PISTA

AN APPROACH TO ASSIST PERSONS WITH COGNITIVE DECLINE

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Nova Palm, Ltd.
2022

First Printing: 2022

Nova Palm Group, Ltd.

141 Prince Edward Road West, Mongkok Kowloon, Hong Kong

www.pistatherapy.com

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Acknowledgement

We want to thank the PISTA mental health scientists and researchers who, over the last 45 years, have dedicated their lives to continuous and ongoing research to develop evidence-based modalities that can help people handle life's challenges and mental conditions.

We would also like to thank Nova Palm Foundation for financially supporting our past and ongoing PISTA research work.

We are also grateful to the individuals who openly shared their needs and struggles. By agreeing to apply PISTA to your situation, you have allowed us to be part of your and your family's transformation. In turn, this has given us deeper insight enabling us to create programs catering for specific needs such as business executive programs, senior care programs, woman's wellness programs, education, learning and memory programs.

And finally, we thank our families for their encouragement and loving support of our goals.

Preface

With all our special “wrinkle-free” creams, hair dyes, operations, facial lifts etc., we can hide the effect of ageing, but we cannot stop the passage of time. Ageing brings with it many fears and concerns. We fear that age will make us less desirable and, therefore, lonely. Age is associated with mental and physical decline and the inability to do what we want.

Cognitive decline is a normal part of ageing. Commonly, cognitive decline or memory problems start around age 60. Though our brain volume starts shrinking after age 40, brain shrinkage is more evident after age 60. This shrinkage affects the areas involved in cognitive functioning.

Though cognitive decline is normal, dementia is not. Many people live to a ripe old age of 90 or even a 100 without dementia affecting their lifestyle. Research continues to study the links between lifestyle, social engagement, education, career choices and dementia.

Ongoing research into cognitive decline has linked what we do in our youth and adult life to increased or decreased risk of dementia in late adulthood. There are strong links between physical activity, social engagement and emotional management and reduced risk of dementia. Long-term depression and anxiety are linked to cognitive decline and a higher risk of dementia.

Life events such as being bullied, losing a loved one, puberty, trauma, and getting fired affect our thinking and behaviour patterns.

Situations, especially in our early years, affect not only the trajectory of our lives but also our memory and the topographic structure of the brain.

Knowing what we can do throughout our lives, from childhood to adulthood, to give us the best opportunity for a healthy brain is the start of preventing and managing cognitive decline. By maintaining physical, emotional, and brain health, we can constructively manage setbacks and obstacles.

For the last 45 years, ongoing PISTA (Processing Inner Strength towards Actualization) research has created PISTA programs to support children, teenagers, adults, and senior citizens. We can only find the answer to many of the problems we experience through research and educational programs.

PISTA research focuses on long-term, systematic study and experience-based solutions derived from research and development. It also focuses on finding answers that we can apply to the different challenges we face daily. The team continues to develop scientific evidence-based modalities that help us navigate each phase of life, develop ourselves, and build perseverance and resilience to pursue what is valuable.

One area of ongoing research is studying cognitive functioning. This research includes understanding how to care for the elderly to enhance their quality of life, especially those with dementia. Another critical aspect of the study is caring for and supporting the primary caregivers.

Through this book, we want to highlight that cognitive decline, though a normal part of ageing, does not need to carry the fear or stigma that

media instils in us. We also want to show that we are not powerless and in the control of “nature”, but there are things we can do to minimize the risk of developing dementia. We also want to highlight ways to improve the quality of life for those experiencing dementia and improve their lives, to improve the lives of their caregivers.

This book will cover some signs and symptoms of specific diseases; the authors do not promote self-diagnosis but rather give vital information that might help readers become self-aware of the condition and seek timely assistance.

Introduction

At some point in every person's life, we experience a "memory slip" or memory problem such as forgetting names, places, events, or even misplacing things. We may ask ourselves, "Did I turn off the gas?", "Where did I put my car key?" or "What is the date today?". Occasionally forgetting things can be a bit annoying, but unless it significantly hinders us from performing our daily activities, it is not seen as a severe memory problem. Memory lapses are a symptom of cognitive decline due to the normal ageing process that causes changes in the brain. Cognitive decline can range from mild cognitive impairment (MCI) to severe dementia that affects memory, judgement, problem-solving, and all other aspects of cognition. The *most* common risk factor of cognitive decline is *apparently* advanced age.

Mild cognitive impairment (MCI) is manifested when a person displays a slight decline in mental capabilities compared to their peers within the same age group. However, it does not affect their daily functioning. The minor decrease in cognitive functioning is noticeable by the person and their family and friends. A family member or friend might say, "Oh, you forgot your schedule again!" or "You don't remember we had dinner last night?". People with MCI show memory and thinking lapses, such as getting lost in familiar places, inability to follow simple instructions, repeatedly asking the same questions, difficulties finding the right word, and problems with making decisions. These problems do not severely interfere with the person's daily activities, such as bathing, eating, dressing, grooming, and

walking. However, in some individuals, the memory decline could mildly interfere with instrumental activities of daily living, such as managing finance and housekeeping. When the decline in cognition interferes with an individual's daily functioning, it may imply a serious memory problem. Forgetting things more often, the inability to perform routine tasks, poor judgment, and difficulties understanding written and verbal information are serious memory problems that may lead to dementia.

Dementia is a general term used to explain the decline in mental functioning – memory, language, orientation, thinking, and judgment – severely affecting an individual's daily life. Having mild cognitive impairment heightened the possibility of developing dementia in later years. People with dementia may also experience maladaptive thinking patterns that lead to faulty and inaccurate views of reality, called cognitive distortions.

According to the Centre for Disease Control and Prevention (2011), more than 16 million people in the United States suffer from cognitive decline. However, despite the high rates of cases, the effect is not well recognized, and this unaddressed issue may lead to severe consequences. The decline in cognitive functioning does not only appear when people reach their 60s. Research also suggests that even young people in their 20s and 30s may experience cognitive decline. Therefore, awareness and education about this matter are crucial as they may help prevent serious cognitive problems like dementia.

Moreover, it is essential to seek help if you or someone you know is experiencing signs of cognitive changes to ensure that you are properly assessed by a healthcare professional. While there is no effective treatment for neurocognitive disorders yet, early detection of

symptoms of cognitive decline leads to immediate care and a better chance of benefiting from the treatment.

This book aims to help readers comprehensively understand cognitive decline and what can be done to slow it down. Even though numerous clinical trials are testing the efficacy of various medications to cure memory problems due to dementia, no drug has been approved by the Food and Drug Administration. However, despite the lack of pharmaceutical intervention, experts say that several approaches may help slow down the decline in cognitive functioning. Although memory problems are said to be a normal part of ageing, there are some ways that, if implemented, could help lessen the impact of the impairment, especially during old age. Early prevention is still better than cure, after all.

As human beings, we experience many changes as we age - in our body, how we perceive things, the way we behave and interact with other people, and how we live our lives. Generally, change is one process all of us will experience throughout our lifespan. Simultaneously, our brain also modifies itself as we continue to engage in the changing environment. Our physical bodies adapt to changes in our environment, as well as our brains. Numerous research studies demonstrated that our brain, to some extent, is adaptable to environmental demands and stimuli, especially regarding learning new things. This ability to be adaptable and flexible results from our brain's neuroplasticity capability – the ability of the brain to change and develop. Thus, knowing how the brain functions and how the positive or negative changes in the brain affect our daily lives would help us to understand why cognitive decline occurs. Fortunately, many

research findings provide scientific data to understand our brain and its functions, and this book will explore these topics.

This book will also introduce how Processing Inner Strength Towards Actualization (PISTA) therapy can help people with memory problems. PISTA includes strategies to improve our thinking, decision-making ability and memory through brain training using the PISTA sound tool and specific activities facilitated by a certified and licenced coach. While PISTA cannot change or stop the brain's natural changes, this method can help manage the controllable factors of cognitive decline.

Here is a practical example of how PISTA can help with one controllable factor: physical exercise is healthy for us. If we know it is so good for us, why are we not consistently participating in at least the minimum workout required for our health? In PISTA therapy, the individual is encouraged to set exercise goals. Once they have set their goals and created an exercise plan, their coach will guide them to identify the real reason they constantly put off exercising. The individual learns how to replace negative thinking and behaviour patterns with more constructive patterns that allow them to remain consistent and motivated even on stressful, busy days.

Although cognitive problems are experienced in our lives because of the biological changes in our brains as we age, we can take preventive measures and learn cognitive skills to reduce the risk of developing them. Focusing on the modifiable factors is one of the main approaches to managing the consequence of cognitive decline or impairment in cognition. This book will discuss ways to maintain brain health and mitigate the risk factors of cognitive decline within physical, psychological, and social domains.

Part I: Introduction to Cognitive Decline

Memory problems are usually associated with adults aged 60 or older whose brains no longer work like they used to. As we age, the brain undergoes changes that influence mental functioning, and one of the consequences is a decline in cognitive performance. However, younger individuals can also be susceptible to cognitive decline due to various factors. It is essential to be aware of the signs of decline in cognitive functioning, particularly during the early years, to prevent further problems and rapid worsening of cognitive decline and to provide early interventions or medical care.

Understanding Cognitive Decline

Cognitive decline is the brain's response to changes in brain functions and neuronal mechanisms that involves a noticeable decrease in mental abilities, specifically in thinking and memory skills. "Memory lapses" can range from mild cognitive impairment (MCI) to dementia. People experiencing mild decreases in cognitive skills tend to have difficulties recalling a specific event or information, performing complex tasks, and executing quick judgments. Even though the decline in cognition is more severe in MCI than in normal memory lapses, it does not affect the individual's ability to perform daily activities. Dementia, on the other hand, is one of the dreaded aspects of ageing and one of the most expensive in terms of personal and financial burdens (Deary et al., 2009). MCI and dementia indicate cognitive decline that is unusual for the person's age, education, or development. But don't fret! Although mild cognitive impairment is a

huge concern, people can still function and perform the activities of daily living. However, it is crucial to know the red flags of cognitive decline because 5 to 10% of people who experience mild cognitive impairment will later develop dementia (Dallas, 2021).

A research study conducted on Dutch centenarians showed that even when people were exposed to risk factors (e.g., stress) related to cognitive decline, high levels of mental functioning were sustained for several years, even after reaching the age of 100. Although we cannot avoid cognitive decline as we age, the study showed that language, semantic knowledge, abstract reasoning, and visuospatial abilities were retained in younger age groups (20-90 years old). However, a vulnerability was observed in their processing speed, executive functioning, and episodic and working memory. This research study further suggested that cognitive functioning remained relatively stable even after age 100, implying that these centenarians were resilient or resistant to several risk factors of cognitive decline (Beker et al., 2021).

The decline in cognitive functioning can be caused by neurodegenerative diseases, such as Alzheimer's disease, Parkinson's disease, or dementia, which causes a severe loss of cognitive functioning that interferes with an individual's daily living. Dementia is used as a general term to describe the set of symptoms due to these neurological diseases. In the past, the goal was to differentiate between neurodegenerative disorders, normal ageing, and dementia. Today, the goal is early detection of cognitive decline to facilitate prevention and early cognitive interventions and treatments (Hartle & Fichman, 2021). Early detection of cognitive decline is vital. Cognitive interventions commonly focus on adults aged 60 years or

older, yet research suggests that increasingly adults ranging from 18 to 60 years old may experience lower levels of cognitive functioning. If a person starts experiencing a decline in cognitive functioning in their 20s and 30s, they will experience significant changes by the time they reach their 60s and 70s. Therefore, the probability of intervention success in their 60s is limited because of the accumulated cognitive changes and decline from an early age to old age (Salthouse, 2009). Likewise, early detection guides the secondary prevention that can be used in developing strategies that control the risk factors (Gauthier et al., 2006, as cited in Johansson, 2015).

Red Flags of Cognitive Decline

Changes in our ability to think are a normal part of the ageing process. Several of our mental skills peak around age 30 and then gradually degrade as we grow older. The cognitive decline associated with age commonly includes slower thinking and problems maintaining focus or multitasking, remembering information, and locating words. According to the University of California San Francisco Memory and Ageing Centre, the following are some of the memory issues that we should be aware of:

- Repetitive questioning
- Getting lost in familiar places
- Tends to forget recent events
- Frequent falls and problems with balance
- Difficulties in planning and organization
- Changes in eating habits and hygiene
- Lack of interest in usual activities
- Lose train of thoughts

- Problems with language acquisition, comprehension, and expression
- Changes in personality

These minor cognitive changes are part of the normal ageing process noticed by the person experiencing them, family members, or other people. People experiencing some of these symptoms do not have problems performing their daily activities as the cognitive changes are not severe enough to interfere with everyday activities. However, it is essential to have regular medical check-ups to keep track of the progression of cognitive decline.

Defining Attention and Concentration

Attention and concentration are similar terms and often used interchangeably, but their meanings differ. Attention refers to our ability to focus on a task or subject. In contrast, concentration refers to our ability to keep our attention on a particular task for a certain period (Royal Brisbane and Woman's Hospital, 2019). Meaning concentration is crucial for maintaining attention for an extended period. This type of attention includes selective, divided, and sustained.

From the term itself, selective attention refers to selecting particular stimuli from the sensory inputs (e.g., hearing, seeing, feeling). We choose to focus on one task or stimulus out of all information or sensory input available. On the other hand, divided attention is concerned with attending to more than one information-processing activity simultaneously, limiting our performance. In this type of attention, there is an optimal allocation of focus among various input

sets by splitting of rapid shifting of attentional focus despite the inability to process all the information (Prasuraman, 1998).

Lastly, the ability to have a prolonged focus on a specific piece of information or task is known as sustained attention or concentration. Attention involves concentration that helps us keep our focus and stay engaged with a task until it is completed or a certain length of time has passed (Cherry, 2021). Hence, concentration is an attentional process that facilitates the control of attention, which is crucial in maintaining the focus on one subject, information, or thoughts.

William James, a psychologist, and philosopher, initially defined the term attention over a hundred years ago as:

"One out of what seem several simultaneously possible objects or trains of thought … It implies withdrawal from some things to deal effectively with others."

- James, 1980

This definition means that people selectively attend to one thought, which is then processed by the mind (Castle & Buckler, 2018). It is commonly recognized that attention is selective but in a more complex form, in which the individual intentionally attends to relevant environmental cues. For instance, there are three dots on a whiteboard, one yellow and two black. When you look at the whiteboard, the yellow dot may stand out more clearly than the two black dots, causing you to focus on that detail. Attention to the yellow dot involves disregarding the black dot. Therefore, attention enables an individual to tune out irrelevant information, facts, feelings, and sensations and focus more on what is important (Cherry, 2021).

How long can Humans Sustain Attention?

The "amount of time" we spend concentrating on a particular activity before shifting our focus or being distracted is referred to as attention span (Barger, 2018). When there is an uncontrollable shift of attention from one activity or sensation to another, distractibility occurs (Schaefer & Millman, 1994). Attention training is a crucial part of education. Students are taught to focus on a subject of observation or discussion for an extended period. Education also builds listening and analytical skills (Maconie, 2007).

