in multi-word or multi-morpheme chunking during language comprehension because the timing of syntactic structure is too variable (Kazanina, N. & Tavano, A. What neural oscillations can and cannot do for syntactic structure building. *Nat. Rev. Neurosci.* **24**, 113–128 (2023))[1]. According to the authors, comprehension requires the formation of hierarchically organized non-adjacent dependencies between words or morphemes that arrive at variable points in time. Temporally regular chunking would break dependencies and disable the comprehension of compositional meaning.

However, this verdict relies on a popular premise that should not be taken as ground truth. The authors assume that syntactic representations in the mind conform to one particular linguistic theory — hierarchical phrase structure/transformational grammar[2]: words and morphemes combine with other words and morphemes into phrases that hierarchically combine into larger phrases, and so on. If that is the ground truth, syntax would indeed be too variable in time for an oscillatory brain substrate to have a role in this process.

Yet, decades of theoretical debate have not been able to decide whether syntax in the mind is hierarchical[2,3]. The neuroscientific application of hierarchical theories has been extremely fruitful, and has shaped our understanding of the neuroanatomical organization of syntax[4]. Nevertheless, not all theories of syntax, sentence processing and language acquisition assume hierarchy. For instance, construction grammar represents sentences as linear concatenations of idiom-like multi-word or multi-morpheme snippets[2]. There is also dependency grammar, in which the representation is essentially a non-hierarchical list of all links among the words and morphemes of a sentence[3].

The cognitive formation of hierarchical representations during real-time comprehension is not a given either. For instance, construction grammar captures item-based learning in language acquisition remarkably well[5]. Moreover, the processing model that corresponds to dependency grammar conceptualizes dependency processing as a set of memory operations that link words and morphemes together and is insensitive to linear order — let alone hierarchy[6]. Remarkably, behavioural evidence even suggests that the hard cases (that is, sentences that would require the build-up of hierarchical structure, such as ambiguities, passives and embeddings) mostly yield false interpretations — note that the average college student struggles with the sentences that are at the heart of the hierarchy dogma[7,8].

But let us assume that hierarchical syntax is a ground truth and that the delta band is useless for its formation. We should still not ditch the oscillations-for-chunking hypothesis just yet. The reason is the unknown interface between perception and syntactic structure building. On the one hand, it is safe to think that syntactic structure is built incrementally. On the other, there is firm evidence that, to avoid memory loss, our brain samples speech as discrete second-long segments (termed implicit prosodic phrases[9] or chunks[10], among others). We do not know how this bottleneck interfaces with structure formation, but it has been argued that syntactic dependencies are indeed confined by the boundaries of chunks[9], such that chunk-wise sampling would ensure that compositional meaning can be understood. It also remains to be tested whether such protosyntactic chunks are sufficiently regular in time for a regular mechanism such as neural oscillations.

We suggest that alternative linguistic theories of syntactic representation, well-established processing models of sentence processing, and current knowledge of perceptual sampling should be better acknowledged before ditching the hypothesis of a link between syntax and delta-band oscillations based on one particular linguistic theory.

There is a reply to this letter by Kazanina, N. & Tavano, A. *Nat. Rev. Neurosci.* https://doi.org/10.1038/s41583-023-00739-0 (2023).

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Competing interests

The authors declare no competing interests.