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Big Data & Neuroscience[1]

Neuroscientist Samantha Anders works as a research scientist at the US government's National Institutes of Health (NIH). Her job involves researching brainwave technologies with the aim of developing brain-machine computer interfaces (BMCI) and biometric systems. She has recently heard about an interesting job opportunity in the private sector, which would involve work with similar brainwave and neuro-technologies to the ones she is using currently at her NIH job. However, the ultimate goal of the research at the private firm would be to develop and sell goods and services to the general public.

Samantha's current job involves gathering and analysing data from electroencephalograms (EEG). Electroencephalography is a method used by neurologists to detect electrical activity in the brain using small, flat metal discs, or electrodes, attached to the scalp (MayoClinic.org). It is commonly used in a medical context to detect brain abnormalities and diagnose disorders such as epilepsy. However, Samantha gathers data from many healthy individuals using EEG to create large databases of brain activity for scientists to analyse. The ultimate goal of her department's research is to develop reliable methods to detect biometric signatures from the data, which could be used to identify individuals.

Samantha is somewhat bored in her current job, collecting and annotating data, and she is doubtful that EEG data will ever be robust enough to serve as biometric signatures. She is also slightly troubled with the thought that scientists might eventually develop methods to reliably detect biometric signatures to identify individuals, if not from EEG data, then perhaps from brain data gathered from other neurotechnologies. She thinks this might be problematic even if the research subjects who've volunteered for this research are informed of this possibility and still consent to participate. She thinks more should be done to protect information about individuals and safeguard their right to privacy, much like is being discussed in the context of individuals' genetic information stored in genomic databases. She is therefore contemplating making a career move and leaving her government job for the new position in the private marketing firm.

The new position would also involve work gathering and analyzing data from EEG, as well as functional Magnetic Resonance Imaging (fMRI), on individuals, but in the context of a new field of marketing, referred to as neuromarketing. Neuromarketing involves the application of neurotechnologies in which psychological (cognitive and affective) states of individuals are leveraged to improve marketing strategies, with the ultimate goal of increasing profits (Rodenburg 2014).

Samantha thinks this might be better use of her expertise and skill because it would not rely on using large data sets to identify particular individuals. However, her friend Kara thinks that using

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EEG and fMRI data for targeting consumers' subconscious is just as problematic and has urged Samantha not to work at the neuromarketing firm. Should Samantha make her career move?

Discussion Questions

1. Were Samantha's reasons for quitting her government job sound? What precautions ought government (and other) research institutions take to protect individuals' privacy with respect to brainwave data? Should the ethical guidelines and regulation differ from those that are used in the context of genomic databases?
2. Why might Kara think neuromarketing is ethically problematic? Are there any other ways (other than marketing purposes) in which these sorts of databases may be used for consumer and commercial applications in ways that might be morally problematic?
3. What is Samantha's ethical responsibility, as a scientist, with respect to the collection of brainwave and neurological data?

Commentary

Current discussions concerning recently launched large-scale data collection projects in neuroscience, such as the US's BRAIN Initiative and the EU's Human Brain Project, raise both epistemological and ethical questions. Concerning the former type of questions, many have asked what, if anything, can "bottom-up" strategies of large-scale collection of data about the brain really tell us about the human mind, consciousness and behaviour. Those sorts of concerns (e.g. about faulty inferences, false positives, etc.) often steer the ethical questions about the implications that the collection of brainwave data may have on our notions of personal identity, privacy, property, the capacity for consent, and the control of behaviour. Additionally, the novel uses of neurotechnologies raise some of the typically issues in the ethics of emerging technologies, such as dual-use dilemmas and governance.

First, the issues of personal identity, privacy, and property in big data neuroscience projects are similar to those that have emerged in the context of genetics and genomics (Choudhury et al. 2014; Illes & Lombera 2008). If data from EEGs, for example, can be used as a biometric signature that can identify individuals, then the identifying data may include sensitive information about the mental health or capacities of individuals. That kind of sensitive information must be protected to avoid its misuse and the potential profiling of individuals (Rodenburg 2014). So, safeguards must be taken to protect the confidentiality of research participants. But, researchers also have a duty to research participants to be clear about the purpose of data collection, its use, accessibility, and purposes.

Also similar to the context of genomics databases, researchers and scientists think it is important to safeguard individuals' mental privacy in a way that does not impede scientific and technological developments (Choudhury et al. 2014; Illes & Lombera 2008; Rose 2014). In this sense, there is a tension in whether to prioritize the principle of autonomy in research involving human subjects, or whether the principles of beneficence and justice ought to become more important in guiding the moral duties and responsibilities of researchers.

With respect to neuromarketing, many have questioned whether the appeal to consumers' unconscious brain signals might be an invasion of privacy or an unethical manipulation of our affective states. Others have proposed that perhaps the field is exploiting useful medical equipment for frivolous and shallow purposes (Ulman et al. 2015). In light of these sorts of concerns, France has recently revised its 2004 rules on bioethics in 2011 to include a section on the appropriate use of brain-imaging technologies. It states: "Brain-imaging methods can be used only for medical and scientific research purposes or in the context of court expertise" (Oullier 2012; Ulman et al. 2015). With this revision, the commercial use of brainwave technologies is currently banned in France.

Ethicists have also noted that using these data to sell goods and services might lead to exploitation of vulnerable groups (e.g. children) who cannot understand or consent to the practices of neuromarketing. As with other research with human subjects, ethicists have argued vulnerable groups should be protected (Ulman et al. 2015).

Lastly, some fear that the potential manipulation of our cognitive and affective states for profit in commercial contexts might spill over to the political realm, where individuals can be manipulated to vote one way or another. Here again there is concern over whether the use of data gathered from neurotechnologies might interfere with our capacity for consent (Rodenburg 2014; Gutmann 2015).

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