Exploring Neuralink's effects on Society

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Abstract:

Neuralink is a biotech company founded by Elon Musk, which is currently developing a brain implant named "The Link". The device's ability to monitor and interfere with an individual's brain data and respond accordingly will advance medicine for people who have the device implanted (Becher, 2023). However, the device's future capabilities raise concerns. The device's potential for human enhancement could be detrimental to education and employment if everyone does not have access to it. Neuralink's plans to make this technology accessible to everyone will help many people improve their health conditions, but the device could still create disparities in competitive spaces over time. Moreover, privacy concerns are still a significant issue. Monitoring a person's brain data comes with many ethical issues, and ownership of user-sensitive brain data has yet to be established. Nevertheless, Neuralink's technology can be integrated into society while respecting user privacy and the fairness of competitive environments by letting users choose if and when their brain data is monitored and restricting the implant for medical purposes only. In the future, these actions would alleviate concerns about education and employment.

Introduction:

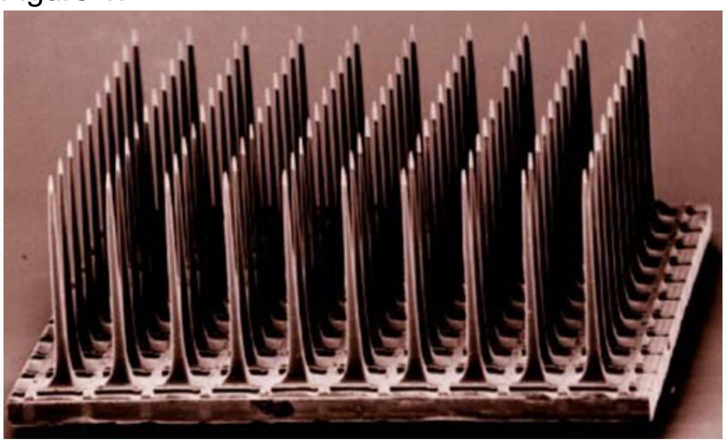
Neuralink is working toward creating an implant that has the potential to treat neurological conditions such as autism, depression, Alzheimer's, and epilepsy (Gurtner, 2021). Neuralink's current efforts have the potential to help the 24 million people who suffer from Alzheimer's and the 50 million who suffer from epilepsies (World Health Organization: WHO, 2007). Furthermore, the company has plans to use the device for certain human enhancements, such as improved memory and AI-Symbiosis, which connects the human brain to AI (Fiani et al., 2021). However, how the technology will affect our future society is unknown. Specifically, its impact on the medical, educational, and employment sectors and the privacy concerns with monitoring a person's cognitive processes have yet to be discussed. The absence of this information prevents the creation of a framework that covers how the Link will be introduced into our society while respecting the previously mentioned sectors. Making a method for the device's smooth integration can keep the disparities created by the technology in the educational and employment spaces to a minimum. If the device's effects on different parts of society are known, specific steps can be developed to mitigate the damaging effects while keeping the favorable aspects of this technology. The Link can be integrated into society if the technology's use is restricted to medical purposes and if users can choose if and when their brain data is accessed, allowing the technology to become more accessible for the people who require the device while maintaining fairness in the educational, employment, and privacy spaces.

Section 1: The applicability of the Link in medicine

The Link is a Brain-Computer Interface consisting of a computer chip that is implanted inside an individual's skull with electrodes entering their brain(Musk & Neuralink, 2019). Neuralink's technology is not an entirely new concept because it makes advancements of the

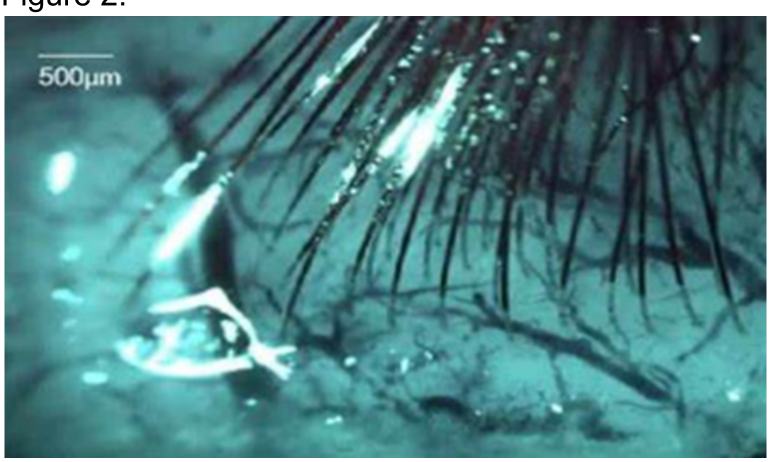
Utah Array. For context, the Utah Array is a 4mm by 4mm silicon chip with 100 electrodes (Bullard, 2019). In contrast, Neuralink advances this technology with a larger quarter-sized chip and 3072 electrodes (Musk & Neuralink, 2019). Furthermore, Neuralink improves the Utah Array's rigid electrodes with flexible electrodes, and the purpose of this improvement is to minimize internal brain injury when the brain shifts around from movement (Kulshreshth et al., 2019). The Utah Array has fixed electrodes that can puncture blood vessels in the brain (Figure 1), while the Link's thin, flexible electrodes avoid blood vessels, reducing the chance of internal bleeding (Figure 2). The improvement in the electrodes' flexibility will vastly decrease the likelihood that any internal injury will happen from the BCI. As a result of Neuralink's improvements, a patient is much more likely to return home after surgery as opposed to being monitored for chronic tissue damage. This benefit has further implications for people with disabilities trying to live normal lives.

Figure 1:



The Utah Array is a 4.2 mm square chip with 1.0 mm spiky electrodes inserted into a user's brain Zhou & Greenberg, 2005, "The Utah array is a 4.2 mm square grid with 100 silicon micro-electrodes, 1.0 mm long and a spacing of 0.4 mm" [Figure 4]).

