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

# Multivariate fMRI Uncovers Classifier-Invariant and Language-specific ASL Verb Representations in Deaf Signers

Verbs are a linguistic universal and in spoken languages partially neurobiologically dissociate from other word types (e.g., nouns) and visual representations of actions (Bedny et al., 2011; Papeo et al., 2019; Elli et al., 2019; Wurm et al., 2019). Sign languages have rich verb lexicons and morphology, the neurobiological underpinnings of which remain underexplored. American Sign Language (ASL) verbs provide an important test-case because they share modality with visual actions and can take highly iconic forms known as classifiers. For example, the plain verb ‘give’ can be modified with a handling classifier to convey how the object is handled, resembling the action it denotes. This has raised questions about their linguistic versus gestural nature and the abstractness of the representations. We used multivariate pattern analysis (MVPA) fMRI to test whether ASL verb representations are invariant across classifier (i.e., form) variation, as well as across sentence contexts. Previous studies on verbs in spoken languages implicate the lateral posterior temporal cortex (LPTC), and in particular, posterior left middle temporal gyrus (pLMTG). We predicted classifier-invariant decoding of verbs in this region (e.g., Wurm et al., 2019; Hauptman et al., 2025).

Deaf signers (N = 17; ASL acquisition ranging from native to late) viewed ASL sentences while undergoing fMRI. Sentences featured six action verbs (give, take, open, close, pick-up, put-down) in three grammatical structures: Subject-Verb-Object with Non-Classifier form, Object-Subject-Verb with Non-Classifier form, and Object-Subject-Verb with Classifier form (e.g. in ASL GLOSS: "MAN OPEN BOTTLE", "BOTTLE MAN OPEN".) Sentences varied in signers’ identity (man, woman), the grammatical subject (man, woman), and object (bottle, book, laptop, teapot). In a non-linguistic condition, participants watched meaning-matched action videos (e.g., a video of a man opening a bottle). As a low-level control, participants viewed perceptually matched but meaningless videos created by superimposed backward-played ASL and action videos that preserved motion, human bodies, and faces.

Individually defined functional ROI-based MVPA (cross validated) and whole-brain searchlight analyses were conducted to decode verbs and actions. MVPA revealed largely non-overlapping decoding of verbs and actions. A language-responsive left LPTC region showed above-chance decoding for ASL verbs ($p<0.001$) (Fig. 1a) but did not decode actions depicted in videos ($p>0.1$). Whole-brain searchlight analyses revealed different spatial distributions for ASL verbs (pLMTG) (Fig. 2a) and visual actions (right-lateralized posterior temporal and occipitotemporal cortex) (Fig. 2b). Training on ASL verbs and testing on actions and vice-versa identified a small degree of overlap across sentences and videos in left posterior lateral temporal cortex (Fig. 2c). ASL verbs were successfully decoded across perceptual and grammatical variation, including signer identity, grammatical subject and object, and word-order (all p’s<0.01). Decoding was further invariant of classifier surface form, i.e., training on classifier constructions and testing on non-classifier constructions and vice-versa showed above chance decoding ($p<0.001$) (Fig. 1b). In conclusion, language-responsive LPT cortex, previously associated with verb processing for spoken languages, represents ASL verbs in a manner invariant to classifier forms.

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## Figures

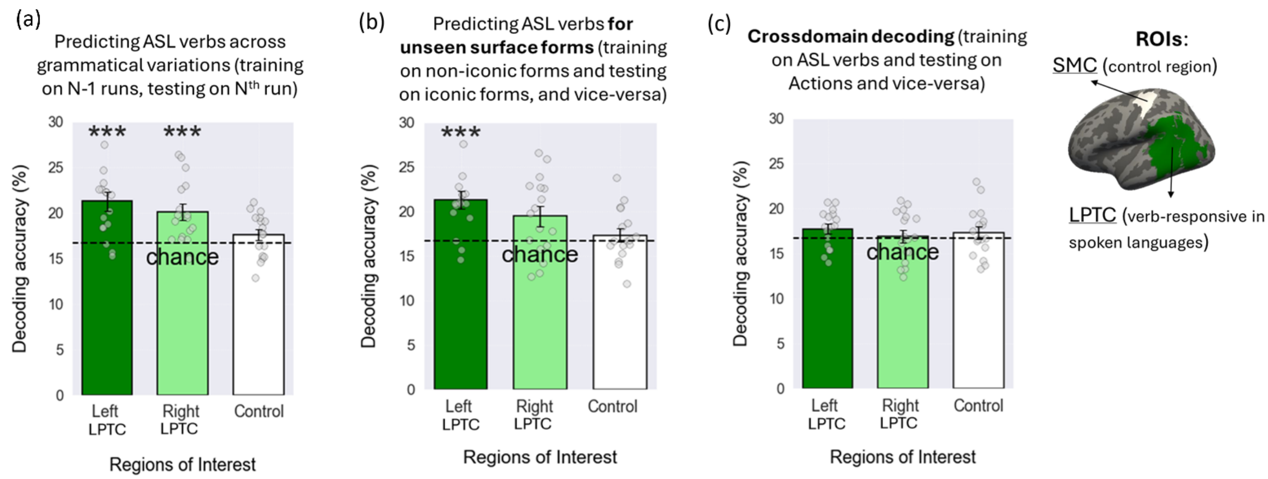


**Fig. 1 Decoding results from ROI-based MVPA**

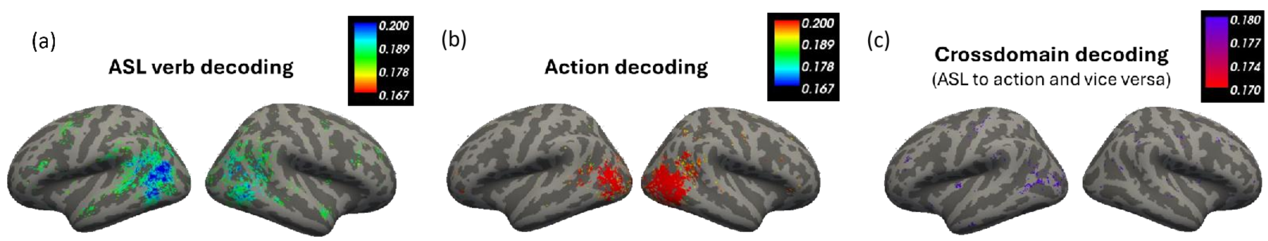


**Fig. 2 Decoding results from Searchlight MVPA**

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