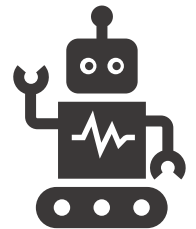


Human Today, Cyborg Tomorrow?

Public Attitudes towards Brain Stimulation Devices
(BSDs) and Brain-Computer Interfaces (BCIs)



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Introduction

- Scientists intensely discuss ethical, legal, and social issues of neurodevices such as brain stimulation devices (BSD) and brain-computer interfaces (BCI).
- But what the public thinks about different use purposes and types has only been examined recently.
- Therefore, we investigated how public judgments vary depending on
 1. the **neurodevice** and
 2. the **order of assessment**

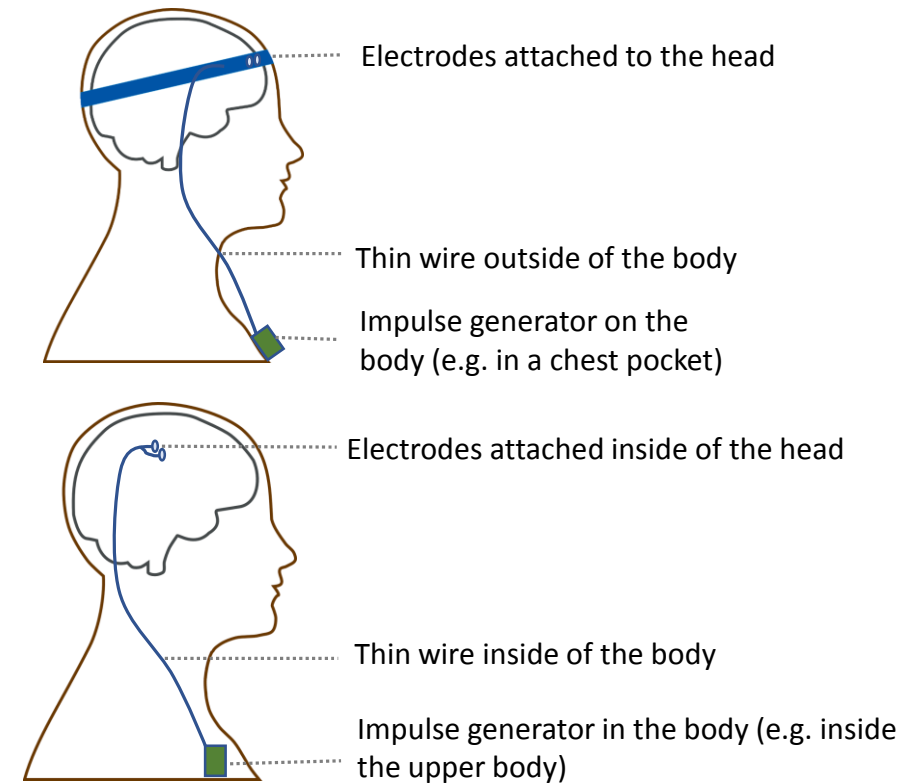


Fig. 1. Pictorial illustration of **non-invasive** BSD (top) and **invasive** BSD (bottom) used in Experiments 1 and 2.

