Neuroplasticity as a transformational tool for improving managerial approaches

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Master's thesis / Diplomski rad

2021

Degree Grantor / Ustanova koja je dodijelila akademski / stručni stupanj: **University of Zagreb, Faculty of Economics and Business / Sveučilište u Zagrebu, Ekonomski fakultet**

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Download date / Datum preuzimanja: **2024-04-20**

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University of Zagreb

Faculty of Economics & Business

Graduate Degree in Management

Neuroplasticity as a transformational tool for improving managerial approaches

Graduate thesis

Louis Tomlinson

Zagreb, September, 2021

University of Zagreb

Faculty of Economics & Business

Graduate Degree in Management

Neuroplastičnost kao transformacijski alat za poboljšanje menadžerskih pristupa

Neuroplasticity as a transformational tool for improving managerial approaches

Graduate thesis

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Zagreb, September, 2021

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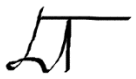
Student signature: 

Place and Date: Zagreb, September 7th 2021

Summary and key words in English

The brain is not merely an organ that directs a person from point A to point B, but from it descends emotions and an awareness of the world around you. Understanding your mind is the gateway to looking after one's well-being and even the well-being of others. For a number of reasons, the concept of Neuroplasticity never seizes to fascinate. Neuroplasticity can offer guidance regarding how people should learn, understand the behaviours of themselves and help inspire people to understand that they, indeed, can change for the better. Ultimately, this thesis intends to fill the gap of knowledge that can give managers the edge when it comes to building their teams and exceeded workplace expectations. It is written with a more applicable approach to management in mind and for those with a less technical understanding of the neuroscience behind it. In particular, the topics of motivation and employee behaviour are focussed on. In the main body, a number of secondary data sources will be evaluated to help answer the question of the thesis. The secondary sources will of diverse origins, ranging from academic experiments to scientific models explaining particular behavioural tendencies. Using different secondary data sets will offer information that can build a more holistic understanding of the ways in which Neuroplasticity can help managers to become more effective leaders.

Key Words: Neuroplasticity, Motivation, Behaviour, Management, Neuroscience

Summary and key words in Croatian

Mozak nije samo organ u tijelu koji usmjerava osobu od točke A do točke B, već iz njega dolaze emocije i svijest o svijetu oko vas. Razumijevanje uma je ključno za brigu o svojoj dobrobiti, pa čak i dobrobiti drugih. Iz više razloga, koncept neuroplastičnosti nikada ne prestaje fascinirati one koji ga proučavaju. Neuroplastičnost može ponuditi smjernice o tome kako ljudi trebaju učiti, razumjeti svoje ponašanja i može pomoći u poticanju ljude da shvate da se mogu promijeniti na bolje. U konačnici, ovo područje može popuniti prazninu znanja koja zainteresiranim menadžerima može dati prednost kada su u pitanju izgradnja timova i izvedba na radnom mjestu. Ovaj rad je napisan kako bi se istaknuli njegovi primjenjivi aspekti u menadžmentu i za one koji nemaju veliko razumijevanje neuroznanosti. Konkretno, u fokusu su teme motivacije i ponašanja zaposlenika. U glavnom tijelu procijenit će se niz sekundarnih izvora podataka kako bi se odgovorilo na ključna istraživačka pitanja. Sekundarni izvori su relevantni i imaju različito podrijetlo, od akademskih eksperimenata do znanstvenih modela koji objašnjavaju određene tendencije ponašanja. Korištenjem različitih sekundarnih skupova podataka autor je kreirao informacije koje čitatelju mogu ponuditi cjelovitije razumijevanje načina na koji neuroplastičnost može pomoći menadžerima da postanu učinkovitije vođe.

Ključne riječi: Neuroplastičnost, motivacija, ponašanje, menadžment, neuroznanost

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1. Introduction

Though not always directly addressed, the idea of neuroplasticity serves to guide the many motivational speakers and self-help gurus that help business managers and other individuals to broaden their learning capabilities and develop their leadership skills. So, when motivational speaker Tony Robbins (2017) offered the following words of wisdom, “Every problem is a gift–without problems, we would not grow.”, he very well could be referring to the cognitive-improvement abilities that come from neuroplasticity.

1.1 Topic and Goals

This section will go over the justifications for carrying out this research. Furthermore, a number of aims related to Neuroplasticity will be brought to attention.

1.1.1 Purpose of Research

The research carried out in this thesis aims to offer an understanding about the ways that knowledge of neuroplasticity will be valuable to managers and those working within the business world. This work is intended to serve as a bridge between the rather complex science behind neuroplasticity and those who could learn greatly from it.

With the guidance of neuroplasticity, light could be shed on new approaches to dealing with challenges within several managerial areas within a business. Understanding the neuroscience behind employee motivation will offer new insights for managers to understand job satisfaction.

Job satisfaction remains an important factor in the workplace; therefore, it can benefit companies to have managers who understand the biological explanation behind it. As renowned psychologist Frederick Herzberg stated with the 'Two-factor theory' (Herzberg, Mausner and Snyderman, 1959), without adequate motivation, employees fail to be satisfied. Job satisfaction is one of the most commonly referred to variables connected to employee performance, absenteeism, and turnover (Spector, 1997).

The applications of neuroplasticity knowledge will be presented to help managers to understand how to encourage their employees to act in desired ways. It is understood that company-wide change efforts are 12.4 times more likely to be successful when senior managers communicate continually (McKinsey, 2015). Insights into neuroplasticity can help explain what it is that makes employees yearn for frequent communication, for example.

This thesis on Neuroplasticity and its applications for business managers will explain, in simpler terms, the fundamental ideas that inspire millions to recognise the behavioural tendencies of themselves and others and learn how to improve them. Having studied the works of the respected leaders in Neuroplasticity studies, from the likes of Michael Merzenich, David Hubel, and Jeffery M. Schwartz a comprehensive understanding of this subject has been developed.

This thesis is intended to enlighten anyone who wants to read it, no matter one's background or profession. Despite taking a focus on Neuroplasticity's potential applications within the world of business, this thesis will touch broadly upon subjects that will be relevant to anyone. Those who wish to understand more about the concept to those who want to know how they, themselves, can develop and improve.

Using, both, secondary and primary research, evidence will be presented to support why neuroplasticity impacts people's abilities to learn new things and behave in certain ways. By confirming these observations with sufficient evidence Neuroplasticity-based principles will be applied to explore how managers can motivate others and encourage them to alter their behaviour.

1.1.2 Objectives of this research

The core objective of this thesis is to answer the following question - In what ways can a comprehensive understanding of neuroplasticity offer a greater awareness of the science behind behavioural tendencies and motivation, thus helping managers to become better leaders?

It is important to understand what this question truly asks and the rationale behind it. To explore the question, the following points of focus have been composed with this thesis. Motivation and behaviour. From this, the following sub-targets have been composed.

Neuroplasticity can help managers to understand the behavioural tendencies of employees. With this, ways can be found to amend their behaviour most effectively. Regarding these behavioural tendencies, the thesis will be looking at phenomena and actions linked to resisting organisational change and exploring how past experiences have influenced the neural traits of employees. With this understanding of the less visible causes and cognitive influences on behaviour, we can find ways to get employees to embrace change.

Secondly, the scientific logic behind motivation will be explored by breaking down the causes and events that take place within the body. Motivation concerns the "psychological processes that cause the arousal, direction and persistence of behaviour" (Ilgen and Klein, 1989). For example, the thesis will discuss the impact of dopamine on motivation and how, with neuroplasticity and conditioning, we can manipulate the release of dopamine to spur motivation. A motivated workforce is critical for a company to persevere through labour. The absence of incentive and motivation is one of the biggest problems for managers. By understanding what internally motivates employees, managers could refrain from the need for materialistic rewards.

It is in these areas; managers would find neuroplasticity most applicable. These are important interpersonal responsibilities that modern managers undertake. The increased productivity and morale from improving these practices can cascade through the business.

1.2 Structure of Thesis

Before exploring further into the thesis, it is important that one understands Neuroplasticity as a concept. Chapter 2 will be explaining the general disparities between types of neuroplasticity, as well as its relationship with the nervous system.

Chapter 3 will be about reviewing the literature based around Neuroplasticity. In this literature review, a narrative has been composed explaining the chronological evolution of

Neuroplasticity as a subject of research. This is crucial for understanding the trajectory of future research in this field. Furthermore, the relationship between Neuroplasticity and management has been examined, exposing areas of limited literature.

In Chapter 4, a variety of secondary sources will be evaluated and discussed to comprehend how Neuroplasticity can influence and address human behaviour and motivation, thus leading us to draw conclusions for how managers can apply neuroplasticity-based principles to make better interpersonal decisions. The key factors that can contest the argument put forward within this thesis are brought to light in chapter 5. This will involve the exploration of obstacles and limitations that can arise in the pursuit of understanding neuroplasticity. A consideration for whether neuroplasticity and its applications hold relevance to only a few working environments will be taken. The findings of this study will be summarised in the closing chapter 6.

1.3 Explanation of methodology

As a means of ensuring that the objectives are met with the most effective information available, secondary data is acquired from renowned researchers from established institutions. Given the complexity of Neuroplasticity within the field of neuroscience, obtaining data primarily would have provoked risks of inaccuracy. A number of diagrams and figures have been included so that the reader can gain a better understanding of the results.

2. Importance of Neuroplasticity in Modern Society

In this section, the concept of Neuroplasticity will be explained to the best degree. This is to give the reader an adequate understanding of it before proceeding with the thesis.

2.1 Defining the main elements of Neuroplasticity

The term Neuroplasticity refers to the " ability of the brain to develop new neurons and/or new synapses in response to stimulation and learning" (Oxford Concise Medical Dictionary, 2010). In the words of a pioneering neurologist, Michael Merzenich, it is "The notion that our brain is continually changing itself physically, and continually changing itself functionally" (Merzenich, 2004).

When breaking down the term, one gets 'Neuro' and 'Plasticity'. Both words have Grecian roots. The term 'Neuro' originates from the Greek term 'Neuron', a term for nerve. The term 'Plastic' derives from the Latin word 'Plasticus' which further derived from the Greek term 'Plastikos', which originally means 'moulded' or 'Malleable'. So, in essence, the brain is plastic. Through alteration and neurological moulding, it prepares people to accomplish things tomorrow that they cannot do today.

