

Computer game highlights stroke paralysis partly due to a lack of 'mental focus'

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Assessing grip strength can show flaws in the brain's attention-control. Credit: Imperial College London

An inability to focus the brain on tasks may partially explain why paralysis commonly occurs in people following a stroke, according to a

news study.

Patients who have suffered a stroke – where the blood flow to the [brain](#) is interrupted by a clot or bleed – often experience a degree of paralysis on one side of the body, termed hemiplegia, affecting the [strength](#) and dexterity in their limbs.

This paralysis has generally been considered to be due solely to damage to the network of neurons which relay nerve signals from the brain through the spinal cord and into the muscles – collectively called the motor system.

But new research from Imperial College London has highlighted the link between the mind and body in this loss of physical function, pointing to the role of the brain's ability to focus on a task, or 'attention-control'.

The team devised a simple computer game to assess [patients](#) in their hospital beds, which they used to show that impairment to their attention-control affects strength and dexterity.

The findings, published this week in *Proceedings of the National Academy of Sciences*, suggest that the ability to focus attention on a task is needed for normal movements and that at least a part of the paralysis from stroke may be due to poor attention-control in patients.

Improving patient assessment

According to the researchers, looking for signs of damage to the brain region controlling this process could potentially lead to more effective assessment and rehabilitation of patients with stroke and has implications for other patient groups as well, including those with [traumatic brain injury](#).

"People have always separated out the physical from the mental, thinking that after brain damage you become physically weak, as well as mentally impaired" said Paul Bentley, Clinical Senior Lecturer and Honorary Consultant Neurologist at Imperial, who led the research.

"What we're doing is saying that these two elements are linked and that the mental aspect may explain at least part of the reason patients may be having physical problems."

In order to carry out any physical task the brain has to dedicate a proportion of its attention to the process – whether we realise it or not. For example, a weightlifter about to raise a heavy dumbbell needs to focus their attention to successfully lift the weight.

Damage to the brain networks responsible for this ability to focus can impact on attention-control, with a large proportion of strokes damaging this region to some extent.

The mental and the physical

In the latest study, researchers tested the link between a person's ability to focus on a task and their physical ability, recruiting a total of 260 people, including 167 who had various degrees of weakness due to stroke. The stroke damage occurred across a broad region of the brain, including outer and inner parts of the frontal lobes, controlling higher level functions, including the attention-control network.

Researchers tested motor function in both of the patients' arms as well as their baseline strength through a series of bedside tests. Patients were asked to play a computer game using a handheld device which detects changes in grip force.

During the game they followed a green star on screen by squeezing the

controller with their hand and varying the force they applied.

As players focus on the star, the game begins to add in other features on the screen to distract them, such as similar colours and shapes, providing the researchers with a way to test how easily someone loses focus.

Analysis of the results revealed that impaired motor control occurred in patients with a wide range of ability to focus.

However, patients with damage to brain regions controlling focus all had impaired movement, dexterity and strength. This implies that normal strength and dexterity require attention focusing to be intact.

Despite the sample size, there were no cases in which patients had poor mental focusing but normal strength or dexterity. However there were many cases of the opposite pattern – that is, weakness, with impaired mental focusing.

Focusing attention

The researchers were also able to highlight the link between attention-control and hand movement and strength, showing that when players were distracted within the game it affected their dexterity and grip strength.

According to the team, the findings show the role the brain plays in coordinating physical tasks and highlights a need to change the way patients are assessed. By testing a patient's affected and unaffected sides and comparing the results, they could pick up on any underlying attention-control issues which may be impairing movement and strength.

"We have effectively come up with a new way which we recommend to researchers and clinicians can assess patients with paralysis," said Dr.

Bentley.

"We separate out the difference between the left and right side of body and then assess weakness in the apparently unaffected arm that is often still abnormal. We call this the two-component model of weakness."

Dr. Bentley adds: "If people have an impairment with their attention-control, it suggests they should have some sort of brain training focused specifically on that area."

Simple bedside test

The researchers are confident that the approach could be rolled out in the hospital setting, helping to assess stroke patients at their bedside and as a way to train their attention, potentially increasing their ability to [focus](#) and regain physical movement in paralysed limbs.

Further trials are needed to calibrate the tests in a larger patient population, says Dr. Bentley, and the group has developed a new portable testing device for the bedside which allows for this assessment.

The test can also detect failing [grip strength](#) that is a known physical marker of ageing, a predictor mortality, and that is likely to be impaired with diminished cognitive faculties, such as due to dementia.

Dr. Bentley explained: "This kind of testing takes about 10 minutes. We can assess and work out how 'good' patients are in each arm and how distractible they are – we can work out the two components of their paralysis and therefore arrange a treatment to fit their particular pattern of weakness."

He added: "Our findings show it is not just damage to the motor system but to the higher executive system and concentration that's partly causing

weakness and the disability we see after stroke.

"By focusing on the psychological and cognitive issues of patients we may be able to help their physical condition, so we're bridging that gap."

More information: Paul Rinne et al., "Motor dexterity and strength depend upon integrity of the attention-control system," *PNAS* (2017).
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Provided by Imperial College London

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