Methods

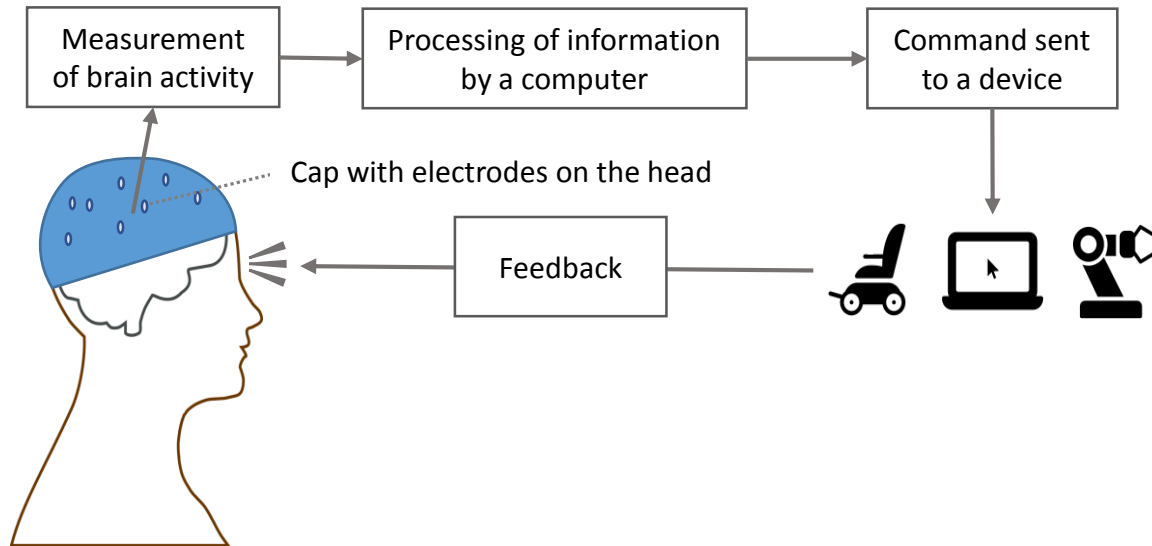


Fig. 2. Pictorial illustration of **non-invasive** BCI used in Experiments 3 and 4.

- We conducted a web-based study (ENHANCE) with an offline-recruited random sample of the adult population in Germany.
- Respondents were randomly allocated to one of **four vignette experiments (N between 558 and 580)**, either about BSDs or BCIs.

Methods

- Within each of the four vignette experiments we used **2 x 2 between-subject designs**, thereby each vignette varied randomly regarding two dimensions:
- **1st dimension = invasiveness:** Whether the neurodevice is *non-invasive* or *invasive* was varied in textual descriptions of the neurodevice and pictorial illustrations (► Fig. 1., 2., and 3.)

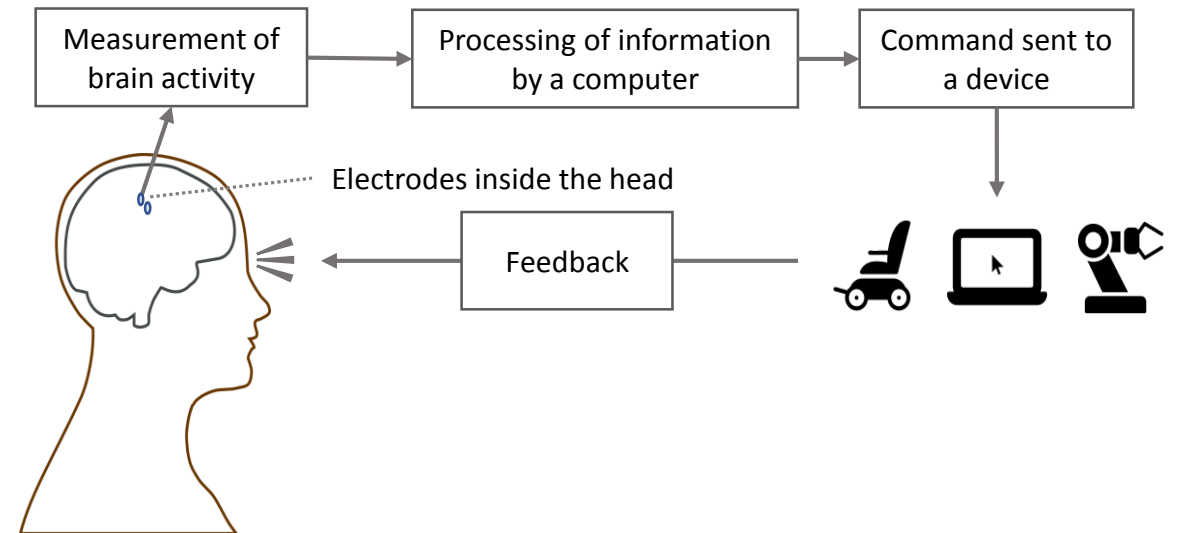


Fig. 3. Pictorial illustration of **invasive** BCI used in Experiments 3 and 4.

Methods

- **2nd dimension = purpose of use:** Respondents assessed the moral acceptability and the willingness to use the respective neurodevice either regarding *treatment* or *enhancement*.