Figure 2:



The Link's flexible electrodes avoid blood vessels and, as a result, do not cause bleeding (Musk & Neuralink, 2019, "An example perioperative image showing the cortical surface with implanted threads and minimal bleeding" [Figure 6]).

The Link's ability to allow people to go home and have increased mobility may enable people who require BCIs to regain some of their initial abilities and to live normal lives if it is well integrated with other neuroprosthetics. A study conducted by Anumanchipalli et al. (2019) demonstrates how BCIs could be used in combination with speech decoders to enable users to speak with their minds, thus providing a solution to muteness. In the study, Anumanchipalli's team used ECoG, a non-invasive brain recording technique, to record participants' brain activity. They developed a speech decoder to translate the brain activity and play the speech across speakers, and Anumanchipalli's team asked five participants to write what they heard. Participants demonstrated high accuracy in their auditory translations, but very few were perfect. The study did not specify the specific number of electrodes used to collect brain activity, but the best ECoG systems have up to 360 electrodes (Tolstosheeva et al., 2015). The Link's higher electrode count could increase the accuracy of recorded activity. Additionally, Neuralink could develop more accurate speech decoding algorithms to make perceived speech more natural. In summary, Neuralink's implant could increase the quality of certain neuroprosthetic appliances, making the experience more natural and seamless for mute users who want to gain the ability to speak.

In addition to working with current neuroprosthetic devices to help users regain basic functions, Neuralink's technology could potentially enable the treatment of paralysis, which occurs when the neurons inside the spinal cord are damaged. An individual with paralysis is unable to communicate messages from the brain to other body parts (Moawad, 2022). Lorach et al. (2023) developed a Brain-Spine Interface to address this condition and tested it on a tetraplegic patient. Two implants were placed in the brain and in the spine to convey the proper electrical signals from the patient's brain to their muscles. As a result, the patient learned how to walk, and the implants even helped his recovery so he could walk on crutches after the BSI was turned off. Moreover, two implants with 64 electrodes each were used, and the patient could function regularly after a year with the implants. Similarly, Elon Musk claimed that two Links placed similarly in the study could cure paralysis in the future (Kolodny, 2021). With the Link's faster chip and 3072 electrodes, a possible benefit could be decreased time to gain regular functionality and more efficient rehabilitation so that patients do not need to continue using the technology to function normally. These improvements could help anyone with a physical disability be closer to using any part of their body they could not before.

Neuralink's advancements from previous technologies can be useful not only to individual users who want to live normal lives but also to professionals who would benefit from having the brain data of those individual users. The Link's flexible electrodes, which minimize the likelihood of injury, could enable patients to return home and perform their daily activities without being closely monitored in the hospital. The Link is a high-bandwidth device that can give researchers access to more brain data than ever before. Researchers can learn more about an individual's condition when patients are exposed to various scenarios at home, meaning creating more effective or new treatments for those conditions could be easier.

Additionally, healthcare professionals can use brain data with Google's AI to make better choices when treating a patient. Google's AI, named Med-PaLM 2, is a large language model capable of having complex conversations with medical professionals to produce references, explanations, and insights (Gupta & Waldron, 2023). Neuralink's implant would provide valuable brain data, which Google's AI could use with medical tests to advise more appropriate treatments for a patient.

Section 2: The Educational Sector

In addition to medical use, Neuralink seeks to develop its technology for human enhancements, such as AI-symbiosis, which could improve problem-solving skills. In order to evaluate risks associated with improving problem-solving skills, the extent to which problem-solving skills are used in our education system must be examined. Problem-solving skills are valued in all parts of our education system today. For example, Kate Mills, a teacher with ten years of experience with 4th graders, emphasizes that complex and nuanced problems in the real world require classrooms to incorporate instruction in teaching problem-solving skills. Mills wants a classroom where students automatically adapt their approaches to solving a problem after being taught a variety of techniques during instruction (Mills & Kim, 2022). The importance of these skills even stretches into high school and college with Advanced Placement classes. The Advanced Placement Program simulates many college-level courses and creates exams for high school students. The College Board, the company that creates the AP tests, claims that for students to overcome their course's challenges, students need to use their problem-solving skills (*Benefits of AP – AP Central | College Board*, n.d.). Recently, educational standards have been shifting to emphasize problem-solving skills so students are better prepared for the future.

As a result of problem-solving becoming a required skill throughout school curriculums, the Link has the potential to affect the educational space if it develops the capability to boost problem-solving skills. Current AI models are already being developed to possess the skills for problem-solving. Complex problem-solving in terms of education requires abstract thinking skills: understanding abstract ideas and then applying them to various scenarios (MSEd, 2022). Researchers have demonstrated that an AI known as WReN can reason with abstraction. WReN was tested by the Programmatic Generalization Matrices (PGM), which tests the ability to learn abstract relationships between objects and attributes. It scored high when compared to other AI models because of the newly developed algorithms that decode abstract ideas into discrete symbolic explanations that the AI could understand (Barrett et al., 2018). Furthermore, AI models have successfully applied abstract ideas to many subject areas. For example, Chat GPT 4 scored in the 99th percentile on the verbal Graduate Record Examination, which tests a student's ability to identify and understand various concepts involved and then use a strategy to solve a problem (Student Progress, 2023). Additionally, Chat GPT can excel in a variety of scenarios because it consistently scores high on many other tests that require the same skills: 90th percentile on the SAT and 5s on many AP exams (Walker, 2023). If AI continues to advance at this pace, future AIs inside the Link could improve a student's problem-solving skills.

Since AI has the potential to increase problem-solving skills and since problem-solving skills are widely used in education, any student with the Link could gain a massive advantage because future Link AIs could boost problem-solving skills. If these skills are required at all levels of our educational system, a student with the device could have a competitive advantage over everyone else. Students with increased problem-solving skills could have better grades in their courses while studying the same amount as their peers. These students could gain tangible benefits such as acceptance into better colleges or better job opportunities. As a result, higher positions in college and in employment could be taken by people with the Link. This scenario could be unfair to everybody without the device because they may have access to fewer opportunities while exerting the same amount of effort as a person using the Link.

