This Week in The Journal

Tool Experience Reduces Representational Similarity to Hands

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(see pages 2980–2989)

People generally have a strong sense of their bodies as distinct from the outside world. This sense of embodiment can be altered pharmacologically or by illusions like the rubber hand illusion, in which subjects begin to perceive an artificial hand as their own. Embodiment might also occur with frequently used tools. This hypothesis stems partly from studies in monkeys showing that cortical neurons that represented visual space around the hands began responding to the area surrounding the end of a rake used to obtain food. Further evidence for embodiment came from work showing that increased use of a prosthetic limb was associated with increased activity in the occipitotemporal cortex (OTC)—an area that responds to images of hands—when viewing pictures of prosthetic limbs (van den Heiligenberg et al., 2018, *Brain* 141:1422). Contrary to the embodiment hypothesis, however, Maimon-Mor and Makin (2020, *PLoS Biol*, 18:e3000729) found that neural representations of prosthetic hands in the OTC were less similar to representations of hands in prostheses users than in control subjects. Schone, Maimon-Mor, et al. extend these findings to other tools.

The researchers used functional MRI to record activity in the OTC of people with frequent or little experience using a litter picker while the volunteers viewed videos of hands, litter pickers, and tongs picking up objects. Representational similarity analysis was then used to determine the extent to which neural activity patterns elicited by litter pickers differed from those elicited by hands. Notably, representations of litter pickers and hands were more distinct in people with experience using this tool than in control subjects. Neural representations of tongs and hands were also more dissimilar in people with litter-picker experience. Similar results

were found in an exploratory analysis of activity in the parietal cortex.

These results suggest that rather than beginning to view tools as extensions of their bodies, experienced users begin to view their tools and related ones as more distinct from hands. Given that the OTC is part of the visuomotor network, the increased distinction may relate to the likelihood that compared with novices, experienced users have more direct knowledge of the distinct motor commands and coordination required to pick up objects with tools versus hands.

Contrary to a long-standing hypothesis, experience with a tool decreases the overlap between its neural representation and hand representations in the OTC. See Schone, Maimon-Mor, et al. for details

Imprecise Feature Representation Improves Associative Memory

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(see pages 3014–3024)

It is often necessary to distinguish highly similar objects or events. The brain may achieve this task by reducing overlap between neural representations of similar stimuli. Indeed, although similar objects initially activate largely overlapping sets of hippocampal neurons, as one learns to distinguish the objects, the neural representations become more distinct. Zhao et al. provide evidence that this process can

exaggerate differences and make memories less accurate.

Volunteers learned associations between objects and faces, grouped into pairs. In competitive pairs, the two faces were associated with objects that differed only in color. In noncompetitive pairs, the faces were associated with objects that differed in both type and color. In all cases, object colors differed by a small, fixed amount. After training, participants underwent functional imaging during which they were shown faces and asked to visualize the associated object. Finally, participants viewed faces and grayscale objects and were asked to make the object the color associated with the face.

As expected, when asked which face was associated with a given object, subjects made more mistakes in matching objects from competitive pairs than matching those from noncompetitive pairs. Furthermore, mistakes usually involved picking the face that was associated with the object of the same type but different color. When asked to adjust the color of face-associated objects, subjects tended to exaggerate the color difference between objects in competitive pairs, but not colors of objects in noncompetitive pairs. Notably, people who showed more color exaggeration also performed better on the associative memory test.

Functional imaging data revealed that, as expected, neural representations activated in the ventral intraparietal sulcus during object recall were more similar for objects in competitive pairs than those in non-competitive pairs. In addition, color information was more strongly represented when recalling objects in competitive pairs than for noncompetitive pairs. Importantly, greater differences in neural representations of objects in competitive pairs were associated with greater exaggeration of color differences and better performance on the associative memory test.

These results suggest that when people must distinguish similar objects in memory, they exaggerate small differences between them. Although this distorts their object memory, the distortion is beneficial because it reduces interference between memories of similar events.

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