

fMRI and MEG reveal different aspects of meaning composition

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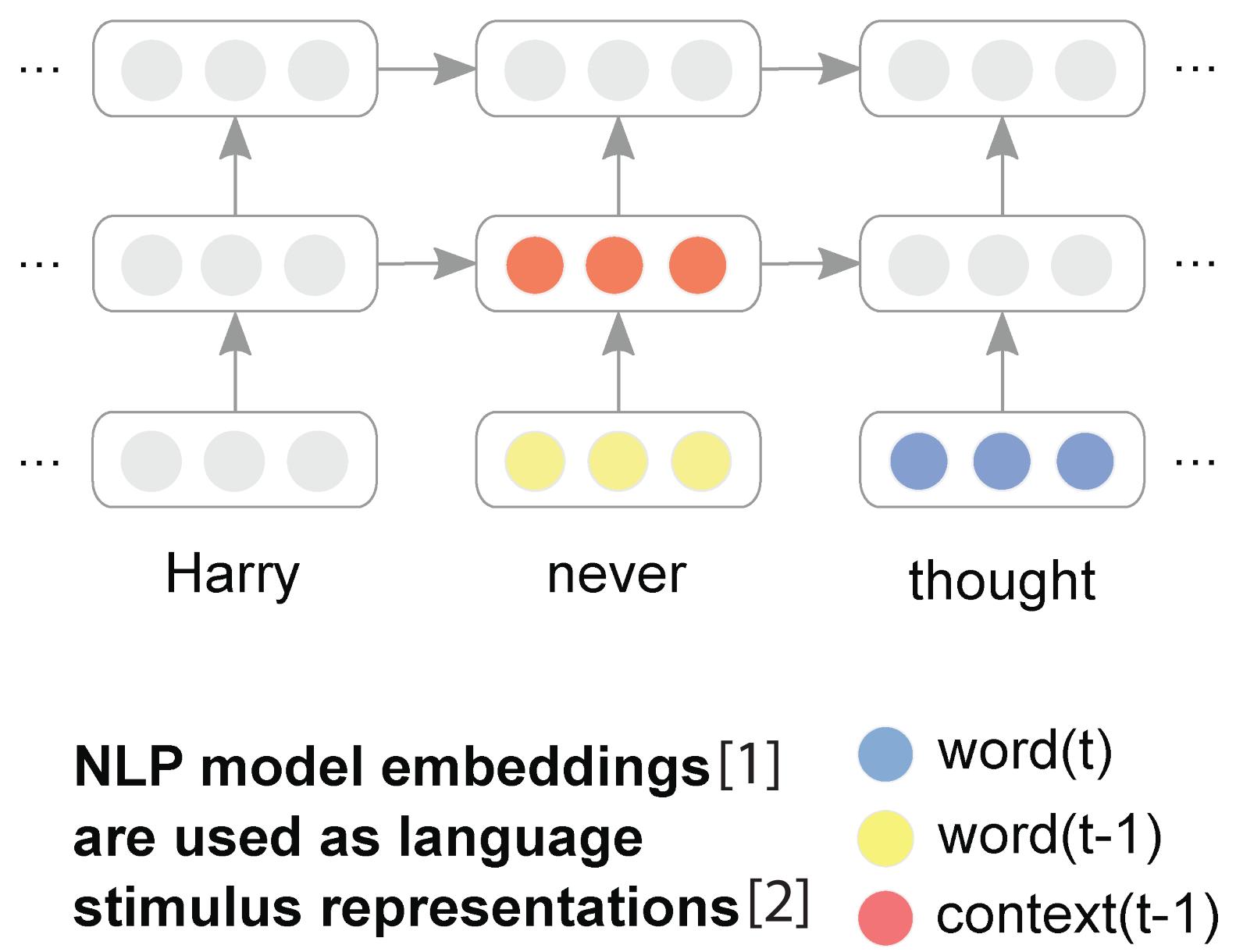
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Accessing supra-word meaning via computational controls in encoding models of people reading natural text

"Mary finished an apple"

supra-word meaning contains the concept of eating



1. Learn a function g

$$g\left(\begin{array}{c} \text{blue} \\ \text{blue} \\ \text{blue} \end{array}, \begin{array}{c} \text{yellow} \\ \text{yellow} \\ \text{yellow} \end{array}, \dots\right) \approx \begin{array}{c} \text{red} \\ \text{red} \\ \text{red} \end{array}$$

