WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

STRAIGHT TALKING BY
TOM GRUBER

PRODUCT DESIGNER, INVENTOR & ENTREPRENEUR, HUMANISTIC AI. CTO SIRI AT APPLE & LIFESCORE

BIG INNOVATION CENTRE

This report is part of the "Creative Disruption and Social Movement" Series of The Innovators Board at BIG INNOVATION CENTRE

EXECUTIVE SUMMARY

Tom Gruber explains how adding AI applications to mobile phones can pull out a range of data about your physical and mental health by using camera and voice-based monitoring. In that way, the mobile phone can detect amazing vital signs of your health of the kind you would get if you went to the hospital or if you had a personal nurse attaching medical devices to you. Thus, the mobile phone becomes your nurse and a mobile hospital.

Furthermore, using a wearable headset we can now also augment people with disability. Through headset displays and Brain-Computer Interfaces, severely disabled people can control things around them using their minds.

The collective intelligence through using mobile phones and other wearable technologies must be implemented and governed so it creates positive changes in people's behaviour. This is a big challenge for profit-seeking big-tech companies in social media which are (too often) wired towards optimising growth hacking and addiction, not wired towards human welfare.

This is how Tom Gruber would look at this whole problem of technology governance. He argues that governance and the role of policy must be about governing the 'optimisation function' of Brain-Computer Interfaces, to ensure mobile phones and wearable technology applications optimise us to live our lives better and to stimulate positive behaviour.

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

Brain-Computer Interface (CBI) Applications

I'm going to be talking about a special angle of the human-machine fusion subject, essentially thinking of what happens when we add AI and Brain-Computer Interfaces (CBI) to the story.

AI in human augmentation works like the **Iron Man** series. He would surround himself with an exoskeleton and created an AI companion named Jarvis to help him drive all the machinery. This isn't just science fiction; AI is involved in the augmentation of humans in some fundamental ways right now.

— Tom Gruber, Product Designer, Inventor & Entrepreneur, Humanistic AI. CTO Siri at Apple & Lifescore

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

1. Neuro-degenerative disease

EXAMPLE: CognixionONE https://one.cognixion.com/

For example, Neuro-degenerative diseases like Amyotrophic Lateral Sclerosis (ALS) and conditions like cerebral palsy may make it hard for you to articulate the muscles of speech, but you still are fully cognitive you're certain you're intelligent you're awake, but you just can't talk.

One of the companies I'm working with – CognixionONE - is building an augmentation for people who have limitations in their ability to speak. What this company has done is create an Augmented Reality (AR) headset that allows people to be able to speak with their brains. It's a modern, industrial design of consumer wearable technology.

Using a headset we can augment people with disability. On the front of the headset is a heads-up display and in the back are Brain-Computer Interfaces (BCI) or EEG (electroencephalogram) electrodes. The way it works is that a person sees in the heads-up display menu options like a computer board or interface, but instead of tapping because they can't use their hands, they use their mind.

There's something called an Evoked Potential (EP) technique in which people with limited ability can use an Augmented Reality (AR) headset to actively stimulate the retina around little targets on a headset screen. Then, if they think about the target on the screen, we can detect it in the back of the head and neck's temporal lobe a few milliseconds later.

This is one of many modalities in which computers are now extending fully brain functional human beings and overcoming their profound physical disabilities, so they can participate fully e.g., through email conversations and texts. It is an example of what happens when we add the machine around the humans today to give essentially superhuman power.

This technology has been kind of around for a while, but it turned out that it was impractical until deep neural net modelling and similar modern technologies came around, and now it works.

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

2. Hospital on Mobile

EXAMPLE: Hospital on Mobile (https://carex.ai/)

Another example of this comes from vital signs monitoring. This is about using camera and voice-based vital signs monitoring for disease prediction and remote patient monitoring.

Here we consider what happens when we point the camera at the face of the human. We already got 2 billion people making selfies each day. We have high-fidelity, high-quality imaging of our faces happening all the time, and it turns out that with today's modern cell phone we have enough signal for vital signs monitoring.

Combining mobile phones with a deep neural network on humans this technology is able to essentially detect or pull out most of the vital signs related to the human's physical and mental functioning. This has been in the labs for a while and the IT industry had made this a big deal about this for a while, but originally this kind of experimental and it really wasn't practical, but it is now.

A company I'm working with called Hospital on Mobile (https://carex.ai/) is actually making it so that mobile phones can truly pull out heart rate variability, blood pressure, temperature and all these amazing vital signs of the kind you would get if you went to the hospital or if you had a personal nurse attaching objects to you.

