

Will Brain-Computer Interfaces, such as Elon Musk's Neuralink, broaden the accessibility of modern-day technology to the disabled community?

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## Table Of Contents

Introduction	3
Disability Theory and modern society	4
Neuralink	6
Brain hacking and other issues	8
Conclusion	10
Bibliography	11

## List of Figures

Figure 1 - A graph demonstrating the proportion of internet users by disabled and non-disabled (Prescott, 2019).

Figure 2 - Tweet exchange between Elon Musk and Isaak Elchanan (Twitter, 2021).

Figure 3 - Image of a paralysed woman trying out BrainGate's BCI to move the robotic hand (NIHNINDS, 2012).

Figure 4 - An image of the implant for DBS devices (*Parkinson's Foundation, 2018*).

Figure 5 - A chart demonstrating devices vulnerable to cyberattacks. (Prescott, 2019).

## Introduction

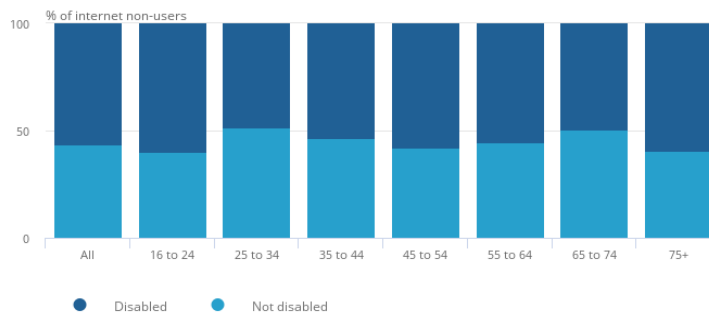
Technology has made its way into society, becoming irreplaceable, having a “*profound impact on humankind’s production patterns and lifestyles*” (Zemin, 2010). The development of touchscreen phones, computers, the web, the internet and Artificial Intelligence, to name a few, demonstrate humanity's commitment to technology. Tragically, despite all we’ve achieved, accessibility is still forgotten, particularly with the disabled community. This essay will discuss this issue, exploring Neuralink as a case study to see how this technology will give the disabled better access to the digital world and shape future technologies so that inclusivity does not remain an afterthought.

## Disability Theory and modern society

*“There are 14 million disabled people in the UK”* (SCOPE, 2016), from a wide range of ages, all making their way through the digital world. Unfortunately, it is widely known among the web development community that *“97 percent of websites fail to meet the minimum level of web accessibility”* (Calore, 2006).

Figure 11: Across all age groups, a large proportion of adult internet non-users are disabled

Composition of adult internet non-users by disability and age group, UK, 2017



Source: Office for National Statistics - Internet Users, Labour Force Survey (LFS)

Figure 1 shows the proportion of internet users by disabled and non-disabled (Prescott, 2019).

However, according to Disability Theory (Siebers, 2008, p.92 - 94), the disabled community faces exclusions in various other aspects of society as well. Throughout the 90s, many committees came forth to voice their issues with society and their lack of accommodation for the disabled relating to architecture (Siebers, 2008, p.85, 180). Even then, this change was met with resistance as people called the community “lazy” (Siebers, 2008). Disability theory infers that, society itself is fundamentally flawed in not designing for the disabled because they cater to the “able-bodied” population. *“In a society of wheelchair users, stairs would be nonexistent”* (Siebers, 2008, p.57); applying this phrase to this context, we can see how the isolation of this community has been widespread and continues on the web and elsewhere in the tech industry, in its lack of inclusivity. *“In 2019, the proportion of recent internet users was lower for adults who were disabled (78%) compared with those who were not disabled (95%).”* (Prescott, 2019).

Despite the resistance to design for the disabled, Elise Roy in a Ted Talk stated *“when we design for disability we all benefit”*. This can be seen in many examples already; Siri, dark mode, text-to-speech software were all built to aid in the use of devices and now has become widespread for everyone’s use (Brownlee, 2019). Outside the web, there are multifunctional inventions, such as the exoskeletons, that are being used not only for rehabilitation but also as military aids (Gorgey, 2018).