2. Obtain context(t-1) residual by applying estimated function \hat{g}

$$\begin{array}{c} \text{red} \\ \text{red} \\ \text{red} \end{array} \triangleq \begin{array}{c} \text{red} \\ \text{red} \\ \text{red} \end{array} - \hat{g}\left(\begin{array}{c} \text{blue} \\ \text{blue} \\ \text{blue} \end{array}, \begin{array}{c} \text{yellow} \\ \text{yellow} \\ \text{yellow} \end{array}, \dots\right)$$

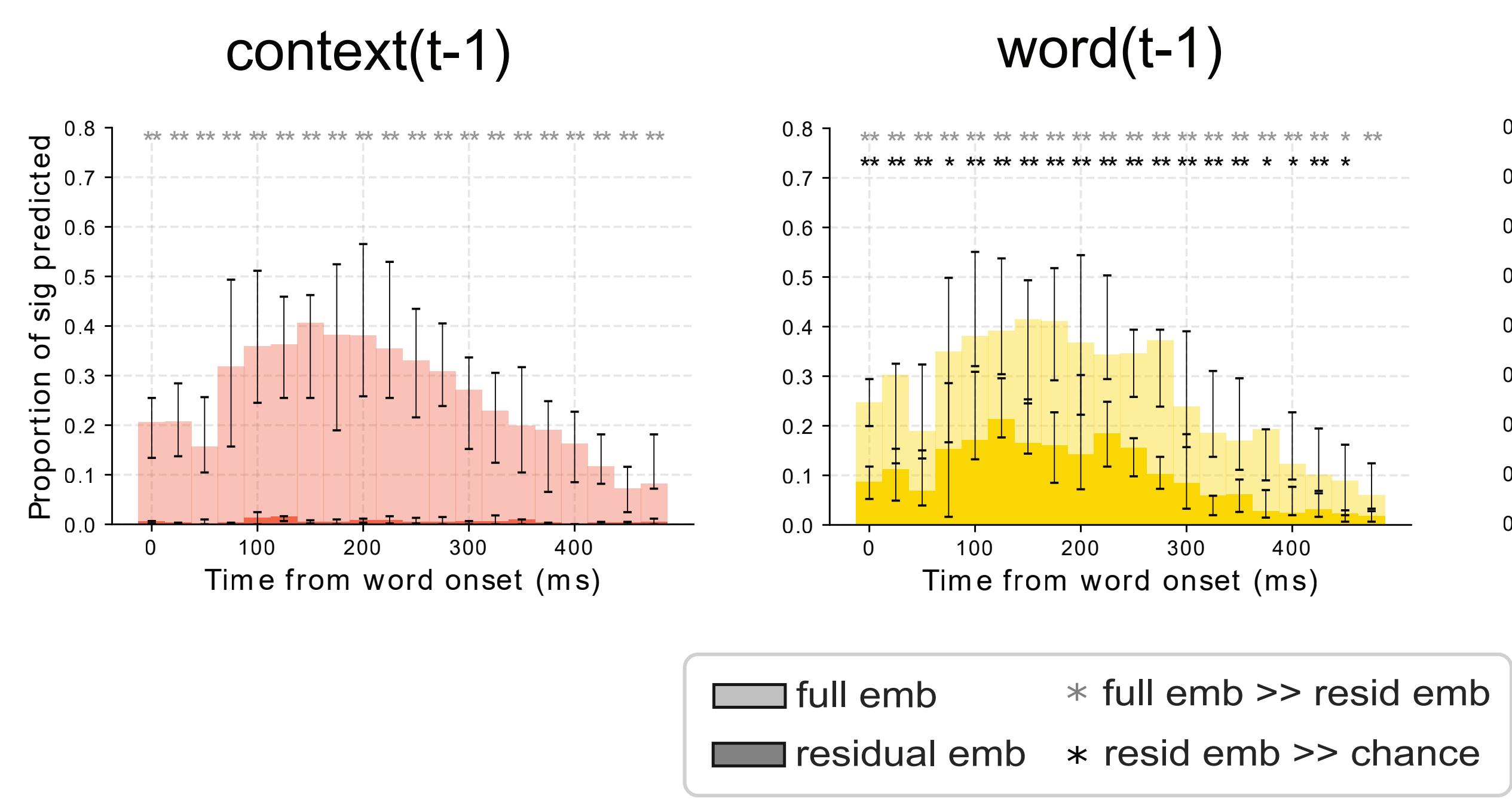
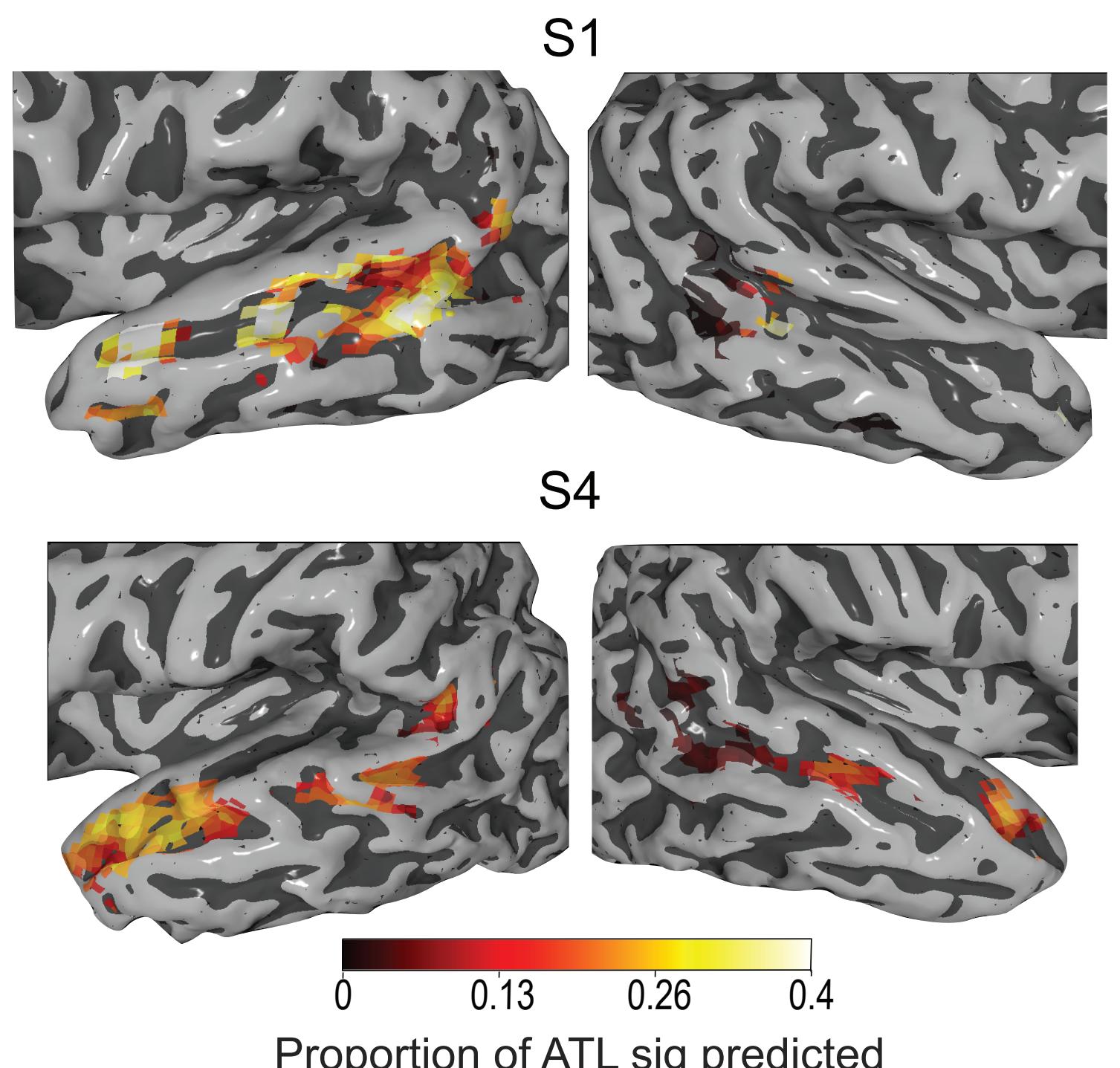