Now, just having the camera on your cell phone turned on as the sensor is not just for curiosity's sake, but it can be used for purpose-driven medical applications of a medical sort.

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

3. Migraine Mitigation

As it turns out 'vital signs monitoring' using mobile phone cameras can be an application for migraines.

Migraines are extremely debilitating to hundreds of millions of people around the world and basically untreatable unless you can predict the timing of the migraine.

Humans cannot predict the timing of a migraine, but if you give very high quality, longitudinal daily measures of things like vital signs (like heart rate, blood pressure and temperature), you can have an AI model that can predict it.

It is about using mobile phones and AI technology to create awareness in real-time by providing a peek into the brain to see things that humans can't see, and interpret the signal. The cutting edge of this is pupillometry, and the cutting edge of pupillometry is micro-pupillometry.

It turns out that you can see an enormous amount of information about what's happening in the brain by looking at the human pupil because computers can see things at 60 frames per second. Hence, you can see how quickly and how much a pupil is dilating. Even the best con-artists can't see this, but the computers (or wearable technology such as mobile phones and glasses we carry around all day can.
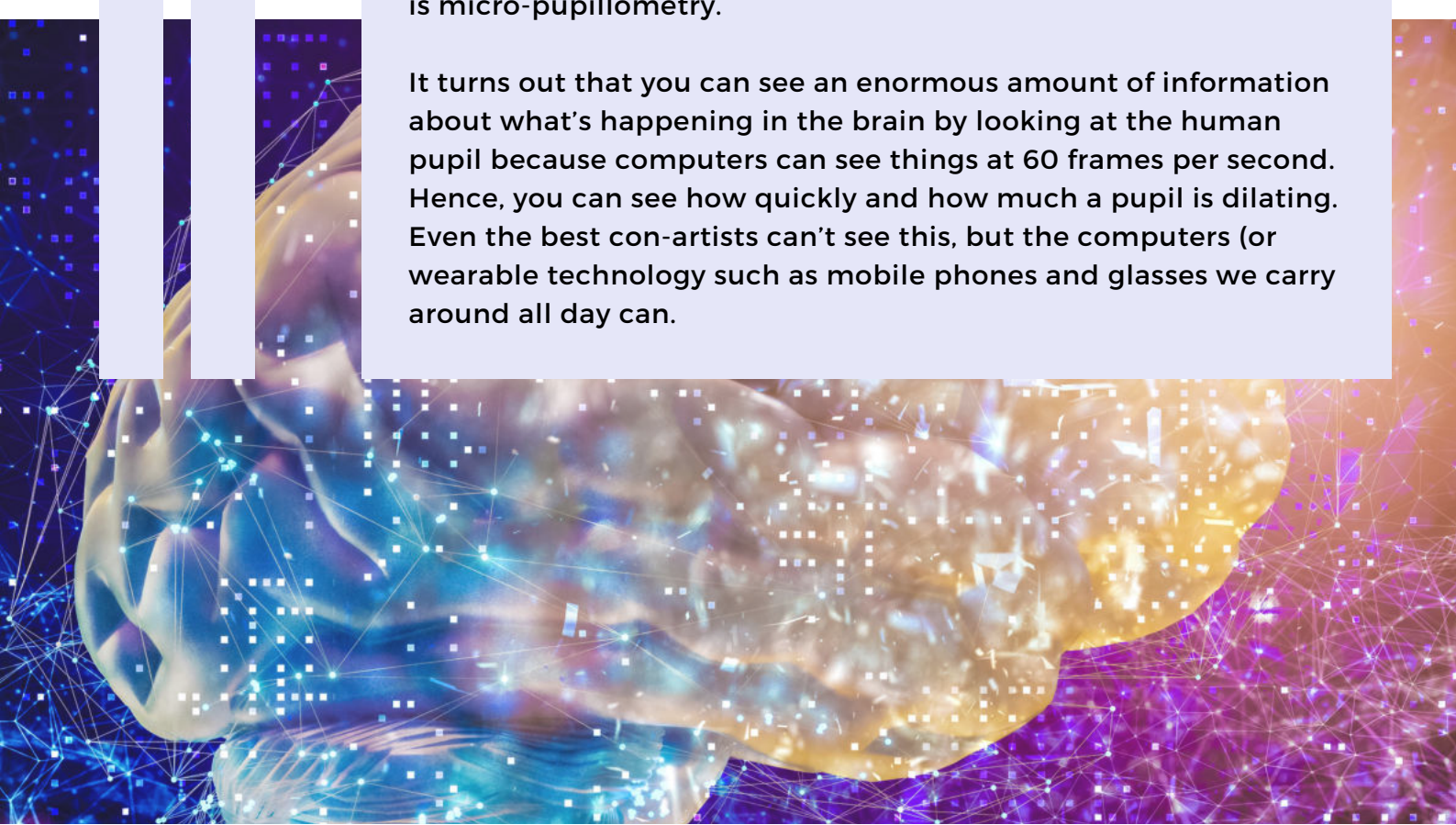
WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

