

## Neuroscience the new face of warfare: experts

Written by Reuters

Thursday, 09 February 2012 14:01

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Directed energy weapons that use wave beams to cause pain, and electrical brain stimulation that boosts a soldier's combat ability - it may sound like science fiction warfare, but experts say advances in neuroscience mean it's on the horizon.

Rapid progress in the ability to map brain activity and manipulate its responses with stimulants could change the face of warfare, a panel of experts said on Tuesday.

The experts, looking at the scope for neuroscience in future military conflict, said researchers on the cutting edge of medical science should remember that their work could have other, more harmful uses, Reuters reports.

"We know neuroscience research has the potential to deliver great social benefit - researchers come closer every day to finding effective treatments for diseases and disorders such as Parkinson's, depression, schizophrenia, epilepsy and addiction," said Rod Flower, a professor of biochemical pharmacology at Queen Mary University of London, who led the panel.

"However, understanding of the brain and human behavior, coupled with developments in drug delivery, also highlight ways of degrading human performance that could possibly be used in new weapons."

The report, published on Tuesday by the UK's national academy of science, the Royal Society, was written by experts in neuroscience, international security, psychology and ethics.

It divided the issue of neuroscience in conflict and security into two main areas - the potential to enhance performance of military forces, and the potential to degrade or diminish the enemy's performance.

Looking at performance enhancement, the report pointed to advances in neural interface technologies which could allow machines such as drone aircraft to be controlled directly with the human brain, and advances in neuroimaging which could help military chiefs screen for recruits with particular attributes.

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"There is also a great deal of research taking place around drugs that improve the alertness, attention and memory of military personnel while in the field," the report said.

The experts said it was in the interests of military commanders to screen for abilities relevant to a given task.

While one person may excel in detecting targets in a cluttered environment, they said, another might excel in decision making skills under stress, and advances in neuroimaging and brain stimulation techniques could help pinpoint these differences during screening and recruitment.

Irene Tracey, an expert on brain imaging from Oxford University and one of the report's authors, said most of the applications of neural interface technology, such as brain prostheses or implants, have so far been only at the trial stage and mostly in medicine - particularly involving the rehabilitation of people using prosthetic limbs.

"You can imagine how you can be used for the military - both for rehabilitation of soldiers and for control of remote devices," she told a briefing in London. "Some of it is the stuff of dreams at this stage, but the speed at which technologies tend develop ... is always alarmingly quick."

### MIND AND MACHINE

Flower gave an example of how an aircraft like a drone could be in future be controlled by a person with such brain implant - raising tricky ethical questions.

"This idea brings about a bit of a blur in the distinction between mind and machine, which obviously has to be addressed very carefully," he said. "If we got to the point where we could control a sophisticated machine, and the machine did something ... like committing a war crime of some sort, who would be responsible for that, you or the machine?"

The report also looked at neuroscientific applications that could give rise to new weapons - particularly advances in neuropharmacology and drug delivery that could speed the development of incapacitating chemical agents.

The report highlighted new so-called directed energy weapons in development, including one called an Active Denial System (ADS) which uses a millimeter wave beam to heat the skin and cause a painful burning sensation.

Malcom Dando, a professor of international security at the University of Bradford and another of the authors, said the changes neuroscience could bring about were mostly in the future, giving experts time to assess their impact.

"We're only at the beginning of a whole stream of neuroscience applications, and that gives us a window of opportunity to weigh up the pros and cons," he said.