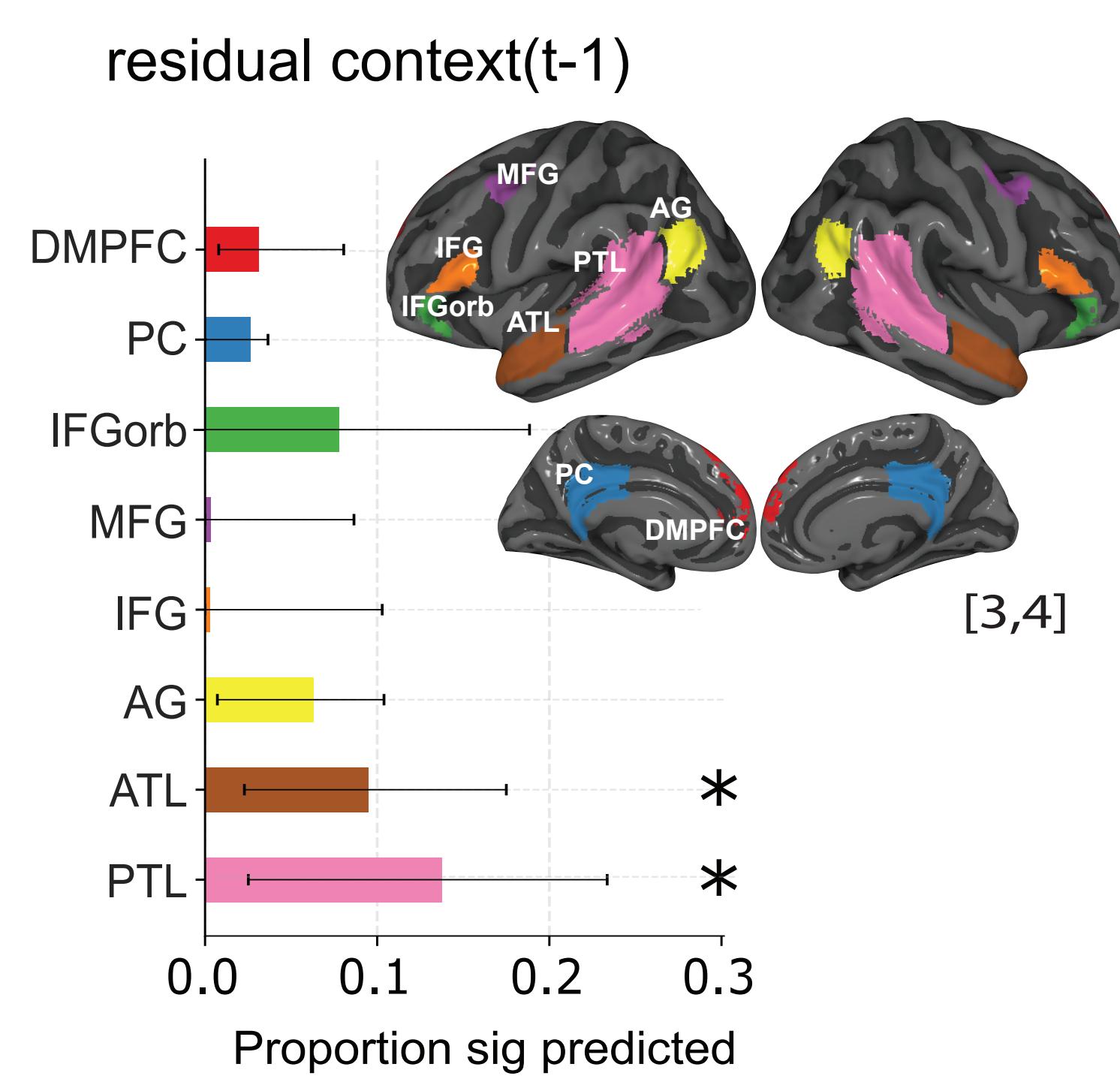
3. Learn a function f

$$f\left(\begin{array}{c} \text{red} \\ \text{red} \\ \text{red} \end{array}\right) \approx \text{Brain Activity} \quad f\left(\begin{array}{c} \text{red} \\ \text{red} \\ \text{red} \end{array}\right) \approx \text{Brain Activity at } 300-325ms$$

4. Reveal which voxels and sensor-timepoints support supra-word meaning

fMRI reveals bilateral PTL and ATL support supra-word meaning

In contrast, MEG is sensitive to unique information in the recently-read words



Manuscript: <https://doi.org/10.1101/2020.09.28.316935>

[1] Peters et al. 2018, NAACL

[2] Toneva and Wehbe 2019, NeurIPS

[3] Fedorenko et al. 2010, JNeurophysiol

[4] Binder et al. 2009, Cerebral cortex

Support: start-up funds in the Machine Learning Department at CMU, the Google Faculty Research Award, and the Air Force Office of Scientific Research grants FA95501710218 and FA95502010118.