This response was submitted to the consultation held by the Nuffield Council on Bioethics on *Novel neurotechnologies: intervening in the brain* between 1 March 2012 and 23 April 2012. The views expressed are solely those of the respondent(s) and not those of the Council.

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Dear Consultation Committee:

I wish to raise several issues regarding the questions posed.

1. Consider the goals of varied biomedical neurotechnologies as critical to evaluating ethical issues regarding their use. A simplified dichotomy may be used to assign such devices to two categories: corrective technology and augmentative technology. The first category employs technology to compensate for disabling functional limitations imposed by disease, injury or genetic conditions. The second category seeks to provide enhanced function above and beyond the intact neural system (including neuromuscular and neurosensory). In the first case, the operator (recipient of corrective technology) can hope to re-acquire experientially-based judgment regarding appropriate use of the technology, if the technology effectively bypasses structural or functional impairments. That experience is based upon living and learning about the world prior to technological introduction to the neural system. The second category places the operator in a realm of function that has little parallel in experience, hence real-world judgment may not be properly informed in making critical risk/benefit decisions regarding use.

2. The second consideration relates to the functional or perceived 'distance' that the operator is from the effector device. A parallel is seen in the US military's use of robotic drone aircraft, where successful operation is dependent upon availability of accurate information (pre-mission planning, intelligence data, geospatial coordinates, and time-dependent situational variables) and the dynamic nature of the situation in which such drones operate. If either condition falls outside expected parameters, errors are likely to occur – less by intention, than by unexpected events/conditions that may have been identifiable if the operator was in proximity of the event. Providing corrective or augmentative neurotechnology that places the operator at an actual or perceived distance from the operational world in which the technology is to function, introduces a potentially unacceptable level of risk of harm. In such instances, social relational rules may have a diminished impact for an operator (witness the harsh communications that occur more frequently over e-mails than would occur with in-person interactions). The current extensive use of robotic surgery techniques run by health care professionals at a distance offer only a limited comparative scenario, because the applied environment is highly restricted to the operative field, with little to no impact on the surrounding social environment. Finally, the field of telehealth, which offers the convenience of evaluative information gathering at a distance, does not interact substantially with the body of the person of interest. Instead, it is used to provide the HCP with health-related information upon which health decisions can be made and recommendations provided the person of interest. The differentiating factors are that neurotechnologies are invasive (physically or electromagnetically) for the operator and are intended to affect the physical and social environment to that person when operated.

3. We have yet to see substantial high-tech transfer from military R&D to civilian applications that are affordable within business-model health care systems. The prices for such technology are prohibitive. Before availability to the open market comes to pass, regulatory bodies may want to begin to attend to access/availability problems as much as technical criteria before release to the general public via the health care system or private industry. This issue may be practically investigated via the patenting process, where ethical issues now considered by Institutional Review Boards are addressed with technology developers/marketers.

If such technology becomes accessible and widespread, the ethically evaluative implications should turn around the concept of benefit v. risk, with risk defined in the broadest terms necessary to encompass social/societal welfare, in addition to the welfare of the operator.

Thank you for requesting input to the process.

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