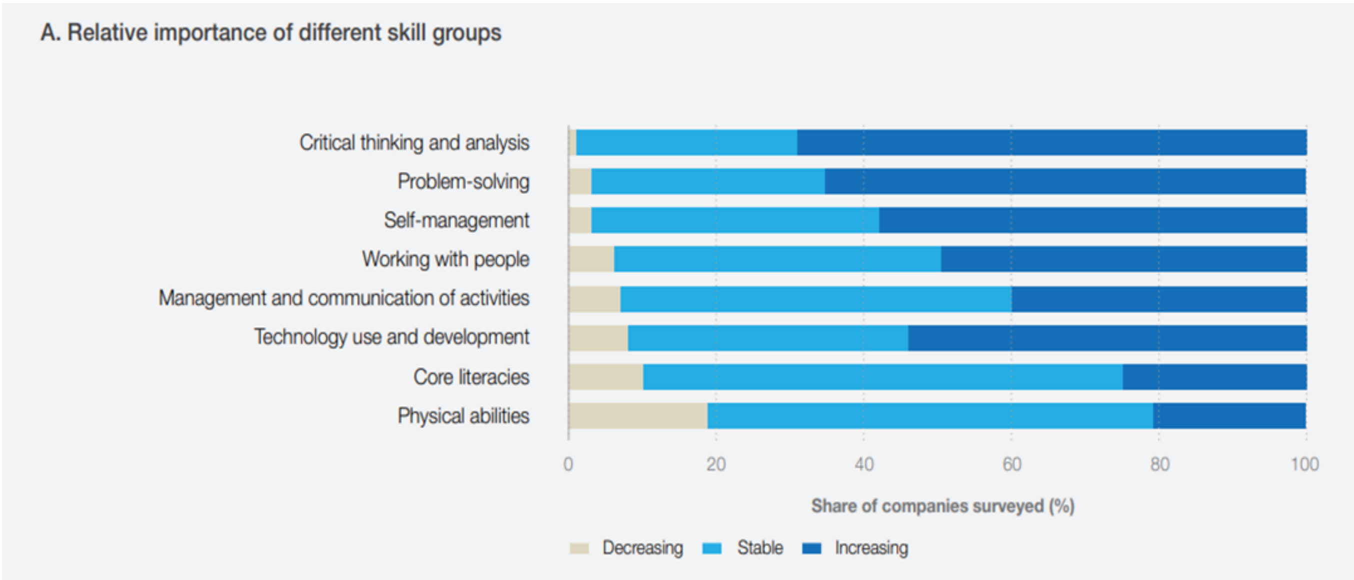
In addition to having the potential to increase problem-solving, there is current evidence on how Neuralink's technology may become capable of boosting memory power. In one experiment, Eleanor Maguire, a neuroscientist at the University College London, investigated whether the distinguishing factor between World Memory Champions and ordinary people was structurally related to the brain. MRI scans found that the right posterior hippocampus was more activated when the subjects were memorizing. This region in the brain is responsible for spatial navigation and spatial memory, so Maguire's team wondered why the subjects used a section of the brain involved in visual processing. The subjects were confronted after the scan and explained they would convert the information into images and assign those images to familiar ideas when they tried to memorize something. Maguire's team concluded this technique resulted from dedicated practice and was not an innate skill (Maguire et al., 2002). This practice to increase memory can be combined with Neurofeedback techniques to bypass the extensive amount of practice needed to master such a skill. Neurofeedback techniques measure a user's brain waves and provide a feedback signal so the user can acquire greater control of brain functions (Marzbani et al., 2016). Neuralink has not reported on how they will provide increased memorization as an enhancement. But, if Neuralink decides to use Neurofeedback techniques, a user could learn to consciously use unrelated parts of their brain for improved memory over a short time. The Link's capability of increasing memory may create a scenario similar to the one when the device develops the ability to increase problem-solving skills: anyone without the device could be disadvantaged.

The Link could not only harm people who do not use the device but also has the potential to harm people with the device. Jason Batterson, a lead author for an elementary school math curriculum and a competitive middle school math coach, noted that students who thoroughly learn concepts benefit from applying their knowledge to a wide range of scenarios (Ferlazzo, 2021). Accordingly, students who attempt to memorize concepts instead of truly understanding them may benefit less. If the Link can boost memory power, some students could recognize this benefit and be encouraged to continue their old habits of memorizing concepts instead of genuinely learning them. Therefore, the Link could limit their learning by reinforcing their old learning habits. Thus, the Link's introduction into the educational space would be detrimental because it would disadvantage anyone without the device and potentially encourage superficial learning habits among the users of the device. AI's capability to analyze abstract concepts and boost cognitive capabilities could also be useful in the employment space.

Section 3: The Employment Sector

Many employers seek employees with good critical thinking skills because they can benefit their companies. Dorine Neba, a Ph.D. in Philosophy and a member of the University of Beau's Department of Curriculum Studies and Teaching, claims critical thinking skills are essential for an employee because they assist the company by cutting costs by making the correct choices, analyzing opportunities, anticipating and planning for trends, and evaluating data (Neba, 2020). Over 60% agree that critical thinking skills are increasing in importance compared to any other skill (Figure 3). Therefore, these skills are necessary for employees now and will continue to be important.

Figure 3:



The largest proportion of employers agree on how critical thinking and analysis skills are increasing in importance for future employees (Schwab & Zahidi, 2020, "Perceived skills and skills groups with growing demand by 2025, by share of companies surveyed" [Figure 27]).

