UNIVERSITY OF AMSTERDAM

Pupil dilation signals decision outcome

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It was already known that our pupils dilate whenever we make a decision. But why? New research shows that the degree of dilation betrays decision-makers' attitude towards an upcoming choice. This is the conclusion of a study conducted by cognitive neuroscientists at the University of Amsterdam (UvA), the results of which were recently published in the online scientific journal PNAS.

Until now, research on pupil dilation during decision-making generally looked at rapid decisions (hundreds of milliseconds). Because of this, it was often unclear whether pupil dilation reflected the final response to the task (such as pressing a button) or the preceding decision-making process. In their study, the UvA researchers therefore used a task that prolonged the decision-making process (across several seconds) in order to distinguish between the response and the decision-making process.

Participants in the study were asked to complete a computer task in which they had to press a button to indicate whether or not they saw a particular image (the 'target'), embedded in dynamic noise. Whenever they saw the image, they pressed the right-hand button, if they did not see it, they pressed the left. In the time between these target images, 'noise' was shown (non-relevant images).

Master's student Jan Willem de Gee explains: 'Though this task focused on elementary perceptual decisions, it called for the subjects to make the same sort of assessments as people like stock traders when they're deciding whether to buy shares in a particular stock. It's about accumulating fluctuating evidence over time for or against a decision'.

Norepinephrine

During the experiment, researchers registered subjects' pupil size. Several studies suggest that pupil size tracks the release of a certain chemical, norepinephrine, which regulates the communication between neurons in the brain. In this study, the UvA researchers were able to show for the first time that pupil dilation starts even before the actual decision, while gathering evidence. This suggests that the release of norepinephrine can actively influence decision-making processes as they are taking place in the cortex.

'Some stock traders require very little evidence in favour of a share, whereas others wait longer before moving to buy,' says De Gee. 'All of our decisions are the result of the interaction between individual attitudes and the evidence collected from our surroundings.' A notable finding was that the researchers recorded the largest pupil dilation in cautious subjects (those more inclined to say 'no') when making a 'yes' decision.

One possible explanation for these findings is that the central release of norepinephrine aids in the gathering of evidence so that intrinsic attitudes have less of an impact on the decision to be made. The researchers plan to test this hypothesis through the simultaneous registration of pupil size and brain activity. These results not only mark an important step in unravelling the fundamental brain mechanisms at work in decision processes, but may also have significant implications for understanding disturbances in cognition and behaviour – for instance in psychiatric disorders such as depression, in which norepinephrine plays a key role.

Publication details

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