2.2 Specifics of the breakdown of the Nervous System

The nervous system comprises of your brain, spinal cord and all the connections between them and your organs. In a way, the nervous system serves as a continuous loop of communication, aligning the body to work cohesively towards functions. For example, the nervous system would tell the immune cells to combat bacterial invaders should they enter the body. The feelings and emotions one experience are also attributed to the nervous system. When someone has a stomach-ache, it is the nervous system that causes the 'ache'.

The nervous system is made up of trillions of neurons. These are nerve cells. While these cells do work together, they do not touch. They are disconnected by gaps known as synapses. To communicate messages from one neuron to another, chemicals are 'spat' from one neuron into the synapse. The chemical is then received from the other neuron, which perceives the message.

“Each neuron may be connected to up to 10,000 other neurons, passing signals to each other via as many as 1000 trillion synaptic connections” (Mastin, 2010).

For Neuroplasticity to occur, the body needs to experience the tweaking of these neural circuits. (Malenka & Citri, 2008). It can happen in the following ways:

- By modifying the strength or efficacy of synaptic transmissions at pre-existing synapses.
- By evoking the growth of new synaptic connections or pruning away existing ones.
- By modulating the excitability properties of individual neurons.

2.3 Main Causes of Neuroplasticity

Neuroplasticity is triggered by exposure to two types of experiences. The first set of experiences being those that create trauma and stress, and the second set of experiences offer repeated exposure to a stimulus.

- Trauma and Stress

In simple terms, the accepted idea is that when something adversely stressful happens to somebody, an intense array of chemicals is released into their nervous system. The intensity of these chemicals activates neurons far more than another chemical would. Stress is defined as ‘’any significant distressing situations that demand necessary physiological and/or behavioural readjustment or adaptation for the well-being of the individual" (Selye 1970; McEwen and Sapolsky 1995).

In regard to the impact of trauma and stressful experiences on Neuroplasticity, there is strong research to suggest that the brain can physically change in response to trauma. A series of studies on PTSD patients have indicated that there is a strong positive correlation between the level of stress that one encounters and the volume of functional changes in areas of the brain like the hippocampus and amygdala (Kolassa & Elbert, 2007).

This idea that the brain changes rapidly following trauma makes perfect sense. Brains, as one would expect, are hardwired to steer clear of threats. As a means of keeping people safe, nervous systems will rapidly process negative experiences and learn from them.

- Repetition and Persistent Exposure

The second means of triggering Neuroplasticity would be through repetition and persistent exposure to a particular stimulus. To achieve positive neuroplasticity this way, one must focus attention on and repeatedly practice new, desirable behaviours.

Through repetition and adequate intensity, changes are seen in the synaptic links between neurons. The more and more one carries out a particular behaviour, it refines neuronal connections and the message that the pre-synaptic neuron sends to the post-synaptic receiving neuron becomes stronger. In other words, a well-used neural pathway is developed that becomes engrained into one's long-term memory. Metaphorically speaking, it is like "water etching a deeper and deeper pathway into the side of a mountain over a period of time" (Muscolino, 2011).

Another way to see it is like a weighting system. Over time and with experience, a kind of weighting system seems to emerge within and across different synaptic networks. These weights are a function of the degree of use or repetition of firing with large (heavier) weights given to pathways firing more frequently (Martin & Morris, 2002).

2.4 Types of Neuroplasticity

It need be known that neuroplasticity occurs in several forms. The most accepted way of dissecting the concept is with Functional Neuroplasticity and Structural Neuroplasticity. Other ways that scientists have found variations stem from a chronological perspective. Some neuroplasticity has long-term results while other occurrences may be short term.

- Structural Neuroplasticity

Structural neuroplasticity addresses the more physical changes to the brain that would occur as a result of forming new synaptic connections (Ackerman, 2021). For example, to support one's learning, the brain may alter its physical structure. Unlike other forms of neuroplasticity, this form is associated with long-term improvement in skills or memory.

The most famous example of this type of neuroplasticity in action was found in a study involving London black-cab drivers. The area of the brain that houses spatial intelligence and navigational skills, the hippocampus, was discovered by researchers to be uniquely larger in London taxi drivers than almost anybody else. (Maguire et al., 2000). The reason for this is because Black cab drivers are required to possess a 'map of London within their heads'. To qualify as a driver, they must pass a gruelling navigational exam known as 'The Knowledge'. This will demonstrate that they can seamlessly forecast the optimal route to take from one area of London to another at any given time. The study found that the length of time spent as a taxi driver positively correlates with the size of ones right posterior hippocampus. As such, this finding indicates the plasticity of the brains structure in response to increased exposure to an environmental stimulus. The stimulus, in this case, is the need to navigate the streets of London with no assisting apparatus.

- Functional Neuroplasticity

The second type of plasticity is functional plasticity. This is described as the permanent changes in synapses due to learning and development (Demarin & Morović, 2014). Unlike structural neuroplasticity, functional neuroplasticity aims to improve the neural efficiency of behaviours utilised daily. This behaviour would eventually become routine.

Perhaps the key difference between Structural and Functional Neuroplasticity is that structural neuroplasticity can help humans to build foundations of ‘fluid intelligence’ while functional plasticity helps the refinement of ‘crystalised intelligence’ (Garlick, 2010). Crystalised intelligence is indicated through the ability to use the knowledge that one acquires through education and experience. For example, knowing the 12th President of the United States. Fluid intelligence furnishes people with the logic and problem-solving skills to approach new situations without the need to refer to pre-existing knowledge.

2.5 The Dopamine System and its relation to Neuroplasticity

To truly understand the link between neuroplasticity and motivation, it is important to look into the science behind motivation.

The neurochemical, Dopamine, plays a very important role within the nervous system. As a neurotransmitter, it is released by neurons to send messages to other neurons. It has a "crucial role in motivational control – in learning what things in the world are good and bad, and in choosing actions to gain the good things and avoid the bad things" (Bromberg-Martin, Matsumoto and Hikosaka, 2010). Because of this, it is considered a key substrate of intrinsic motivation, promoting attentiveness and engagement (Baik, 2013).

Of several messages that it can transmit throughout the body, it is a major component of the body's reward system. Dopamine effectively creates the state of motivation that actively seeks these rewards (Bromberg-Martin, 2010). In this context, the reward is the attractive and motivational property of a stimulus that induces appetitive behaviour (also known as approach behaviour) and consummatory behaviour (Schultz, 2015).

It is important to understand dopamine as a neurotransmitter as it can give value to the accomplishment of a task. The presence of dopamine within the process of learning, which will be explained further with the 'Seeker System', promotes intrinsic motivation to approach a subject with a more attentive attitude.

2.6 Recent Research in Neuroplasticity

Neuroplasticity, as a field, is studied in great depth by neuroscientists worldwide. There continues to be exciting new advances in neuroplasticity research. One of the most significant findings as of recent came from the labs at MIT in the US. A study had revealed that when one synapse strengthens, neighbouring synapses weaken. David Orenstein, of MIT, expressed that this finding will explain how the synaptic strengthening and weakening of synapses occur simultaneously to produce plasticity. As one connection strengthens, other neurons must indeed weaken to compensate (Orenstein, 2018). This offers justification for the common assumption that one's tendencies to repeat a behaviour become stronger over time. This research serves to show that society continues to be at the frontier of knowledge regarding Neuroplasticity and there is still much to learn.

3. Review of the History of Neuroplasticity and Its Impact on the working environment

This section will be based on the current literature that is available regarding Neuroplasticity and its applications within the workplace. A retrospective outlook on early literature will be followed by more contemporary works.

3.1 Introduction to Neuroplasticity

On April 24th, 2021, an article was published by the BBC. It was titled ‘Covid: Smell training recommended for lost sense of smell’(2021). The article proposed a solution to help those who have been unable to regain their sense of smell following bouts of the COVID-19 virus. The solution manifested around the idea of Neuroplasticity.

The smell training recommended by researchers in the journal, International Forum of Allergy & Rhinology, would have subjects sniffing four distinctive, easily identifiable smells twice a day for several months. Such smells would be Oranges, Mint, Garlic and Coffee. Through this regime, "It aims to help recovery based on neuroplasticity - the brain's ability to reorganise itself to compensate for a change or injury." With frequent repetition and attention, smell training aims to help the brain find new smelling pathways to recognise different odours.

In another case, neuroplasticity was used to remove the cognitive attachment an individual had to a lost limb (Hegarty, 2011). Ramachandran was able to alleviate an amputee’s “phantom pain” caused by the traumatic removal of his left arm by tapping into the patients mental processing function. With a mirror box creating a visual illusion for the patient that both limbs were intact, the brain thinks that both limbs are still there, and the pain is relieved. By changing the patient’s perception, the neural connections changed.

Neuroplasticity is being utilised more and more for a range of purposes. Whether it be with helping many to recover from illness and injuries, teaching someone new languages or even addressing somebodies’ irrational fears.

Regarding the topic of Neuroplasticity, one must understand that it is only recently that the concept has begun to receive attention from those outsides of the Neuroscience community. The notion itself had been repressed in a way, under the assumption that the human system was fixed after the youthful period of one's life. This idea, however, has been contested and there are now huge amounts of evidence to suggest otherwise. With today's most reputable neuroscientists largely in agreement that the brain continues to change throughout adulthood, many have taken an interest in how we can continue to develop ourselves well into our senior years.

The intentions from the study were to understand to what extent knowledge of Neuroplasticity helps managers to become better leaders. To do this, it is important to understand how to use neuroplasticity to understand the causes of a certain behaviour to a sufficient level before suggesting ways to adjust it.

3.2 Origins of Neuroplasticity

The use of the term, 'plasticity' in reference to the malleability of the brain has been said to have been found in the works of the famous neurologist Sigmund Freud in the latter half of the 19th Century. However, it can certainly be said that the modern perspective of brain plasticity was first noted in the book Principles of Psychology (James, 1890) by the American philosopher William James. It was he who first made the connection between plasticity and the forming of behavioural habits through repeated use of specific brain paths. He stated, 'the phenomena of habit in living beings are due to the plasticity of the organic materials of which their bodies are composed' **(**James 1890**).** While there is evidence to suggest that James had no knowledge of the Synapse, a fundamental component of the nervous system, his speculations galvanised modern perspectives on Neuroplasticity. The point was made that the Neuronal pathway is formed or opened up from repeated use.