Critical thinking skills are necessary for many fields, and current AI models have displayed that they have the potential to recreate them. Critical thinking can be defined as analyzing and evaluating different perspectives of a problem to create a judgment (Ryan, 2023). AI has shown the ability to understand complex concepts and make decisions from them. IBM Project Debater tested an AI against debate champion Harish Natarajan. The AI was equipped with subcomponents that would analyze and assess the relevance of a source and make judgments on which side of the argument to support. The AI did not win, but it showed its capability to evaluate differing perspectives and arrive at a conclusion from them (Bar-Haim et al., 2022). Therefore, future AIs in Neuralink's technology could allow finer cognitive abilities, such as better critical thinking skills, when implanted into a user's brain.

AI could not only boost a user's critical and abstract thinking skills, but it could also slow how those skills decrease in humans over time. Abstract thinking and critical thinking can be categorized as fluid abilities (MSEd, 2022). Traditionally, fluid abilities involve problem-solving and thinking logically in novel situations, and researchers have previously described how age affects fluid abilities. Schaie and Willis (2013) conducted the SLS (The Seattle Longitudinal Study), where they tested a sample of adults ranging from 22 to 70 years old every seven years. Schaie's team tested the subjects with the Raven's Progressive Matrices, and they concluded that the most pronounced decline in fluid abilities was at 60 years old. Fluid abilities do decrease drastically at a certain point, meaning employees who naturally age would experience a loss in the skills crucial for specific jobs. However, the Link's ability to boost critical thinking could make this decrease in an employee's fluid abilities less severe, and employees with the device could work efficiently even as they age.

Neuralink's technology may not only benefit employees over the long term, but it may develop the ability to grant short-term optimizations to employees as well. The Link could be advantageous for a user wanting to optimize their brain for a specific occupation, and one study has shown how human brains already have the potential to be optimized for certain tasks. Eleanor Maguire studied taxi drivers in London and noticed that they had to navigate London's long and windy roads all day, so she wondered if there could be physical discrepancies in their brain composition compared to an average person. Maguire found that the longer a driver was at the job, the larger their rear hippocampus was compared to an average person. She concluded that the brain had adapted to meet the demanding task of memorizing the streets of London, a phenomenon known as neuroplasticity. However, Maguire found the drivers' front hippocampus volume had decreased so that space could be made for the rear hippocampus, which is responsible for spatial navigation and spatial memory. As a result, the taxi drivers' were worse than the average person at a different type of memory test. Maguire concluded that there was a "trade-off" where the improvement of the drivers' performance on one task resulted in decreased performance on another (Jabr, 2011). If the Link develops the capability to stimulate the parts of the brain responsible for neuroplasticity, then employees can grow certain parts of their brain that require the most involvement in a specific job.

In short, The Link can potentially provide massive advantages to an employee by boosting critical thinking skills and keeping them sharp over time while optimizing their brain for a specific job. These employees could benefit from being employed in better jobs because employers could consider how they are already more adept at helping their companies grow. However, everyone else may be disadvantaged because they have to put in more work to meet employers' high expectations. Therefore, if the Link is released to the public, anybody without the device could become disadvantaged because their peers may be ahead by having Neuralink's device. However, all of these human enhancements and effects on the employment space will be far into the future. Instead, Neuralink is prioritizing developing its technology for advancing medicine for the initial years of its technology development.

Section 4: Accessibility and its relation to medicine and competitive environments

Elon Musk's first priority is to have the Link function to cure neurological problems; Neuralink is currently developing the Link to achieve that aim (Fiani et al., 2021). But Musk wants the device to help humans compete with AI in the future. He believes that future AIs will be able to simulate brain function, and for humans to compete, they must merge their brains with AI (Kulshreshth et al., 2019). These two reasons are why Neuralink is trying to make the device as accessible as possible for everyone.

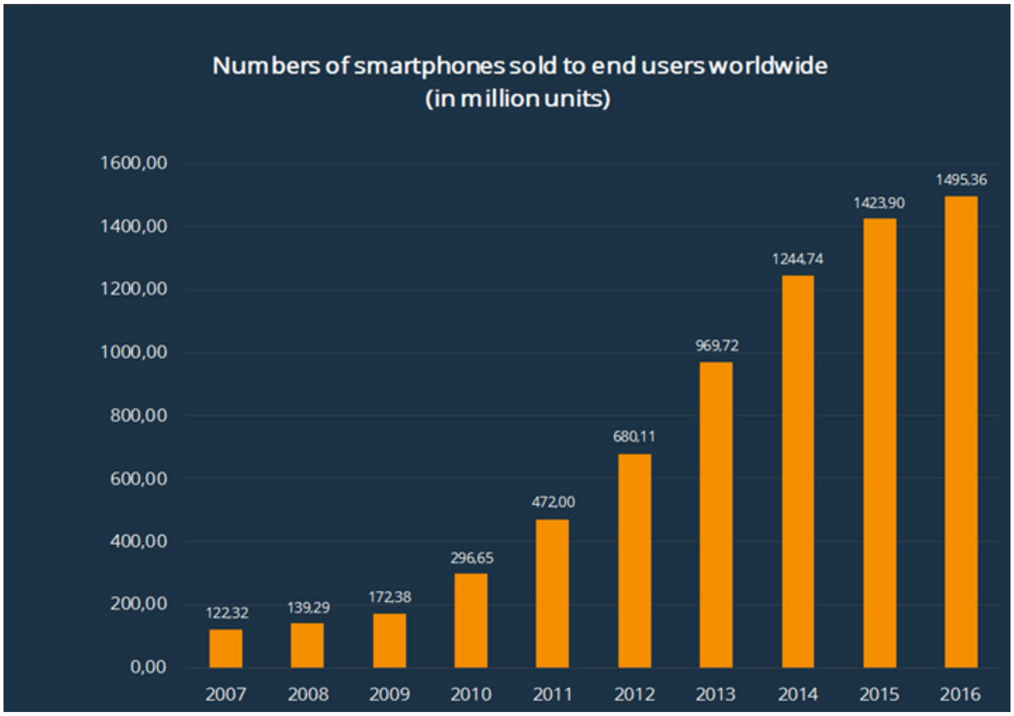
However, the company has challenges concerning the device's functional lifetime. The Link would likely need to be replaced every few years for consumer safety. Fluid ingress, the movement of body fluids into enclosed spaces, is one reason the implant would need to be replaced, leading to less accessibility because consumers would need to purchase the device multiple times for long-term use (Kulshreshth et al., 2019). However, Neuralink has plans to solve these problems, and one solution is to extend its longevity. Neuralink has done extensive testing through accelerated lifetime testing, which ages the implant four times faster so they can learn how to reduce failures and complete more tests for improved longevity (*Neuralink on X*, 2023). Neuralink designed the implant to be housed in a titanium case coated with perylene-c, which excludes any fluid and moisture to increase the implant's lifetime (Kulshreshth et al., 2019). Neuralink has not released any statement on how long their device can last, but a close competitor has done similar testing to extend their device's longevity. Blackrock Neurotech has developed a BCI named the NeurPort Array from a series of connected Utah Arrays. The company has found that the device can last over eight years in a human with no adverse health effects (Blackrock Neurotech, 2023). If Neuralink aims to compete with its competitor and achieve its goal of making its device as accessible as possible, the company should also aim for the Link to last eight years.