There is a distinct difference between the attention span of different age groups. Children in a younger age group are not capable of having the same or longer attention span as children older than them. By age four, a child's attention span increases to about 8 to 12 minutes; by age five, a child's attention span is between 10 to 14 minutes. Before the age of 18, the average attention spans per age are as follows (Ward, 2020):

- 2 years old - 4 to 6 minutes
- 4 years old - 8 to 12 minutes
- 6 years old - 12 to 18 minutes
- 8 years old - 16 to 24 minutes
- 10 years old - 20 to 30 minutes
- 12 years old - 24 to 36 minutes
- 14 years old - 28 to 42 minutes
- 16 years old - 32 to 48 minutes

On the other hand, factors affecting an adult's attention span vary, such as the nature of the task, the time of the day, where the task is

performed, and the subject matter. Typically, the attention span of adults is 15 to 20 minutes. As mentioned, a “normal” attention span depends on a person’s age. As we grow and age, our attention span increases until later in our senior adult phase, when our attention span tends to decrease. Most researchers argue that the decline in attention span is related to technological innovation and Internet-based reading. According to researchers, this is especially noticeable among those living in high-tech and computer-savvy generations. Not all memory decline is related to technology; certain medical and psychological conditions may significantly affect the deterioration or inability to sustain attention. For instance, people with attention deficit disorders typically have a threshold of typical attention span due to their condition (Cartmel, 2022).

As people, we tend to have a longer attention span when we find the activity or information interesting, enjoyable, or intrinsically motivating (Dukette, 2009). We also experience longer attention spans when we perform more efficiently than others learning how to do the task or having difficulty doing it. This means that when we feel we are performing better than others, we can maintain our attention span for an extended period. However, noise, stress, hunger, and fatigue can interfere with and reduce our attention span regardless of how interesting our task is.

The goldfish is known for its notoriously short attention span in the animal world. On average, a goldfish has an attention span of nine seconds. According to a study by Microsoft Corp., there is evidence of a decline in human concentration after eight seconds. The study highlighted the effect of increased digital and technology use on our brains. Microsoft researchers connected 112 individuals to

electroencephalograms (EEGs) to study their brain activity and surveyed 2,000 people. The findings showed that in the year the mobile revolution began, the year 2000, the average attention span of people decreased from 12 seconds to 8 seconds. This study showed that one of the side effects of increased mobile usage is attention span decline. According to the report:

"Heavy multi-screeners find it difficult to filter out irrelevant stimuli — they're more easily distracted by multiple streams of media."

On a positive note, the research indicates that our multitasking ability has drastically improved in the mobile era. The theory behind the findings lies in the brain's ability to change and adapt over time. The survey also shows the generational differences in mobile device use. For instance, survey questions such as, "When nothing is occupying my attention, the first thing I do is reach for my phone", 77% of participants ages 18 to 24 answered "yes" compared to 10% of participants over 65 (Stephens, 2020).

However, Simon Maybin (2017) of BBC News conducted his own research to debunk the idea that human attention spans are declining. The Microsoft study reported that the average attention span has decreased from 12 to 8 seconds. However, Maybin claimed the data did not come from Microsoft's research. The figure appears in the report, but Microsoft cited it from another source called Static Brain. Yet, when Maybin searched for the data to back up the claims, he found nothing.

According to Maybin's article, the notion that attention span is declining is invalid. The Open University's psychology lecturer, Dr Gemma Briggs, backed this claim. He studied the attention span of

drivers and crime witnesses. Dr Briggs asserted that the idea of an average attention span is pointless. She noted that:

"It's very much task-dependent. How much attention we apply to a task will vary depending on what the task demand is."

Meaning that attention span depends on the task we perform. If the task requires more attention, like driving or counting money, we can adjust our attention for an extended period to accomplish the task.

Also, the idea that goldfish have short attention spans is misleading. It turns out there are no findings to back up the claim. Based on Maybin's interview with Professor Felicity Huntingford, who studied fish behaviours for almost half a century, goldfish can do different types of learnings like mammals and birds have displayed. In research, goldfish are used as a model for learning and memory formation because they have a memory and are capable of learning. Goldfish are also the species used by neuropsychologists and scientists as a model for examining memory formation.

Therefore, the idea that goldfish have short attention spans and no memories is false. There is also no substantial evidence that the human attention span has declined to eight seconds. There might be various research claims that attention span decreases as people age; nevertheless, there is no actual data about the exact duration of time that we can sustain our attention.

Problems in Concentration

When a person has difficulty sustaining attention, there is a problem with their concentration. Problems in concentration exist in cognitive

decline, brain fog, and other medical and mental health conditions. The difference lies in the degree of severity and how it affects a person's daily functioning. Cognitive decline may affect daily activities; however, it is concerning when it severely interferes with day-to-day activities. If it does, then it needs to be addressed immediately.

The inability to concentrate may result in significant life issues, such as problems making progress in careers, academics, and other critical areas in life. The cause of concentration difficulties is probably rooted in several factors, which differ from person to person. Understanding the signs will help determine when to seek professional help for yourself or your family. Some warning indicators of concentration problems include feeling jittery and anxious, irritation, frustration, a preoccupation with racing thoughts, and poor memory. These symptoms can indicate serious medical conditions and mental health issues.

Psychological Factors

Although ADHD is common in children, it can also occur in adults. This mental health condition includes difficulty focusing, impulsiveness, mood swings, and poor time management (Liao & Nazario, 2021). ADHD symptoms manifest differently in adults. Even though adults might have difficulty focusing, hyperactivity or extreme inattentiveness is the primary concern in children. Adult ADHD includes failure to finish a particular task yet manifests hyperfocus tendencies on the wrong or unnecessary things (Jacobson, 2015).

Anxiety may also affect concentration. When we feel anxious, it causes our brains to prepare for the threat by increasing our body's responses. For instance, improper breathing that causes less blood flow in the brain disrupts the ability to concentrate during an anxiety attack. But, if anxiety is utilized and managed well, it can help to improve focus and concentration (Abraham, 2021). Also, anxiety usually comes with disturbing thoughts that make concentrating difficult. These disturbing thoughts include worries about a specific event or intrusive recollections of a past traumatic incident (Willkinson & Rothschild, 2020). Another psychological condition that may lead to problems in concentration is depression – a mood disorder that goes beyond the feeling of sadness – as it affects the part of the brain responsible for attention, memory, and decision making (Liao & Nazario, 2021).

Medical Factors

An underlying medical condition may cause difficulty in concentration. According to research on female rodents, high oestrogen levels are associated with the inability to pay attention and learn. Even though this study was conducted on rodents, the researchers from Concordia University assert that their findings suggested a good model for human learning (Mathew et al., 2010). Likewise, a dysfunctional adrenal gland may also cause changes in energy level and concentration ability (Abraham, 2021). Problems in concentration can also be attributed to thyroid problems. The hormone in this gland is essential to several body functions, such as thinking. If the thyroid gland is not working correctly, this may lead to poor concentration (Liao & Nazario, 2021). A low red blood cell count may also lead to problems in concentration because the brain is deprived of

the necessary energy and oxygen carried by the red blood cells (Abraham, 2021).

Brain Fog

There are undoubtedly occasions when you may feel disorganized, confused, out of focus, or struggle to put your thoughts into words. Your mind feels clogged with so many thoughts that you space out, forget things, and lack mental clarity, impairing your capacity to think and recall information.

"Ultimately, brain fog can impact the way you feel about yourself. Individuals often do not feel like themselves as the loss of mental sharpness feels foreign to them."

-Sabrina Rominoff, *Clinical Psychologist*

Brain fog or mental fatigue is not a medical condition but a term that explains the cloudy-headed feelings caused by various factors and health conditions. Although this differs from cognitive problems related to MCI and other forms of dementia, mental fatigue should not be ignored. Brain fog has many causes, but it is usually rooted in a stressful environment, chronic health conditions, or a lifestyle prone to hormonal imbalances. Examples of causes of brain fog include overworking, lack of sleep, recent hospital admission, and too much time on sedentary activities such as watching TV and computer use. Brain fog can also be caused by increased levels of inflammation and hormonal changes that affect mood, energy, and focus, throwing the entire system off.

When should we be concerned if something is not right?

According to Dr Lynee Shinto from Oregon Health and Science University, it is important to know that brain fog can be attributed to many reasons, many of which are less frightening than Alzheimer's disease. The causes may include:

- depression
- lack of sleep
- vitamin and mineral deficiencies
- other causes mentioned earlier

Many of these causes may come in pairs or even trios. For instance, depression may result from a lack of sleep or vice versa. Overworking may increase the time spent in front of the computer and cause high-stress levels that affect sleeping patterns.

Brain fog is less severe than the cognitive decline associated with Alzheimer's disease. Alzheimer's has a significant effect on memory and the ability to function. To determine if it is more than just a brain fog, Dr Shinto asks her patients some questions related to their daily functioning, such as:

- Have you given up working and providing for your family's finances? If so, why?
- Have you stopped performing the usual activities that you have always done?
- Have you stopped socializing and doing some leisure activities that you enjoy?

If the answer to all these questions is “yes”, it indicates a need to talk to a primary care provider for further screening and assessment because Dr Shinto asserted that *“these functional changes, partnered with memory complaints, may indicate something more than brain fog”.*

The difference between brain fog and cognitive decline associated with dementia and its other form lies in the extent of severity and frequency of symptoms.

The PISTA (Processing Inner Strength Towards Actualization) method can help with brain fog, memory problems, mood swings and poor concentration triggered by environmental factors such as stressful life events, health conditions, and poor lifestyle. PISTA teaches people how to understand themselves and control the mind rather than being controlled by environmental triggers and stimuli.

Chronic Fatigue Syndrome

Fatigue is characterized by a chronic feeling of physical and mental tiredness caused by lifestyle, social, psychological, and overall well-being concerns rather than an underlying medical condition. Everyone is susceptible to fatigue, and most adults will experience it at some point in their lives. While some people may recover, others suffer from prolonged fatigue, affecting their daily functioning. Fatigue may appear as a feeling of tiredness or sleepiness. The intense tiredness can be alleviated by getting enough rest, napping, or withdrawing from the stressful environment or events that lead to fatigue. However, chronic fatigue syndrome is different as the fatigue is too overwhelming, and rest is not enough to ease the problem.

If the persistent fatigue lasts for more than six months and is experienced physically and cognitively, it is not just simple fatigue. Persistent fatigue is more complex, and this condition may refer to chronic fatigue syndrome (CFS) or Myalgic Encephalomyelitis (ME). The cognitive symptoms, which are one of the devastating characteristics of CFS, are usually thought of as mild cognitive impairment, yet some individuals describe the symptoms as brain fog (Ocon, 2013). The self-report concerns include problems with attention, memory, concentration, and slowed information processing speed, specifically in complex tasks requiring constant attention (Cvejic et al., 2016).

Also, post-exertional malaise (PEM) is a symptom of CFS/ME that comprises excessive weariness that is not eased by rest, and the illness worsens after any physical or mental activity (CDC, 2021). Difficulties with sleeping, thinking, concentration, pain, and dizziness are also experienced by an individual with CFS/ME. Some characteristics of this syndrome include:

- Inability to function the same way as before the illness.
- Changes in ability to perform daily tasks like taking a bath, preparing a meal, cleaning the house, and performing mental tasks.
- People with CFS/ME also have difficulties keeping their jobs, going to school, and participating in family and social events. Their social life and connections with family members and friends are affected.
- The condition may last for years or longer, which may result in severe disability.

- When experiencing this condition, at least one of every four ME/CFS patients is bed-ridden or house-bound for a prolonged period.

The symptoms of each CFS case may vary, yet up to 85% of people reported to have experienced cognitive impairments (Kamaroff, 1993). Patients subjectively define the impairments as brain fog which includes sluggish thinking, problems with focus, confusion, lack of concentration, poor memory, or lack of clarity in thought processes. In fact, one of the most incapacitating symptoms of CFS is brain fog (Jorgensen, 2008).

Consequently, the perception and experience of mental fatigue related to mild cognitive impairments in CFS serves as the conceptual definition of brain fog. Physiological research has investigated mental fatigue and impairment as a result of orthostatic stress that involves an immediate increase in blood pressure in response to a change in cerebral blood flow (CBF).

Based on neurocognitive tests that assess the impairments in CFS, it turns out that the affected cognitive domains are attention, information processing, recall and reaction time (Cockshell & Mathias, 2010). However, the cognitive fatigue feature in CFS shows relative changes in anatomical structures of the brain based on functional magnetic imaging (fMRI).

Child Chronic Fatigue Syndrome

Chronic fatigue syndrome does not only affect people between 40 and 60 years of age. It also affects children, adolescents, and younger adults. Children and adolescents diagnosed with CFS experience

severe incapacitating fatigue that lasts at least three months. They suffer from headaches, sore throat, muscle pain, nausea, and light-headedness. However, the core symptom of CFS in children is post-exertional malaise. Post-exertional malaise is experienced as an increase in fatigue, malaise (feeling of discomfort or uneasiness), and CFS symptoms after excessive mental and cognitive activities. It may manifest during or after performing activities such as taking a bath or walking upstairs and can severely affect some children. When diagnosing CFS in children, the presence of post-exertional malaise is the most relevant symptom. Other common symptoms in children and adults are cognitive impairments and poor sleep quality.

Children's most common cognitive complaint is often called "brain fog". Research shows that 86.7% of adolescents and 76.5% of primary school children experience "brain fog" (Collin et al., 2015). According to two studies, different attention problems are evident. One study found problems with attention retention, switching attention, selective attention, auditory learning, and immediate recall compared to healthy children. The other study found difficulties with alternative attention but not divided or sustained attention (Mizuno & Watanabe, 2013).

In research on Japanese children diagnosed with CFS, the researchers noted that they often experienced fatigue because of their schoolwork. The researchers reported that during the assessments for divided attention, the children's fatigue caused an increase in frontal activation as children performed dual verbal tasks. This means their brain was making more effort that required more mental resources to compensate for poor task performance.

On a more positive note, some of the abnormalities experienced by children were reduced as the children's fatigue improved after

cognitive behavioural therapy; however, this is based on a single small study that requires further investigation (Mizuno & Watanabe, 2013). Other more general strategies that could help children with attention difficulties are:

- Attention process training
- Helping the children maintain attention by working in the school environment
- Using different approaches to improve memory, such as overviews, reducing the pace of new information, and giving verbal information with guided imagery

-Rowe et al., 2017; Nagy-Szakal et al., 2017

Environmental Factors

Stress is one of the environmental factors that can contribute to concentration problems. When stressed, the areas of our brain responsible for attention and thinking do not receive the required energy. Stressful situations activate the "fight or flight" system, priming the body for threats in the immediate environment. Experts believe that the survival centre of the brain takes control in stressful environments and robs us of our capability to acquire the focus necessary for concentration. Too much stress may lead to burnout, which is also an environmental factor affecting concentration. Focusing on any task while experiencing emotional exhaustion will remain a tough battle until the underlying issue is addressed.