We can attribute the first significant publication of the connection between the nervous system and plasticity within the book The Croonian Lecture: La Fine Structure des Centres Nerveux (1894). Early adoption of the term 'Neuronal Plasticity' was found in the literature by the Spanish Pathologist Santiago Ramon Y Cajal in 1894. It is said that the term provoked dispute amongst the Neuroscientific community of the time, for the term described 'nonpathological

changes in the structure of adult brains.' The concept of cognitive impressionability with adults had long been accepted to be non-occurring, for many believed that the adult brain contained a fixed number of neurons that cannot be replaced. The idea of adult plasticity was short-lived, and even Cajal reverted his views to the traditional doctrine by the 20th Century.

Cajal was also credited with challenging the idea of the Nerve Net Theory. Instead, he proposed the Neuron theory (Cajal, 1959). This idea is said to have served as a catalyst for the existence of the Synapse within literature. The theory proposed that the nervous system is composed of masses of neurons that are separated by tiny distances. It would be a small number of years later that these distances coin the term, 'Synapses'. (Shepherd, 1991). The significance of the neuronal theory is not only due to its contesting of the nerve net theory, which did not acknowledge the existence of Neurons, but it was the additional work of Tanzi, who built on Cajal's idea and made the connection between repeated learnings and practise and the strengthening of these neuronal connections.

While originally written in Italian, Tanzi stated "It is evident that the conductivity of the nervous system will stand in an inverse relation with the spaces between neurons. To the extent that exercise tends to shorten distances, it increases the conductivity of neurons that is their functional capacity." (Tanzi, 1983).

3.3 Recent History of Neuroplasticity

The early ideas that behavioural habits are formed by the strengthening of neural connections laid the topical groundwork for later generations of neuroscientists.

~~In 1949, Donald~~ Hebb (1949) proposed the idea that learning causes neuronal adaptations. He wrote,' When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased (Hebb, 1949) Essentially, when the first Neuron fires, the second connected Neuron fires too. Through frequent occurrence, chemical changes occur which strengthen the connections between these neurons. This results in the formation of habits and non-deliberate tendencies. The significance of the

Hebbian Theory, as it became to be known, is that it scientifically evinced the concept of cortical plasticity.

The 1960s saw the applications of Neuroplasticity first be put into practice. The American Neurologist, Paul Bach-Y-Rita, was able to use his knowledge of the concept to help patients with neurological disabilities. Of several projects that he had worked on, his work with the blind was most revolutionary regarding Neuroplasticity (Bach-y-Rita, 1990). Bach-Y-Rita developed a machine where a camera transmits vibrational signals to a patient indicating the tonal qualities of objects within the camera's vision. The vibrations would activate the skin sensory receptors, communicating with the brain what is infront of the individual. Before long, the brains of the blind individuals would begin to interpret the signals, allowing them to see the objects in front of them to a rudimentary level. The patients have presented a 'vocabulary 'of objects and the trainer would record the time it would take for each object to be identified. The process of introducing objects for the patients to identify was repeated over time, and the latency of recognizing these objects would fall. For the first few presentations, recognition times would be within 5-8 minutes, but after 10-Plus hours of training, the recognition time fell to within 5-20 seconds, highlighting the clear development of visual analysis techniques (Bach-Y-Rita et al., 1969). Through repetition and adequate intensity, the neural connections that allow the individual to perceive an object become more efficient. The studies provided significant amounts of information that concerned brain plasticity and the development of 'perceptual mechanisms.'

The idea that the adult brain is, indeed, dynamic, and continuously modified by experience is hugely significant regarding Neuroplastic research and its potential applications. For many decades, the brain was perceived to be a 'non-renewable organ' that contained a finite number of brain cells (Fuchs and Flügge, 2014). The 'no new neurons' dogma, as referred to by Fuchs and Flugge, covers the concept that one's behavioural tendencies become fixed after the incredibly neuroplastic childhood period. Many reputable scientists agreed on this. In the early years, the idea saw the support of the likes of Camillo Golgi, who developed the Net Nerve Theory, as well as Santiago Ramon Y Cajal. Despite Cajal's objection to the idea in his book, Structure des Centres Nerveux (1894), his later literature presented a more sceptical view of adult neuroplasticity. He stated, 'nerve paths are something fixed, ended, immutable. Everything may die, nothing may be regenerated. It is for the science of the future to change, if possible, this harsh decree" (Ramón y Cajal, May, DeFelipe and Jones, 1991).

It can be said that the ‘no new neurons’ dogma had adverse impacts on the development of neuroplastic research, causing scientists to divert attention from detecting plasticity within the brains of adults (Fuchs and Flügge, 2014).

It was not until the late 20th century when the no-new-neurons dogma began losing ground. Studies from around the world were emerging, contesting the idea in favour of adult neurogenesis and malleability.

Regarding the new outlook on Neuroplasticity, leading neuroscientists Michael Merzenich and Dean Buonomano were able to discover that plasticity was lifelong. They concluded their findings as ‘adult animals are not fixed entities, but rather, are dynamic and are continuously modified by experience. The cortex can preferentially allocate an area to represent the particular peripheral input sources that are proportionally most used.’ Such attitudes cemented the idea that frequent usage of select neuronal pathways will trigger behavioural change, even in adults.

Since the late 1990s, experiments have recurringly supported the notion of ‘life-long plasticity’. One such study proved that small amounts of computerised plasticity-based training can change older human brains to maintain and improve cognitive function. (Shah et al., 2017). One of the reasons for this plasticity to have occurred from computerised training is because virtual reality-based games can alter neurochemical levels within the brain, creating a cognitive climate for neuroplasticity to occur. (Koepp et al.1998)

3.4 Neuroplasticity and its connection to working environments

With the waves of research proving that adult plasticity indeed exists, a new era of research has emerged, with vast amounts of literature has been published aimed to help readers to incite self-induced neuroplasticity. Common themes taught in the literature are methods of triggering neuroplasticity and conditioning.

More specifically, the literature is sought that ties the concept and applications of neuroplasticity within the workplace environment. Particular attention has been paid to literature intended for managers and those in roles of leadership.
Within the literature, several neuroscientists and other experts have offered the following techniques to create an environment for neuroplasticity to occur:

1. Safe Environment
2. Rewards
3. Facilitating the Right Connections
4. Keeping the circuitry alive.

Humans Are Instinctively programmed to perceive threats at an amplified level to rewards. Indeed, there was a time when this programming was critical for our survival. In the book, The Happiness Hypothesis, American psychologist Jonathon Haidt clarifies that this behaviour is embedded into our nature. Without such vigilance, he argues ' The cost of missing the sign of a nearby predator, however, can be catastrophic. Game over, end of the line for those genes.' (Haidt, 2006). It is due to this overactive survival instinct that challenges can be presented when implementing Neuroplasticity-based behavioural change within the workplace.

Threats can activate the limbic system, which impairs the function of the brain in significant ways. For example, more adrenaline is released, which can make one feel more focused, but reduce the ability to make the most optimal of decisions. Fear also takes blood away from the brain, instead of rushing towards the limbs and muscles. This mechanism would have facilitated ones need to escape danger or fight back. With all energy going into self-preservation, it can be argued that this is far from the optimal environment for facilitation learning and neuroplasticity within the workplace.

The idea that a safe environment is optimal for learning is common knowledge. For example, feeling safe in school, away from violence and other stressors increases student engagement and translates to higher academic achievement. Until people’s minds are at ease, they fail to pay attention to their goals and learning. The common practice recommended for facilitating neuroplasticity within the workplace is to reduce the presence of potential threats. The following methods have frequently been suggested as ways to create unthreatening environments within the workplace:

- Rewards

It is suggested that one way to create a sense of safety is to offer the brain a reward, which counter-acts the threat.

In the short term, the best types of rewards that one could use for people to embrace change, and thus begin the process of neuroplasticity, would be to offer external, tangible rewards. These are easier to comprehend in a short space of time. Such rewards would include financial bonuses and holidays. It is also highlighted that, in the long-term, materialistic rewards can hinder neuroplasticity and the adoption of behavioural change because the intrinsic motivation to retain a particular behaviour fails to cultivate.

- Safe Zones.

Another recommended way for creating a safe environment is with a more obvious technique. Formal 'safe zones' can be created within the workplace, where workers can experiment with new ideas and try different approaches to combatting problems. These safe zones are risk-free, proactively encouraging employees to trail new ideas and experiment with change.

According to renowned neuroscientists Jason Wright and Jaak Panksepp, this is essential for activating peoples 'seeking systems' (Panksepp et al., 2014). In essence, our 'Seeking systems create the natural impulse to explore our worlds, learn about our environments, and extract meaning from our circumstances.'. Pursuing the urges of our seeking system releases dopamine, motivating us to explore further (Cable, 2018). The heightened sense of security would give workers greater elements of 'psychological safety, defined as the degree to which employees are comfortable taking interpersonal risks. This would allow them to focus on engaging in neuroplasticity-based behavioural change.

- Facilitating the Right Connections

Once that the environment has been reduced of threats to a sufficient level, it is understood that people can focus their attention in the right way for cultivating new neural connections (Emery,2019). Feeling alert and engaged releases neurochemicals that accommodate brain change. (neurotracker.com, 2021) To do this, we need to apply our complete attention to new ideas/behaviours and mentally retain these pieces of information long enough to ‘synaptically encode’ the knowledge into our brains (Dispenza, 2010).

The emphasis in this stage of facilitating neuroplasticity to occur is focussed attention. This is necessary to make neural connections. Therefore, the literature makes it clear that distractions

can be detrimental to the process. When we do not pay complete attention, ‘our brain activates a host of other synaptic networks’ that can distract it from its original intention. So, by limiting sensory distractions around us, like sounds and visual cues, the brain does not need to make connections other than the connections it is proactively pursuing (Emery, 2019). It is no surprise that active employee engagement and a proactive focus towards the new behaviour/ stimuli is crucial for commencing neuroplasticity in employees. Such findings are supported with the Macleod Report (McLeod and Clarke, 2009). This report emphasised the positive correlation between employee engagement and organisational performance. In this report, four key factors were attributed to building stronger employee engagement. These were engaging managers who develop employees with greater interpersonal approaches, accommodating an employee voice within the organisation, making the focus visible for all and, finally, employees have a clear line of sight to the strategic narrative of the company. The report proceeded to emphasise the concern that many managers are struggling to engage staff to any satisfactory degree, with one British survey claiming that more than two-thirds of business leaders said that engaging their staff was the biggest challenge they faced. So, only with sufficient attention paid to a stimulus is one able to sculpt the neural connections within the brain. Without, no strong, lasting connections can be made (Syka and Merzenich, 2010).