4. Mental Health

Another example is a company called 'Mindstrong'. Here we are concerned with the fact that humans have no ability to predict severe mental illnesses and these can be really debilitating as PTSD (Post-traumatic stress disorder), Bipolar disorder and schizophrenia. These diseases are absolutely impossible to predict on a day to day basis.

If you're lucky you stumble your way into a psychiatrist's office at some point, and maybe a neurologist can do a diagnosis that you have this condition.

What really matters is that you can predict when your illness happens, so that you can get yourself into the hospital or that someone can help you make sure you keep taking your medicine. Otherwise, you end up on the street.

EXAMPLE: Mindstrong (https://mindstrong.com)

So Mindstrong realised that you cannot just have everyone in the hospital every day. Instead, they found that the phone can obtain signals about the brain and your state of mind. It turns out that as you use your smartphone, you're giving information about how well your brain is functioning – if your brain is off a bit, this is picked up in the signal.

They have done this by building a deep neural network that uses over 3,000 data points a day to monitor changes in a human's core cognitive function and working memory. With these easy to stop mental functions, mobile phones can now be used to predict severe mental illness and the lifesaving consequences.
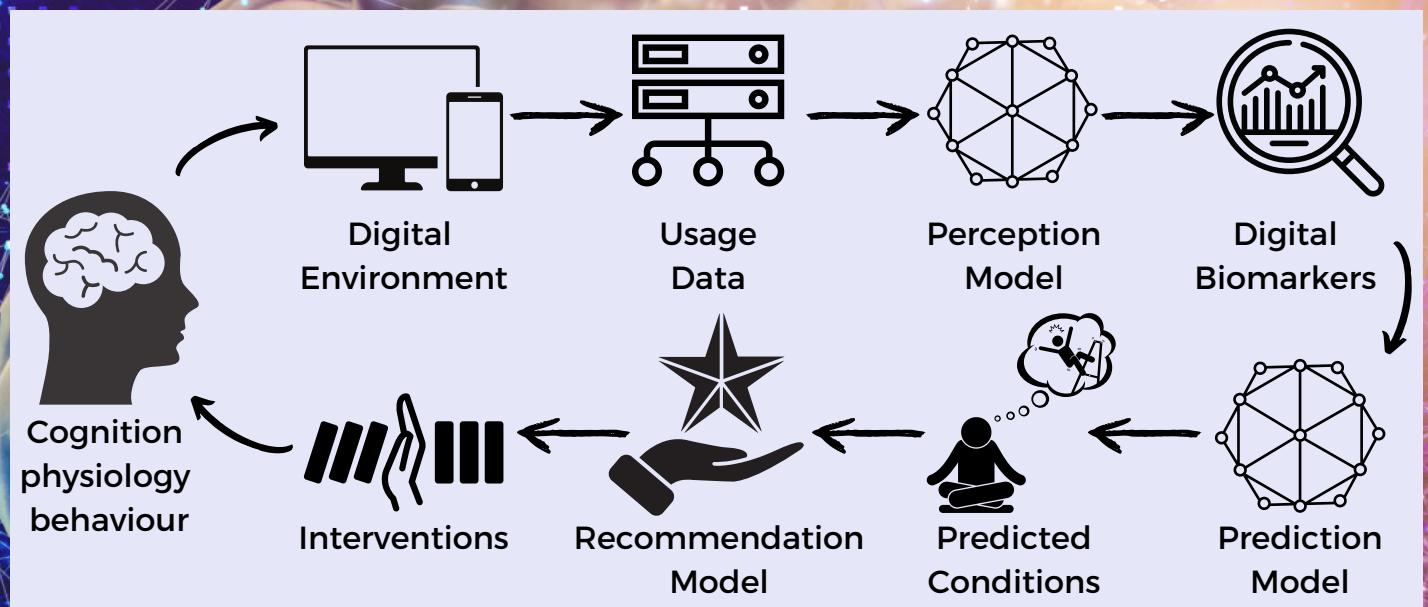
WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