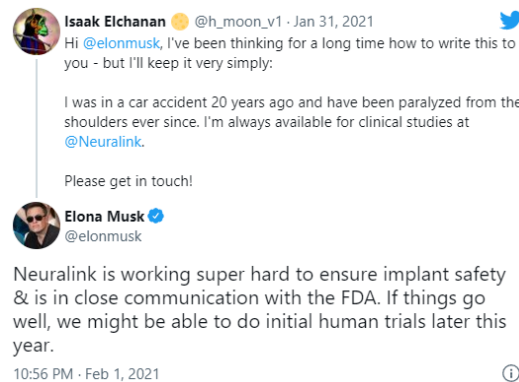


Figure 2, Tweet exchange between Elon Musk and Isak Elchanan (Twitter, 2021)

Neuralink has addressed a niche audience as its primary consumers, one that typically gets no attention from major development. The disabled community is apparently excited for this technology in their enthusiasm to volunteer for human trials. Yet the promise that Neuralink has and its potential is exciting not only for the disabled but also for the rest of the community (World, 2021). This suggests Roy's notion to be true- everyone benefits from this approach for inclusivity.

As stated by Musk, BCI (Brain-Computer Interface) development, will be able to bridge the gap between A.I. and human intelligence. This is beyond its original purpose, revolutionising the way humanity will interact with technology, creating a "full AI symbiosis" (Neuralink, 2020). The topic of accessibility can bring forth interesting ideas if we "view disabilities as a dimensional difference, not a defect" (Cresswell, 2012); this is the approach Neuralink takes in the use of the "Link".

## Neuralink

Neuralink was founded in July 2016 by Elon Musk. Their aim is to create a device that will “connect the human brain to computer interfaces”(Pd, 2021), striving to give “people with paralysis” a sense of “independence”(Neuralink, 2021), supplying a means by which this community can express themselves through BCI applications.

*“BCIs may replace lost functions, such as speaking or moving. They may restore the ability to control the body, such as by stimulating nerves or muscles that move the hand. BCIs have also been used to improve functions, such as training users to improve the remaining function of damaged pathways required to grasp.”*(Schalk and Allison, 2016). Neuralink is not at the stage where it can “replace lost functions”; however, it will begin to bridge the gap between the number of people using the internet from “78%” in disabled adults to match the much higher “95%” in the non-disabled.

An example of what some pre-existing BCIs are capable of doing is BrainGate. Their device uses brain waves to command a robotic limb to move with their thoughts(NIH/NINDS, 2012).

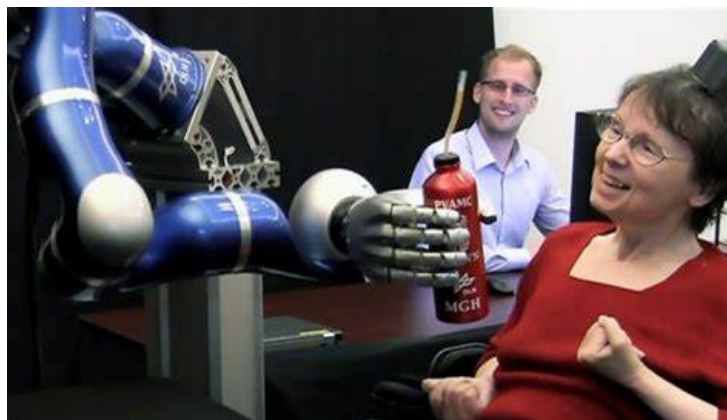


Figure 3 - Image of a paralysed woman trying out BrainGate’s BCI to move the robotic hand(NIH/NINDS, 2012)

However, where Neuralink stands apart from other devices is that the device is comparatively small in scale, “about the size of a large coin”(Neuralink, 2020). Neuralink covers the aesthetics in a smaller frame that can be hidden by hair or a cap, more outstandingly is that they have been able to connect to “over 1024 channels of information from the brain” which is scaled up considerably from other BCIs that at most connect “a few hundred electrodes”. Naturally, as time goes on, BCIs develop into smaller, more robust pieces of technology, all striving to aid the disabled community, which revolutionise robotics, neuroscience, and neurotechnology as a bi-product.

