Speeding up comprehension with grasping actions

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Once they understood the word that appeared on the screen, the test subjects grasped the cube under the word displayed. Credit: CITEC/Bielefeld University

Hearing or seeing a word doesn't mean that it is immediately understood. The brain must first recognize the letters as such, put them together, and

"look up" what the word means in its mental lexicon. In an experiment, cognitive psychologists at Bielefeld University's Cluster of Excellence Cognitive Interaction Technology (CITEC) have shown how word comprehension can be sped up – namely by having study participants grasp objects while reading at the same time. Privatdozent Dr. Dirk Koester and his colleagues reported the findings of their discovery in the research journal *PLOS One*. According to the researchers, the method could offer an approach for new therapies, such as treating stroke patients.

"Latest theories in cognitive science research hypothesize that our memory also records physical sensations as part of the words stored," says Dirk Koester, who works in the CITEC research group "Neurocognition, Action and Biomechanics" led by Prof. Dr. Thomas Schack. "Similar to an entry in a reference book, the brain records a word like 'whisk', associating it with concepts such as 'inanimate' and 'kitchen device.' In addition to this, the brain connects the word to one's own experience – how a whisk feels, for instance, and that a spinning motion is related to it." In their new study conducted with 28 participants, Koester and his colleagues lend support for the thesis of the embodiment of knowledge.

Koester explains the central finding of their study: "When the study participants had to grasp an object while reading, their brain processed parts of the meaning of the words earlier than in previous studies in which words were evaluated without something being gripped."

The participants sat in front of a computer screen, where three cubes were lying next to each other on the tabletop: one about the size of an apple, one the size of a table tennis ball, and one the size of a dice. On the screen behind the cubes, three white fields were displayed. Words then appeared in one of the fields on the screen – sometimes made-up words, sometimes real ones. When a pseudo-word such as "whask" was

displayed, the participants did not have to do anything. But if a real noun like "orange" appeared, they were supposed to grip the cube corresponding to that respective field. An EEG electrode cap recorded brain activity, allowing the researchers to then evaluate how the word was processed.

As demonstrated in previous studies, it takes the brain a third of a second to process a word. "In our study, however, we were able to show that comprehension can already begin much earlier, after just a tenth of a second – if a grasping action is required," explains Koester. This study not only provides evidence that the brain has a common control center for language and movement, but "it also shows that our brain's processing steps shift very quickly and adjust to current tasks – in this case, the task of grasping something while reading."

Koester believes that the findings from this study could also be used in the future for various therapies, such as treatments for aphasia, a language disorder that can occur after a stroke in which one's ability to comprehend or formulate words is impaired or lost. "Similar as in our experiment, patients could practice words they cannot access by indicating not only verbally but also with grip movements to show they recognize a word. In short, motor training," explains Koester. "As such, one's knowledge of words would be strengthened through the 'back door' of motor control."

More information: Dirk Koester et al. Action Priority: Early Neurophysiological Interaction of Conceptual and Motor Representations, *PLOS ONE* (2016). DOI: 10.1371/journal.pone.0165882

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