Another challenge stands in the way of Neuralink's goal of having the Link as accessible as possible: price. Elon Musk aims to have the cost of the device and surgery down to a few thousand dollars (Zafar, 2020). Compared to DBS, an invasive technique used to treat Parkinson's disease, which costs anywhere from $35,000-$100,000, the Link could be more economically feasible for more people(Smith, 2019). Compared to conventional brain technologies, Neuralink's device is more affordably priced, but a fairer comparison for price would be to other BCIs. Another BCI company competing with Neuralink is Kernel. Kernel is developing a BCI called the Flux, which relies on magnetic fields to record brain activity, and it has similar goals to Neuralink concerning healthcare and human enhancement with AI. Despite using a different brain data recording process, the Flux is estimated to be manufactured for a few thousand dollars(Nanalyze et al., 2021). Neuralink is on the right path in making its technology as accessible as possible because its device is at a competitive price in relation to the future BCI market.

Neuralink has the intention to make the device more accessible for medical purposes, but if Neuralink's devices were accessible to the public without restrictions, disparities in competitive spaces would be created. It is important to acknowledge that when the Link is released for consumer use, some people may use the implant to improve their health conditions, but some people may purchase the device to enhance themselves to do better in competitive environments (i.e., school, college, and jobs). A trend in another mass consumer technology must be analyzed to predict the effects of introducing a technology like Neuralink to the public, where some people will use the technology to excel in competitive environments.

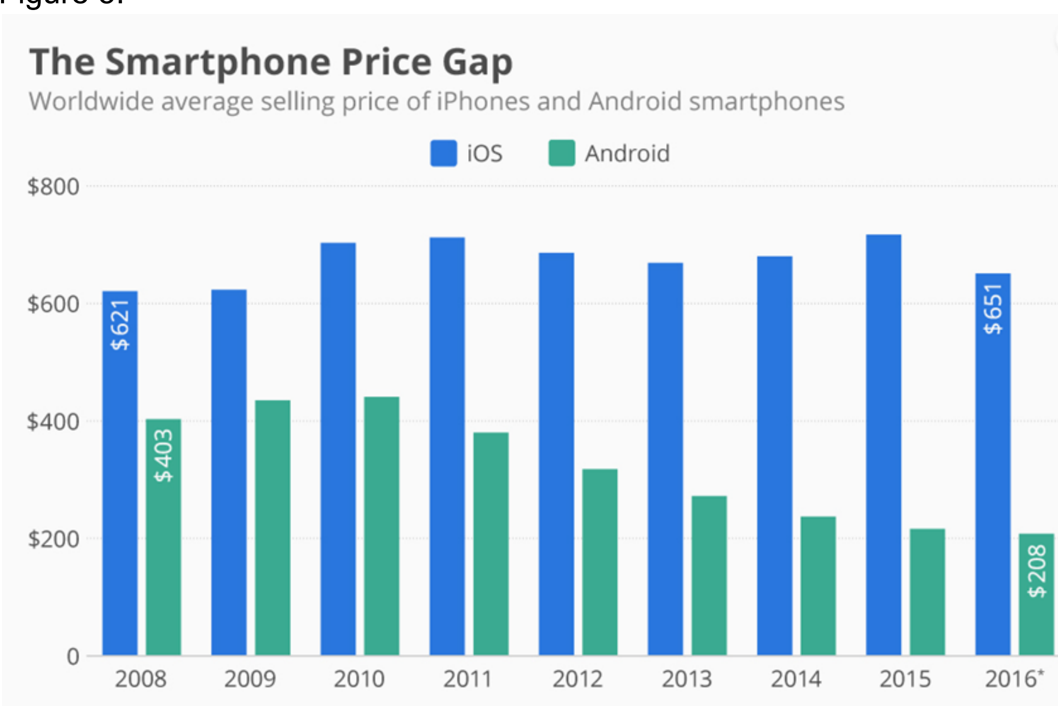
In this scenario, smartphones can be compared to the Link because they are both mass consumer devices trying to reach as large of a market as possible. Figure 4 demonstrates that the number of people with smartphones was only 122 million as of 2007 at the iPhone's launch, but by 2017, this number reached 1.5 billion smartphones sold annually. The increase in smartphone users occurs because of the growing price difference between iPhones and Androids, indicated by Figure 5, which shows how Androids were only $200 cheaper than iPhones as of 2008 but $400 less than iPhones by 2016. Simply put, more people can own Androids because they are more affordable. As Android makes cheaper models, its overall market share increased to 81%, as indicated by Figure 6, by 2015, showing how a more significant percentage of people own an Android smartphone. Although these smartphones come at an affordable price and are accessible to more people, they have fewer capabilities compared to iPhones.