- Keeping the Circuitry alive.

Once the employee/ subject of neuroplasticity is engaged in the stimuli, it is very necessary the ensure that attention is paid for a longer duration of time. This means that one must find ways to keep the new way of doing things occurring.

Repetition is often regarded as a fundamental component of neuroplasticity. Referred to as the ‘fire-together, wire together’ credo, to make any lasting synaptic connection requires repeated activation (Dispenza, 2007).

The science behind this stage is rather straightforward. Repetition leads to the enhancement and reinforcement of new synapses being formed. Repeating an action or thought process increases the number of synaptic connections that provoke this behaviour. Over time, these heavily frequented synaptic connections ‘create a well-used pathway’ that becomes part of the long-term memory (Muscolino, 2011). It is also important to consider that, while strengthening synaptic connections requires repetition, the forming of new synaptic junctions, in the process of synaptogenesis, requires repetition over a grander timescale of days-weeks. (Kukushkin and Carew, 2017) This step is emphasised heavily in the context of adaptive cognitive change. For

example, the changing of a mindset or outlook. We can also stress the importance of repetition for the development of new skills and abilities (Emery, 2019).

3.5 Identifying the research gap in Neuroplasticity

The extensive research has helped to determine that there is, indeed, a gap in the literature regarding Neuroplasticity and its relevance to Management.

In the literature review, the narrative was emphasised. It consisted of a chronological picture of the changing attitudes and breakthrough developments within the field of neuroplasticity. Since the late 19th Century, an understanding of Neuroplasticity and its capabilities has evolved at varying rates. The prior doctrine that neuroplasticity seizes post-childhood kept further exploration into its relevance within the workplace and throughout adulthood at a rudimentary level.

However, when it was found that neuroplasticity occurs throughout the entirety of one's life, the scene exploded with pioneering literature and research. An array of literature was sourced, elevating awareness, and understanding of Neuroplasticity within organisations and the workplace. To understand how to measure the applicability of neuroplasticity to Managers and their performance, this literature held significant relevance.

Understanding the basis of literature available already had indicated that there are already ample contributions within the following fields of literature:

- How people can improve their own lives with Neuroplasticity?
- The necessary conditions for Neuroplasticity to occur and how to implement this in the workplace.
- The importance of Neuroscience within the field of management.

Nevertheless, a gap in the literature had been distinguished. There was a lack of literature that highlighted, more specifically, why managers can improve their interpersonal skills with an understanding of neuroplasticity.

What should be known is how an understanding of neuroplasticity can help managers to become more emotionally intelligent when dealing with colleagues and subordinates. To do this, one must understand exactly why managers can apply neuroplasticity-based principles and learnings to cultivate employee motivation and desirable behavioural-based performance within the workplace.

This thesis is committed to understanding the limitations posed to managers who wish to improve their abilities with the help of the notion. The rationale for this study is to identify more specifically the value of neuroplasticity training to managers and whether it truly helps to correct interpersonal skill deficits through a wider understanding of why people behave as they do and how one can motivate them to perform better. With this knowledge, businesses, and managers themselves would be able to make more informed decisions as to whether investing time and resources into learning about Neuroplasticity can guarantee that interpersonal skill deficits will be addressed.

This study also holds substance as an attempt to highlight which types of managers will best benefit from neuroplasticity. By understanding exactly what skills/characteristics could be improved and the limitations that present themselves, it would be possible to understand whether neuroplasticity should be incorporated into particular learning and development programmes for managers and leaders.

4. Research

This section presents forth the research carried out in effort of identifying the ways that a understanding of Neuroplasticity can help managers.

4.1 Problem Definition

Before investigating the secondary research, it is important to truly understand the problem that is being addressed in this study.

4.1.1 Problem

It is the following problem that provoked the original title question of this study. Many managers lack an adequate understanding of Neuroplasticity. A concept that could help them to truly understand the behavioural traits and cognitive abilities of themselves and colleagues. Poorly informed managers can engage in counterproductive interpersonal behaviours with their teams (Adhikari, 2020). Cases of this will see managers making public examples of their employees, succumbing to favouritism, and rushing to blame others. According to a British survey carried out in 2017, 58% of respondents say that they did not think managers were equipped to deal with the human or emotional sides of their jobs (Muller-Heyndyk, 2021). This suggests that many managers fail to possess the adequate interpersonal skills that are truly required for the position. It is estimated that 19% of managers have only taken the position for the pay rise. An additional 17% say they had taken the role only as they assumed it was the right logical move (Frontline Leader Project, 2019).

4.1.2 Solution

Following the identification of this clear interpersonal skill deficit, the subsequent solution is proposed. Managers should gain a more comprehensive understanding of the concept of neuroplasticity and apply it to their managerial approaches.

Knowing that the brain is malleable and that humans behave in particular ways due to the conditions that they have experienced, managers will be able to understand the psyche behind

goal setting and offer more effective ways to motivate employees and themselves. By understanding the role of dopamine and other chemicals in encouraging humans to adopt behaviours and learn new things, managers can implement better solutions that are backed by science.

4.1.3 Result

By correcting the problem with the proposed solution, the following result is expected. Managers with a broad understanding of neuroplasticity and its applications within the business world will harness great interpersonal skills, thus developing them into better leaders. "Leadership is defined as the process of influencing the activities of an organized group toward goal achievement." (Rauch & Behling,1984). It can also be described as ‘’a social process in which one individual can influence the behaviour of others without the use of threat or violence." (Buchannan and Huczynski, 1997). Those versed in the ideas around Neuroplasticity, and neuroscience in general, would be able to understand how better to intrinsically motivate others to act in desired ways. This, of course, would dismiss the need to influence in a forcible nature. Also managers are expected to be able to visualize the process of developing better. For example, they would understand why mistakes are a necessary part of the learning curve and the importance of repetition. This would equip them with unique approaches to organising goal achievement.

This question forms a meaningful objective of the research. By understanding to what extent, and how this can influence managerial teachings and the amount of literature coming to light around Neuroplasticity within a business.

4.2 Methodology of Research

This section focuses on the research approach and methods adopted in the pursuit to understand how a comprehension of Neuroplasticity can contribute to the performance of a manager within the fields of motivation and understanding behaviour. It is important to draw data that directly clarifies the relevance of Neuroplasticity within these areas.

4.2.1 Methodological Approach

Secondary Data had been sourced to build a case around this thesis. Secondary data is more effective in this study as the context of this research draws upon elements from the realms of neuroscience and complex behavioural psychology. Sourcing data collected by professionals with years of experience is therefore needed.

However, it should be known that using secondary data has limitations. This research is often composed with a different purpose than the question that this thesis intends to answer. Furthermore, given the various aims of the research, both quantitative and qualitative data will be used. This mixed research, using information gathered in a range of ways, will provide a more holistic, dependable set of results for interpretation.

4.2.2 Source Analysis

The following sources were used to understand the relationship between Childhood neuroplasticity and adult behaviour.

- ‘Childhood Adversity as a Plasticity Factor That Modifies the Association Between Subsequent Life Experience and Psychopathology’ (Dunn, 2018)

The first source acquired explores the relevance of childhood adversity (Negative experiences) to one’s susceptibility to stresses and mental illness within adulthood. The paper is titled ‘Childhood Adversity as a Plasticity Factor That Modifies the Association Between Subsequent Life Experience and Psychopathology’ (Dunn, 2018). These negative experiences accounted for include neglect, abuse, and poverty.

This source was found to be useful and applicable to the studies as it explains how the brain, through neuroplasticity, is directly affected by childhood experiences. The research was published by the Journal of the American Medical Association, a highly reputable institution. The data samples of participants were sourced from the National Epidemiological Survey on Alcohol and Related Conditions (NESARC) from 2001-2005. While the data had not been sourced recently, it is not deemed to be time sensitive.

- ‘How Early Experience Shapes Human Development: The Case of Psychosocial Deprivation'(Nelson, Zeanah and Fox, 2019)

The second source that was selected was an academic research article published in 2019. It was titled ‘How Early Experience Shapes Human Development: The Case of Psychosocial Deprivation' and it intends to address the question 'What happens to the brain and behaviour when a young child is deprived of key experiences during critical periods of brain development?'. The research focuses, in particular, on the consequences of institutional rearing and the absence of a maternal relationship during childhood. The contributors to this article have credibility too, coming from Harvard Medical School, Tulane School of Medicine and the University of Maryland.

The article helps in the building of this case as it attempts to explore the impact on the brain and adult behaviour as a result of one's lack of adequate parental figures and maternal nurturing. By understanding the fundamental impact of this experience on the cognitive development of individuals, one can understand better how childhood experiences can affect one adult behaviour through neural plasticity.

- ‘Transtheoretical Model’ (Prochaska & DiClemente, 1982)

The source used to understand Neuroplasticity’s role within behavioural change is a model. It maps the stages of behavioural change. The model is effective as it is simple to comprehend and highly applicable for the transition to a variety of behaviours.
Regarding motivation, the following source was used.

- ‘The Growth Mindset and Academic Performance’ (Dweck, 1986)

The source collected to understand the link between motivation and Neuroplasticity was a study carried out in 1986. While this may be perceived a little outdated, it continues to hold weight. The study is the first publicised evidence that the ‘growth mindset’ can stimulate intrinsic motivation. To ensure reliability, the student samples were randomised regarding demographics and abilities. A stratified random sample of 65 regular public schools in the United States was taken. This provided 12,490 ninth-grade adolescents to be pooled within the selection. It is a form of explanatory research, aiming to explore the relationship between two variables. One being academic performance, the other being mindset.

4.3. Findings and Discussion: Neuroplasticity and Behaviour

As a manager, it is crucial to understand why people behave the way they do. This insight can allow managers to lead with greater empathy, a highly desirable characteristic of a manager. Furthermore, managers often must amend or direct the behaviour of subordinates to align with the companies' ambitions.

Drawing upon two key areas within the field of behaviour, cognitive malleability is highly involved. This would be within childhood, where adolescent experiences are proven to have a heavy influence on adult behaviour, and with concentrated behavioural change.

