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Behavioral Modification: What You Need to Know

Analysis by Tessa Lena

STORY AT-A-GLANCE -

- Neuroscientists have been working on a number of advanced techniques with military applications
- Magnetogenetics is a technique of using magnetic fields to remotely control cell activity
- In human experiments, scientist experimented with reducing religious feelings
- In animal experiments, researchers were able to induce specific behaviors in mice using genetically modified viruses and magnetic fields
- Another area of behavioral modification is "digital vaccines," which is special software for behavioral change

This story is about behavioral modification, both as a philosophical ambition and as a military application. This topic is vast — so I'll focus on a few relatively recent developments, especially in the area of magnetogenetics. But first, morality pills!

Morality Pills

In August 2020, Forbes published an article titled, "Could A 'Morality Pill' Help Stop The Covid-19 Pandemic?" It was based on the opinion of a bioethicist Parker Crutchfield who stated the following:

> *"Moral enhancement is the use of substances to make you more moral. The psychoactive substances act on your ability to reason about what the right thing to do is, or your ability to be empathetic or altruistic or cooperative."*

The problem that Crutchfield was trying to solve with his theoretical 'morality pills' was the pesky COVID contrarians, the proverbial grandma killers who refused to comply with masking and social distancing.

> *"The problem of coronavirus defectors could be solved by moral enhancement: like receiving a vaccine to beef up your immune system, people could take a substance to boost their cooperative, pro-social behavior."*

The author seemed to think very highly of his own ability to make perfect decisions about things — including about the best pandemic response — and therefore he had no qualms about imposing his opinions on others in the form of pills or, perhaps, morality injections. He went as far as to say that "a solution would be to make moral enhancement compulsory or administer it secretly, perhaps via the water supply."

Crutchfield further referred to his **work**, in which he explored the concept of enhancing democracy by secretly medicating the citizens. He stated the following:

> *"Some theorists argue that moral bioenhancement ought to be compulsory. I take this argument one step further, arguing that if moral bioenhancement ought to be compulsory, then its administration ought to be covert rather than overt. This is to say that it is morally preferable for compulsory moral bioenhancement to be administered without the recipients knowing that they are receiving the enhancement.*
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> *My argument for this is that if moral bioenhancement ought to be compulsory, then its administration is a matter of public health, and for this reason should be governed by public health ethics.*
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> *I argue that* ***the covert administration of a compulsory moral bioenhancement program better conforms to public health ethics than does an overt***

> ***compulsory program. In particular, a covert compulsory program promotes values such as liberty, utility, equality, and autonomy better than an overt program does***. [emphasis mine]."

Bravissimo! Does this combo of freedom and covertly administered forced medication come with DeBlasio fries?

The good thing about morality pills is that they are seemingly theoretical … hopefully. How about creating fake memories? That, now, is actual science! In 2014, Smithsonian Magazine published an **article** titled, "Meet the Two Scientists Who Implanted a False Memory Into a Mouse," which described a series of rather sadistic experiments showing that implanting false memories was achievable. (Should we mandate morality pills for the scientists? Just wondering.)

Implanting a False Memory in a Mouse

The scientists did a number of manipulations that I will describe in great technical detail in just a second — but the gist of it is that they placed a mouse in a particular box and gave the mouse a foot shock while simultaneously triggering a memory of being in a different, "safe," box from an earlier experiment when the mouse was is that other box without receiving the shock.

They then placed the mouse in the "safe" box again, and the mouse acted terrified, as if it associated that first box with being given a shock, while in reality the shock was given in the second box, not in the first box. The conclusion that the scientists drew was that in the mouse's mind, it "remembered" being given a shock in the box in which it had never been given a shock.

Great technical detail: Working with genetically engineered lab mice, the scientists injected their brains with a biochemical cocktail that included a gene for a light-sensitive protein (channelrhodopsin-2). The cells participating in memory formation would then produce the protein and become light-sensitive themselves.

