Neuroethics of Genetic Engineering

In the Wellcome Trust exhibition the Narrator looks at the cabinet of books containing the human genome. Opening one, scans a few pages. There are neuroscience exhibits in the same room. Looks at these as appropriate to voice over.

narrator (v.O.)

When we think about what we are, at least in a biological sense, we generally arrive at the level of our genes and the structure of our brains. If we choose a material thing that makes us who we are, then genetic codes and neural circuits come first. There is great room for variation: billions of base pairs make up our unique genomes; and the connections between our brain cells form and change over our lifetimes, from the womb to our deathbeds. A working kidneys may be vital for our survival, but they clearly aren't so bound up in our identity. As such, it's little wonder that these two areas attract so much attention and so much controversy, especially when anyone suggests intervening with them.

Narrator is in a museum (Grant, Science, Huntington's), gazing down, or otherwise looking at, a variety of microscopes.

narrator

In 1906 Santiago Ramon y Cajal shared the Nobel Prize in Physiology or Medicine "in recognition of work on the structure of the nervous system".

We move to look at images of neurons, preferably in the same museum environment. We continue to move to other exhibits as the narrator talks.

narrator (CONT'D)

He was the first to prove that the brain consisted of many billions of little contiguous units called neurons and is seen by many as the founding father of modern neuroscience. In 1978 the same Nobel Prize went to Arber, Nathans and Smith for the discovery of restriction enzymes, which made possible the field of synthetic biology. Both Prizes have represented the dawn of new and hotly debated ethical dilemmas in science, neuroethics and the ethics of genetic engineeering. Perhaps what is so exciting now, though, is that we have the technology to bring these two controversial disciplines together, to bring geneticist modification to the brain, and in so doing perhaps change the very fabric of what makes us, us.

narrator

By rearranging genes, silencing some and introducing others, we can make organisms and cells perform a variety of new tasks. Synthetic biology is a broad and broadening discipline in which biological systems are genetically programmed to do new things, often in the realms of industry, or art, or medicine. Let's consider a simple example.

narrator

--in front of a set of fluorescent petri dishes.

These bacteria are E.coli. Harmless strains of these are frequently used in synthetic biology. Here, they have had one gene added to their DNA, a gene which codes for 'green floursecent protein', GFP. GFP originally comes from a bioluminsecent species of jellyfish, and is used across the biosciences to mark out interesting biological phenommena by making them glow. Technology such as this inspired Eduardo Kac's famous image, the GFP bunny. Such glowing animals have been made in research to study disease genetics, and GFP plants are soon to be commercially available. This is, in essence, the core unit of synthetic biology and one of the simplest manipulations scientists and non-scientists perform.

narrator

--standing in front of one of the proteins printed on the wall in the lab.

It is controversial enough, and there's no shortage of opposition to even these simple genetic changes, but the field is highly promising: by copying and pasting genes from different organisms into other organisms, usually bacteria, we can design biological units to do useful things. Many of these applications would be environmental. Modified bacteria could be used en masse to produce some of the raw materials or food that we extract today at a cost to the environment. These methods could be used to process CO_2, plastics and other waste products of industry. In addition, these methods could be used to produce much better medical treatments.

narrator

--in the anatomy museum, among the bell jars.

And yet, even the staunchest supporter of synthetic biology may hesitate over bringing it to bear on the brain. Still, the potential outcomes are promising. Synthetic biology methods, if used in Neuroscience, could allow a greater deal of precision in the study of complex neural systems. Given the increasing importance and power of Neuroengineering, we must examine the more controversial aspects of allowing artificially modified organisms to enter so vital an organ of our body as the brain. Since it is the part of us which most defines our identity, any abuse of its sovereignty, even with electrodes, and often with the use of narcotics, is seen to compromise a person. Will the artificially engineered substance affect personality and cognitive behaviour; and should those who pioneer such methods be held morally responsible if the automony of individuals is undermined in the future?

narrator

-- outside UCLH, away from the traffic.

Yet, inserting new genetic information into brain cells may form the basis of new treatments to combat brain diseases. The brain is, afterall, the site of some of the most subtle, and many of the most crippling medical conditions. Neural conditions are among the hardest to observe, study and treat. For example, by using genetic treatments to balance the transmission of neurotransmitters, little chemical messengers which convey information between brain cells, and change the way these cells connect to one another, genetic treatments may one day progress to help combat bi-polar disorder, autism, schizophrenia, depression, and so on. However, there are concerns that genetic intervention to cure these conditions could effectively change someone's peronsality, the state of their mind and the way they behave in a way that not only erases their illness, but also who they were. Inaction, especially in the case of a disease such as Alzheimers may have a similar propensity to erase a person of their selfhood, but would other examples of this treatment, for instance, conditions which remain difficult to define, be less desireable?

narrator

-- Wellcome Collection upper floor.

Let's take the case of Alzheimer's disease. The accumulation and proliferation of a faulty protein, a bad version of β-amyloid, in Alzheimer's disease, leads to the formation of plaques. These dense masses of proteins are asociated with brain cell death, and thus memory loss and cognitive function issues in sufferers. The advent of synthetic biology may well give us new tools to tackle these plaques. For example, we could insert genetic information which would create another molecule to cut up the plaques and help slow down the disease. However, assuming we could create such a system, the ethical implications here are even more complex, because we are dealing with patients who may not have the presence of mind to understand what genetic engineering is, so they cannot make a sound decision as to whether or not they agree with it.

narrator

--among the pills in the british museum north wing?

The question of whether or not to treat some conditions is even more subtle. Take for example attention deficit hyperactivity disorder (ADHD). Its pathological status is somewhat questionable, and it is clear that genetic changes that are 'too strong' or are higher up the scale will be more neuro-enhancements than medical treatments. Especially in the US, stimulant drugs, such as Ritalin, are already taken not only to treat ADHD, but has come to be used as a performance booster on university campuses as and when more concentration is needed. In fact, the lines between illness and just having a different healthy mental state is often an unclear one. Becuase genetic engineering could have a permanent change on the brain, is it worth its risks when the conditions that it treats are so hard to diagnose, we won't be able to help the fact that some pateints won't have the exact condition we thought they did, and won't benefit at all?

Narrator

--in the corridor of the engineering building or some such sleek place.

Brain cells, neurons and their supporting glial cells exist in networks that harbour our intelligence, memory, voluntary motion, ability to learn etc. Several undesirable effects could surface in connection with neural engineering technologies in the long term. First, privacy, autonomy, and numerical identity could be violated.

In addition, the application of enhancing neural engineering technologies would be in danger of promoting social injustice.

Widespread use of neural engineering for the purpose of enhancement could fan the flames of medicalization. And finally, intensive use of virtual environments might cause addiction, trigger negative personality changes, and blur the difference between artificial and real environments.

Taken overall, these ethical problems appear substantial. Anticipative debate is needed to avoid these pitfalls and facilitate responsible further development and appropriate use of neural engineering technologies. is needed. In fact, the lines between illness and just having a different healthy mental state is often an unclear one. Becuase genetic engineering could have a permanent change on the brain, is it worth its risks when the conditions that it treats are so hard to diagnose, we won't be able to help the fact that some pateints won't have the exact condition we thought they did, and won't benefit at all?

Narrator,

---in the traffic island over Euston road

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Widespread use of neural engineering for the purpose of enhancement could fan the flames of medicalization. Finally, intensive use of virtual environments might cause addiction, trigger negative personality changes, and blur the difference between artificial and real environments.

That is only the start of the potential issues. Resources need to be targeted at responsible further development; and when the neural engineering technologies become a real possibility, they need to be used appropriately. We need debate.