



## Press Release

**Embargoed to June 29, 2017, 14:00 EST / 20:00 CET**

### **Leading neuroscientists call for ethical guidelines in the use of brain-computer interfaces**

**They say data protection, liability, and security issues must be considered or the technology may be abused**

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Tübingen, 29 June 2017

Leading researchers in the field of neurophysiology, neurotechnology and neuroethics say there is an urgent need for ethical guidelines for the use of brain-computer interfaces (BCIs). In the current issue of Science (DOI: 10.1126/science.aam7731) the researchers say that data protection, liability and safety issues have been neglected when it comes to using brain-controlled systems.

Technologies that translate brain activity into control signals of computers, robots or prostheses are already very well developed and are now about to enter everyday life environments. In their article, "Help, Hope and Hype," the researchers, headed by German psychiatrist and neuroscientist Surjo R. Soekadar (University of Tübingen), stress the need for responsible handling of such BCIs. As a central requirement, the authors call for a veto function for interrupting unintentional BCI-controlled actions. In addition, all data should be encrypted and temporarily stored as in the case of an aircraft's black box, they say.

The researchers have dealt intensively with the ethical aspects of BCI systems, and some of them have significantly contributed to the development of this technology for the medical field. Meanwhile, private investors such as Facebook's Mark Zuckerberg and Tesla's Elon Musk are exploring ways of using this research area for their businesses.

The Tübingen neuroscientists point out that guidelines could help researchers, developers, and users to deal with the ethical aspects of this technology in a responsible way. At the same time, they stress the importance of informing the public about this new technology's possibilities – and its limitations. So far, demonstrations of mind-controlled systems have raised hopes and enthusiasm; but Soekadar and

his team stress that the discussion about the social consequences and implications must be based on facts.

BCIs translate brain activity into control signals of external devices such as robots or prostheses. In 1999, the Tübingen neuropsychologist Niels Birbaumer, co-author of the Science article, enabled patients with locked-in syndrome to spell out entire letters via their brain waves. In 2017, he showed that even totally paralyzed patients in a completely locked-in state (CLIS) could give simple yes/no answers using a BCI. Soekadar recently demonstrated that BMIs can now be used in everyday life environments, for instance enabling quadriplegics to eat and drink using a brain-controlled exoskeleton hand.

Current BCIs are still very limited when it comes to reading out more complex thoughts, says Soekadar. "But this may change soon. So we have to think ahead." The amplified brain signals have to be protected from unauthorized access. Questions related to accountability for any BCI-related damages or accidents have to be addressed. A central requirement would be the implementation of a "veto" function to interrupt unintended BCI-related control signals, according to the authors. "The end-user must be able to stop the machine at any time", says Soekadar. Also his system has a veto function triggered by specific eye movements. Currently, electrical brain signals recorded from the scalp cannot be reliably used for a veto function, he points out.

Like in an aircraft, all biosignals and control commands should be stored in a black box for a certain period of time, Soekadar says. This would be the only way to handle possible liability issues. In addition to adequate protection against unauthorized access, all stored data should be encrypted using advanced encryption standards. This is currently not a common practice, and may result in the possibility of critical misuse ("brainhacking"), according to Soekadar. In implantable systems or BCIs that can also stimulate brain tissue, greatest caution is required; in extreme cases, so-called "brainjacking" would be possible, i.e. the manipulation of the system to influence specific brain functions or behavior.

"Technological advances in the BMI field are currently developing at such rapid rate that it is high time to define a legal and ethical framework" says Jens Clausen, neuroethicist at the University of Education in Freiburg and member of the Center for Ethics in the Sciences at the University of Tübingen. It would be also an ethical question to manage expectations and hopes of possible end-users and their relatives, because spectacular demonstrations may lead to exaggerated expectations, the authors explain. In this case, he says, it is the responsibility of the media and other stakeholders to provide a balanced view of the benefits and limitations or risks of these technologies. Fostering the knowledge of the technical possibilities and limitations ("neuroliteracy") should become a focus of public education.



Moving an exoskeletal hand using brain waves: Will this soon be a common thing?  
Photo: Surjo R. Soekadar / Universität Tübingen

**Publication:**

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