Namely, they "surgically implanted thin filaments from the laser through the skulls of the mice and into the dentate gyrus. Reactivating the memory — and its associated fear response — was the only way to prove they had actually identified and labeled an engram [a unit of cognitive information imprinted in a physical substance].

The researchers sacrificed the animals after the experiment and examined the brain tissues under a microscope to confirm the existence of the engrams; cells involved in a specific memory glowed green after treatment with chemicals that reacted with channelrhodopsin-2."

In order to manipulate a specific engram to create a false memory, they "prepared the mouse, injecting the biochemical cocktail into the dentate gyrus. Next, they put the mouse in a box without shocking it. As the animal spent 12 minutes exploring, a memory of this benign experience was encoded as an engram.

The following day, the mouse was placed in a different box, where its memory of the first (safe) box was triggered by shooting the laser into the dentate gyrus. At that exact moment, the mouse received a foot shock. On the third day, the mouse was returned to the safe box — and immediately froze in fear. It had never received a foot shock there, but its false memory, created by the researchers in another box, caused it to behave as if it had."

Here you have it. The scientists were allegedly able to create a false memory in a mouse by torturing it and its fellows. False memories, check. How about manipulating religious feelings in people? Did the scientists try? Sure they did.

Experiments To Manipulate Religious Beliefs With Magnetism

In 2015, an article called, "Neuromodulation of group prejudice and religious belief" was published in "Social Cognitive and Affective Neuroscience."

The authors of the study "presented participants with a reminder of death and a critique of their in-group ostensibly written by a member of an out-group, then experimentally decreased both avowed belief in God and out-group derogation by downregulating

pMFC activity via transcranial magnetic stimulation. The results provide the first evidence that group prejudice and religious belief are susceptible to targeted neuromodulation."

Magnetogenetics

Speaking of magnetic stimulation, let's talk about magnetogenetics. Magnetogenetics is a biological technique that involves the use of magnetic fields to remotely control cell activity. According to the behavioral research company **Noldus**, "magnetogenetics, or the use of electromagnetic control, involves activating cells using magnetic fields. With magnetogenetics researchers have found a way to control neurons with electromagnets."

For context, magnetogenetics is adjacent to two other methods, optogenetics and chemogenetics. Optogenetics is based on switching populations of related neurons on or off on a millisecond-by-millisecond timescale with pulses of laser light. Optogenetics is an invasive method that requires insertion of optical fibers that deliver the light pulses into the brain. Chemogenetics uses engineered proteins that are activated by designer drugs and can be targeted to specific cell types.

The "Magneto" Experiment

In 2016, two University of Virginia scientists **demonstrated** that neurons in the brain that have been supplemented with a synthetic gene can be remotely manipulated by a magnetic field. In their own words, they "may have discovered a major step toward developing a 'dream tool' for remotely controlling neural circuits."

At the time, Güler, a biology professor at UVA, and UVA neuroscience Ph.D. candidate Michael Wheeler "engineered a gene that can make a cell sense the presence of a magnetic field. They coupled a gene that senses cellular stretch with another gene that functions as a nanomagnet. This synthetic combination turns on only when in the presence of a magnetic field, allowing them to control neuronal activity in the brain."

> *"In a series of tests on mice that had the Magneto gene used to express comfort or pleasure, the mice voluntarily went to a chamber of their cage where the magnetic field was present, similar to going there as if food was present.*
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> *Likewise, when the magnetic field was turned off, the mice did not display any particular preference for that area of the cage. But when the magnetic field was turned back on, they again moved to that area of the cage. Mice without the Magneto gene did not display any behavioral changes in the presence of magnets."*

According to the **Guardian**, the premise of the experiment was that nerve cell proteins activated by heat and mechanical pressure "can be genetically engineered so that they become sensitive to radio waves and magnetic fields, by attaching them to an iron-storing protein called ferritin, or to inorganic paramagnetic particles."

The technique used the protein TRPV4, which is sensitive to both temperature and stretching forces that "open its central pore, allowing electrical current to flow through the cell membrane; this evokes nervous impulses that travel into the spinal cord and then up to the brain."