Trouble in concentrating is accompanied by exhaustion, and rest can help increase the ability to concentrate for lengthy periods. Finally,

lack of sleep can impair focus, something most of us are aware of. According to research, sleep helps the brain cells to regenerate and recover, and missing one night of sleep makes it difficult to focus and avoid distractions (Abraham, 2021).

What is Memory?

"Memory is the diary that we all carry about with us."

- Oscar Wilde

Memory refers to the psychological process that allows individuals to acquire, store, retain, and recall information. It is one of our essential capabilities as human beings which helps us operate in the present and think about the future. Without memory, it would be hard to recall what we learned from the past and remember our plans for the present and future. Learning requires memory because it entails processing enormous amounts of information that takes various forms, including visuals, sounds, and meaning.

Encoding, storage, and retrieval are the three primary processes of memory. Humans, because of memory, can both retain and recover information. How memory processes information is fascinating. Unfortunately, retaining and recovering information does not always involve a perfect and smooth process. Sometimes people experience forgetfulness or have problems remembering things correctly. In some cases, recalling a specific memory may be difficult because a piece of information may not have been encoded appropriately. People may exhibit minor memory problems, like forgetting someone's name or today's date. More serious memory problems such as forgetting where you live may be a sign of a severe condition such as Alzheimer's disease and other forms of dementia, affecting the individual's quality of life and capability to function (Cherry, 2022)

The following section will discuss the three stages and three processes of memory to give a deeper understanding of what memory is.

Stages of Memory and their Functions

The scientific community accepts three major classifications of memory: sensory memory, short-term memory, and long-term memory. However, researchers and experts have debated the types of memories for years. The type of memory refers to the kind of information stored and the length of time the information is maintained. To create a memory, the received data starts in sensory memory, moves to short-term memory, and finally enters long-term memory. However, not all information is passed through all three stages; much of the data is forgotten. Whether the information is passed on or forgotten depends on how the information is received and processed. Ageing and various medical conditions affect short-term and long-term memory.

Sensory Memory

In this stage, our five senses (sight, smell, hearing, touch, and taste) process sensory information, which is only retained for a short period. Unless the information is received and passed on for more processing, it will be forgotten. The sensory memory allows the brain to process external sensations. It also lets us see the world as a continuous sequence of events rather than disjointed pieces. The scarcity of sensory input may result in the absence of learning and processing information. Our brain has nothing to work on if our senses do not sense anything or gather information from the environment. Neither the short-term nor long-term memory will function if there is nothing to process. Sensory experience may proceed to short-term memory or become more permanent in long-term memory if there is an attached

memory to the recurrent sensory experience (Ohwovoriole, 2021) or when we consciously attend to it.

There are three types of sensory memory: iconic (visual sensory memory), echoic (auditory sensory memory), and haptic (tactile sensory memory). George Sperling (1960) studied iconic memory. During his recall test, Sperling briefly showed 12 letters to the participants. He then asked the participants to recall as many letters as possible. The results showed that, on average, participants could remember only one-quarter of the letters. This implies that they only remembered the letters briefly and that it was impossible for them to register them all. However, in some cases, iconic memory may seem to last longer, a phenomenon called eidetic imagery or photographic memory. People with this memory can report details of an image for an extended time (Solomon, 1995).

In contrast, echoic memory, an auditory sensory memory, stores information through hearing. Echoic memory can last about four seconds (Cowan et al., 1990), meaning that a person can remember the last statement a speaker said even after the speaker has finished speaking. Some people reported that their echoic memories last for an incredibly long time. Similar to iconic memory, the findings indicate that eidetic imagery (or photographic memory) for hearing also exists. For instance, Mozart could listen to long compositions and play them almost perfectly despite not having much musical training. He might have an eidetic memory for music (Solomon, 1995).

Short-term Memory

Some memories passing through the sensory memory are forgotten. However, when a person aims to remember information and consciously attend to it, the data goes into short-term memory (STM). According to Baddeley and colleagues (1990), short-term memory can temporarily keep a small amount of information for more than a few seconds but normally for less than one minute.

Working memory refers to the processes utilized to make sense of, modify, interpret, and store information in short-term memory, which is not stored permanently but becomes available when needed. It is not a memory bank like STM, although it is called memory. Instead, it is a set of memory procedures or operations used to successfully accomplish a task (Unsworth & Engle, 2007). For example, short-term memory is necessary for solving math problems; it needs to store the given formula for a few seconds. Working memory will process the stored information's structures making the information accessible when required.

Since STM has a limited time and capacity to hold a piece of information, working memory can be used to rehearse the data stored in short-term memory, preventing the deterioration of information. This process of rehearsing the information mentally or out loud to keep it in memory is called maintenance rehearsal. Engaging in this process allows us to keep the information we want to remember in our minds (Stangor & Walinga, 2014).

Long-term Memory

Once the information has passed through the short-term memory, it can enter and stay in the long-term memory (LTM). LTM is a memory bank that can store information for days, months, and years. There is no known limit to what we can remember because the LTM's capacity is larger than STM's (Wang et al., 2003). Although we may forget some information after learning it, some things will remain permanently (Stangor & Walinga, 2014).

However, some factors can influence how long information is retained in long-term memory. Firstly, how the memory was encoded. If there is an intent to remember the information during sensory input, the memory will likely be more vivid. Secondly, frequent memory access plays a role in the capacity and duration of the long-term memory's ability to hold information. If maintenance rehearsal is utilized, the data stays for a long time and becomes clearer (Cherry, 2021).

Long-term memory has two components, procedural and declarative. Procedural memory (or implicit memory) includes information about activities learned through repetition and practice, such as cooking, swimming, typing, riding a bike, and driving a car. These memories become so deeply embedded that they almost become automatic and allow us to perform a skill without thinking much about it (Lum et al., 2011). On the other hand, declarative memory (or explicit memory) contains facts, rules, events, experiences, and definitions that can be retrieved when needed. This component requires conscious recall and effort to bring out the information in response to a specific request or need to remember. For example, someone asked for the name of your favourite professor. To answer this, you must recall all the information

about the professors' classes you attended during your college years and choose which one is your favourite. This is an example of an active retrieval of information from long-term memory storage.

Three Process of Memory

The "memory's processes" refers to how the memory from the three stages (sensory, short-term, and long-term) are processed. Three memory processes have been distinguished: encoding, storage, and retrieval. These processes work in chronological order. They must interact for information or events to be effectively remembered. For instance, being in a new place necessitates learning new people's names. One way to remember is to associate their name with their face or specific characteristics that would help you maintain the information over time. If you meet that person again, recognizing their face or memorable characteristic will serve as a cue to remember that person's name.

However, two types of error might occur: forgetting and misremembering. Forgetting is a failure to recall a name, event, or piece of information while misremembering is when there is a false recall or recognition. Now the question is, at which stage did memory processing go wrong for these two errors to occur? It is not easy to provide a precise answer to this question.

According to McDermott and Roediger (2022), the inaccuracy or memory problem is not because one of the three memory processes is dysfunctional. Instead, because all three processes of memory are linked to one another, the problem is not caused by one process. For instance, the encoding process depends on how the information is

stored and what cues help us recall that knowledge when we try to retrieve it. The retrieval process can itself change the way information is remembered. The essential idea here is that the memory processes influence each other and are inherently connected. The answer to the question of *"at which process"* did memory processing go wrong when memory errors occurred would be hard to identify as they depend on each other. Therefore, when an error occurs, all three are responsible, and it should not be attributed entirely to just one of the processes.

Here, according to McDermott & Roediger (2022), the three processes of memory, encoding, storage and retrieval are discussed:

Encoding

Information input into the memory system is the first step of the memory process. This step includes the experience of understanding and learning information encoded in three different ways: visual (image), acoustic (sound), and semantic (meaning). In research, psychologists usually examine the recall process by allowing the participants to study a list of pictures or words. However, this type of study means encoding images or words takes place in a controlled environment. Controlled environments are not as complicated as "real-life" situations, where encoding is much more demanding. For instance, encountering countless sights and noise while walking along a busy street is common. This busy environment is filled with continuous sensory data. It would be overwhelming to focus on every piece of information and encode it all into the memory system. Therefore, the brain responds to selective environmental occurrences while skipping the ones on which our concentration and attention are

not focused. One of the fundamental principles of encoding is that it is selective. Another principle is that encoding is prolific.

We encode an event by focusing on it and trying to make sense of it. Our lives are full of regular events such as news programs and traffic noises, and we do not need to pay close attention to everything all the time. Yet, when there is uncertainty or something strange happens, we tend to pay close attention to that happening and strive to figure out why we see or feel what we feel. For example, if you saw a dinosaur while walking on the street, this would, of course, be very unusual in this era unless it was a mascot. As a result, your focus would be directed to the dinosaur, trying to make sense of the strange sight you are seeing. The concept of distinctiveness explains the attention and understanding you invested in the dinosaur. The key to remembering events is associated with the event's remarkableness (Hunt, 2003). Simply put, it is easy to remember an event that appears strange, noticeable, extraordinary, or unique to the environment.

Likewise, when there is a strong emotional component to memory, it is much easier to encode and retain it. For example, events that create vivid memories, such as disasters, pandemics, and terrorist attacks, are easily recalled in detail. People who indirectly or directly experience tragedies may have vivid memories of those experiences. Brown and Kulik (1977) coined the term flashbulb memory to characterize this type of vivid memory, which refers to how the mind captures some memories like a photograph. Memories then become permanently engraved in the mind with remarkable clarity relative to other memories because of the distinctiveness and emotional aspect associated with the encoded information.

The initial registering of information is crucial in the learning and memory process; unless the information is encoded, it will not be successfully retrieved later. However, even if an event or piece of information is encoded in the memory system, there is no assurance that it will be accurately remembered later.

Storage

Memory storage refers to where information is stored, how long it lasts (duration), how much information can be stored (capacity), and what kind of information is retained. How information is recalled affects how it is stored, which is why a great deal of research has examined the differences between short-term and long-term memory (McLeod, 2013).

According to psychologists and neurobiologists, experiences leave memory traces or engrams. In order to store memories, the brain biochemically changes itself and its neural tissue. The basic notion is that experiences or incidents in the environment generate engrams through memory consolidation. These neural modifications happen after learning to build the memory trace of the experience. Neurobiologists are interested in the specific neural processes that start changing when memories are formed. In contrast, psychologists look at how memory trace describes the physical alteration in the nervous system that represents the experience.

Using the concept of engram or memory trace is beneficial in understanding the memory storage process. However, memory traces are not little boxes of information buried in our brains waiting to be retrieved full of accurate information about the recalled experience.

Memory traces are unlike audio or video recordings that accurately capture the experience. As discussed earlier, errors in our memory do occur. Believing that remembering only entails retrieving past experiences from storage is not always the case. When we recall past events and reconstruct them, we do so with the help of memory traces and our current beliefs about what happened.

Therefore, memory is a combination of beliefs and what is remembered. Simply put, remembering is reconstructive (we recreate our past using memory traces) rather than reproductive (a complete recreation of the past).

Retrieval

This process entails retrieving or obtaining information from storage (McLeod, 2013). Failure to recall a memory or information occurs when there is an issue with the retrieval process from storage. The faulty retrieval process could also result from how the information was encoded. The three stages are interdependent; therefore, all the phases are responsible for the memory error or problem. Also, the primary process in memory is the retrieval and should be given more importance than encoding or storage (Tulving, 1991). Why is that? Because it is pointless to encode and store the information if it cannot be retrieved. It is like buying all kinds of stuff you do not need because it is on sale.

Every day, humans encode and store a large amount of information from events such as conversations, scenery, sounds, and so on. All this encoded information leaves memory traces. Over time, only a few of

the encoded memories will be accessed, while most of the memories will never require retrieval.

The type of cues in the environment plays an essential role in determining what information can be recovered from memory. For example, you may hear a song on the radio that suddenly triggers a memory of eating your favourite ice-cream with a friend. You were not attempting to remember this memory; however, you recalled it because the song and memory were linked during the encoding process. Now, every time you hear that song, it will bring the experience back to mind. The encoding specificity principle (Tulving & Thomson, 1973) is a general principle underlying the effectiveness of retrieval cues. This principle refers to linking memories to the context in which they were created. Memories are more easily recalled when the situation we are in is similar to the context in which the memory was created. For example, returning to your hometown may evoke memories of long summer days playing with friends even if you have not been there for a long time. Another example is when you lose your keys and repeatedly return to where you usually keep them. The location provides a retrieval cue that matches stored memory while encoding the information.

Although this process appears similar to pulling a book from the shelf and returning it to its original place, research suggests otherwise. According to studies, our memories are not objective but rather reconstructive; our memories are not fixed but constantly changing. Unlike printed books, where information can be accessed without modification every time, our memories are susceptible to alterations when we try to access them.

7 Common Memory Problems

Forgetting things and events from time to time is normal. As people age, they tend to become more forgetful. Although healthy people may experience memory loss or distortion as they age, these are not considered indicators of Alzheimer's or other neurocognitive diseases. It would require treatment and intervention only if memory loss or distortion symptoms become severe and persistent. But how can we tell if memory lapses are a normal part of ageing or if it is a symptom of a serious medical problem? According to Harvard Health (2021), there are seven common memory problems that a person may experience:

1. **Transience:** this memory problem causes a person to forget facts, details, or events over time. Often, the information is forgotten after learning it. Our memory has a use-it-or-lose-it quality. Unused memories are the most likely to be forgotten, while repeatedly remembered memories are the least likely to be forgotten. Though transience may appear to be a sign of memory loss, brain experts claim it is essential because it clears the unused memories, allowing the brain to have newer and more useful ones.
2. **Absentmindedness:** when people fail to pay close attention to a specific event, absentmindedness occurs. An example would be forgetting where you put your car keys because you did not focus on where you placed them. This probably happens because your thinking is focused on something else. It may also be possible that you are spacing out, so your brain did not encode the information correctly.

3. **Blocking:** knowing what you want to say but finding it difficult to pinpoint or communicate the answer. It is that sensation of what you want to say is “right on the tip of your tongue”. You know what you want to say, but the answer is not forthcoming. At that moment, the brain is temporarily incapable of retrieving a memory. In several cases, the roadblock is a similar memory to the one you are searching for, resulting in the incorrect memory being retrieved. An example would be knowing the person but struggling to recall their name. Memory blocks, according to scientists, become more prevalent as we age. They are responsible for the challenges older people may experience, especially when remembering other people’s names. According to studies, people can retrieve roughly half of blocked memories in less than a minute.
4. **Misattribution:** occurs when you recall a memory that is only accurate in part while misattributing some facts or detail, like time, place or the person involved. For instance, you remember laughing at your friend who fell in the streets when it was, in fact, your mom. Meaning the brain retrieved the memory with slight errors. Misattribution, like several other types of memory lapses, becomes more common as people age. As people grow older, they have more problems with poor concentration and information processing, which causes the brain to absorb fewer details when learning new things. As we age, our memories deteriorate, and older memories are prone to be misattributed.
5. **Suggestibility:** this refers to the vulnerability of memory to the power of suggestion. In this case, information learned after

an event is incorporated into the recollection even though it was not experienced. In other words, your memory may be filled with false memories to fill the gaps of a particular memory or event.