Treatment:

- *How would you evaluate the use of this technology for medical reasons (e.g. for the prevention, diagnosis or treatment of an illness)? Morally, I find it...*
- *Can you imagine using this technology for medical reasons (e.g. for prevention, diagnosis or treatment of an illness)?*

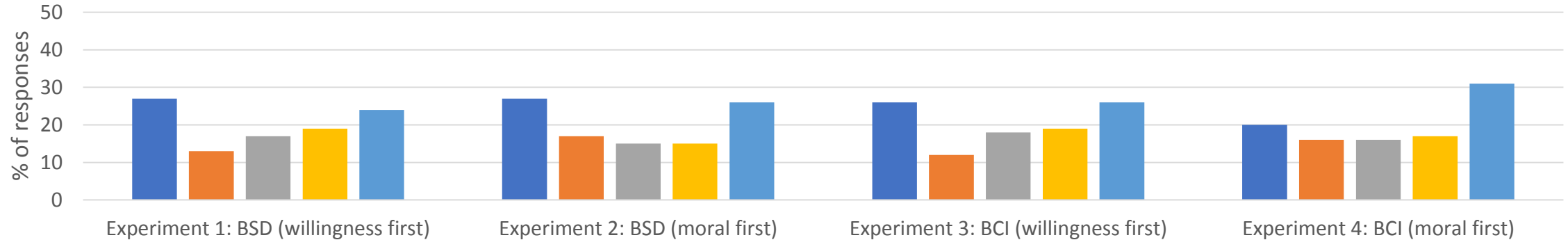
Enhancement:

- *How do you evaluate the use of this technology for non-medical reasons in order to improve one's mental performance (e.g. in one's spare time or profession)? Morally, I find it...*
- *Can you imagine using this technology without medical necessity for the improvement of your mental performance (e.g. in your spare time or profession)?*

- In experiments 1 and 3, the *use willingness* was assessed prior to the *moral acceptability* and in experiments 2 and 4, the *moral acceptability* was assessed prior to the *use willingness*.

Results

Moral acceptability of using a neurodevice



Willingness to use a neurodevice

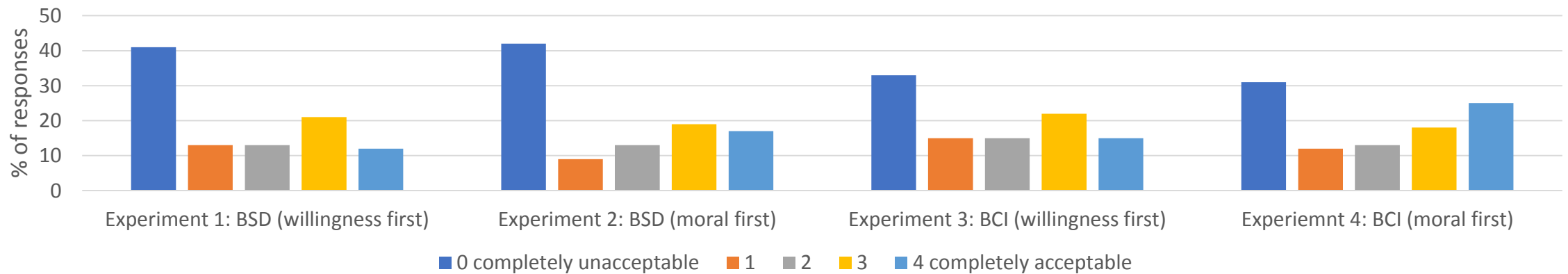


Fig. 4. Frequency of responses for *moral acceptability* (top) and *use willingness* (bottom) for Experiments 1-4.