*“Prosthetic limbs for the disabled will receive a major fillip with this technology. Thanks to the connection between the brain and the robotic limb, the feeling would be far more ‘natural’. The connection may even incur feelings equivalent to the real limb.”*(Amyx, 2017). The potential of unlocking the brain and transmitting it to commands for computers to interpret are almost endless. “The Link is a starting point”(Neuralink, 2021)from which they could branch out into DBS(Deep Brain Stimulation) able to connect to the parts of the brain that control motor functions.



Figure 4 - An image of the implant for DBS devices. (Parkinson's Foundation, 2018)

DBS is currently used to help people with PD(Parkinson’s Disease) by sending pulses to help control tremors and other symptoms. Musk hinted that the “*Link*” would eventually be able to predict intended movement, that with a “neural shunt” it would be possible to “*restore somebody’s full-body motion*”(Neuralink, 2020), as this was similar to “*re-wiring*”. To settle doubts, Musk even reinforced this claim, stating “*I’m confident*”. The future applications of this device to manipulate the body's chemistry to bring back movement is a big jump from where Neuralink is at the moment. In a way, Neuralink will turn us partially into a computer, being able to manipulate core functions of our brain, such as being able to “*save and replay memories*” and with other implants rewire our nervous system to restore feelings. The applications extend past the scope of the disabled community, “*if you’re feeling down you can go access some good memories*”, *Musks claims*, creating a world where the users of Neuralink have a superior control over emotions. Some say people are defined by their memories, yet Neuralink claims they can be read and stored. In a sense then, it is possible to achieve digital immortality through the storage of memory in computer servers. Musk’s aspiration for the Link is for it to be able to transfer data “*into a new body or into a robot body*”, perhaps he means to have the link skip over bodily limitations.

It is now only a matter of time until the ability to control devices with the mind is made available to the wider population. Expanding the initial demographic to the world means that it will bring forth new applications, moving away from medical purposes. For instance, the “*gaming experience for gamers around the globe will undergo a revolution.*”(Amyx, 2017). Neuralink will undoubtedly catch the eye of the gaming industry, further expanding experiences the gaming community are exposed to with BCI technology. With the development of VR, combined with the Neuralink device, the way we can interact with mediums will be completely renewed. This may be able to create a hyper-real environment where we can try new things, such as giving a completely paralysed user the chance to drive a car in this alternate reality or being able to create digital art simply by visualising it and having a 3-D model of said idea, produced through this emerging technology.

The possibility of being able to add and take equipment to alter the human form, and get it working as designed is the future. By doing so, there is a risk of undermining the unique experience the disabled community goes through. If we truly “*view disabilities as a dimensional difference*” (Cresswell, 2012), then there is no need to *fix* them but only to allow a new way for them to communicate. Understanding their needs has led us to push them to the forefront of the idea of identity in the modern age; the sanctity of “*memories*” can now be manipulated as if they were mp4 files. The way humanity will define itself will be changed through the development of a single device made to help make the inaccessible accessible. Those with paralysis, Musk describes this as, “*broken wires...jump over those wires and transmit the signals over those wires. You can give somebody the ability to walk again naturally*”, already, Musk begins to link humans to machines, talking about the makeup of the human body as reminiscent of computer parts. “*There is no body*”(Siebers, 2008, pg.2). Musk here is implying another level of identity, uniting everybody under one umbrella, where a disability is not ridiculed or ignored by society; instead, it is another fixable component in our bio-machine.

## Brain hacking and other issues

The promises of Neuralink can convert the masses; after all, the potential of being part of the future is compelling to most. Perhaps take a couple of things into consideration as to why you should be mindful of Neuralink. Due to the “neural signals” being captured and transmitted to computers, there are skeptics such as Preeti Padma that fear this will lead to vulnerabilities in security. The consequences of these signals being in the public domain are evident; theoretically, these signals could be intercepted, which would allow “*brain-hackers*” “*to gain access to a user’s private information*”(Padma, 2020). As of late, there has been a surge in cybercrime, with huge data breaches that have devastated many companies like Tesla(Brook, 2018).

