Decoding a Variety of Concepts Including Abstract and Non-Existent Objects From Brain Activity During Mental Imagery

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Mental imagery is a sophisticated brain function that enables high-level inference and creation. The ability for mental imagery varies among individuals along various dimensions, such as vividness, abstractness, and factuality. However, investigating the neural mechanisms underlying individual differences in this ability is challenging because we cannot directly observe the content of mental imagery. To address this issue, we introduce a brain-decoding method that evaluates the content of mental imagery in terms of various concepts. This method extends a previously developed method that decodes rich perceptual experiences, from brain response to naturalistic audiovisual stimuli, using tens of thousands of words. By applying this method to mental imagery, we can decode various concepts, including abstract concepts and non-existent objects, to study important functional aspects of mental imagery. To this end, we measured brain responses from 44 participants using fMRI while they performed a mental-imagery task inspired by a previous study. In this task, participants recalled concepts associated with 30 specific words while rating the subjective vividness of each image. The imagined concepts were decoded using our method from fMRI signals measured during this task. We found that the decoding performance for 20 of the 30 wide-ranging concepts was significantly above the chance level, demonstrating successful decoding of mental imagery for these concepts. In addition, decoding performance correlated with the vividness of mental imagery, suggesting that our method effectively assesses the vividness of mental imagery. Thus, our decoding method can provide a useful tool for investigating the neural mechanisms underlying the individual’s ability for mental imagery.

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