6. **Bias:** every individual is susceptible to bias. Even the person with the sharpest memory does not have a flawless view of reality. Bias affects our perceptions which are encoded with a memory. Beliefs, experiences, prior knowledge, and current emotion are filtered through your personal bias. When your thoughts and experiences are stored in your brain, biases can influence them. Even when retrieving a memory, your attitude and other biases at the time can influence the recalled information. Although everybody's opinions and preconceived conceptions influence their memories, little study has been done on the brain mechanisms that cause memory bias or if it worsens with age.
7. **Persistence:** people tend to worry when they suddenly start to forget things. Yet, some people are distressed by memories they wish they could forget but cannot. Another common memory problem is the persistence of unpleasant memories, negative emotions, and ongoing worries that accurately reflect horrifying events and negative distortions of reality. For instance, people with depression and post-traumatic stress disorder (PTSD) are prone to having persistent and disturbing memories. PTSD occurs because of exposure to traumatic events such as sexual abuse. People with this mental health condition experience constant flashbacks and intrusive memories of the traumatic event. This means that the brain tends to remember harmful or painful events repeatedly,

making it difficult for the person to comprehend the memory accurately.

Memory Problems and Mood Swings

Memory problems, mood swings, and problems in concentration are associated with certain medical conditions. Detailed information about these conditions would help better understand the causes and treatment. The following section details the signs and symptoms of medical conditions associated with memory problems, mood swings, and concentration problems. The purpose is to better equip you with knowledge and awareness and not to encourage self-diagnosis.

The related medical conditions presented here include Alzheimer's disease, acute stress reaction, and attention deficit hyperactivity disorder (ADHD). Depression can also affect the said domains; however, its impact will be discussed in the book's next section.

Alzheimer's Disease

Alzheimer's disease (AD) symptoms involve problems with short-term memory, behavioural and mood changes, confusion, incapability to recognize familiar people, difficulties in decision making, severe memory loss, and problems with swallowing, talking, and walking. In the U.S., over 6 million people suffer from this disease, and experts predict that by 2050 there will be sixteen million Alzheimer's patients.

Alzheimer's is one of the several forms of dementia that leads to a breakdown and eventually death of neural connections in the brain. This effect on the brain's neural connections results in memory loss and problems in both cognitive functioning and behaviour. Memory

loss or forgetfulness appears to be a normal part of ageing; however, it is also one of the indications of Alzheimer's disease. This neurological disease more commonly occurs and affects people ages 60 and older (late-onset). Still, an early manifestation of symptoms (early-onset) may occur in people younger than 60, especially if it runs in the family history. There is no cure for Alzheimer's, but medications may help manage the symptoms and allow the person to live for three to twenty years after the diagnosis.

The Risk Factors of Alzheimer's Disease include:

- old age
- a family history of the disease
- having a particular gene
- gender
- a severe head injury
- having less than eight years of education
- race and ethnicity

Assessment of medical history and symptoms and performing test that measures memory, attention, problem-solving and language skills, and brain scanning are needed before the diagnosis.

Acute Stress Reaction

The physical and psychological reaction to a stressful event is known as acute stress reaction (ASR) or acute stress disorder. The symptoms of ASR are shortness of breath, anxious feeling, nervousness, agitation, irritable mood, thoughts of impending doom, capability to cope, palpitation, increased blood pressure, and insomnia. Another symptom, hyperventilation, is rapid breathing that may lead to

numbness in hands and lips, headaches, chest pain, dizziness, or loss of consciousness. These reactions are natural reactions to a traumatic and stressful event, such as the loss of a loved one, a natural catastrophe, or physical abuse. The symptoms usually settle quickly, yet in several cases, they may persist for several days or weeks.

The symptoms of an acute stress reaction may influence memory formation as our brain struggles to turn short-term memories into long-term memories under a stressful situation. Cognitive impairment involves problems with attention and working memory, which can result from exhaustion from stress (Scott & Goldman, 2021).

Attention Deficit Hyperactivity Disorder

Poor memory and mood problems are evident in the symptoms of ADHD. This condition is a common developmental disorder affecting over 5 million school-age children.

ADHD is characterized by:

- hyperactivity
- impulsiveness
- difficulty concentrating
- inability to remain still
- difficulty maintaining attention and focus
- problems following directions

Although ADHD is common in childhood, it is not always diagnosed until adolescence or adulthood. Factors leading to ADHD include genetics, brain injury, exposure to toxic chemicals, being underweight after birth, or tobacco and alcohol use during pregnancy. Symptoms

can be treated and managed with medications, therapy, and educational intervention involving parents or caregivers.

Post-Traumatic Stress Disorder and Memory Disturbance

Trauma is a strong emotional response to a distressing experience, such as loss of income, chronic illness, or the death of a parent. It is not an event but rather a response to a traumatic event accompanied by long-term consequences if not addressed immediately and adequately. People who have experienced frightening, dangerous, or traumatic events may exhibit a range of reactions, such as fear and shock. In scary or difficult situations, almost everyone will manifest a trauma response, but most people will be able to work through the symptoms. However, some people continue to have this intense trauma reaction for an extended period, despite the absence of danger or termination of the incident. These people may be diagnosed with post-traumatic stress disorder (PTSD) (National Institute of Mental Health, 2019).

If a traumatic event happens before age 18, it is known as adverse childhood trauma. Harmful childhood experiences are associated with chronic mental and physical health issues.

Among children with PTSD, only a few studies have examined their neuropsychological functioning. There is some evidence showing that children exposed to intimate partner violence (Samuelson et al., 2019), motor vehicle accidents (Moradi et al., 1999), as well as physical and sexual abuse (Yasik et al., 2007) have verbal memory deficits.

Memory disturbances are common and part of the PTSD diagnostic criteria (American Psychiatric Association, 1994). For instance,

people with PTSD re-experience traumatic events that may comprise intrusive traumatic memories and the inability to remember the crucial aspect of the trauma as an avoidance mechanism. Also, PTSD patients frequently have memory problems and concerns with emotionally neutral content, even though these concerns are not part of the diagnostic criteria.

To understand the problems, studies over the past 20 years have primarily focused on memory impairments linked to PTSD because memory problems reduce patients' interest in and compliance with therapy.

Through research on adult patients with PTSD related to combat (Bremner et al., 1993), childhood abuse (Bremner et al., 2004), rape (Jenkin et al., 1998), political hostility (Johnsen & Asbjornsen, 2009), and the Holocaust (Golier et al., 2002), researchers discovered there is a loss of verbal declarative memory associated with PTSD.

However, the data showed that visual memory impairments were less prominent than verbal memory impairments (Danckwerts & Leathern, 2003).

It is critical to demonstrate that any memory deficiencies reported in PTSD patients are due to post-trauma stress and not because of other psychiatric conditions typically associated with PTSD, such as depression, substance use disorders, and traumatic brain injury. For example, veterans with PTSD and comorbid psychiatric illnesses such as anxiety or substance abuse have worse neurocognitive functioning than veterans diagnosed only with PTSD. Therefore, the possibility of memory deficits is probably caused by the combination of two existing psychiatric conditions (e.g., PTSD and depression), not

because of the PTSD diagnosis alone (Berret et al., 30). Another example is that almost all the neuropsychological research on PTSD patients excluded those patients with traumatic brain injury (TBI), which is frequently related to memory impairment and is often comorbid with PTSD.

Regardless of age, physical, psychological, and emotional trauma can affect a survivor's memory. Without intervention, the trauma and associated memory loss can disrupt survivors' lives, as well as the topographic structure of their brains.

The Two Primary Frameworks in Understanding Memory Impairments in PTSD

Samuelson's (2011) literature review will elaborate on the two frameworks that describe the nature of declarative memory dysfunction and its relationship with PTSD.

To understand the memory impairments in PTSD, the two primary frameworks presented in this section are the continuum of the nature versus nurture paradigm. In other words, either the environment influences neurobiology or heredity influences our susceptibility to PTSD.

Framework 1: Neurobiological Aberrations in PTSD

The first framework shows that memory deficit is due to the neurobiological abnormalities initiated by PTSD. Research findings established the different neurobiological systems and functional deformities involved in PTSD. For instance, abnormal activities in the hippocampus and hypothalamic-pituitary-adrenal axis (HPA), the

prefrontal cortex, and the catecholamine system are primarily associated with memory deficits. Furthermore, the hippocampus, a separate part of the brain susceptible to stress, has been the subject of PTSD studies for over 15 years.

In animal studies, the glucocorticoid toxicity in an animal's hippocampus and memory dysfunction under stress provides that intense exposure to stress, especially traumatic stress (Luine et al., 1994), may lead to similar human changes. Moreover, smaller hippocampal volumes on both the left and right sides are evident among adults with PTSD, according to meta-analysis studies. Lastly, in functional imaging findings, abnormal cerebral blood flow in the hippocampus has been demonstrated when performing an activity that requires declarative memory (Shin et al., 2004).

Over time, the link between declarative memory and hippocampal activity has been extensively established among older adults with and without dementia (Carrion et al., 2007). From this established research, continuous documentation of declarative memory deficiencies, and hippocampal irregularities in PTSD, will logically follow the link between hippocampus disruption and declarative memory performance in PTSD patients. Yet, the two research studies that explored this relationship found an expected association between the loss of hippocampal volume and declarative memory performance (Bremner et al., 1995) that is not evident in some studies (Woodward et al., 2009).

Likewise, several studies further clarified the influence of PTSD on the prefrontal cortex (PFC). One example is the production of glucocorticoids and catecholamines in the PFC in response to stress (Theirry et al., 1976). The release of these hormones in response to

stress may result in poor PFC performance, affecting the working memory, behaviour regulation, executive functioning, and emotion (Arnsten, 2000), all of which are related to PTSD (Vasterling et al., 2002). In addition, multiple MRI studies found lower frontal brain volume in PTSD patients (De Bellis et al., 2002) and lower volume medial prefrontal regions, particularly the anterior cingulate and subcallosal cortex (Rausch et al., 2003).

Overall, the research suggests that PTSD may create abnormal brain changes in the neurological system and functional structures, which may result in memory problems.

Framework 2: Memory Deficits as a Risk Factor for PTSD

The second framework, on the other hand, proposes that pre-existing memory problems are one of the risk factors for PTSD after trauma exposure. In other words, a history of memory issues before trauma exposure increases the likelihood of PTSD diagnosis. Furthermore, PTSD is a psychiatric condition caused by a traumatic life event. As a result, all cognitive and neurobiological impairments related to PTSD are presumed to be caused by that event.

Prospective twin studies prove that pre-existing memory and learning deficiencies, associated hippocampal impairment, and increased likelihood of developing PTSD. The twin studies were conducted by Giberson and colleagues (2006). They investigated monozygotic twins with divergent combat exposure and discovered that identical co-twins of war veterans with PTSD, who have not yet undergone combat exposure or PTSD themselves, showed similar deficiencies in verbal recall.

Likewise, smaller hippocampi were also evident in combat veterans with PTSD and their co-twins (Gilberston et al., 2002), implying that memory deficits in PTSD and smaller hippocampus correspond to a pre-existing genetic factor. A recent longitudinal study explored the extent to which poorer neurocognitive performance before a severe natural disaster foretold the development of PTSD symptoms (Parslow & Jorn, 2007).

From the abovementioned research findings, it is evident that memory dysfunction is both the consequence of PTSD and a pre-existing risk factor for PTSD development. The downward spiral proposed by Vasterling and Brailey (Vasterling & Brailey, 2005) implies that pre-existing neurocognitive deficits may result in a higher risk of PTSD if there is ineffective coping or when an individual has fewer resources to cope. In return, the development of PTSD will then cause severe cognitive dysfunction. Regardless of the cause, the implications of memory impairments on everyday functioning and therapy are the primary concern, as memory deficiencies limit the PTSD patient's capacity to cope with life's obstacles and, in particular, can hinder their ability to participate in and adjust to psychological treatment.

When does the Onset of Age-Related Cognitive Decline Occur?

Despite several publications over the last 100 years about changes in cognitive functioning, determining the exact age at which age-related decline in cognition begins remains unclear. This is unfortunate as knowing the exact age of the onset of cognitive decline is crucial for practical and theoretical reasons.

For practical reasons, it is relevant to determine the onset of cognitive decline to know when to implement interventions to prevent or reverse the symptoms. Nowadays, most interventions target adults 60 years of age and above. With fewer interventions available, people experiencing a decline in their 20s and 30s will be more likely to experience significant changes by their 60s and 70s. If untreated or unmanaged, the brain continues to change, and symptoms will worsen by the time they reach their 60s. This implies that changes accumulated over a prolonged period may be more challenging to overcome and can affect the success of the intervention.

For theoretical reasons, knowing the onset age is critical in determining the cause of cognitive declines. Early declines are clearly not caused by events occurring later in life, such as menopause, retirement from paid work, or several age-related disorders. An answer to the question of "when does cognitive decline begin?" may indicate when the patient needs to learn information about the causes of the decline.

Prior research suggests that cognitive decline was not typical among people under 60, particularly healthy individuals. However, according

to research published in the British Medical Journal, cognitive decline may start as early as age 45. The study's implications are noteworthy as it emphasizes the need for people under age 60 to live a healthier lifestyle. This implication also agrees with research conducted by the Alzheimer's Association (2018) that brain changes associated with Alzheimer's will start to take place as much as 20 years before the onset of symptoms. Though the brain will initially adjust to the changes, cognitive decline begins as the damage to neurons increases. The degeneration will eventually become more visible in the form of memory loss and disorientation.

Research into the Onset of Age-Related Cognitive Decline

Research has constantly demonstrated that a decline in cognitive functioning seems to occur after the brain reaches maturity, which is during the 20s or 30s. However, there are disagreements about age-onset decline as several studies claim that cognitive decline begins later in life. For instance, according to Aartsen et al. (2002), the decline may start after mid-life but most often begins at age 70 or older.

Albert and Heaton (1988) asserted that limited performance declines occur before age 50. According to Plassman et al. (1995), cognitive functioning generally remains stable throughout adulthood until age 60. Yet, Ronlund et al. (2005) stated that there is little to no decline in performance before age 55. Lastly, Schaie (1989) demonstrates that most cognitive abilities peak in early midlife, stagnate until the late 50s or 60s, and then manifest a slow decline that accelerates in the late seventies.

