Helpful for robotics: Brain uses old information for new movements

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Information from the senses has an important influence on how we move. For instance, you can see and feel when a mug is filled with hot coffee, and you lift it in a different way than if the mug were empty. Neuroscientist Julian Tramper discovered that the brain uses two forms of old information in order to execute new movements well. This discovery can be useful for the field of robotics. Tramper will receive his doctorate on Thursday 24 April from Radboud University Nijmegen.

Every time you move, the brain deals with two problems. First, there is a slight delay in the sensory information needed to execute the movement. Second, the command from the brain directing the muscles to move is

not entirely clear, because neuronal signals contain a certain amount of natural static interference. According to Tramper, the brain has a clever way of getting around both problems: It combines the old information from the senses with experience gained through similar movements made in the past. This means that our senses use two forms of old information in order to make new movements.

Computer versus test subject

Understanding the brain processes behind movement can be of great importance to fields like robotics. Therefore Tramper is trying to model his findings so that it will be possible to use them in robots in the future. He has already succeeded in this for certain hand-eye coordination experiments, to the extent that a computer can perform at about the same level as human test subjects. As a post-doctoral researcher within the Donders Institute, Tramper is researching how these types of models can be integrated into bio-inspired robots (robots based on biological principles).

SpaceCog

Tramper is currently working on a project called SpaceCog. The goal of this project is to develop a robot which can independently orient itself in space, something that humans do automatically. This is difficult to achieve, because each time a robot moves, it must reinterpret the information from its cameras and other sensors in order to determine whether the changes to its input are the result of its own movement or an external cause. The researchers involved in SpaceCog want to figure out how our brain has solved this problem. Tramper has three years to come up with a good computer model addressing this issue.

Looking towards the future

Tramper is studying hand-eye coordination by having test subjects play a special computer game. The subjects use a game controller to move a digital right hand and left hand on a screen. They have to move the two hands independently of one another and make them each follow a particular path in order to reach a final destination. It turned out that the test subject's eyes moved ahead of the digital hands. In other words, the eyes looked at a point that the hands would reach in the future. This type of eye movement is called smooth pursuit, and before now it had only been detected in the case of external stimuli, when a subject was following an object's movement. Tramper detected smooth pursuit eye movements at locations the hands had not yet reached, meaning these movements were triggered by internal stimuli.

Smooth pursuit

Tramper explains, 'We'd previously demonstrated for other types of eye movement that the eye anticipates and moves in advance of external movement To our surprise, this is also the case with smooth pursuit. It is probable that this is a compromise between where you are at a particular moment and where you want to get to. When moving, you need to keep track of your current location (which is constantly changing) and your target destination. Smooth pursuit eye movements can help you do this by letting your eye "hover" between both locations. If we can teach robots to do something like this, it will help make their movements much more natural. This will increase the number of ways in which robots can be put to work.'

Provided by Radboud University Nijmegen