5. Biofeedback loops to control our mental stages

I want to end with this image (below), which is worth going into. Today, we live digitally mediated lives, and the way we interact is often using social media or other kinds of things. We have a brain, we have a mental state, and we use our smartphones which of course tracks our brain activity. Then we end up going to the world of digital which then produces data on our digital footprint (or online behaviour). This is then used by tech companies to manipulate us. However, the same data can also be used to predict our conditions or mental states. If you go round the circle (see image), and track data of your predicted condition you can then also predict your interventions or how to act, like going to the hospital or taking medicine for migraine, so now we have a new kind of feedback loop.

Here the human, the digital environment, AI models and sensors are all in a biofeedback loop of the more sophisticated kind. Thus, we have now established a biofeedback loop with humans and machines that will begin a new kind of co-evolution.

This is not future stuff; this is happening right now with our phones that we are co-evolving in this digital environment. Non-invasive Brain-Computer Interfaces can radicalise the life of people with a severe disability

Digital Environment → Usage Data → Perception Model → Digital Biomarkers → Prediction Model → Predicted Conditions → Recommendation Model → Interventions → Cognition physiology behaviour →

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

Non-invasive Brain-Computer Interfaces can radicalise the life of people with severe disabilities.

Every example I showed you so far is not invasive! It does not require any sensors or invasive attachment in any way, no injections or surgery or anything.

When you go underneath the skull you get in deep trouble quickly in terms of physiology and infection risk, it is a much harder mountain to climb.
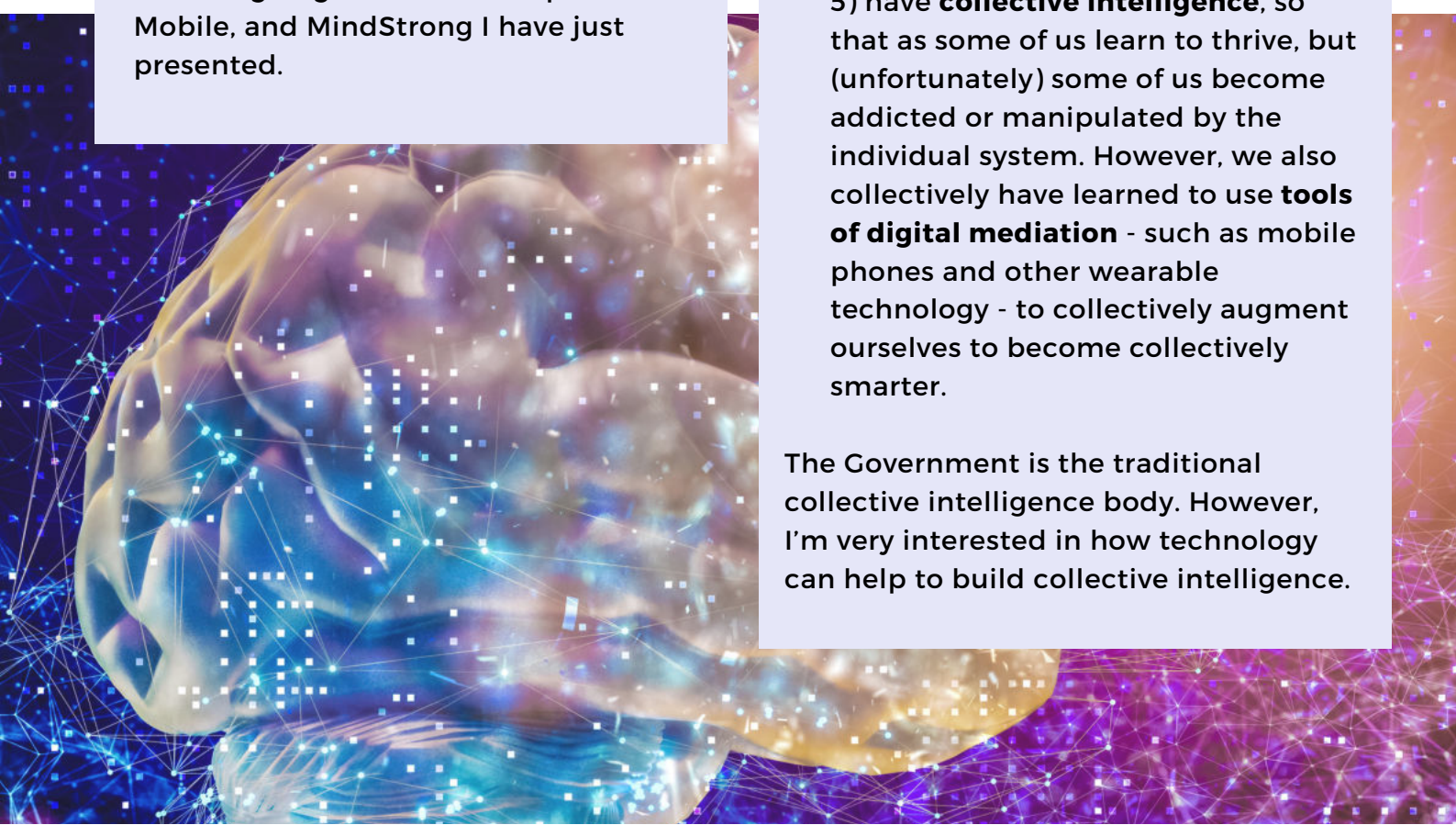
Therefore, I want to just make everyone aware that there is a ton of Brain-Computer Interfaces (BCIs) available, right now, without invasive technology, including CognitionONE, Hospital on Mobile, and MindStrong I have just presented.