Figure 4:



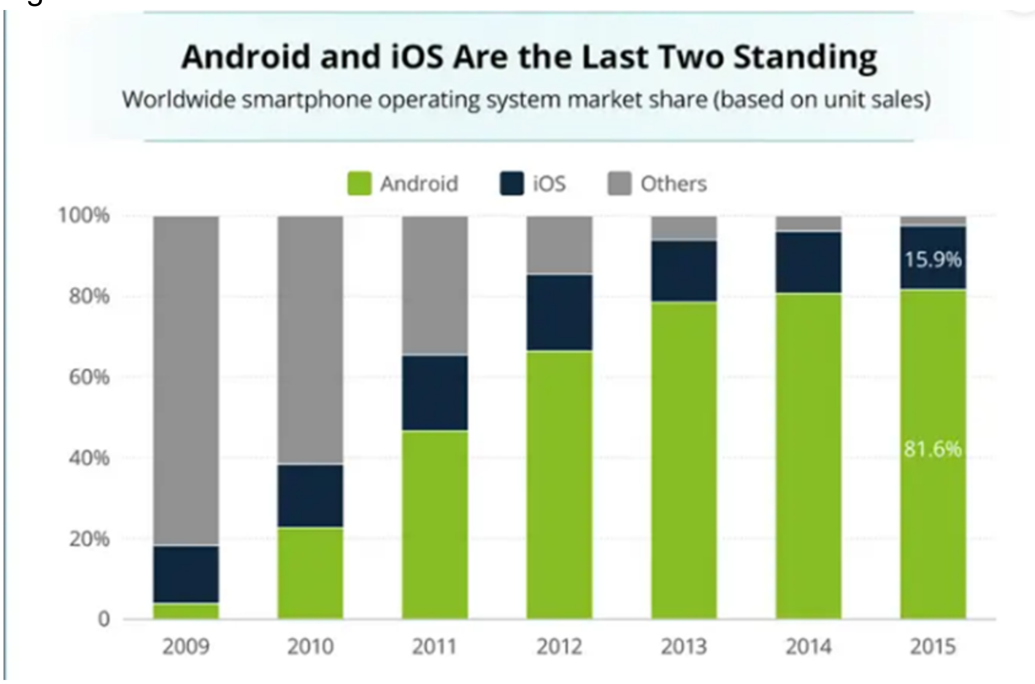
As time progresses following the iPhone's release, the number of smartphones sold increases exponentially (Ludynia, 2017).

Figure 5:



Over the years, the iPhone's price stays relatively stable, but the price of an average Android slowly decreases (Richter, 2016b).

Figure 6:

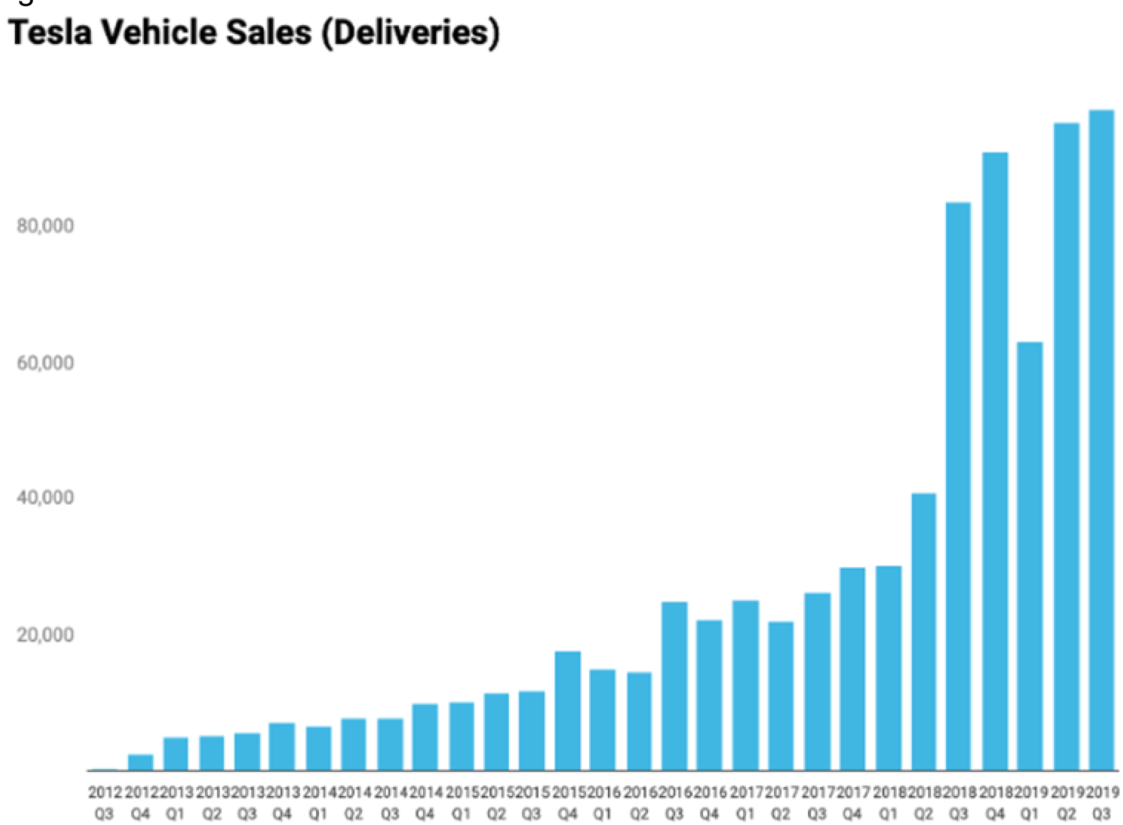


Android’s share over the smartphone market only increases over time (Richter, 2016a).