Based on these claims, it is evident that there is a significant gap between the large body of scientific findings and common statements regarding the time course of cognitive ageing. Since the nature and trajectory of the phenomenon is not yet accurately described, it is crucial to understand the reasons for the disparity. Hence, the apparent discrepancy in research studies does not imply an untrustworthy assertion but rather shows the complexity of the condition.

Some researchers utilized a cross-sectional research design to study the age onset of cognitive decline. This research method examines the prevalence of a particular disease and observes it without any manipulation involved. The data is collected from a large sample of individuals at a specific point in time. In parallel to this, researchers also employ longitudinal studies to analyse the same individuals repeatedly to determine whether any changes occur over time. Previous cross-sectional research observed declines using the Army Alpha test (which measures verbal and numerical ability and the ability to follow directions and information) between the ages of 18 and 50. When the comparison was based on longitudinal observation of the same persons at different ages, the results revealed that cognitive ability improves with age rather than declines. In longitudinal comparisons with persons up to roughly 60 years of age, further longitudinal investigations have confirmed that levels of cognitive functioning are generally maintained or even enhanced as people age.

In addition, according to the findings of Salthouse (2009), combined with the results from research about non-human animals and neurobiological variables, age-related cognitive decline starts relatively early in adulthood. However, because measures based on

integrated knowledge (e.g., performance tests of vocabulary or general information) are constantly observed to increase until at least age 60, not all aspects of cognitive functioning demonstrate early age-related declines. Also, as people age, the rate of age-related deterioration increases. For example, in a laboratory study of roughly 800 people aged 61 to 96, the decline in speed variables was about twice as large compared to adults under 60. In contrast, the decline in memory variables was nearly four times greater.

Further exciting research regarding the association between age and cognitive decline was demonstrated by Jones and colleagues (2014). In their study, Jones et al. examine the relationship between age and scientific output (e.g., scientific discoveries and research), which stems from prominent examples of people who have huge breakthroughs at an early age. One such example is Isaac Newton, who developed calculus, gravitation, and optics theories at 23. He is considered a genius because he was able to make a significant contribution to science and technology at such a young age.

Numerous studies demonstrate that the age of great scientific contribution peaks in the 30s or 40s. Despite the rapid rise of creativity during the early 20s and 30s, there is a gradual decline during the 40s and beyond. The question is, why?

During early life, a person is focused on schooling, gaining knowledge and skills, and less on scientific contributions and the production of scientific outputs. Creativity peaks at an early age because creativity is viewed as a new combination of existing knowledge and knowledge acquired through training. Psychologists noted that, generally, a minimum of ten years is needed for most people to master a specific field (Ericsson & Lehmann, 1996 as cited in Jones et al., 2014).

Nonetheless, the frequency of significant scientific contributions tends to decline in middle age and continues to wane later in life. As mentioned previously, there is a rapid increase in productivity and creativity during the early life cycle, in contrast to the mid and late-life cycle, where a slow decline is prevalent. This pattern can be explained by various factors such as institutional factors, health, and changes in investment-work-leisure choices in life as the scientist ages. These mechanisms are also the reason why scientists may spend less time researching as they age, suggesting lower creative capacity.

The Jones et al. study concludes that revolutionary discoveries occur during the early 20s and 30s and dramatically decrease between the 40s and 60s. The probability of producing significant innovations in the 70s and beyond is approximately zero. This can be explained by the changes in neurological mechanism, where the functioning of the prefrontal cortex responsible for working memory, executive functioning, and ability to focus declines with age, restricting creative thinking.

Age-related Cognitive Decline may Start Earlier in Women

Karlamangla and colleagues (2017) from the University of California Los Angeles (UCLA) examined the current findings on cognitive decline in middle-aged women, suggesting that decline starts sooner than previously assumed.

The data came from the Community-Based Longitudinal Study of Women's Health Across the Nation (SWAN), a community-based, longitudinal, observational study of middle-aged women. The

cognitive abilities data was collected from 2,709 healthy women aged 42 to 52, of which 80% had their cognitive abilities tested at three or more visits. However, some women were removed due to health issues and their location. The remaining 2,124 participants were clinically followed for ten years following menopause.

SWAN carried out a test that included an annual processing speed test, an immediate and delayed verbal episodic memory test, and a working memory test. Overall, the study generated and analysed 7,185 cognitive test results with an average follow-up period of 6.5 years, considering the practice effect, memory retention, menopause symptoms, and other variables.

After adjusting for the characteristics mentioned above, the research provided robust and substantial evidence of an early decrease in cognition among middle-aged women. The study showed declines in two of the four cognition tests. The women's cognitive clarity diminished, on average, by 4.9% over the ten years. The average rate of deterioration in cognitive speed was 0.28% per year, particularly in the speed of perception and reaction, declining by approximately 1% every two years. Likewise, verbal memory declined at an average rate of around 1% every five years.

This study adds to the existing knowledge that women in their 40s and 50s are experiencing cognitive ageing, with significant decreases in processing speed and verbal memory with time. Yet, the authors acknowledge the need for further research to identify the factors that cause these decline rates and to develop interventions that may help in decreasing the deterioration of cognitive functioning due to ageing.

Cognitive Changes: What is Normal and What is Not?

Understanding the natural cognitive changes associated with ageing is vital because it impacts older people's day-to-day functioning. However, even though younger age groups may not experience dementia and mild cognitive impairment, they can experience slight cognitive changes. Therefore, it is necessary to know what normal brain changes are to help distinguish between normal and disease conditions. Being informed makes it possible to anticipate what can go wrong as we age.

Normal Cognitive Changes with Ageing

Some cognitive abilities, such as vocabulary, are resilient to brain ageing and improve with age (Harada et al., 2013). Other cognitive capabilities such as routine memory, skills, and knowledge remain steady and may also increase with age. However, normal brain ageing may result in decreased processing speed and problems in multitasking.

The typical cognitive ageing discussed in this section includes minor declines in these cognitive domains: processing speed, attention, memory, language, and executive functioning.

Processing Speed

This refers to how fast our brain acknowledges and responds to cognitive activities or stimuli. It may include the capability to quickly solve rudimentary math problems, rapid recognition of visual cues, and immediate reaction to dangerous situations. The decline in this

cognitive domain is part of normal ageing that begins in the third decade of life to old age. Slowing down a person's processing speed can negatively affect them, particularly in performing tasks requiring speed (Harada et al., 2013). For instance, difficulty responding immediately with your address or phone number in response to someone's query for it. The decline in processing speed is also responsible for higher car accidents among older adults (Howieson, 2015).

Attention

Attention is the ability to focus and concentrate on relevant information or stimuli and respond to them. The three subtypes of attention: are divided, selective, and sustained attention. With ageing, the decline is more evident in selective and divided, as these two subtypes require complex attention. Yet, this decline does not suggest a neurodegenerative condition. Sustained attention, which refers to the capability to focus over a long period, does not usually decline with ageing.

People unable to focus on one thing are easily distracted by things within their environment. Selective attention is the ability to focus on specific information while disregarding the irrelevant information in the surroundings. For instance, at a party, you give your full attention to the person you are speaking to without being distracted by other conversations or noise. On the other hand, divided attention is the ability to focus on various tasks simultaneously, such as talking on the phone while cleaning the house (Harada et al., 2013). The elderly have more difficulty switching between tasks because of the decline in their attention due to ageing (Howieson, 2015).

Memory

Older adults commonly complain about memory changes, such as the declining ability to use techniques to enhance learning and memory. The ability to encode new information and acquire memory declines across a person's life. In cognitively healthy older adults, the ability to retain information is preserved, but a decline in the ability to access newly learned information (memory retrieval) is evident.

Language

As we age, our overall linguistic ability (e.g., vocabulary and comprehension) stays intact, remains stable, and even improves over time. However, the ability to execute a word search and construct words for a specific category (e.g., letters, animal names) within a set time decreases as we age (Harada et al., 2014). Recalling a piece of information involves memory. However, the problem lies in difficulty recollecting the details despite their availability in the individual's knowledge or vocabulary store (Howieson, 2015). For example, it is more difficult for adults aged 70 and up to recall a person's name or word familiar to them during a conversation.

Executive Functioning

This refers to higher-level skills such as conceptualizing a problem, the ability to make appropriate decisions, as well as the ability to plan and carry out efficient actions. The decline in executive functioning leads older adults to have slower problem conceptualization and do not perform well in events that require strategic thinking (Howieson, 2015). Research shows that older adults think more concretely than

younger adults. It is noticeable as people age, notably after age 70, that their concept formation, abstraction, and mental flexibility decline (Harada et al., 2013).

The Informational Processing Model and Ageing

Cognitive psychology focuses on how an individual understands, learns, remembers, and reasons about certain information. The study of cognitive ageing investigates how these mechanisms change over time and between individuals. Normal ageing has been defined as the changes that occur during ageing in people who do not have visible nervous system diseases.

In research findings, healthy older adults demonstrate declines in some cognitive domains, particularly in attention, working memory, and episodic memory, compared to younger counterparts. (Verhaeghen et al., 1993; Craik & Salthouse, 2000). However, older adults perform better on cognitive tasks where they can use knowledge based on experiences, such as tests evaluating wisdom and general knowledge (Craik & Salthouse, 2000).

The model of information processing introduced by Cowan (1998/1999) is one way to understand how ageing affects cognition. The model explains the association between attention, working memory, and how long-term memory is stored. In this model, the working memory refers to an activated part of long-term memory that holds both the information inside and outside the focus of attention, which has a very constrained and limited capacity.

From the processing model's point of view, the difficulties in controlling the focus of attention are the consequence of ageing. In

older adults, the impairments in attentional control enable irrelevant and relevant information to get into the focus of attention. This may result in impairment in performance on the tasks that need the ability to discern irrelevant and relevant information. When irrelevant information has already entered working memory, older adults may make mistakes when suppressing their attention to it (Damas & Hartman, 2008). As a result, the consequence of ageing on the focus of attention may be to blur the boundaries or broaden the focus, giving older adults little control over the existing information inside the focus of attention.

Research has focused on the dynamic relationship between brain functioning and cognitive processing because of the increased access and availability of MRI scanners over the last two decades. Discussing how changes in brain functioning impact cognition due to age is critical in distinguishing between normal and pathological ageing.

Functional Neuroimaging Studies in relation to Attention, Working, and Episodic Memory

According to functional imaging studies, older adults revealed impairments in tasks requiring attention, working memory, and episodic memory compared to younger adults, implying age differences in brain activation (Cabeza et al., 2002; Rypma & D'Esposito, 2002). Age difference fMRI studies utilize tasks that control attentional resources to measure the mechanism of the brain. The result shows that more frontal cortex regions are activated in older adults than younger ones. Meaning older adults requires more brain mechanism to perform the task.

In contrast, in the Stroop Interferences Age Differences Study, similar brain regions were activated in both the older and younger adults during the interference tasks. The Stroop test showed that older adults performed tasks slower and had more activated frontal cortex regions than their younger counterparts (Langenenecker et al., 2004). More frontal activation in tests of sustained, selective, and cross-modal attention shifting was also seen in older adults, showing the age differences in attentional control and brain activation in a broad range of attention activities (Townsend et al., 2006). Therefore, older adults need increased frontal cortical activation to execute a task requiring attention.

Similarly, functional neuroimaging studies of working memory have revealed the link between the ability to engage the frontal brain regions to compensate for the reduced performance and age differences in working memory performance. In comparison to younger adults, the increases in prefrontal activation among older adults depend upon successful task performance, suggesting the involvement of compensatory mechanisms performed by the brain (Stem, 2022; Han et al., 2008). To support this claim, three different tasks involving working memory were presented.

In the first task, less dorsolateral prefrontal cortex (the brain region involved in executive functions such as working memory and selective attention) was found among fast-performing younger adults compared to slower-performing younger adults. However, increased activation was evident in faster-performing older adults compared to slower-performing older adults (Rympa & D'Esposito, 2000). In the second task, older and younger adults who completed an n-back working memory task's 1-back condition (an assessment for verbal and

visuospatial working memory) had similar performance results. However, the variances revealed that older adults activated more prefrontal cortex bilaterally than younger adults. Consequently, older adults performed worse in the higher working memory load conditions and had less frontal activation than younger adults (Mattay et al., 2006). In the final test based on a sentence comprehension test requiring high working memory, both older and younger adults exhibited equivalent comprehension scores; however, older adults needed more frontal activation to do the task (Grossman et al., 2002).

Because the younger counterparts do not require more mental resources to complete the tasks, the abovementioned examples imply that no increased activation was found in young adults compared to older adults. However, older adult brains require more effort to complete a task that needs working memory.

According to episodic memory research, older adults demonstrate more bilateral frontal area activation than younger adults. For instance, Cabeza and colleagues (2002) introduced the hemispheric asymmetry reduction for older adults (HAROLD) model to better understand age differences in the frontal cortex activation during memory tasks. In younger adults, there is an age-related change in the hemispheric encoding/retrieval asymmetry (HERA; Tulving et al., 1994) brain pattern activation wherein encoding processes activate the left prefrontal cortex as retrieval processes activate the right prefrontal cortex. However, in older adults, there is a reduction in hemispheric asymmetry, explained by the HAROLD model. This model revealed a reduction in this asymmetry because there was more bilateral activation in both encoding and retrieval tasks. Again, greater

activation in a particular brain region implies that many resources are being utilized to compensate or help with task performance.

Overall, functional imaging data about attention, working memory, and episodic memory demonstrate that older adults recruited more frontal cortical areas to perform at the same precision as younger adults across all tasks. This supports the notion that supplemental activation results from neural compensation (Stern, 2002). Also, decreases in posterior cortical areas were observed, possibly suggesting a shift toward a frontal cortex-dominated pattern of brain activation.

What is Considered to be Abnormal Cognitive Changes as we Age?

The typical changes we notice in cognitive functioning as we age do not necessarily mean that the neurodegenerative disease exists. Normal cognitive ageing includes people who do not meet the conditions for dementia or any mild cognitive impairment. Neurological disorders such as Alzheimer's and Parkinson's disease are not normal yet have become an inevitable part of ageing. People who experience regular cognitive changes may forget things but will eventually remember later; however, this is not the case for people who suffer from neurological disorders. Therefore, the presence of neurological disorders leads to abnormal changes in cognition associated with age. According to Heather Snyder, an expert and senior associate director at the Alzheimer's Association,

"Alzheimer's disease is not normal ageing."

Alzheimer's disease is the most common cause of cognitive decline among older adults, and its prevalence increases with age. At 65, less than 5% of the population has a clinical diagnosis of Alzheimer's disease; however, this number jumps to more than 40% by age 85. Abnormal changes in cognitive functioning are linked to the development of Alzheimer's disease. The symptoms include a gradual deterioration in memory and learning new things with minor problems in executive functioning and eventually changes in language and visuospatial processing. Many of these changes are similar to normal cognitive changes, but the difference lies in the severity (Murman, 2015).

