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Talk Title: Mind captioning: evolving descriptive text of seen and imagined content from the human brain via features of language models

Abstract:

Humans can recognize and recall intricate visual content consisting of multiple components like objects, places, actions, and events, alongside their interactions and relationships. While previous brain decoding studies have succeeded in predicting individual visual components, producing comprehensive descriptions of such intricate mental content remains elusive. In this presentation, we introduce a novel generative decoding method that translates brain representations into texts via semantic features of language models. Our method generates a descriptive text of mental content through iterative optimization, gradually aligning semantic features of candidate descriptions with target brain-decoded features by replacing and interpolating words within the candidates. We assessed the effectiveness of our method by testing whether we could generate accurate descriptions of seen and imagined content from human brain activity measured by functional magnetic resonance imaging (fMRI). We trained linear decoding models using fMRI activity measured while subjects viewed video clips to predict semantic features computed from corresponding video captions. We then used these models to decode fMRI activity for new video stimuli. Applying our text generation method to brain-decoded features resulted in progressive evolutions of descriptive texts guided solely by the brain, wherein the evolved descriptions became increasingly well-structured while accurately capturing key aspects of viewed video content. Furthermore, our method successfully generalized to generate descriptions of imagined content, although notable individual variations were observed. These results showcased the utility of language model features to decode semantic

representations of complex visual content, demonstrating the feasibility of directly interpreting brain representations by translating brain signals into linguistic descriptions.

Biographical information:

Tomoyasu Horikawa currently serves as a Distinguished Researcher in NTT Communication Science Laboratories. He received his B.A. from Waseda University in 2008 and completed his Ph.D. at Nara Institute of Science and Technology in 2013. After working at ATR Computational Neuroscience Laboratories, he joined NTT in 2021. Additionally, he worked as a JST PRESTO researcher from 2018 to 2022. His research has primarily centered on developing brain decoding techniques integrating deep learning technologies to understand the neural basis of subjective experience.