Childhood has a huge impact on one's life. It determines what people would end up doing, who they will have relationships with, where they will be living but, most importantly for managers, how they will act and respond to their environment.

Regarding neuroplasticity, the infantile period (Up to the first five years) of one's life is proven to be when the mind is most malleable. Maternal support can help develop the volume of the child's hippocampus, the emotional control centre of the brain (Luby et al., 2012). Furthermore, we now understand that poverty, abuse, and neglect can all have lasting impacts on the brain's development during those critical years when brain structures are being formed.

For managers to understand neuroplasticity to the extent that they can truly display better interpersonal skills, exploring the importance of neuroplasticity in childhood will be a big help. In this section, two secondary sources were selected that offer evidence confirming childhood as the potential source of particular behaviours and impulsions in adulthood. Both of these sources address the concept of neuroplasticity and neural development, confirming their sensitivity to the presence and absence of experiences throughout one's childhood.

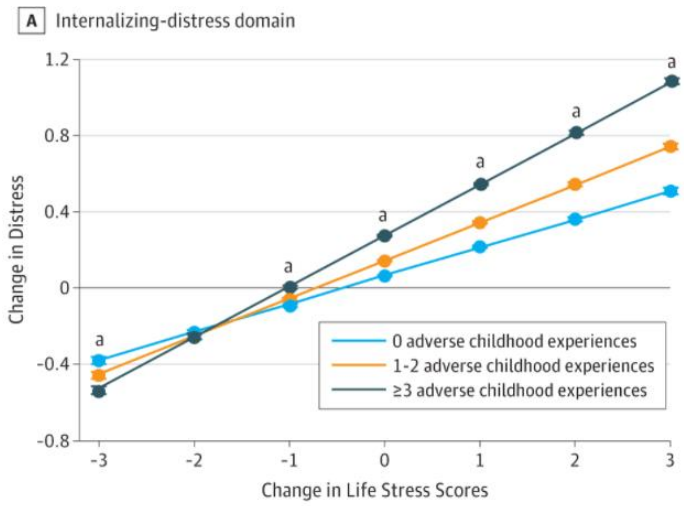
4.3.1 Source One: 'Association of Childhood Adversity With Differential Susceptibility of Transdiagnostic Psychopathology to Environmental Stress in Adulthood' (Albott, Forbes and Anker, 2018)

The article presents several findings from its research. Amongst several, the following are most significant to the research that I am doing. The research sampled participants in two waves. The first wave was from 2001-2002, and the second wave was 2004-2005. In total, this provided 34,458 participants for analysis.

The data showed a positive relationship between the number of adverse experiences that one would have in childhood and their susceptibility (sensitivity) to changes in the level of stress within their adult lives.
In adulthood, those who have experienced more adversity at a young age tend to be more sensitive to the negative experiences, responding unfavourably, but on the other hand, they are likely to be more receptive to positive changes in the environment too. The research discovered that reductions in the number of recent stressors, like financial troubles, were associated with lower levels of psychopathology symptoms and this was especially found amongst those adults who had been exposed to adversity within childhood. This is visibly shown in Figure 3. The graph indicates that the reduction in distress within the environment has a greater effect in lowering the life stress scores of those who had experienced greater levels of adversity within childhood.

This observation stands to support the Differential susceptibility hypothesis (Belsky, 2013) The idea proposed here is that the unique development of individuals can make them differentially susceptible to experiences within the environment. This is a theory that heavily draws upon the notion of neuroplasticity.

Figure 1: Change in Each Transdiagnostic Psychopathology Domain by Change in Life Stress and Level of Childhood Adversity



(Albott, Forbes, Anker, 2018)

This graph shows that experiencing a higher amount of adversity within childhood would lead to a heightened stress response when stressors are introduced.

A negative score on the 'Change in Distress' axis represents the removal of stressors into the environment. A positive score is the introducing of stressors into the environment. A similar finding within this body of research was that those with childhood traumas possessed a phenotype of heightened stress. In other words, those with a history of childhood adversity and trauma tend to be more susceptible to stressors in general, possessing this as an observable characteristic. This heightened stress, which may be in the form of PTSD or responsibility aversion, is a product of neuroplasticity within their development.

The occurrence of adversity within one's childhood would have huge implications for the trajectory of brain development. Childhood is a period when the brain is most plastic and the presence of trauma, paired with the deprivation of necessary caring mechanisms, will leave the neurological footprint that will have someone more or less sensitive to changes in the environment. These findings can be applied to a professional workplace setting. For example, the possibility of lay-offs within a department poses a clear threat to the employees, thus becoming a negative stressor. The findings of this research would imply that those employees

who tend to display greater symptoms of stress within this period may do so as a result of the neurological conditioning that would have occurred through childhood adversity.

Managers truly can benefit from an understanding of this concept. It offers a less visible explanation of what can cause workplace stress. It need not be discussed at length how damaging over-stress can be to employees and the workplace in general. Stress is a common reason for absenteeism, an economically detrimental challenge for many companies. In 2019, it was estimated that 17.9 million working days were lost due to work-related stress and mental health issues in the UK (UK Office of National Statistics, 2020) Furthermore, those who are unable to sufficiently deal with stress can become unwilling to take on further responsibilities within work. This has long-term consequences as they fail to develop as assets to the company. It is up to managers to help them reach their optimum levels of productivity, but it is often argued that managers are not doing enough. The lack of managerial support has long been a factor in work-related stress (Health and Safety Executive, 2020).

Managers should understand that each employee has had a different upbringing. These unique experiences have caused their brains to develop in different ways. This will cause the employees to respond differently to stresses in the environment, like change and unprecedented circumstances. Managers should harness this information and take unique approaches to cultivate the development of their employees. Those who may be more susceptible to stress should be observed and understood. They may have been conditioned this way. Managers can also take from this the fact that some are more responsive to positive changes in the environment too. Those more prone to negative stresses may also be more positively responsive to positive experiences. Active encouragement and such will be more useful to these people in particular.

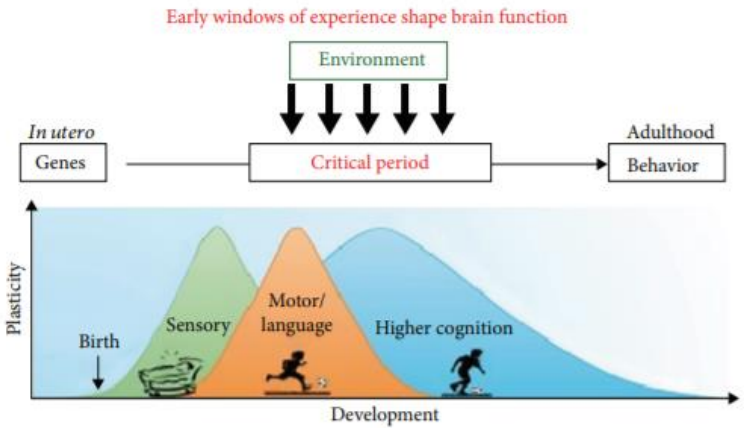
4.3.2 Source Two - ‘How Early Experience Shapes Human Development: The Case of Psychosocial Deprivation'

This source that I had chosen is an academic article written for the international journal, Neural Plasticity. The article aims to draw together various bodies of research to understand the impact of early deprivation on the human mind. The article, in essence, promotes the idea that psychological neglect at a young age has significant implications in the development of the brain.

While a rather broad assumption, and one with the agreement from the consensus, the article backs it with a series of more specific findings that emphasise the relationship between childhood and the behaviour of adults. It is important to understand that there is a critical period within infancy where experiences have very powerful effects on one's cognitive development. This is simply visualised in Figure 2.

The first finding perceived to be significant to this thesis states that early parental deprivation will lead to a series of adverse cognitive and behavioural traits. These include poorer spatial memory, attachment issues and less stable stress response systems (McLaughlin et al., 2015). The influence of a parental presence is fundamental in the development of these abilities. The article summarises this point by saying ' Through rhythmic cross-modal matching of infant behaviours, emotional states, and biological rhythms, parents shape infants' relational responses. This is known as 'biobehavioural synchrony' and it is important for the healthy development of stress response systems, the building of secure relationships and other crucial elements of psychological intelligence. Such a social bond between infant and parent sets the framework for cognitive development and the infant's lifelong capacity to regulate stress and modulate arousal (Feldman, 2007).

Figure 2: A visual representation emphasising the importance of the infant period on the a person's cognitive development due to heightened levels of plasticity



(Hensch and Bilimoria, 2012)

Similar to the first article of research that was used, this strongly emphasises the importance of the first few years of one's life to the neural development of stress response systems. The ability to appropriately deal with stress and recover from it is influenced heavily, therefore, by infantile foundations.

The second finding shows that children, following severe socio-emotional deprivation and early institutionalisation, tend to have reduced levels of grey and white brain matter throughout their lives (Eluvathingal, 2006). Both components of the brain are important. Grey matter is responsible for information processing while white matter is facilitating the transferring of information throughout the nervous system. We can attribute this happening, of course, to the notion of neuroplasticity. The study that produced these findings was based in Romania, and the researchers carried out neurological assessments on children who have spent time in orphanages. The results of the research showed that these children displayed 'relatively mild specific cognitive impairment and impulsivity.

With evidence to support the assumption that those exposed to early deprivation tend to display more cognitive and behavioural problems, the researchers suggested that this would have been a result of certain neural pathways lacking stimulation during 'critical' periods of brains development. In the report, it was stated 'The concept of inadequate stimulation during development may be operational in social deprivation, in which a failure to achieve adequate stimulation during the postnatal period may lead to dysfunction of related brain structures.' (Eluvathingal, 2006)

With the results in mind, it can be seen how the concept of neuroplasticity, and its wider implications within the world of psychopathology and behaviour, can help managers to comprehend the behaviour of colleagues. Due to circumstances that were out of their control, people could, indeed, act in ways that will differ from employees who have had different childhoods.

These incidences at childhood may be difficult for an employee to explain and effective managers should be able to show compassion towards these experiences and offer a unique approach to motivating, discipline and responsibility if needed. Managers who operate in international settings, or with teams from diverse backgrounds, would benefit immensely from the understanding of parental deprivation and its adverse cognitive repercussions.