Although both normal cognitive ageing and Alzheimer's disease involve "memory issues", with Alzheimer's disease, the information does not come back and no longer seems familiar. To further understand the differences, Snyder said that indicators of natural ageing include failing to pay monthly expenses. However, it is worse in Alzheimer's disease with the individual forgetting how to pay bills or handle their finances. In abnormal ageing, the changes in cognition are more severe and rapid, whereas the changes in normal ageing are subtle and primarily affect the speed of thinking and attentional control. Since there are also changes in the brain as we age, abnormal ageing includes problems in the motor system resulting in excessive and frequent tripping and tremors.

It is important to monitor the symptoms of cognitive changes. Although a memory lapse may not be alarming, it should be addressed because it is our brain's method of alerting us that something is wrong. Remember that having mild cognitive impairment symptoms increases the risk of developing other forms of dementia. If the memory problems are more severe than the usual forgetfulness and interfere with daily functioning, consulting a doctor is the best option.

Normal and abnormal cognitive ageing symptoms differ from person to person. What is normal for one person may not be typical for another, making it difficult to determine when a person should be concerned about the cognitive changes. One of the biggest challenges in improving well-being, especially for older people, is determining the risk factors, mechanisms, and individual differences in age-related cognitive decline (Deary et al., 2009).

What Happens in the Human Brain as we get Older?

The degree to which brain function declines with age varies from person to person. The brain's complicated structures and processes change as neural networks and pathways link and disconnect, starting when the embryo is 3-4 weeks of age and continuing into old age. As we age, the parts in our body and brain regions gradually decline. Generally, brain ageing includes changes in structure, white matter, grey matter volume, and neurotransmitter systems (Han, 2020).

Structural Changes

Around age 40, the volume or weight of the brain decreases approximately 5% every decade, accelerating after age 70. However, the volume lost varies throughout the brain as some areas shrink faster than others. Some brain regions, such as the frontal lobe, cerebellum, and hippocampus, start to shrink significantly at around 60 to 70. This leads to changes in cognitive ability since these areas are responsible for higher cognitive functioning and the encoding of new memories. As people age, these brain areas suffer the most damage.

The wrinkled outermost layer of the brain, known as the cerebral cortex, contains neurons that are affected during brain ageing due to thinning of the outer-ridged surface. This decline in synapse circuits leads to fewer connections, resulting in slower cognitive functioning.

From the perspective of the "retrogenesis" or "last in, first out" hypothesis, the brain regions that develop late (e.g., frontal lobes) are most vulnerable to age-related brain changes as these regions tend to have more complex cortical architecture than areas that mature early. Research shows that the medial orbitofrontal cortex, one of the late-

maturing medial frontal areas, is sensitive to ageing, explaining the decline in executive function often seen in healthy elderly samples. The deterioration impairs the memory function and adds to memory issues in non-demented elderly and people with MCI. Moreover, the rate of decline in specific brain regions is considerably higher in old age than in middle-aged adults (Fjell et al., 2014).

Moreover, one of the brain structures essential for human cognition that is also affected by ageing is the hippocampus. This structure plays a significant role in executive functioning, learning, spatial navigation, encoding, and memory consolidation. MRI studies show that people diagnosed with mild cognitive impairment (MCI) and dementia demonstrate a smaller hippocampus. Also, findings reveal that in older adults, a smaller hippocampus volume is linked to poor scores on commonly used cognitive ability tests (Shea et al., 2016).

Grey Matter and White Matter

The decline in grey matter starts after age 20, with the most prominent loss in the prefrontal cortex. However, a study conducted among 66 adults ages 23 to 81 showed a widespread decrease in grey matter volume from middle age onwards, whereas grey matter volume in the frontal cortex declined earlier (Giorgio et al., 2010). Grey matter makes up the brain's outermost layer and extends to the spinal cord, making signalling and processing of information more efficient, enabling humans to function normally.

Moreover, a large number of neurons in grey matter allows it to process and release new information through axon signalling found in white matter. Throughout the nervous system, grey matter is

significant in all aspects of human life as it enables the individual to control movement, memory, and emotions (Mercadante & Tadi, 2021). The loss of grey matter as we age affects memory and executive functioning. Yet, it also results in physical decline, evident in balance and coordination problems. One of the factors of volume loss of grey matter with ageing is the accumulation of protein beta-amyloid in the brain, particularly among patients with Alzheimer's. Also, the existence of beta-amyloid in cognitively normal people suggests a higher chance of developing Alzheimer's disease in the future (Harada et al., 2013).

During adolescence, grey matter volume declines roughly 1.6% a year, in contrast to the previous assumption that grey matter only starts to decline after age 20. However, the decrease during adolescence is related to the calibration of connections between brain cells and increased tissues in the cerebrum, which is white matter. This mechanism is positive because as white matter increases, the speed of signals sent between brain cells also increases (Mills & Anandakumar, 2020).

However, human developmental neuroimaging studies commonly assert that grey matter in the brain declines during adolescence, with lesser brain size implying poor cognitive performance and vice versa. This idea is perplexing because cognitive capacity improves considerably from childhood through young adulthood while at the same time, brain volume and cortical thickness decline.

Should the Brain Volume and Cortical Thickness increase as Cognitive Functioning Improves?

A research study from the University of Pennsylvania School of Medicine (2017) provides an answer to this paradox. The study reveals that while brain volume decreases from childhood to young adulthood, the volume of grey matter increases. The result further asserts that females with smaller brain volumes have higher grey matter density than males, which means that despite having lower brain volumes, their cognitive performance is equivalent to males. Although adolescents lose brain volume, and females have a smaller brain volume than males, increased grey matter density compensates for this, resulting in higher cognitive processing and mental development.

Grey and white matter are distributed throughout the central nervous system, particularly the brain and spinal cord. If grey matter facilitates information processing in the brain, white matter facilitates information transfer. White matter is essential in connecting and uniting various regions in the brain to perform the transfer of different mental operations. A sheath called myelin covers the white matter to protect the nerve fibres from damage and improve nerve signals speed, and transmission. As we age, the decline in white matter volume is greater than grey matter volume. For instance, an autopsy study of normal brains aged 20 to 90 reveals that the volume loss of white matter was 28%, double the 12% loss seen in grey matter (Pakkenberg & Gundersen, 1997).

The development of mature personality traits in children and adolescents, such as motivation, demeanour or bearing, and executive function, is connected to the development of white matter in the frontal

lobes. However, for older adults, the ageing brain may result in a reduction of white matter in the cerebral area of the brain. The role of white matter is to connect, transfer, and communicate. This means the loss of white matter results in the usual cognitive decline, such as slowed information processing, a drop in attention span, and forgetfulness. Slow and inefficient information processing occurs when the white matter is disrupted, and if the disruption is severe, the brain will not process any information at all (Filley, 2005).

Neuronal Changes

Brazilian researcher Dr Suzana Herculano-Houzel estimates that, on average, 86 billion complex neuronal networks in the brain serve as the nervous system's building blocks. It receives sensory input from external stimuli, sends motor commands to our muscles, and transforms and relays electrical signals. There are three classes of neurons: sensory, motor, and interneurons. Sensory neurons carry the information sensed by our sense organs such as eyes, nose, ears, tongue, and skin to the brain. Motor neurons, on the other hand, facilitate the control of muscle movements such as speaking and walking, then carry the messages from nerve cells in the brain to the muscles. Lastly, the interneurons act as a carrier of sensory information and regulator of motor activity. Neuronal changes contribute to the ageing brain's shrinking and thinning cortical layers. As the connection between brain cells decreases, an individual's learning and memory and sensory and motor functions are impacted. Our neurons continue to function, but their mechanism decreases with ageing.

Neurogenesis, the formation of new neurons, decreases as we age though it remains present at low levels. Neurogenesis is significant to the ability of the adult brain to operate normally and perform self-repair in response to cerebral diseases. Neurogenesis only occurs in the developing nervous system, such as the brain, spinal cord, sensory organs, and nerves. It is thought that to preserve the functional stability of adult brain pathways, a fixed number of neurons in the brain, particularly in the hippocampus, are necessary (Galvan & Jin, 2007). For instance, recent findings show that hippocampal neurogenesis, the formation of neurons in the hippocampus, continues throughout life but decreases as we age, contributing to cognitive impairment in people with Alzheimer's. Disease conditions related to cognitive impairment (e.g., Alzheimer's), depression, and anxiety affect the hippocampal neurogenesis, which is crucial in learning and memory (Bobcock et al., 2021).

Changes in Neurotransmitter Systems

Neurotransmitters are molecules that serve as our body's chemical messengers, utilized by the nervous system to deliver messages between neurons or from neurons to muscles or target cells. The ageing brain generates fewer neurotransmitters such as dopamine, acetylcholine, serotonin, and norepinephrine. The lack of these chemicals in the brain is responsible for declining cognition and memory.

Dopamine, the "feel-good" organic chemical in the brain, is significant in executive functioning, motor control, motivation, arousal, reinforcement, and reward system. This neurotransmitter decreases from early adulthood at around 10% per decade and is associated with decreased cognitive and motor performance. Due to

increasing age, problems with dopaminergic pathways between the frontal cortex and the striatum and reduced binding of receptors are evident (Peters, 2006). Moreover, serotonin, the chemical that serves as a mood stabilizer, also decreases with age, predisposing the elderly to develop depression. Also, the disturbance in cholinergic and serotonergic function, both involved in higher cognitive functioning, has a significant role in cognitive impairment in Alzheimer's (Cidis et al., 1998).

Understanding Mild Cognitive Impairment (MCI)

Mild cognitive impairment is a transitional stage between normal ageing, dementia, and identical clinical precursors to Alzheimer's disease Goldman & Moris, 2001). Generally, mild cognitive impairment (MCI) refers to cognitive impairment beyond that experienced among normal functioning older adults of similar age and education level (Petersen et al., 2001). According to the literature, the syndrome is a heterogeneous clinical state that may switch back to normal, remain constant, or progress to several other forms of dementia over time (Bruscoli & Lovestone, 2004). MCI is also the first clinical indication of Alzheimer's disease (Studart et al., 2016).

Isolating mild cognitive impairment variants representing distinct preclinical forms of specific dementia and exploring the robust predictors of clinical course between affected individuals is still ongoing. However, one of the most examined dementia precursors is amnestic mild cognitive impairment, which has been linked to the development of Alzheimer's disease. Amnestic impairment includes problems in memory, atypical scores in formal memory assessments and normal general mental status, and difficulties in daily functioning (Peterse, 2000). The impairment is not that severe compared to someone with dementia (e.g., the capability to function is maintained). Physiological factors such as hippocampal shrinking and the occurrence of the APOE4 allele have been linked to the rapid development of Alzheimer's disease among those with an amnestic form of mild cognitive impairment (Visser & Scheltens, 2004).

However, empirical and ethical assertions in the literature emphasize the need for caution when treating mild cognitive impairment as a

clinical diagnosis. Experts argue that normal older adults experiencing changes in cognitive functioning have a higher risk of developing dementia. Yet, there are also claims that mild cognitive impairment is a poor predictive factor of dementia in the general population (Ritchie et al., 2001). Likewise, some are against the classification as they suggest that those who meet the diagnostic criteria for the syndrome have Alzheimer's disease pathology (Morris et al., 2001). Mild cognitive impairment appears to fall somewhere between normal and severe cognitive impairment (i.e., dementia) or relatively close to it.

Despite experts cautioning that mild cognitive impairment is not treated as a medical illness, early detection and treatment of MCI will benefit the individual by offering them time to perform legal or early planning for their future when dementia arises. However, the potentially negative perceptions of MCI are why consideration is needed. For instance, people with mild cognitive impairment may be identified as a risk factor for excessive use of long-term-care resources, which may affect their insurance coverage. People with MCI may encounter stigma, which can have intra- and interpersonal ramifications if they are viewed as cognitively impaired. Since not everyone knows enough about MCI and the experiences of people who live with it, stigma develops. Therefore, asking about the patient's subjective experience of living and dealing with mild cognitive impairment is one way to understand the consequences of such a diagnosis.

Amnestic and Non-amnestic Mild Cognitive Impairment

Mild cognitive impairment (MCI) can be categorized as amnestic (aMCI) and non-amnestic (naMCI). The most prominent impairment

in memory and the most noticeable cognitive manifestation of deficiency likely to develop Alzheimer's disease is the amnestic MCI. This cognitive disability primarily impacts memory, causing a person to forget critical memories that were previously quickly recovered (e.g., appointments, recent events, and conversations). On the other hand, other than memory, non-amnestic MCI influences thinking skills and other cognitive domains such as language, visuospatial, executive, and motor learning. This type of MCI is more likely to progress into other dementias (Paulsen & Gehl, 2022). Research studies support these notions.

According to a study published in an open-access journal, Frontiers in Ageing Neuroscience, conducted by Csukly et al. (2006), individuals with aMCI have a higher risk of developing Alzheimer's dementia. However, those with naMCI have a higher risk of developing non-Alzheimer's dementia (Petersen &Negash, 2008). The structural difference in the brain in MCI and healthy groups were measured by MRI, while neuropsychological tests examined the differences in cognitive performance. MRIs showed that the thickness of the entorhinal cortex, fusiform gyrus, isthmus of cingulate gyrus, precuneus, the volume of the amygdala, and hippocampus decreased among individuals with aMCI compared to healthy groups. This result is in line with the previous studies showing that healthy MCI or Alzheimer's disease patients can be distinguished from each other based on the volumes of the temporal lobe structures of the amygdala or hippocampus (McEvoy et al., 2009).

Similarly, researchers from Albert Einstein College of Medicine studied 733 individuals. The participants who lived in the Bronx were at least 70 years. They were followed for an average of five years up

to 16 years. At the beginning of the study, each participant took a cognitive evaluation for baseline and at least one annual follow-up visit. The APOE-4 gene variant that is somewhat known to increase the risk for Alzheimer's was also tested. Researchers discovered that those with aMCI had more than a two-fold increased risk of death, while those with naMCI did not appear to have a mortality risk. Yet, participants with dementia have a threefold higher chance of death than those who are cognitively healthy.

Researchers also discovered that carrying the APOE-4 genetic variant, having more medical co-morbidities, and experiencing severe depression were all linked to a higher risk of death. Nevertheless, the senior author of the study and director of the Einstein Ageing Study, Richard Lipton, M.D., asserted that although there is no cure for MCI, dementia, or Alzheimer's disease, these findings show the importance of early detection and monitoring of cognitive impairment to prolong life.

Subjective Cognitive Impairment

The self-reported decline in cognitive performance that is not measured or detected objectively through neuropsychological testing is called subjective cognitive impairment (SCI) (Sperling et al., 2011). It is named "subjective" because the person subjectively experiences the symptoms, even though others do not seem to notice any difficulty, and cognitive test scores do not indicate any issues. Other terms have been used in literature, such as "subjective cognitive decline", "subjective memory complaint", "self-reported memory complaint", and "subjective cognitive concerns" (Jessen et al., 2014; Kaup et al., 2015).