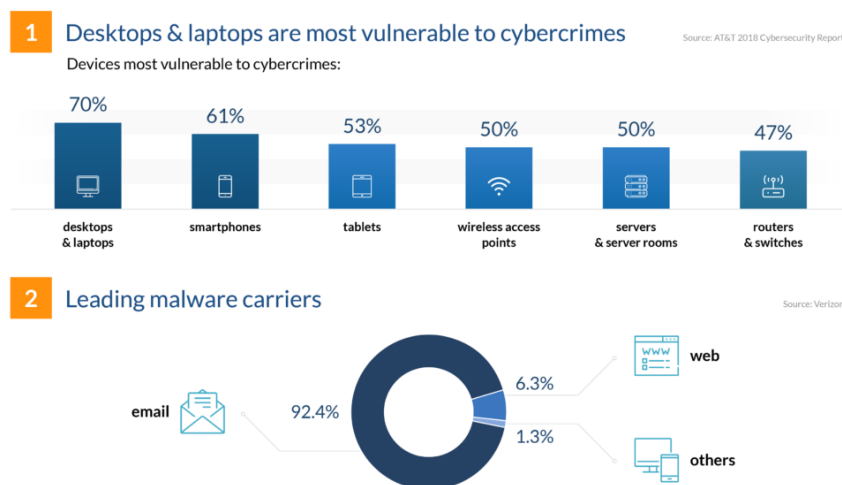


Figure 5, A chart demonstrating devices vulnerable to cyberattacks. (Prescott, 2019)



Unfortunately, there can never be guarantees on security when it comes to devices. The benefit of phones and laptops being compromised is that they can be taken offline by rebooting or pulling the plug. The Neuralink device will not be able to reset immediately, therefore the cybersecurity on it will have to be close to impenetrable or else it could cause a great deal of damage. The workaround for Neuralink is *“they have control of both hardware and software”*(Neuralink, 2021), and each component they build allows more flexibility in the number of security layers.

Other than security, human testing is an ethical issue for a myriad of reasons. Thus far, Neuralink has been tested only on animals, which they are under fire for due to alleged animal cruelty in the labs and the deaths of several of their monkeys due to the implant. Therefore, the safety of human testers is put into question, as *“approaches involve drilling into the skull to embed electrodes, which can cause “long-term brain inflammation””* (Hackett, 2021). All major operations have a risk, however, the FDA is in the process of signing off the product as safe for human clinical trials.

The first to have the operation will be taking a big step for the evolution of the *“Link”* it is clear that Musk is passionate about improving the reach of the device from all his predictions for it. The clinical trials will provide a lot of data for Neuralink to debug and test the UX of the device, as *“animals can’t tell us how they feel”*(Neuralink, 2021), people being able to communicate their experience is an irreplaceable step in the development process. This stage is fundamental and as seen before, the disabled community is eager to participate and voice their opinion on the device designed for them.

## Conclusion

Neuralink introduces a device capable of allowing interactivity with computing devices using the mind as opposed to the body. For those within the disabled community who face a digital divide, they may find an outlet in which to express themselves through this technology. As BCIs have been around for a couple of decades, the research further informed our understanding of the human brain and the possibility of “symbiosis” with A.I. In a sense, the strive to get humankind to keep up with the technology we built is based on the demand for accessibility. Therefore, we hinder our own creative potential when we don't “design with accessibility in mind”.

Neuralink is a driving force for the mindset considering accessibility in this way. But, as it is still in its early stages of development, it is evident that the continued development of neurotechnology will bring forward solutions that will “benefit all of us”. The potential Neuralink has medically to impact thousands of lives has been backed up by other BCI research such as BrainGate, which demonstrates to us that Neuralink is no longer an idea but a reality.

Despite the risks, the evidence shows us that security will not be an issue as they have taken precautions to integrate security into the design. Neuralink means to not only open up the disabled community to the world of technology but also to open up the rest of the world to a new point of evolution; the age of the human, A.I symbiosis.

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