While some countries have enjoyed relative stability during one's lifetime, a less ethnocentric manager would be aware of how geopolitical adversities, like war and famine, could lead to a greater portion of one culture's population being orphaned, or without key family members. These circumstances could, as found in the research above, provoke the presence of neurological impairment and behavioural issues that could have impacts within the workplace.

Both sources address the detrimental effects that adverse experiences can have on our behaviour. The first source, showing that one's ability to handle and perceive stress can be determined at an early age, while the second source further emphasising this point concerning whether maternal figures were present or not.

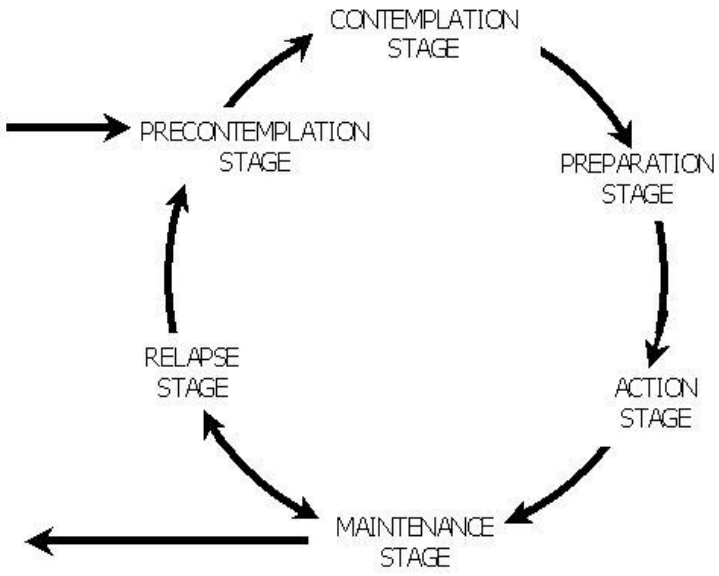
The key takeaway for managers from this is that individuals will often require unique levels of nurturing and supervision when introducing new workplace stressors into the environment. Employees should not be blamed for not being able to handle certain situations as well as others, for their stress response mechanisms have been influenced by situations beyond their control.

4.3.3 Source Three – 'The Transtheoretical Model'

An effective way to present forth the role that neuroplasticity has regarding behavioural forming is found when humans actively set out to change a particular behaviour. One such proven model of behavioural change, the Transtheoretical Model (Prochaska & DiClemente, 1982) is highly dependent on the power of neuroplasticity for its success. To progress through the steps of this model, the human mind indeed needs to be malleable. The transtheoretical model was developed by Prochaska and DiClemente in the late 1970s. It had evolved through a series of studies examining smokers who were able to quit independently of pharmacology and other aids (Prochaska & DiClemente, 1983). The model assumes that people do not change their behaviours quickly, but rather through a cyclical, often long-term, process.

According to the model, a person goes through five stages of change. Each of the changes requires the person to develop a new state of mind regarding their behaviour before taking a particular set of actions.

Figure 3: The Transtheoretical Model



(Prochaska & DiClemente, 1982)

This model (Figure 3) will be presented in a modular structure, breaking down the stages to directly explain the dependence this renowned theory of behavioural change has on the notion of neural plasticity. After describing each step within the process, research-backed neuroplasticity-based reasonings will be applied behind these stages. With this information, a strong discussion will be built. exploring the utilities of this knowledge for those in managerial positions.

Findings:

1. Precontemplation

This is the first identified stage of the model. At this stage, the ambitions to change behaviour are sparse. The subject would often be unaware that their behaviour is problematic (Prochaska & DiClemente, 1982). In many ways, they will underestimate the benefits of changing the behaviour. Given that the subject is not serious about changing, they may feel defensive in the face of people's efforts to get them to change their behaviour. They lack focus and motivation at this stage.

In the workplace, the subject could be an employee who has a bad habit of gossiping about colleagues. He/she may not consider this a problem, nor put much thought into the adverse

effects of these actions. Within this stage, synaptic plasticity is likely to occur (Hebb, 1949). It should be noted that one can develop adverse behaviours just as easily as one can engrain themselves with good behavioural tendencies. The subject would be frequently performing an undesirable behaviour, strengthening the neurological pathways that encourage this behaviour to occur. This strengthening occurs typically with the frequent stimulation of the postsynaptic cell (Bear, Connors and Paradiso, 2007) over time it becomes more responsive to the neurotransmitter that is released presynaptically in a process known as 'long-term potentiation (Bliss and Cooke, 2011).

Older habits tend to be carried out with little conscious thought. For example, making a cup of tea as soon as one enters the kitchen in the morning. These behaviours require little energy or attention, so these actions tend to be operated by the brain cerebral cortex.

2. Contemplation

The second stage of behavioural change is the contemplation stage. At this point, people begin to become aware of the problematic consequences of their behaviour.

Despite recognising the adversities, they may still feel ambivalent towards changing their behaviour. They will likely contemplate whether the behavioural change is worth it, considering the demands of energy, effort, and sacrifice that it will cost to overcome it. This may lead them to undermine the long-term benefits associated with the change. Despite this, they are more open to receiving information about bad habits.

At this stage, it is hugely important to get clear on the positive benefits of behavioural change. Understanding how a certain behaviour is going to make life better links new emotions to the action. Positive association is a fundamental component of the process of neuroplasticity. For example, learning about the cardiological benefits of running will make one feel positive about this activity.

A concept popularized by Tony Robbins in the book 'Awaken the Giant', neuro-associative conditioning is a system that can create changes in human behaviour provided that this behaviour can remove the pain or create pleasure (Shultz, 2015). For the rewiring of the brain to occur, the change needs to occur intrinsically. The person needs to be clear that they, themselves, want to make the change. With intrinsic motivation, the joy neurochemical,

dopamine, is released into the brain. Attaching dopamine to the process of behavioural change is crucial. With this, repetition becomes a pleasure, not a chore, which enhances the chance that neuroplasticity would occur to an adequate level.

At this stage, the person can also identify the cues that provoke the behaviour which they want to change. These cues can often be subtle and hard to recognise, like the smell of coffee that may trigger a desire for a cigarette. Recognising these cues is very important for cognitively adopting behavioural change.

3. Preparation

Once the person has contemplated to the extent that they decide to pursue behavioural change, they begin the stage of preparation.

They may be vocal about this new commitment, telling others about their desires to change. It is important not to skip this stage, it allows for the user to make avid research, accept the scale of the change, and forecast when it could be difficult.

For behavioural change to occur, the body requires vast amounts of energy. The area of the brain that operates tried and tested routines, the Basal Ganglia, requires little energy to operate effectively. When we change behaviour, it is the Prefrontal Cortex of the brain that comes into action, processing new information. This is a highly energy-intensive part of the brain which can lead us to feel uncomfortable and easily exhausted. People are often unaware of this occurrence, failing to prepare for the excessive cognitive demands of the change (Rock and Schwartz, 2010). Therefore, at this stage, humans should consider reducing their mental loads and plan to conserve energy.

Furthermore, it is important at this stage to plan rewards that encourage behavioural change. When associating actions with pleasure, the body releases dopamine, a source of motivation. Feeling rewarded for undertaking a new action or mindset, neuroplastic change occurs. The new behaviour or skill that one wishes to adopt should hold a level of difficulty that encourages the person to actively recognise when they are performing this action. For cognitive change to occur, the brain needs to experience challenges as well as novelty.

4. Action

Then comes the stage when people recently change their behaviour. They do this with the intent to keep going and move forward with this change. This behavioural change could be in the form of removing problematic behaviour or acquiring more desirable behaviours.

This action may even take the form of changing one's environment as a means of changing their behaviours. During this stage of change, the person exerts a high amount of energy and commitment to maintaining willpower. They are at risk of relapse at this stage, and it is important to sustain motivation with rewards and encouragement.

At this stage of behavioural change, we draw upon some of the fundamental conditions that need to be fulfilled for neuroplastic change to occur, Intensity and engagement. What is occurring at this stage, with each repeated use of the new behaviour, is that the old neural pathways that would be active during the old behaviour would weaken. Simultaneously, new neural pathways that can normalise the new behaviour within the brain are getting stronger.

5. Maintenance

Finally, once the action of changing behaviour has occurred to an adequate extent, the person must maintain this behaviour. This stage is where people would work to consolidate the gains which they attained during the action stage. It is important that, for the right amount of time, the person consistently engages in the new behaviour.

At this stage, it is absolutely crucial that the new behaviour is repeated and practised. Neurological experts have said that shorter bouts of intensive repetition of a new behaviour are needed to create new connections. The validity of this principle has been proven time and time again. Most notably, in Donald Hebb's book 'The Organisation of Behaviour', he said "When an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic change takes place in one or both cells such that A's efficiency, as one of the cells firing B, is increased."

It takes time for both, structural and functional, neuroplasticity to occur for a person. So, patience is also required. Neuroplasticity does not occur at the moment of pursuing said action, but at other times, when the body reflects on the new experiences.

Changing behaviour is not easy. While the model presents a programme for what needs to be done, it lacks rationale and suggestions for how it should be done. Behavioural change is very much about switching your mindset. To do this, it is important to abide by the principles of neuroplasticity, making your progression more effective and consistent. Understanding the fundamental influence that neuroplasticity has on one's ability to change behaviour will help managers in a variety of departments and roles:

- Change Management

Within the field of change management, having this understanding could be crucial for ensuring the successful implementation of new organisational changes.

The first reason for this would be because it can explain Humans natural dislike for change and partialness to routine, thus explaining the rationale behind certain resistances to change. Knowing that adjustment to change is a highly energy-intensive process, managers can make sure to alleviate certain employees of excess responsibilities, enabling them to focus on the subject of change.

For the rewiring of the brain to adjust to new behavioural demands, intrinsic motivation needs to be present. With this knowledge in place, managers will appreciate the importance of obtaining early 'buy-in' from employees. Obtaining support from employees is fundamental for energizing the movement and implementing the changes with greater fluidity.

Workers can become distressed when they feel change contrasts with their attitudes and beliefs. This is known as Cognitive Dissonance and will lead to change resistance (Festinger and Carlsmith, 1959). As change managers, we can use neuroplasticity to reshape the beliefs of change recipients, therefore gaining their 'buy-in'.

