

# Does the brain encode the gaze of others as beams emitted by their eyes?

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With great interest we read the recent report of Guterstam et al. (1) in which they show that the direction of someone's gaze can be decoded from blood oxygen level-dependent (BOLD) activity in areas MT+ (middle temporal complex) (and temporo-parietal junction). In preceding publications, they presented evidence that the observation of directed gaze evokes motion adaptation (2) and the experience of physical interactions with the environment as if the gaze were pushing the targeted objects (3). The authors suggested that these behavioral effects originate in a cognitive representation of another person's gaze as a force-carrying beam emanating from the eyes, traversing space and operating on the environment. Against this backdrop, BOLD activity in MT+ is now interpreted as a representation of the motion of the imagined beam.

Undoubtedly, this intriguing concept is in line with the observations. Yet, we are convinced they do not contradict an alternative interpretation. Rather than reflecting a moving beam, the BOLD activity in MT+ might represent the observer's expectation of motion of the other and/or of the object targeted. An agent shifting attention to an object is likely to engage in physical interactions at any moment, entailing both movements of the object and of the effectors. Guterstam et al. (1) reject this alternative by arguing that in their control condition, in which the agent was blindfolded, MT+ activity did not allow the decoding of stimulus orientation. Indeed, this could be explained by the blindfold's preventing the beam from being imagined. However, it could as well be due to the fact that the

observer may no longer expect interaction-associated motion between the agent, now blindfolded, and the tree. The authors resort to yet another argument to refute the alternative interpretation, namely the assumption that a mighty tree may not be accessible to manipulations with the agent's unreinforced hand, and consequently that no expectations about interactions are triggered. However, a tree can be approached by means other than grasping, and moreover the stimuli presented did not allow estimates of the size of the tree relative to the agent; assuming the tree to be a tangible toy is equally possible.

Even though we find their hypothesis very inspiring, we think, moreover, that in light of previous research on area MT+ and on the modeling of the other's intentions the alternative interpretation is more parsimonious. First, it is well established that area MT+ encodes predictions and expectations about the motion direction of objects needed to elicit object-directed eye and hand movement (4–7). Second, perceived gaze is known to be a central building block in modeling intentions of others in an attempt to predict imminent actions, thereby helping the observer to initiate reactions (8–10). Bringing these lines of research together, they provide evidence which allows the results to be explained without postulating an additional cognitive faculty like the encoding of someone's gaze as energy beams.

Hence, in our view, more carefully controlled experiments will be needed to test the hypothesis preferred by the authors against the alternative hypothesis of interaction-related movement expectations.

<sup>1</sup> A. Guterstam, A. I. Wilterson, D. Wachtell, M. S. A. Graziano, Other people's gaze encoded as implied motion in the human brain. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 13162–13167 (2020).

<sup>2</sup> A. Guterstam, M. S. A. Graziano, Implied motion as a possible mechanism for encoding other people's attention. *Prog. Neurobiol.* **190**, 101797 (2020).

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