Results

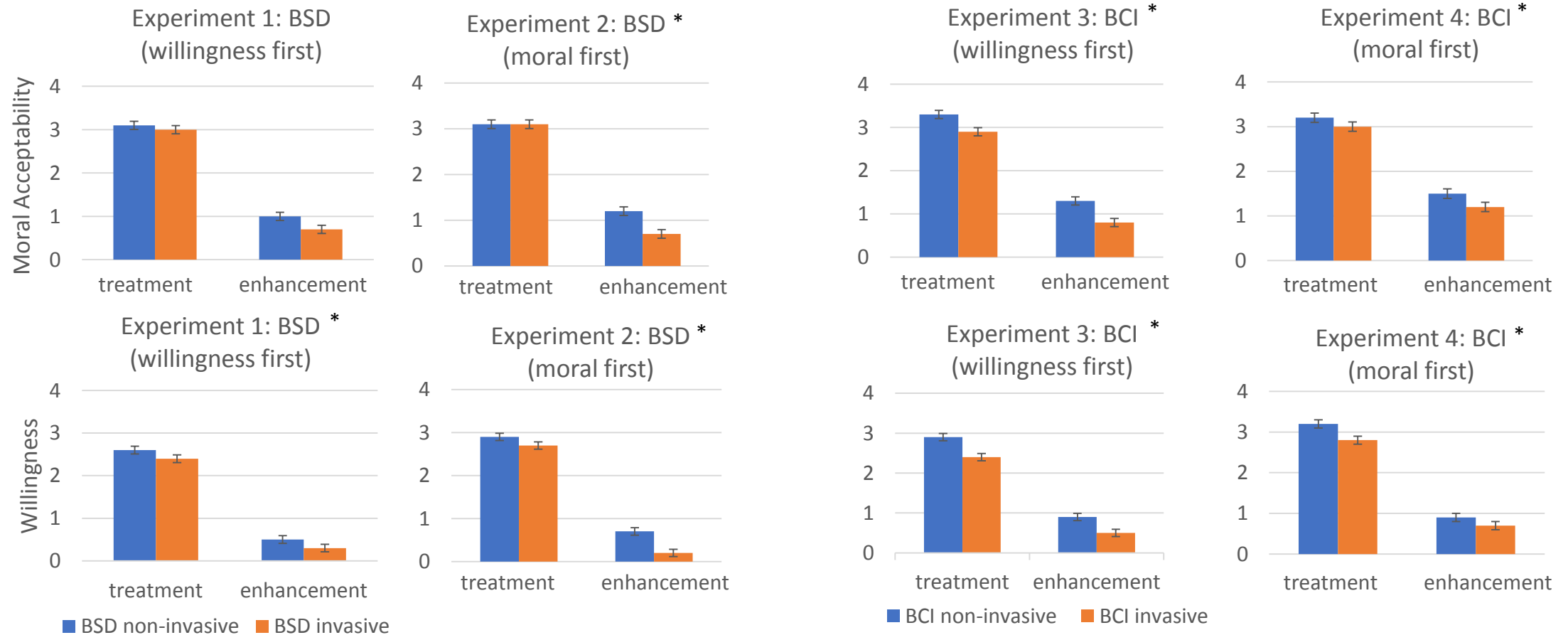
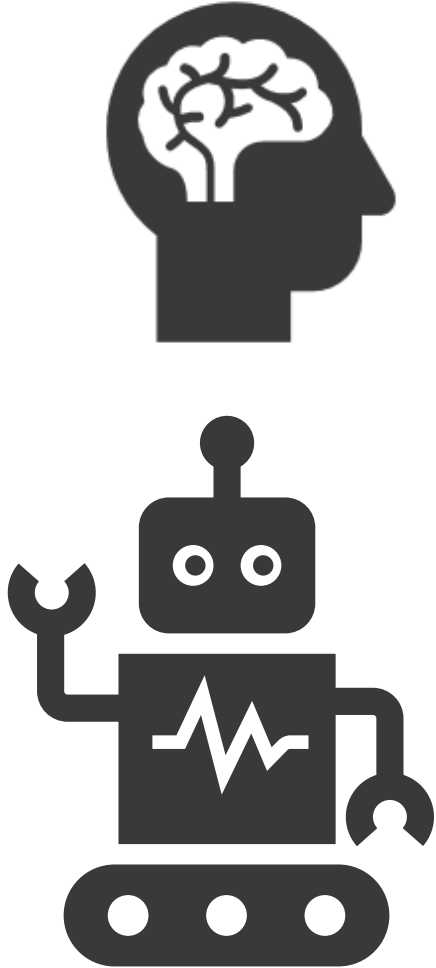


Fig. 5. Predicted values (with standard errors) of *moral acceptability* and *use willingness* for experiments 1-4. All models show significant differences for *purpose of use*, * show significant differences for *invasiveness*. Color labels on the lower left of each side apply to all plots.

Results



- Linear regression models show a statistically significant lower acceptability and use willingness **for invasive as compared to non-invasive devices** (in 7 out of 8 models) and for **enhancement as compared to treatment** (all models).
- Investigating sociodemographic variables, we found that **men and younger people are more willing to use a neurodevice** than women and older people.

Discussion



- Our results suggest that the **demand on neurodevices with the purpose of enhancing key human features seems limited** compared to treatment purposes. Thus, the idea of widely artificially augmented humans currently remains more science-fiction than reality.
- Our findings also show a **stronger hesitancy towards invasive as compared to non-invasive neurodevices**. This could be due to fears concerning an operation or cyborgization of humans.
- While the development and application of such neurodevices is still in its infancy, our results offer interesting insights into related public attitudes.