However, the term “cognitive” instead of “memory” is used because the initial symptoms of Alzheimer’s disease are not classified only within the memory domain. The term “decline” indicates a gradual decline or a change from a previous level of functioning, and the change is not just an isolated complaint (Jessen, 2014).

The inclusion criteria for SCI considers:

(1) Self-reported sustained loss in cognitive abilities compared to the prior normal condition, which is unrelated to an acute event.
(2) Normal results on standardized cognitive tests.

The exclusion criteria are: (1) having mild cognitive or dementia diagnosis; and (2) cognitive decline due to psychiatric disorders, neurological conditions (except Alzheimer’s disease), other medical disorders, or substance abuse (Jessen et al., 2014). Simply put, a person with SCI must not have a mild cognitive, neurodegenerative, psychiatric, or other medical illness that affects cognitive functioning but has self-reported a decline despite performing well on cognitive tests.

The consensus is that cognitive impairment is the first clinical symptom of an individual whose performance in a standardized neuropsychological test is below average for their age, gender, and education (McKhann et al., 2011; Frota et al., 2011). However, research indicates that the participants have already experienced subjective memory complaints before performing lower on cognitive tests (Studart et al., 2016).

According to several research studies, subjective cognitive impairment (SCI) could be one of the first indications of Alzheimer's disease or other forms of dementia, even before MCI. For instance, in one study, over 500 adults were given an annual cognitive exam. Participants who described having SCI at their regular follow-up examinations were nearly three times as likely to be identified with mild cognitive impairment or dementia later. Intriguingly, the initial concerns of memory decline occurred on average six years before a mild cognitive impairment (MCI) diagnosis.

In addition, imaging scans showed brain changes among people with SCI. One brain change is higher levels of beta-amyloid protein. The reported concerns from those with SCI included feeling worse about their memory and difficulty in task organising and prioritising.

SCI has been linked to other diseases (such as depression, anxiety, and other chronic health problems) that create problems with cognitive functioning but may not cause cognitive deficits. It can also serve as a predictor of more severe memory loss in later life. Therefore, it is crucial to consider SCI because research suggests that it may progress to moderate cognitive impairment and eventually to Alzheimer's or related dementia. Studying SCI would help determine any early cognitive changes in the disease process. Likewise, early identification of Alzheimer's disease and other dementias is crucial for efficient treatment, as some medications are more effective before cognitive functions deteriorate dramatically (Heerema, 2022).

Subjective Experience of Patients with Mild Cognitive Impairment

As the proposed precursor of dementia, mild cognitive impairment has been one of the primary research topics related to ageing. Yet, according to Linger and colleagues (2006), only a few studies into the subjective experience of what it is like to live with mild cognitive impairment have been researched. These studies examined the patients' perspectives about their experiences in living with and making sense of their condition.

From Linger's study, 12 older adults with amnestic or non-amnestic mild cognitive impairment were recruited from a university-based memory disorders clinic. In-home and semi-structured interviews were utilized to gather the details of their personal experience with MCI and how they perceive and give meaning to their experiences. Qualitative studies usually focus on the "individual differences" and "meaning-making" experience of the participants as it provides a deeper understanding of the uniqueness of an individual while experiencing similar circumstances.

Assigning meaning was the major component of living with mild cognitive impairment for the older adults in this study. Also, their perception of the meaning of their experiences consists of related emotional and cognitive dimensions, which was in line with the expectations of normal cognitive ageing, personal experience with dementia, and coexisting health problems.

Emotional Dimension of Assigning Meaning

In Linger's study of 11 older adults, the emotional reactions after receiving a MCI diagnosis ranged between positive (5 responses), neutral (4 responses), and negative phrasing (2 responses). When conveying their perception of their diagnosis, most of the participants use positive language, which includes statements such as "wonderful", "glad", "good", and "happy".

According to the narrative reports, older adults receiving the MCI diagnosis instead of the diagnosis of Alzheimer's felt relieved. As a result, the relevance of mild cognitive impairment was associated with perceptions of the absence of a dementia diagnosis. Participants expressed their feelings with strong statements using figurative wording and relief. However, fewer meanings of relief emerged when participants weighed MCI against the potentially life-threatening medical conditions it could cause.

Linger (et al. 2006) provided a narrative accompanied by feelings of relief from a 65-year-old man with an amnestic type of MCI.

"Well, to be quite honest, I think I was relieved. I knew that I had a problem. I was concerned probably like everyone would [be], that I had Alzheimer's…"

The 69-year-old participant was aware that he had a problem. Learning that he did not have Alzheimer's disease gave him the feeling that a cloud had been lifted from his shoulder.

Some participants expressed satisfaction in receiving expert validation of their symptoms. They were able to generate meaning regarding

their illness which was as comforting. Feeling "fine" is one of the most frequently reported neutral answers to being diagnosed with MCI. "Fine" was also the typical response, especially among the women in the study, when asked how they felt about the diagnosis. In comparison with positively framed reactions, neutral replies were relevant regarding participants' pre-diagnostic awareness of changes in cognitive performance. Neutral reactors rarely mentioned dementia, in contrast to those who expressed relief. For instance, a neutral response from an 81-year-old woman with amnestic type of MCI said that:

"It didn't make me feel too bad because I knew, you know, that there were things that maybe I was having trouble with."

Feelings of fear or distress about the MCI diagnosis are less frequent because these negative feelings only occur when they expect an impending dementia diagnosis. According to a 79-year-old man participant with amnestic type:

"It is . . . scary because I think it could lead to Alzheimer's."

Cognitive Dimension of Assigning Meaning

Regarding the cognitive dimension of meaning-making, the older adults evaluated how the diagnosis would affect them. They interpreted the event in terms of face-value and prognosis-focused cognitive appraisals. For face-value appraisal, when asked what the diagnosis of mild cognitive impairment meant to them, they interpreted the syndrome within the definition of how memory loss happens in everyday life. They tended to focus on the symptoms experienced when analysing the event.

For instance, when asked about the meaning of MCI diagnosis, one older adult responded:

"I'll remember that [my wife] told me she was going out, but I won't remember with who or where she was going... They're [the diagnosticians] telling me that I can't remember things, and I already know that."

The statement illustrates that he interpreted the symptom of memory loss in MCI as something that would happen because that is what mild cognitive impairment is. Face-value appraisal meant the symptoms fitted what they already expected to experience, which was facing memory loss in everyday life.

Another participant with face-value appraisal said that the diagnosis implied:

"It's just that... I just don't remember everything [chuckles] that I, you know... maybe I should; I don't know."

In contrast, older adults with prognosis-focused appraisal focused on forecasting the likelihood of the development of the disease, as one participant stated:

"MCI to me means that it would lead to Alzheimer's disease."

Also, participants with prognosis focus appraisals frequently expressed powerlessness, uncertainty, and concern about the future. Some of them expressed concerns that they did not even understand the disease. They were unsure whether the condition would progress or if it could be reversed. Participants were also concerned about the

risk of forgetting important details in the future if their symptoms worsened. For instance:

"I do not want to get to the point where I don't remember my own daughter's name."

When asked about their perceived implications for the future, both face-value and prognosis-focused participants illustrated the impact of mild cognitive impairment on their outlook for the future. The researchers received responses that included both marginal (I do not worry about it) and marked (I have not made specific plans of going back home) expressions of concern. Participants with higher levels of concern regarding the future spoke about their planning activities.

Contextual Factors to Meaning Assignment

Regardless of the diagnostic type, the participant's perspectives on the meaning and future consequences did not appear to differ (amnestic or non-amnestic). Yet, the older adult's narratives about mild cognitive impairment are inconsistently provided as a source of information for health care professionals. However, the personal meaning-making of a diagnosis occurs within the context of three main factors: (1) normal ageing expectations, (2) occurrence or history of dementia within the family, and (3) coexisting medical diagnosis.

Normal Ageing Expectations

Mild cognitive impairment was perceived as a predictable part of the ageing process by half of the older adults who positively framed their emotional appraisals of the diagnosis and by all but one of the neutral

appraisers. In contrast, distressed appraisers did not consider the syndrome a normal part of ageing.

History of Dementia within the Family

In Linger's study, four participants shared their personal experiences of people diagnosed with dementia. Even though it was not a common theme in the study, the researchers noted that the participants' perspectives of living with mild cognitive impairment were significantly influenced by their encounters with people with dementia. For instance, a distressed appraiser feared his symptoms would undoubtedly lead to dementia. He then described his personal experience living with his parent diagnosed with Alzheimer's and a sibling with Lewy bodies as a "hell of a thing". As a result, the earlier histories and encounters with the diseases affect the impression of MCI.

Coexisting Health Problems

After ruling out the clinical potential of cognitive impairment related to a medical disease, the narratives of living with MCI demonstrated coexisting health risks. The impairment concerns that older people experience are still attributed to concurrent conditions such as musculoskeletal issues, eye disorders, chronic fatigue syndrome, grief, and overall physical decline. This means that older adults believe that their cognitive decline results from pre-existing medical conditions.

Discussing the existing health condition appears to serve a range of purposes. Changes in physical health, for example, are a reasonable explanation for moderate functioning changes that occur in the

community or the household. In other cases, the disclosure of concurrent illnesses provided context for mild cognitive impairment's unique but relative impact on everyday living.

Although it varies from person to person, it is important to determine people with mild cognitive impairment's subjective experiences and meaning making. It may benefit patients and those who surround them. Developing a deeper understanding of what persons with MCI go through may help physicians be more mindful when disclosing the diagnosis, as the patients' interpretations may differ. How a patient interprets what the physician is saying can influence the patient's perspective of the diagnosis positively or negatively. Therefore, Linger et al. (2006) suggested in their study that future researchers should include systematic and longitudinal analysis of disease interpretation and its influence on health behaviours of people with MCI.

Reversing Mild Cognitive Impairment

Mild cognitive impairment does not have the same impact on daily functioning as other types of dementia, but the symptoms should not be ignored. Although MCI may not result in severe cognitive impairment because the person may still perform daily tasks, the symptoms must be addressed to avoid the worst-case scenario.

According to new research, the symptoms of mild cognitive impairment in older adults can be reversed through a six-month aerobic exercise program. The number of MCI adults aged 65 and above in the United States ranges between 15 and 20%. Blumenthal and colleagues (2019) from University Medical Centre in Durham

studied the effects of regimented exercise among 169 participants. The average age of the participants was 65. The results suggested that there might be a method to reverse the age-related cognitive concerns. Reversing MCI symptoms does not imply that it will completely disappear, but it allows for improved cognitive function.

At the beginning of the study, all individuals were inactive. They also had both cardiovascular risk factors and MCI symptoms. The researchers wanted to see how physical activity and diet influenced cognitive ability. As part of the study, the participants adhered to the Dietary Approaches to Stop Hypertension (DASH) diet, consisting of high-fibre, low salt foods including vegetables, nuts, beans, grains, lean meat, and low-fat dairy. The participants were divided into four groups:

- Group A with aerobic exercise
- Group B adhered to the DASH diet (with no exercise)
- Group C undergo both the DASH diet and exercise
- Group D only received a phone call for health-related education

The results showed that people who exercised and ate the diet displayed a 5-point average increase in executive functioning skills than those who only exercised or dieted. The cognitive ability involving executive functioning enables a person to plan and organize goal-driven action and to focus and regulate their behaviour. However, the researchers did not find a significant improvement in the memory domain.

According to Blumenthal, by including regular daily exercise, people with cognitive impairments but no dementia may improve their

planning skills and performance in a cognitive task. The results were promising because the improvements were achieved in just six months. At the start of the six-month program, the participants' initial executive functioning scores were equivalent to those of a 93-year-old, but their chronological age was 28 years younger. Yet, after six months of physical activity, the average scores matched those of an 84-year-old, implying a nine-year improvement in executive functioning.

Despite the study's promising results, Blumenthal asserts that further research is needed that includes larger samples and a more extended period to analyse if improvements in thinking abilities are continuous and whether those improvements can be attained through various lifestyle approaches such as exercise and diet.

Dementia

This condition has become more common among older adults, yet it is not a normal part of ageing. Some older adults live without any signs of dementia. Several different forms of dementia exist, including Alzheimer's disease, vascular dementia, frontotemporal dementia, and mixed dementia, which is the combination of two or more forms of dementia.

The loss of cognitive functioning, such as thinking, remembering, and reasoning, affects the person's daily functioning and activities. It may even cause problems in emotion regulation, resulting in personality changes. Dementia can range from mild to severe. During the mild stage, the person starts experiencing problems with functioning, while in the severe stage, the person entirely relies on others to do the basic daily activities. Therefore, early detection of symptoms is crucial to provide an immediate assessment and treatment. Although dementia has no cure, obtaining an early diagnosis enables the condition to be managed and for proper plans to be made (National Institute on Ageing, 2021).

Long nursing hours and physically challenging caregiving are related to dementia. Several studies suggest that dementia caregivers or care providers are more burdened than other caregivers. For example, according to a survey of 227 dementia caregivers in the United States, nearly a quarter gave 40 hours or more of personal care per week, which includes bathing, feeding, and assistance with toilet use. Over two-thirds of caregivers stayed for more than a year, with one-third staying for five to seven years.

Addressing the concerns of dementia caregivers is essential as they serve a significant purpose in taking care of dementia patients.

Behavioural and Psychological Symptoms of Dementia

It is estimated that over 75% of dementia cases are taken care of by a family member or friends at home. With most dementia patients living within the community, the burden of care falls mainly on the primary caregiver (Shulz & Patterson, 2004). According to 2013 data, the estimated number of dementia cases was 44 million; this number is predicted to rise to 75 million by 2030 and 135 million by 2050. (Prince et al., 2013).

Behavioural and psychological symptoms are common in dementia. They are indications and symptoms of disrupted perception through content, mood, or behaviour. Anxiety, depression, apathy, repetitive questioning behaviour, psychosis, hostility, sleeping difficulties, and socially inappropriate behaviours affect all people with dementia (Lyketsos et al., 2011).

Unfortunately, the behaviour and psychological symptoms are challenging, distressing, and costly aspects of care. It may also result in various adverse patient health outcomes, including additional illnesses, death, hospitalization, and early placement in a nursing home. (Kales et al., 2005). Caregivers caring for dementia patients in their homes are more likely to experience stress, depression, decreased income from employment and poor quality of life (Borson & Raskind, 1997).

Types of Behavioural and Psychological Symptoms of Dementia

The neuropsychiatric symptoms of dementia are psychosis (delusions and hallucinations), nervousness and apathy (lack of enthusiasm or interest), aggression, depression, and anxiety. Dementia patients also experience disinhibition, socially and sexually inappropriate behaviours, motor movement disturbance, night-time activities, and appetite and eating. Even though these symptoms are the most common in dementia, distinct kinds of dementia are linked to specific behaviours.

