This abstract has been accepted for presentation at the Interdisciplinary Workshop “Sign Language Grammars, Parsing Models, & the Brain”, 6-7 November 2025, Max Planck Institute for Human Cognitive & Brain Sciences, Leipzig, Germany. For further information about the event visit: https://sign-language-grammars-parsers-brain.github.io

Neural Encoding of Verbs in Natural Sign Language Narrative

The distinction between nouns and verbs is a linguistic universal (Langacker, 1987; Croft, 2025). Across languages, nouns tend to refer to entities and serve a referential function, whereas verbs denote actions, events and relations, serving as predicates (Talmy, 1985). Verbs serve as a grammatical glue, their argument structure relating other sentence elements. For spoken languages, the noun/verb division is reflected in neural organization. Neuroimaging studies find dissociable neural networks for verb and noun processing, the left middle temporal gyrus (MTG) preferentially implicated for verbs (Elli et al., 2019 ; Papeo et al., 2019; Wurm & Caramazza, 2019).

The neural basis of verbs in sign languages is underexplored but particularly interesting, since many sign languages have a rich lexicon of iconic motion verbs, whose perceptual form resembles the action being referred to. One study found that ASL motion verbs activate the language system, rather than action perception system, but whether a verb-specific neural signature is observed has not been tested (Newman et al., 2015.) Here, we examine the neural basis of verb comprehension in Polish Sign Language (PJM). Even for spoken languages, prior imaging studies have used either single words or in one study isolated sentences, whereas we studied neural basis of verbs in discourse context.

Twenty congenitally Deaf native signers watched a continuous Polish Sign Language (PJM) narrative while undergoing fMRI. To capture linguistic structure, two native PJM signers (authors MK, JH) annotated verbs (plain, directional, depicting), nouns (plain, depicting), and gestural elements using an annotation system developed by Deaf PJM signer and psycholinguist (author PT). In parallel, motion energy features - direction and speed extracted with spatiotemporal Gabor filters served as a low-level baseline to dissociate visual form from linguistic structure (Dupré La Tour et al., 2025).

To test how these linguistic and perceptual features are represented in the brain, we modeled BOLD signal as a function of feature type using an encoding-model approach. We used ridge regression with a nested cross-validation scheme (Dupré La Tour et al., 2022).

Consistent with prior findings from spoken languages, verbs, but not nouns, reliably explained variance in the left posterior MTG. Unique variance analysis comparing the full model, with verbs, to the noun model, revealed unique variance explained by verbs in the left posterior MTG. Importantly, the verb effect was not simply due to low level features of visual motion: activity in the MTG was not accounted for by motion energy or by gestural elements. Instead, the effect was driven by verbs, primarily by depicting verbs, with little contribution of plain or directional verbs.

Taken together, these findings suggest that the well-established role of the left MTG in verb representation extends beyond spoken language to narrative context in sign language. They also demonstrate the feasibility of using feature-rich annotations and encoding models to investigate the neural basis of linguistic categories in the context of sign language research.

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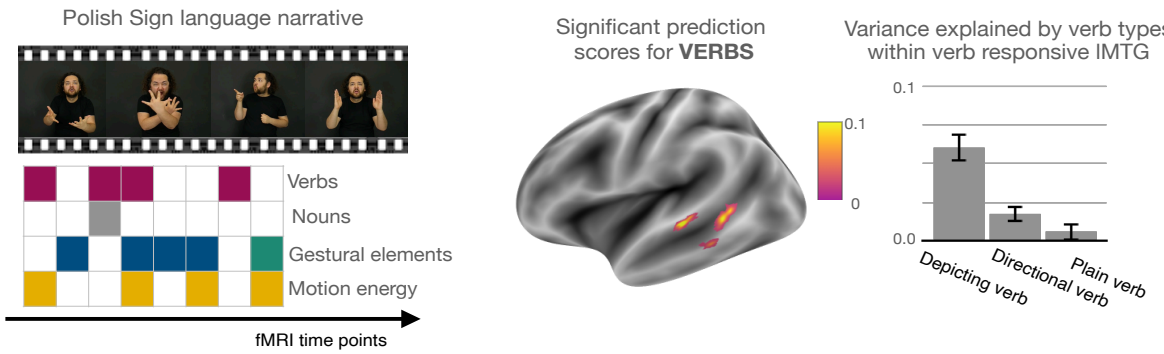

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