

BCIs for patients and healthy users: Two fundamentally different views illustrated by the ‘curve of normalcy’

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Abstract. This paper introduces the curve of normalcy as a framework to illustrate the fundamentally different perspectives on BCIs in the Human Computer Interaction (HCI) and the medical domain. While the medical domain aims to bring patients back to the normal range, HCI is not focussed on enhancing humans outside the range of normalcy but rather to shift the complete curve rightwards.

Keywords: Brain Computer Interface, Human Computer Interaction, Enhancement, Cognition, Medicalization.

1. Introduction

Brain Computer Interfaces (BCIs) have become a topic of research and development in two different, and to some extent, separated domains. The original drive of BCI research comes from the wish to develop a means of communication for severely handicapped patients. More recently, the Human Computer Interaction (HCI) domain started to show interest. Both fields clearly have different perspectives on many BCI aspects. For instance, the medical approach aims to restore patient abilities back to normal, while the HCI approach is focused at a broad target group, including healthy users. This paper is about these different perspectives and I will use ‘the curve of normalcy’ to combine both perspectives in the same framework.

2. The Curve of Normalcy

Terms like ‘enhancement’ and ‘restore to normal’ imply that there is a (statistical) distribution in which certain boundaries define what we should consider as normal human capabilities. A simple assumption is that the curve follows a normal distribution with a certain mean and variance and a lower and upper boundary of normalcy (for instance mean $\pm 2sd$). Now, we can use this curve to illustrate the different approaches of the medical and the HCI domain.

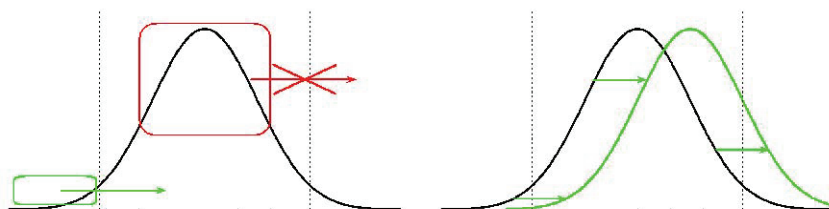


Figure 1. The ‘curve of normalcy’ to illustrate the perspective from the medical domain (left panel) focusing on restoring patients’ functioning back to normal and the perspective of the HCI domain (right panel) developing technology that can help improve abilities of the whole population.

In the medical domain, the aim is to get people from below the lower limit into the range between the lower and upper limit of normalcy (fig. 1, left panel). However, researchers stay away from the use of the same technology to ‘enhance’ people that are within the normalcy range [Lucivero and Tamburrini, 2008]. The focus of medical applications on the lower limit is reflected by the current system for the approval of developing medicines or applying therapies. However, a consequence hereof is that the lower limit shifts

rightward (also known under the term medicalization). Nowadays, certain behavior or states are classified as pathological while not so long ago they were seen as within the range of normalcy. Examples include ADHD in school children and mild forms of depression. In the HCI domain, the aim is to move the complete curve to the right by introducing technology that is useful for the whole population, young, old, ill, or perfectly healthy, see Fig 1, right panel [Van Erp et al., 2006]. Shifting the curve to the right through for instance tool making and education is inherent to human civilization. Modern society would not be possible without the use of technology to provide us with cognitive abilities beyond that of our brains, even as simple as paper and pencil to memorize a grocery list. From the HCI point of view, a BCI is a new means to allow users to interact with technology, irrespective of their 'position' on the curve of normalcy. If BCI technology results in safer cars by prohibiting driver drowsiness or computer systems that better understand the desires or the emotional state of the user, than that is of benefit to us all. While the lower limit (however fuzzy it may be) is always crucial in the medical domain, the lower and upper limits of normalcy are not so relevant in HCI: technology should be adjusted to the task, the environment and the needs of the user, whether at the low, middle or high end of the curve. Also, pushing beyond the upper limit is acceptable in HCI and is by no means a reason to deny someone cognitive enhancement technologies. For instance, pilots are outside the curve of normalcy on numerous dimensions, but it is completely acceptable to develop decision support systems for pilots to make flying safer. This implies that BCI technology for healthy users cannot be simply labeled as 'enhancement' and thus morally and ethically undesirable. The same way that striving for the best education for our children, drinking coffee during long meetings and meditating before going to sleep cannot simply be labeled as enhancement. That is not to say that there are no societal, moral and ethical questions involved in technological developments, but the approach to the curve of normalcy is completely different.

3. Discussion

We cannot talk about therapeutic treatment or human enhancement without considering the lower and upper limits of normalcy. The curve of normalcy sketched here is not intended to set these limits but to illustrate the different perspectives on developing BCI technology. It also helps in identifying issues we should address as BCI community. For instance: where does the use of technology stop being therapeutic: at the lower limit, the mean, the upper limit, or the maximum human limit? Who are the peers to base the curve of normalcy on? Is a bright university professor that sees his IQ level drop to 110 after a transient ischemic attack (TIA) entitled to therapeutic BCI treatment? How can we define a curve of normalcy for dimensions such as emotional and cognitive state? How should we value individual needs versus the 'norm of the population'? Is there a natural limit of humanity with respect to the use of technology? Is the blurring boundary between human and machine a threat or an opportunity? Should technology for healthy users be left exclusively to the HCI domain? One's answers to these questions may be biased by the domain one is working in.

As a community that originated in the therapeutic use of BCI technology, we must not close our eyes to the fact that the technology will spin out to the middle-and right part of the curve of normalcy. A similar trend can be seen for pharmaceutical treatments including memory enhancers and mood brighteners that are used by an increasingly wider population (either through illegal distribution or through shifting the lower limit of normalcy). Non-pharmacological developments will follow the same trend, maybe even faster as the side effects turn out to be limited. This forces us to develop a broader perspective on the societal, moral, and ethical issues on BCI technology. For instance: who can judge risks and benefits of specific BCI technology, and who should? What may the effect of BCI use be in relation to epistemic enslavement (the fact that we may become dependent on technology even for basic tasks such as perception and cognition)? What could potentially be the misuse or immoral use of the technology, e.g. forced Deep Brain Stimulation treatment for convicts or neurofeedback in schools?

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