If this same pattern is extended to Neuralink's device, then initially, only a few people will have the device for the first few years following its release. However, cheaper models of the Link will be released so more people can access Neuralink's technology, but these cheaper models will be less capable. These models may have fewer electrodes, less capable AI, or an inferior ability to boost critical and problem-solving skills in their users as compared to the more expensive models. At any point along this process, there will be people who do not have the same advantages that people with the Link do. If they cannot afford the device or have it installed into their brains for medical reasons, they could be disadvantaged in many competitive spaces because they may not have the same abilities as people using the Link. If Neuralink's device is released without any regulation regarding ownership of the device, then there may be people who could be put at an unfair disadvantage.

If the Link is sold without regulation, competitive spaces will be affected negatively, but the opposite is true for the medical space. Neuralink's developments in research throughout the years could positively impact the medical space. Elon Musk's electromotive company, Tesla, can be compared to the Link because they are both technologies trying to reach more consumers. The company had massive growth in the amount of Teslas it sold from 2015 to 2018, selling 10,000 cars for most quarters in 2015, with sales increasing to 80,000 by the end of 2018 (Figure 7). Most of these sales were from the Model 3, an affordable version of the more expensive Model S (Watson, 2019). Tesla did this because it has used innovative techniques to make production as efficient as possible. With cheaper manufacturing costs and more affordable models, more Teslas have gotten to consumers. The Link will be expensive initially, but if cheaper models are made, and production is optimized, anybody who needs the implant to cure a neurological condition or become a more active member of society can benefit from a more affordable cost. In addition to helping people with their medical conditions, Neuralink's device may become capable of processing brain data to gather information on a wider range of thought processes, which provokes privacy and ethical concerns.

Figure 7:



Tesla sales rise slowly through the years but increase massively by Quarter 3 in 2018 (Shahan, 2019).

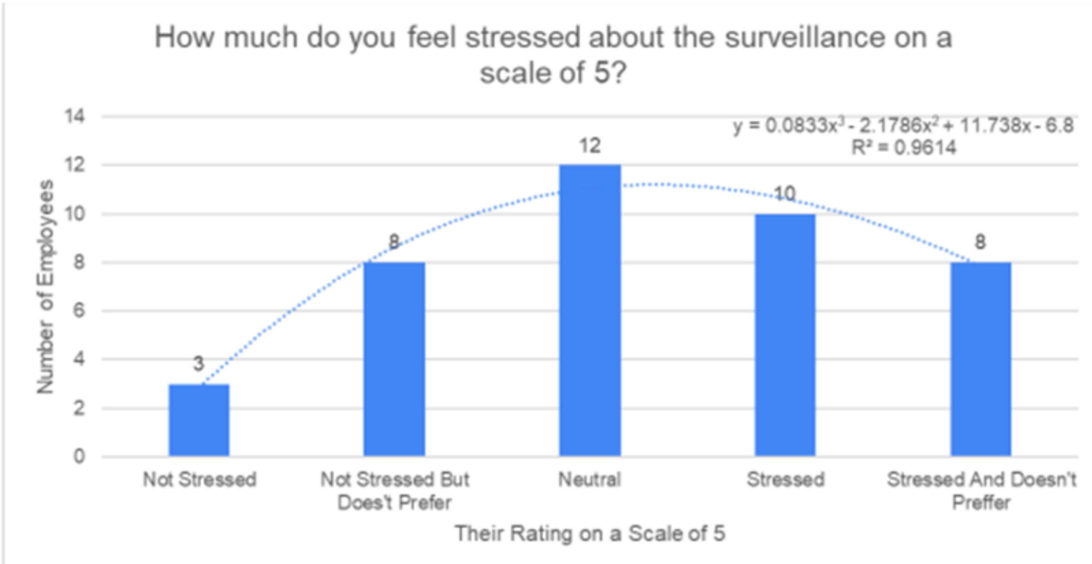
Section 5: Privacy and Ethical Concerns

The Link may develop the capability to record a person's thoughts, feelings, and emotions by turning mental states into digital data. Rainey et al. (2020) define this process as reductionism. Reductionism may occur if scientists study a user's feelings or marketing companies study how a user reacts to a particular product over the long term. The authors claim that Neuralink's technology will not be able to fully capture the meaning of a person's thoughts because they are subjective and require a thorough understanding of that person's experiences and environment. The paper also mentions ethical concerns related to this process. If anyone were to make inferences from a person's thoughts, it would be detrimental to cognitive liberty. Cognitive liberty is the freedom of a person's thoughts without external influence. Users may fear their ideas being monitored because they know technology may misinterpret their thoughts. As a result, users may censor some ideas, preventing honest reflection inside their minds. The authors mention how this technology comes with a high ethical risk because accessing a person's thoughts gives anyone who monitors them the power to manipulate or profile the user.

If Neuralink wants to release its technology for consumer use, it is crucial the company addresses the many ethical issues around its device.