However, If the change becomes associated with a burden for the employees, the ability to achieve support becomes more difficult. Again, managers are able to combat this issue by designing change as a stimulus. Change can be associated with good through frequent rewards for adaptation. Employees can be given bonuses or praised by management for responding well to the stimulus. Furthermore, a changing culture can be developed through frequent incremental changes. A company that continually adapts conditions the workers to live with change.

- Human Resources

Within the field of HR, there are duties that managers perform that could be improved greatly by those who understand and apply the conditions needed for cognitive restructuring to occur. The first being within Learning and Development. It is not uncommon for employees to undertake training programmes to adopt more desirable behaviours. For example, somebody within the sales department may take part in a programme that aims to improve their ability to negotiate. With an understanding of the neuroscience behind the behavioural change, the manager can design a training programme with greater effect. A training programme needs to offer engagement, stimulation, and a degree of difficulty in order for the learner's brain to develop and learn from the experience and adopt new behaviours and skills.

Managers can provide experiential learning opportunities to provide the workers with new insights and engineer more suited neurological connections.
Experiential learning is the process of learning through experience and is more specifically defined as "learning through reflection on doing". In the business world, this learning can be orchestrated with individuals being mentored by a person who has faced similar challenges.

Expert speaker sessions and peer group learnings are also good methods. By giving the learner a more concrete 'real-life' experience, they can have 'lightbulb' moments that create new neural connections within the brain. For example, an experienced mentor can enlighten and coach employees about 'Just-In-Time' processes. This could help change their attitudes towards the concept and motivate them to change their behaviour accordingly. It is important that these 'lightbulb' moments that occur are held in focus. Because

Neuroplasticity works best with intensity and frequent reminders. Coaching and mentoring needs to be frequent to build 'attention density'. This density is what leads to changes in the internal wiring which develops new ways of thinking.

The second way that we can use this understanding of the impact of cognitive malleability on behaviour is when it comes to appraisals. This is the specific and formal evaluation of an employee to determine the degree to which the employee is performing his or her job effectively.

Managers may be able to deliver appraisals with fewer errors given their understanding of the plasticity. The importance of positive reinforcement and support may not be overlooked as understanding that the maintenance stage of behavioural change relies heavily on support to sustain their new behaviour.

4.4. Findings and Discussion: Neuroplasticity and Motivation

This section will cover the notion of motivation and explore how Neuroplastic principles can help managers to develop their skills as motivators within the workplace.

4.4.1 Explaining the importance of motivation within the realm of Neuroplasticity

Motivation, in brief, 'can encourage and energize activities that lead to the attainment of the needs, give satisfaction or produce rewards' (Pristiyono, Hasibuan and Hasibuan, 2019). Within the field of management, the ability to motivate well is the ability to create excitement within someone's work, to the point where one wants to work effectively to achieve objectives. There is an abundance of research worldwide that indicates that many managers fail to truly motivate their employees. From one US-based study on over 50 Fortune 1000 companies, 85% of employees felt a sharp decline in motivation after the first six months of joining a company (Sirota, Mischkind and Meltzer, 2006). In another survey, which was brought to light by Gallup Consultants, it was found that only 15% of workers around the world felt fully engaged with their jobs (Gallup, 2021). These findings go to show that there is, indeed, a skill deficit within the field of management for adequate motivational practises.

From poor motivation cascades a range of problems for companies. High employee turnover, diminished productivity, and a lack of cohesiveness amongst employees. Of course, all of these adversities can be detrimental to the wellbeing of a company, causing lower competitivity and an inability to adapt fluidly to the dynamic environment that many operate within.

Managers use a wide range of motivational tools as a means of motivating their workforce. Such tools take a variety of approaches. Some instil fear, others reward performance. Fear tactics can include video cameras to observe employees and threats of termination. Rewards can come in the form of an employee of the month competition, performance-based bonuses,

and public compliments. While these methods have proven to be effective time and time again in the short term, they fail to retain long-term motivation. Motivation is far more effective when it is intrinsic, found in the pursuit of building self-esteem.

This section will explore how Neuroplasticity and motivation are linked. To do this, research is examined around the concept of the 'growth mindset' and its impact on intrinsic motivation. From this, the knowledge will be applied to management, looking into ways that the principles of neuroplasticity can guide managers to become better motivators of their work teams.

4.4.2 Source Four: The Growth Mindset and Academic Performance

The works of Carol Dweck will be drawn upon. She is an American psychologist, who emphasised that individuals should hone greater self-awareness of their brain's ability to evolve and improve at particular functions. It is this new perspective of their abilities that can spur intrinsic motivation to become better at tasks and to learn. This idea is popularly known as the 'growth mindset'. The growth mindset is defined as a belief that intelligence levels are malleable and improvable (Yeager and Dweck, 2012).

The root of this realisation, as Dweck explains, stemmed from the differing performance of students within schools. 'My colleagues and I have now shown repeatedly that students who believe their intelligence can grow to learn more, acquire deeper knowledge and do better—especially in hard subjects and in negotiating difficult school transitions—compared with equally able students who believe their intelligence is a fixed trait' (Dweck, 2021).

This is important as an individual with a growth mindset works hard for improvement in their abilities, without an incentive reward in mind. They tend to self-drive their own learning and are shown to display a greater propensity to cope with the demands set for them (Dweck, 1986). The motivation to accomplish a task, which may have been extrinsic originally, can thus become internalised.

This growth mindset can motivate people to embrace challenges and put in the effort to learn. Past setbacks and mistakes will be received as a necessary part of the learning process, cultivating greater amounts of motivation from those who perceive it this way (Ng, 2018).

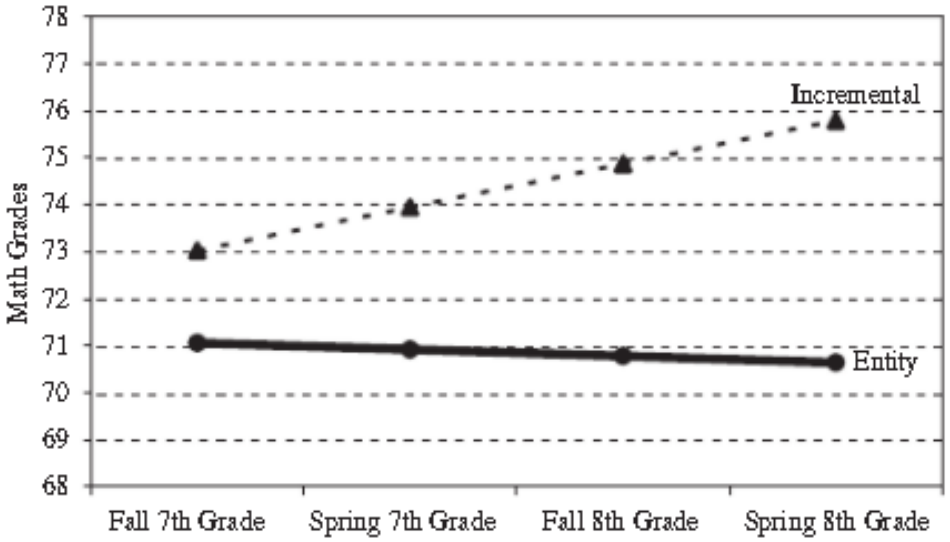
This empirical study is highly relevant to this thesis as it offers a great insight into how people who understand neuroplasticity and, thus, their own adaptive capabilities, can become more productive, motivated, and shows greater potential to improve. Parallels can be drawn between the task of a teacher to motivate students to thrive academically and the role of a manager to cultivate the best from their subordinates.

Two studies took place exploring the role of differing theories of intelligence in the achievement of adolescents in the field of mathematics. The first study followed 373 7th Grade children in New York City. Their achievement-related beliefs were measured, to determine which theory they would follow. Some would take a more pessimistic viewpoint, thinking that their intelligence was fixed. 'I am incapable of improving my cognitive abilities, so what's the point'. Those who subscribed to this notion would be assumed to follow the Entity theory (Park and Kim, 2015). The opposing school of thought, the incremental theory, is one adopted by those who understand that their brains are malleable and capable of exhibiting new levels of intelligence.

To assess the contribution of ones theory of intelligence to the trajectory of achievement over the junior high school transition, the researchers looked at the growth curves in mathematics grades for students with different beliefs. The Hierarchical Linear Modeling (HLM) program was used to compute the growth curves.

According to the studies, teaching this growth mindset to junior high school students would result in increased motivation and stronger academic achievement (Blackwell & Dweck, 2007). The results of the first study concluded that believing that the brain is malleable, and therefore intelligence being controllable, led to an upward trajectory in grades over a two-year period. The latter study offered a similar conclusion, confirming that those who believed that intelligence was fixed (Entity theory) were less likely to attain success within their task. Thus visually demonstrated in Figure 2. by a flat trajectory of improvement over the same period.

Figure 4: Graph demonstrating the relationship between the theory of intelligence, time, and math achievement over two years.



(Blackwell & Dweck, 2007)

From this, it was concluded that those who endorsed more of an entity theory, believing that they possessed a fixed, uncontrollable intelligence, were more prone to withdrawing effort when faced with difficulty and error. In contrast, believing that the brain could be developed through effort and attentiveness would overcome difficulty with resilience spurred by intrinsic motivation. (Dweck & Leggett, 1988).

The relationship suggested here between Neuroplasticity and intrinsic motivation is certainly something for managers to be aware of. The study showed that intrinsic motivation, spurred by the growth mindset, would have people actively seeking new knowledge and ways to improve at their own will (Blackwell, Trzesniewski and Dweck, 2007). Another similar set of research suggested that individuals with a growth mindset were also more receptive to corrective feedback (Moser et al., 2011). They would exhibit a greater error positivity response, showing heightened attention to mistakes. This would imply that, to some, errors are not sources of demotivation but can be indicators of how to improve, thus being received positively. In the working environment, such errors could be a poor customer review, for example.

People do not like to take risks that show their weaknesses, thus avoiding mistake-prone activities. However, with the growth mindset, we can argue that people will not be afraid to

make these mistakes. They will have the ability to learn from them, showing greater resilience to challenge and responsibilities.