6. Future perspectives on how to augment our mental health

There are really two directions that we can go with this (meaning how Computer Brain Interfaces (CBIs) may impact our mental health):

- We **individually are learning** how to manage a new kind of cognitive onslaught. But, we **need some help to control** the toxicity of social media and control our lives and attention to the online feeds of information that come to us.

- The second part is that we through brain bio-feedback loops (see Section 5) have **collective intelligence**, so that as some of us learn to thrive, but (unfortunately) some of us become addicted or manipulated by the individual system. However, we also collectively have learned to use **tools of digital mediation** - such as mobile phones and other wearable technology - to collectively augment ourselves to become collectively smarter.

The Government is the traditional collective intelligence body. However, I'm very interested in how technology can help to build collective intelligence.

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

6. Future perspectives on how to augment our mental health

There are really two directions that we can go with this (meaning how Computer Brain Interfaces (CBIs) may impact our mental health):

- We **individually are learning** how to manage a new kind of cognitive onslaught. But, we **need some help to control** the toxicity of social media and control our lives and attention to the online feeds of information that come to us.

- The second part is that we through brain bio-feedback loops (see Section 5) have **collective intelligence**, so that as some of us learn to thrive, but (unfortunately) some of us become addicted or manipulated by the individual system. However, we also collectively have learned to use **tools of digital mediation** - such as mobile phones and other wearable technology - to collectively augment ourselves to become collectively smarter.

The Government is the traditional collective intelligence body. However, I'm very interested in how technology can help to build collective intelligence.

WHAT HAPPENS WHEN WE ADD AI AND BRAIN INTERFACES TO HUMAN-MACHINE FUSION?

How shall we govern the impact of the internet and social media?

All of us are subject to an AI intervention at any time on social media – it is an amplifier of misinformation, propaganda and hate speech, but also joy and socialising - it is a turbocharged feedback loop among humans. The problem is when you turbo-charge or amplify the lowest of human qualities like gossip, hate, fear and ignorance, then you end up pushing yourself into the gutter.

We need to understand how the governance or interventions surrounding ethics happens now, and how AI and the data being generated by sensor technology give power to actors like social media companies, and other people making Brain-Computer Interface (BCI) instruments.

How does the power of sensor technology give feedback to humans that causes their behaviour to change? That is a conversation going on right now.

It is our job as leaders of collective intelligence to think of ways to intervene by changing the modality and the mechanisms of feedback. This is the biggest lesson that happens all the way up and down the stack.

How far are the producers of AI systems prepared to submit public judgements on ethical and social desirability?

I like to take an engineering approach to ethical intervention in the AI world. What I mean by this is, that if policymakers understand how the technology works, then we don't have to wait.

The way AI intervenes in social media is well understood by the industry. There is a function called 'the objective function', which is the metric by which AI is trained and evaluated – it's the thing that drives recommendations on how the systems behave.

This 'objective function' is currently clearly wired towards growth hacking and addiction, not wired towards human welfare. This is a problem. Therefore, what this optimisation function is optimised for, is the way I would look at this whole problem.

Humanistic.ai

WITH GLOBAL SOCIAL MOVERS AND TECH-DISRUPTERS

BIG
INNOVATION
CENTRE

WWW.BIGINNOVATIONCENTRE.COM