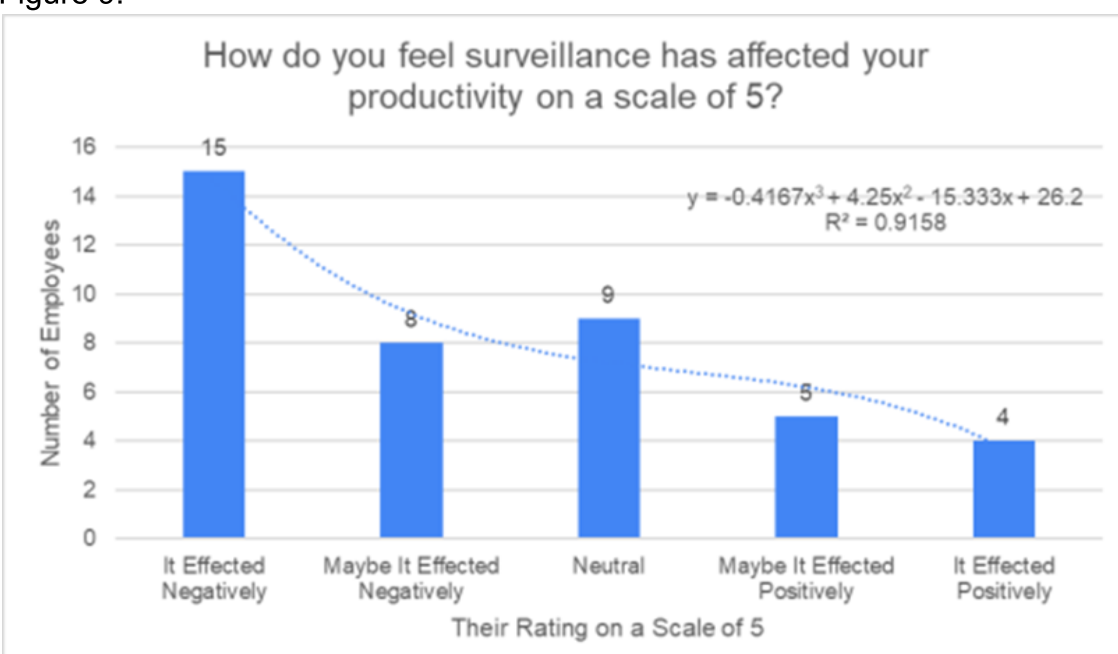
A less apparent issue concerning the device's ethics relates to how brain monitoring may affect an individual. Monitoring a person's thoughts is unethical because of the many adverse effects it brings into their life. One study explored how surveillance impacted an individual's mental health. In the context of the workplace, Rehman (2022) wanted to explore the impact of workplace surveillance on employees' stress and productivity. Rehman selected 41 employees randomly and monitored them with CCTV, biometrics, network-based access control, social media monitoring, and screen capture monitoring. The number of monitoring techniques increased throughout the study. The employees then took a questionnaire responding to questions on their mental health after they had been monitored. As shown in Figure 8, 18 of the 41 (44%) employees reported stress after they had been monitored. Rehman confirmed a statistically significant relationship between the amount of workplace monitoring and employee stress. According to Figure 9, 15 employees (37%) confirmed the surveillance affected their productivity negatively, and eight (20%) stated that the monitoring could have decreased their productivity. Rehman demonstrated an indirect, statistically significant correlation between the monitoring techniques and employee productivity, meaning employee productivity decreases as the number of monitoring techniques increases. Rehman proposed a possible explanation of why these correlations were observed: If employees feel they have no control over their privacy, they are more likely to feel suffocated, which means they will become stressed and less productive. Neuralink's technology only takes the invasion of privacy further. If a person's thoughts are monitored, they may feel a lack of control, which might decrease their productivity at work. More generally, as their stress levels increase, their mental health will also worsen. Neuralink's technology only expands upon the harmful effects monitoring a person may have on their life. As a result of all these privacy and ethical issues, Neuralink has many policies to clarify with their potential customers before they can release their device to the public.

Figure 8:



A large portion of the employee's surveyed (18/41) say how surveillance does make them stressed (Rehman, 2022, "Histogram of Responses to the question "How much do you feel stressed about the surveillance on a scale of 5?" [Figure 11]).

Figure 9:



15 of the 41 employees responded saying that surveillance does affect their productivity negatively (Rehman, 2022, "Histogram of Responses to the question "How do you feel surveillance has affected your productivity on a scale of 5?" [Figure 12]).

Section 6: Conclusion

There are two main types of users for Neuralink's implant. The first type of user uses Neuralink to improve their quality of life by having the Link help treat their health condition. Regarding medical advancement, the Link should be able to develop and advance to increase its capabilities to help these types of people. The second type of person will use the Link to gain an advantage in a competitive environment, which will disadvantage everyone without the device. For these reasons, it is essential to let Neuralink develop its technology in a way that creates benefits in the medical space but does not disrupt fairness inside competitive environments.

However, Elon Musk wants students and workers to have the Link. He believes that AI will eventually be able to simulate brain function and that for humans to compete in these spaces, they must merge with AI (Kulshreshth et al., 2019). The unregulated introduction of the Link to society would likely be more harmful than helpful in these spaces. The few who own this implant could create breakthroughs or perform better in their fields, but anybody without the technology may struggle to compete with them. As a result, Neuralink could make these spaces unfair for people who cannot access the device.

Instead of trying to compete with AI, AI should be viewed as a tool that is distinct from us. AI is a tool that we control and grows over time to understand a broader range of scenarios to help more people with their jobs. A promising way to mitigate disparities created through technology would be to require training to make students and teachers aware of AI and ensure that they have access to a free version of it. If AI remains distinct from people's minds, students could be prevented from using it on competitive exams, and employees could still use AI programs on their computers as a tool for their jobs.

The company has one more crucial issue to address before its device is available to consumers: privacy. Neuralink may desire to track and record brain data to study the function of the brain. To ensure privacy and prevent manipulation from others, Neuralink must keep the data confidential between their researchers and the users. Additionally, to ensure the user's mental health and peace of mind, users should be allowed to control whether they are monitored and what time of the day they can be monitored. For example, a user might not want to be monitored at work because it increases their stress and decreases their productivity. All of these measures could preserve competitive environments while letting the Link advance the medical space.

Overall, the Link is a device currently in development for advancing medicine, and it has the potential to help hundreds of millions of patients with neurological conditions. However, if this technology is developed for enhancement, it may disadvantage millions of employees across many industries and could also discourage proper learning habits in future students. If Neuralink can mitigate these adverse effects while respecting education, employment, and user privacy, then this technology could drastically improve the future of humanity. Restricting AI to computers only and letting users choose if and when their brain data is monitored while keeping the data confidential are reasonable and simple solutions to preserve the previously mentioned spaces. There are already large language models that exist that can be accessed by any student or employee with a computer and internet connection. Making users aware of their options concerning brain monitoring can be as simple as a pre-surgery consultation. Additionally, keeping brain data safe is a matter of using encryption and private servers between the researchers and the device. Neuralink is a technology that can be detrimental to many different parts of society. But if specific regulations are used, the device can just as easily become a technology that has massive benefits to our future.

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