What is understood from the research presented is that Neuroplasticity has grand ties to motivation, and more specifically, the cultivating of intrinsic motivation. Those who choose to approach tasks and challenges with the growth mindset -an awareness of neuroplasticity and potential for growth - exhibit greater levels of motivation. Dweck's research poses the question of how employees can also find motivation from adopting this mindset, thus improving their productivity within the workplace. By instilling workers with a growth mindset, managers can transform their workforce. The following benefits could be obtained from this:

- Internalising motivation

The mindset promotes the message that people could personally gain from undertaking difficult challenges and learning about new things. They can become more refined at giving presentations, for example. Targets and tasks that were, initially, perceived to be in the company's interest could now offer motivational appeal to employees. For example, delivering a sales pitch to a high-profile client could be a daunting task for some. One which would require a manager to attach an extrinsic reward, like a compensatory bonus. However, this is also an experience that can teach someone new skills. For example, what questions to anticipate with clients of particular needs. By instilling the mindset, managers can give tasks to employees that can help them to grow and excel, reducing the need to attach a substantial extrinsic reward to the job.

- Leads to greater responsiveness to feedback

Employees who adopt this mindset may also respond more positively to constructive criticism and feedback. Failure is often associated with demotivation. For one to commit effort into reaching a goal, only for them to not get the result they want is often a painful feeling. People would be put off from attempting it again. However, those with a growth mindset can harness the frustration from mistakes and learn from them. The mismatch created by mistakes (Errors) can deploy neurochemicals this indicates something is wrong, causing corrective changes to occur within the circuitry of the nervous system. Understanding that errors are the gate to plasticity and improvement can guide employees to embrace mistakes as a learning cue, amplifying motivation.

With this in mind, managers would benefit from instilling this mindset into employees for the sake of being able to instruct and appraise employees without the risk of leaving them demotivated. Instead of perceiving negative feedback as a threat, causing stress and alarm to employees, the feedback will be absorbed, taken on board, and can be used to improve the character and ability of the receiver.

- Employees are more open to greater responsibility

The notion that it is difficulty and 'being at the frontier of one's abilities that leads to growth and improvement is a key component of the growth mindset. With a comprehension of this, we can anticipate employees to be willing to take on more ambitious tasks, fuelled by the idea of learning from this experience. We also learn more quickly when we experience surprise, usually in the form of unprecedented events. Taking on tasks that can expose one to new scenarios and novelties is a great way to make links and learn. This would be majorly beneficial for managers who are looking to improve the capabilities of their workforce.

Given the presence of the seeking system, it is important to understand how creating an environment where employees can pursue this will stimulate motivation and urge for better performance.

Giving employees free rein to try learning on their own and try new things gives them a greater sense of purpose within the workplace. They will not feel like personnel, following strict orders and protocols, but will feel like the company is concerned about their growth. This could lead to greater engagement and satisfaction with their jobs, reducing employee turnover and a lack of drive.

- Developing a culture of innovation

Furthermore, understanding the concept could lead to greater bouts of creativity and innovativeness within the company. The employees, incentivised in a dopamine-induced cycle to learn and discover, may adopt a mindset of thinking more 'outside of the box. While looking to learn new methods of carrying out particular functions, they can discover more innovative solutions that could make particular processes more efficient. This innovative behaviour could be identifying more efficient production methods, finding new ways to implement emerging technologies or developing fresh ideas about extending the product life cycle. Despite the

diverse ways in which innovation can be realised within a company, the common element is that employees can traverse the plain of ideas and ‘what ifs’.

With all considered, managers can apply an understanding of neuroplasticity to motivate their staff in several ways. The emerging research on neuroplasticity offers workers the potential to be aware of how they can enhance and improve their learning capabilities. An intrinsically motivating concept in itself as it enables them to pursue longer and more productive careers. Sharing this knowledge, and instilling employees with a growth mindset cultivates greater intrinsic motivation. With a greater willingness to take on new, unfamiliar tasks, employees find themselves becoming greater assets as they pursue learning and self-improvement.

Furthermore, a workforce that embraces mistakes and actively learns from them can mitigate the risk of demotivation during appraisals and performance reviews. This can create a culture of more consistent feedback between management and employees, driving performance. Pairing the ‘fixed mindset’ perspective with the idea that people find intrinsic pleasure from learning in their own ways can imply that managers should manage with less autonomy. It is widely regarded that worker feel more motivated when they were allowed to think independently and do their jobs without constant supervision (Michel and Hargis, 2016). The fear of being punished for mistakes, or failing to meet a strict set of targets, can tarnish the ability of the seeking system to thrive. Its absence will, therefore, need to be compensated with forms of extrinsic motivations that can be costly and ineffective in the long run.

5. Limitations and Counter Arguments of Neuroplasticity within the workplace

Despite the points made throughout this thesis, it is necessary to identify and address the possible limitations of neuroplasticity and how managers can apply it within the workplace.

5.1 Learning a new skill takes time and practice

From what can be understood from the many 'Gurus' of the Neuroscientific community, neuroplasticity needs several conditions to be fulfilled for the changes to be effective. The process of learning something and acquiring it as a skill takes time and practice. Neuroplasticity occurs in a process deemed gradual and slow-moving. When helping someone to adjust their behaviour, by the transtheoretical model, we are dealing with a behavioural change of a longer time frame.

For some companies, time is indeed a factor. When time is not on your side, changes need to be implemented quickly. The process of consulting staff on behavioural change while progressing through the logical steps of the transtheoretical model be majorly inefficient and, potentially, detrimental to the company's fluidity.

To be more responsive to changes within the external environment, sometimes it is better to invest more in extrinsic motivators, like financial bonuses and status symbols. To truly materialise on instilling the 'growth mindset' into employees, suitable resources need to be available within the workplace. An educational environment should be present, offering a training curriculum, case studies and literature that can help employees to fully comprehend their potential.

5.2 Neuroplasticity can only work on biologically available material

For some individuals pursuing neuroplastic growth, it is unlikely that the same results can be obtained using a standardised approach to others around them. For example, those with cognitive defects cannot be expected to achieve the same results as their colleagues.

Even in healthy individuals, it should be noted that neuroplasticity declines with age. As we become less flexible, so does the brain. Of course, this does not mean that the brain becomes fixed at a later stage, as previously assumed by the earlier generations of neuroplasticity pioneers. Much of neuroplasticity is, simply, geared towards childhood and younger people. It is a biological necessity that helps them to develop an understanding of the world around them.

5.3 Giving employees free rein to pursue their 'seeking systems' and experiment could be costly to organisations

As previously mentioned, there are certain professional environments where employees would need to follow strict procedures and protocols. This would require a command-and-control style of leadership. This is a style that uses standards, procedures, and output statistics to regulate an organisation Authority remains at the senior positions and decisions are made in a top-down approach.

Under these circumstances, it may not be optimal for managers to cultivate the 'growth mindset' in employees. Instead, it may be more important to emphasise a risk-averse culture amongst the team. Mistakes will not be encouraged and actively embraced but could instead harm a company. For example, a company that manufacturers Jet engines can't facilitate the presence of 'mavericks' within their teams. The consequences of unorthodox behaviour and spontaneous experimentation could be too dire.

Also, in companies with high turnover, short-term projects, and often menial labour demands, it could be argued that managers need not waste time emphasising an employee's ability to grow. Cultivating employees with a growth mindset is a long-term strategy. It is most effective when the employees are loyal to the company and are there for the long term.
It is not easy for managers to gain an insight into the background of employees. It can be a personal thing and one that could lead to false assumptions and biases.

5.4 The conditions necessary for neuroplasticity exceed those found in the workplace

To facilitate ample cognitive development, one needs to adopt a healthy lifestyle. Ample amounts of sleep, good food, adequate exercise and having time to reflect are key elements of maintaining a malleable brain.

There is research that suggests that neuroplasticity takes place all of the time, including when one is sleeping (Tamaki, Berard, Watanabe and Sasaki, 2018). Our brain undergoes continuous change and is constantly shaped by what we interact with.

Managers have little control of their employees' personal lives. They cannot regulate the hours in which they sleep at night, or whether they chose to do exercise in the evening. With this in mind, this undesirable behaviour can be adjusted with education. As part of the drive to educate employees about the 'growth mindset', managers must consider that successful learning will factor in the lifestyle of employees. Managers should emphasise the link between exercise and neurological wellbeing as well as the importance of consistent, adequate sleep.

6. Conclusion

The findings of this research can be summarised as follows. With all considered, comprehensive knowledge of neuroplasticity and its applications within the workplace can present new opportunities to managers in a range of fields.

The thesis intended to explore the extent to which it can help managers to become more effective at understanding people and their drives. This was achieved by exploring the link between neuroplasticity and the sculpting of behavioural tendencies. As presented in the research, it is clear that the notion of cognitive malleability is hugely influential for bridging the link between one's experiences as a child to how they behave in adult life.

An employee's ability to handle multiple responsibilities at once, maintain interpersonal relationships with colleagues and react positively to inconsistencies can be determined partially by their earlier lives. These experiences would have scripted the brain to perceive these events in different ways. With this in mind, it can help managers to understand better why their employees act differently in similar situations. Understanding this will inform managers that different, less standardised levels of nurturing would be needed for different members of their teams.

Furthermore, understanding how behavioural change relies heavily on the restructuring of the brain will remind managers not to overlook the important conditions, like repetition, positive reinforcement, and attentiveness. With this knowledge, managers would find opportunities to improve in a variety of functions. In particular, this can help with implementing organisational changes without hostility and resistance and, also, training employees to become more productive assets.

The second avenue explored in this thesis was how knowledge of neuroplasticity can assist the efforts of managers to motivate their teams. The point was that the brain is plastic, and one that can be used to refine skills and intelligence, serves as the basis of the 'growth mindset'.

Accompanied by the research of Dweck, it can be said that the adoption and embracing of this mindset serve as a significant source of intrinsic motivation. It encourages people to perceive mistakes as opportunities to learn while educating them on why they must adhere to the principal conditions of neuroplasticity if they want to gain new skills and knowledge. By accommodating the cultivation of this mindset through education, the redesigning of the workplace and self-endorsement, managers would be able to guide a more self-aware, intrinsically motivated team through more ambitious challenges in the future.

This work intends to help clarify the link between neuroscience and management. In a world that is seeing the growth of automation and capital-intensive business, it is important to remember that humans will continue to be fundamental assets to companies for the indefinite future. Humans are capable of far more than many perceive themselves to be. Those managers who are aware of this can play the important role in helping them to realise their ambitious trajectories through education and encouragement.

To build on this, the researcher recommends that this study be complemented by identifying the most suitable ways that companies can help their employees to grow with the designing of programmes and cultivation of a working culture that embraces neuroplasticity principles.

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