> *The scientists "used genetic engineering to fuse the protein to the paramagnetic region of ferritin, together with short DNA sequences that signal cells to transport proteins to the nerve cell membrane and insert them into it …*
>
> *When they introduced this genetic construct into human embryonic kidney cells growing in Petri dishes, the cells synthesized the 'Magneto' protein and inserted it into their membrane. Application of a magnetic field activated the engineered protein, as evidenced by transient increases in calcium ion concentration within the cells."*
>
> *"Next, the researchers inserted the Magneto DNA sequence into the genome of a virus, together with the gene encoding green fluorescent protein, and regulatory DNA sequences that cause the construct to be expressed only in specified types of neurons.*

> *They then injected the virus into the brains of mice, targeting the entorhinal cortex, and dissected the animals' brains to identify the cells that emitted green fluorescence. Using microelectrodes, they then showed that applying a magnetic field to the brain slices activated Magneto so that the cells produce nervous impulses."*

When the scientists placed the animals into an apparatus split into magnetised a non-magnetised sections, "mice expressing Magneto spent far more time in the magnetised areas than mice that did not, because activation of the protein caused the striatal neurons expressing it to release dopamine, so that the mice found being in those areas rewarding. **This shows that Magneto can remotely control the firing of neurons deep within the brain, and also control complex behaviours."**

Let me just say that as a citizen, I don't feel particularly relaxed knowing that this research exists — especially under today's circumstances. Usually, whenever there is a technology that is suitable for behavioral modification and crowd control, somebody tries to use it. Politicians and greedy corporate leaders are funny this way! When there's a hammer …

Dr. James Giordano's Talk on Military Neuroscience

Speaking of hammers, I highly recommend you watch this mind-twisting, sci-fi-sounding, and frankly creepy presentation on military applications of neuroscience by Dr. James Giordano, Professor at Georgetown University Medical Center who has served as a Senior Science Advisory Fellow of the Strategic Multilayer Assessment group of the Joint Staff of the Pentagon.

In his presentation, Dr. Giordano talks about neuroweapons and how new developments in brain science can be used in the military (and beyond). Some of the applications and scenarios he describes will make you scratch your head very hard!

"Digital Vaccines"

Another area of behavioral modification is the so called "digital vaccines," or behavioral modification software. According to the Center for Digital Health at Brown's Alpert Medical School, digital vaccines are "a solution to the problem of creating sustained behavioral change" and "a subtype of digital therapeutics, which use neurocognitive training to promote positive human behavior using technologies like smartphone apps."

They are called "vaccines" because they create resistance to disease through a different mechanism. (I would posit that they are called "vaccines" because it's a trendy, investor-friendly word that might also potentially come with a lack of legal liability — but that's just my cynical guess.)

Carnegie Mellon University hosts Digital Vaccine Project, an initiative that focuses on the development and evaluation of "digital vaccine" candidates. Among other candidates, they are talking about a "digital vaccine" for COVID-19, which looks suspiciously like a gamified, nudging bot designed to train people to practice good "health-hygiene habits," as defined by the owners of the algorithm.

This sounds to me like a good ol' missionary in a shiny digital form: an unsolicited and unwanted "boss" with a superiority complex and no sense of tact!

Sooner or later, the scientists will figure out that their "patients" become annoyed by the bot out of their wits — at which point the hopeful priests of behavioral modification will come up with a "fix" on top of a "fix" — and money will be made by investors every step of the way — as it usually goes, at the price of the people.

Let me end by saying that technological behavioral modification is a rotten idea, driven by maniacs. The fact that hunger for total control is so painfully prevalent in our world doesn't change the pathological nature of that hunger.

The need for mechanical control is born out of fear and anxiety, and that's undeniable. And yes, today, the Machine still reigns and has the power to bully but without a doubt — whichever way we get there — we are moving toward a world where we are fully alive and free. The stronger and braver we are in the face of the darkness, the sooner we get free.

About the Author

To find more of Tessa Lena's work, be sure to check out her bio, **Tessa Fights Robots**.

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