For example, in vascular dementia, depression is more common, and in Lewy body dementia, hallucinations are more evident than in Alzheimer's. The loss of executive control such as disinhibition, wandering, socially inappropriate behaviours, and apathy are often manifested in people with frontotemporal dementia (Marra et al., 2007).

Although the hallmark symptoms of dementia focus on the cognitive domain, behavioural and psychosocial symptoms typically predominate (Devanand et al., 1996). Compared with cognitive and functional loss, which tends to be progressive, behavioural, and psychosocial symptoms change episodically and last six months or longer.

Causes of Behavioural and Psychological Symptoms of Dementia

Cognitive decline is insufficient to explain the behavioural and psychological symptoms of dementia. Therefore, various other contributory factors have been identified.

Neurobiological Factors

The extensive and reciprocal connections between brain centres responsible for emotion and cognition have been shown in neuroscience (Messulam, 1998). According to the circuit model, the frontal-subcortical circuits that affect human behaviour include the frontal, basal ganglia, and thalamic components. The cause of behavioural and psychological symptoms in people experiencing dementia is the lack of synaptic or circuit network connections.

Acute Medical Conditions

Compared to those without cognition problems, people diagnosed with dementia may be disproportionately affected by pain and undiagnosed illnesses (Kunik et al., 2010). This means people with dementia can have acute medical conditions resulting in psychological and behavioural symptoms. For instance, based on community studies, 36% of older adults with dementia had an undetected illness related to behavioural and psychological symptoms, such as agitation, repetitive questioning, delusions, and hallucinations (Hodgson et al., 2011). However, aggressive behaviour in dementia patients is associated with pain (Kunik et al., 2010), which can be reduced through pain

management (Husebo et al., 2014). Also, taking medication can alleviate the pain symptoms.

Unmet Needs

According to the need-driven dementia-compromised behaviour (NDB), unmet basic needs or goals (e.g., physical, psychological, emotional, or social) are said to cause the behavioural and psychological symptoms of dementia. This implies that dementia patients' linguistic ability to articulate wants or goals is impaired, and they may convey and express their demands through various behaviours, such as hostility.

Pre-Existing Personality and Psychiatric Illnesses

Persistent personality characteristics and traits may influence the development of behavioural and psychological symptoms of dementia (Gunten et al., 2009). For instance, major depression, anxiety, bipolar disorder, or other lifelong psychiatric disorders, as well as their treatment (e.g., antidepressants, anxiolytics, and mood stabilizers), may influence the development and intensity of the symptoms. Therefore, dementia patients with previous personality or psychiatric history are more likely to have psychological and behavioural symptoms.

Factors Related to Caregivers

One of the complicated aspects of dementia is the unique role family caregivers have. People taking care of dementia patients have higher psychological discomfort and stress levels. Compared to caregivers

not dealing with dementia patients, caregivers looking after dementia patients have much lower self-efficacy, subjective well-being, and physical health (Ballard et al., 2009). The difference is even higher when comparing non-caregivers and caregivers. For example, several studies demonstrate that people caring for dementia patients have a rate of depression ranging from 23% to 85%, while those caring for patients with only anxiety have a depression rate of 16% to 45% (Livingston et al., 2005).

Environmental Triggers

The stress threshold of a person with dementia decreases as their ability to comprehend stimuli diminishes; an increase in their frustration level accompanies this. If uncontrolled, acute anxiety and severe agitation may emerge. In other words, stress affects dementia patients' ability to understand. They experience considerable stress due to environmental factors which affect their comprehension. For example, adjustments in routine, too many conflicting or inaccurate stimuli, a lack of stimulation, changes in physical and social environments, and demands that exceed functional capabilities can all produce stress (Smith et al., 2006).

Caregivers of People Suffering from Dementia

Providing care for a dementia patient costs money, causes distress, and results in poorer quality of life for caregivers. Yet, without their caregivers, dementia patients would experience poorer quality of life and require immediate institutional care. Balancing caregiving with other demands (e.g., child-rearing, career, and relationships) are obstacles that caregivers face daily, implying an increased

susceptibility to burden, stress, depression, and other health concerns (Cassie et al., 2008). Several studies have found that caring for a person with a physical disability is less stressful than caring for someone with dementia (Ory et al., 1999; Mohide et al., 1998).

The concept of care providers and care managers by Archbold (1981) demonstrates how family caregivers care for their loved ones experiencing dementia. The one who gives hands-on care, such as dressing, helping with finances, and other activities of daily living, is the care provider. The care managers organize others to provide care, for instance, a nurse for personal care and a professional accountant to help with finances. Grown children and relatives are often caregivers, while spouses serve as care managers. Care providers' stress level is higher than care managers (Schulz & Martire, 2004).

In providing care, family caregivers are motivated by feelings of love or reciprocity, spiritual accomplishment, a sense of duty, guilt, social pressures, or in rare situations, greed. If driven by a sense of duty, guilt, or social and cultural expectations, caregivers are more likely to resent their role, leading to more significant psychological distress. Better health, relationships, increased social support, and feeling less burdened are experienced by a caregiver if the caregiver has identified more beneficial aspects of their caregiving role experience (Cohen et al., 2002).

Known as the "invisible second patient", family caregivers of people with dementia are crucial to the care receivers' quality of life. Sometimes the effects of being a family caregiver are positive, but generally, it is accompanied by high chances of burden, psychological concerns, social isolation, problems with physical health, and financial problems. Caregivers experience isolation and lack social contact and

support (Brodaty & Hadzi-Pavlovic, 1990; LoGiudice et al., 1999). They also sacrifice their leisure activities and hobbies, have less time with family and friends, and give up or lessen their employment engagement (Brodaty & Hadzi-Pavlovic, 1990; Leong et al., 2001). Fewer negative psychological symptoms are evident among caregivers who are more fulfilled with their social interactions (Lowery et al., 2000).

Family caregivers are crucial to dementia patients' quality of life. Personal characteristics that indicate which care providers are susceptible to the symptoms listed above are widely recognized. Hence, caregivers prone to negative consequences must be identified and prioritized for interventions (Brodaty & Donkin, 2009).

Early Cognitive Decline

If cognitive decline is prevalent in older people, what about younger ones? Memory lapses are not limited to a specific age group, and young adults in their 20s are also susceptible. A research study revealed that even young, healthy, and educated adults experience a decline in cognitive functioning. According to University of Virginia researchers (2009), cognitive abilities peak around the age of 22 and subsequently deteriorate until the age of 27. The Salthouse study further reveals that memory decline starts at 37, whereas the capability to acquire new skills and improve vocabulary and general knowledge increases until age 60. This study suggests that a particular form of mental decline occurs in early adulthood. However, the amount of knowledge and how it is effectively used and integrated into our capabilities will progress throughout adulthood if we have no pathological disease. Simply put, cognitive abilities will continue to improve and adapt if no disease impairs our brain.

Moreover, some research studies suggest that in the mid-20s, memory will start to decline, but the effects may not manifest until later in life. Psychologist Denise Park (2019) from the University of Michigan conducted a study on more than 350 individuals ages 20 to 90 and asserted that people in their 20s show evident signs of decreased cognitive ability. However, the decline is not noticeable in younger adults (20s and 30s) despite the rate of decline being the same as those in their 60s and 70s. This is because the cognitive loss is not significant enough to affect the daily activities of young adults.

Regarding gender, as women age, they experience faster cognitive decline than men. Middle-aged women have stronger brain functions

than men but decline faster as they age. According to research, the overall cognition, executive functioning, planning, time management, and brain processes used in problem-solving decline five years earlier in women. This does not include memory. The apparent difference in cognitive decline between men and women is attributed to biological, genetic, social, and lifestyle factors; hence further research is needed (Levine et al., 2021).

Memory Problems in Young Adult

Poor lifestyle and health factors increase the risk of Alzheimer's disease and dementia, particularly among young adults, according to a University of California Los Angeles (UCLA) study published in the open-access journal PLOS ONE on June 14, 2014. The study implies that some people may complain more about memory concerns if they are depressed, do not get enough physical activities, or have high blood pressure, which is also evident among young adults.

The UCLA researchers gathered more than 18,000 participants for the study and discovered that various risk factors heightened the risk of self-reported memory complaints within all adult age groups. The findings provide the researchers with a better understanding of how early lifestyle and health choices affect memory in later life. Exploring the possible relationships between these factors can also help determine the interventions focusing on lowering the risk of memory problems.

Among 18,552 participants from 18 to 99 years old, the research emphasized known risk factors, including depression, low education level, lack of physical activity, high blood pressure, diabetes, obesity,

and smoking. The prevalence of memory issues among younger adults was surprising, according to the study's senior author, UCLA Professor of Ageing, and director of the UCLA Longevity Centre, Dr Gary Small. He stated that:

"In this study, for the first time, we determined these risk factors may also be indicative of early memory complaints, which are often precursors to more significant memory decline later in life."

Younger adults aged 18-39, middle-aged adults from 40-59, and older adults between 60-99 have an increased likelihood of memory complaints due to various risk factors such as depression, low educational attainment, lack of physical activities, and high blood pressure. The highest risk factor for memory concerns in all age groups is depression. Regardless of age, having one risk factor can drastically increase the occurrence of memory complaints, and this is exacerbated when the number of risk factors increases.

In this study comprising 14% younger adults, 22% middle-aged adults, and 26% older adults, 20% of the participants reported having memory complaints. According to the researchers, the memory concerns in younger people may differ from their older counterparts. The distinction is due to the significant role of stress and the omnipresence of technology. The internet and wireless device use often lead to constant multi-tasking, affecting their attention span. Therefore, continuous multi-tasking due to technology use makes it hard for the younger age group to sustain focus and memory.

Moreover, previous research has shown that education is a crucial component of "cognitive reserve", or the capacity to compensate for gradual brain pathology. These findings imply that engaging in

educational activities at any stage of life may be beneficial. Associate clinical professor at Semel Institute and the first author of the UCLA study, Stephen Chen, further stated that:

"We hope that our findings will raise awareness among researchers, health care providers and the general public about the importance of lowering these risk factors at any age, such as getting screened and treated for depression and high blood pressure, exercising more and furthering your education."

According to Fernando Torres-Gil, a professor at UCLA and associate director of UCLA'S Longevity Centre, the result of the study will serve as a foundation for future studies to help better identify how the abovementioned risk factors, if addressed immediately, can lower the occurrence of memory complaints.

Brain Circuit Crucial for Memory Formation

Recalling the name of someone you met yesterday or the scenery from a recent beach trip means your brain has stored these short-term memories in the hippocampus. This part of the brain is significant in forming new memories. It is also in charge of learning and emotions. Those memories are then "consolidated" or moved to a different area in the brain for longer-term storage. This brain mechanism has been the subject of research among scientists to determine how our brains function during memory formation. For example, a new Massachusetts Institute of Technology investigation of the neuronal circuits indicates that memories are generated concurrently in the hippocampus and the brain's long-term storage location, the cortex.

However, long-term memories remain “quiet” for around two weeks until attaining maturity.

The case of Henry Molaison, the famous amnesiac patient whose hippocampus was damaged during an operation, suggests that long-term episodic memories (recollection of specific events) are stored outside the hippocampus. This patient, also known as Patient H.M., underwent an operation to manage epileptic seizures but experienced hippocampal damage during the procedure. As a result, Patient H.M. stopped retaining new memories after the surgery but could still retrieve memories formed before the surgery. According to researchers, these memories are kept in the neocortex, which also engages in cognitive activities such as attention and planning.

To explain how memories are transferred from short to long-term memory, earlier scientists developed the standard model. This model suggests that short-term memories are created and stored in the hippocampus before gradually being transferred to long-term storage in the neocortex. In comparison, the multiple trace hypothesis, a more contemporary theory, proposes that traces of episodic memories stay in the hippocampus. These traces may preserve memory specifics, while the neocortex stores the more general outlines. These previous memory studies were centred on evaluating how a lesion in a specific brain region affects memories since there was no straightforward method to evaluate these hypotheses until recently. But in 2012, a method to identify engram cells, which include specific memory, was developed by Tonegawa’s lab. This method permits the scientist to determine the circuits engaged in memory storage and retrieval. It also gives scientists the ability to synthetically reactivate memories

through optogenetics, a way to turn on and off the target cells using light.

Science researchers used the optogenetics approach to tag memory cells in mice under a fear-conditioning event – a situation where mild electric shock is conveyed when the mouse is inside a certain chamber. The researchers used light to reawaken memory cells artificially and then observed if the reactivation elicited a behavioural response in the mice. Through this, the researchers could also see which memory cells were activated when the mice were placed in the room with the fear conditioning event, causing them to retain the memory on their own.

Memory cells were identified in three regions of the brain that encode emotional connections associated with memories: the hippocampus, the prefrontal cortex, and the basolateral amygdala. Researchers found that, after one day of exposing the mice to a fear-conditioning event, the memories were kept in engram cells in both the hippocampus and the prefrontal cortex. However, the engram cells were “silent” in the prefrontal cortex.

Also, according to researchers, the prefrontal cortex already contains information about memory. The result contradicts the typical notion of memory consolidation, which proposes a gradual transfer of memories to the prefrontal cortex once the memory is already in place. The silent memory cells in the prefrontal cortex gradually matured over two weeks. By the end of the same period, the hippocampal engram cells went quiet and were no longer needed for natural recall, but the traces of memory remained. The engram cells in the basolateral amygdala remained constant throughout the experiment after the memory formation. These cells communicate with engram cells in

both the hippocampus and the prefrontal cortex to elicit the emotions associated with distinct memories.

Overall, the results imply that traditional theories of memory consolidation may not be valid since memories are created quickly and simultaneously in the prefrontal cortex and the hippocampus.

Early Decline in Cognitive Functioning as a Predictor of Psychosis

Psychosis is a condition that often affects how the brain processes information. It is not an illness but rather a symptom of other mental health issues that often include hallucinations (sensory experiences that seem real but are not) and delusions (having a strong belief that is not true or based in reality). Psychosis also includes impaired or lost contact with reality. Among people with psychosis, cognitive impairment is the major contributing factor to the ability to function. In other words, patients with psychosis will eventually experience a decline in cognition that impacts their daily lives, including reduced attention, information processing, memory, reasoning, and abstract thinking.

However, according to population-based cohort studies, wherein the research participants are followed up and observed over an extended period, individuals who develop psychotic disorders in later life performed below the level of their peers in childhood cognitive tests (Cannon et al., 2002), scholastic achievement (MacCabe et al., 2008), and military conscription tests (Zammit et al., 2004). There are three arguments against this notion. First, the prior occurrence of cognitive deficits in schizophrenia is due to neurodevelopmental impairment –

a condition that affects brain functions responsible for emotion, learning ability, self-regulation, and memory (Demjaha et al., 2012). Second, the relationship between poor cognitive functioning and schizophrenia is possibly driven by socioeconomic factors. For instance, urban birth (Mcgrath & Scoth et al., 2006), migration (Fearon & Morgan, 2006), and low socioeconomic status (Wicks et al., 2005). Also, the observation that poor cognitive or educational performance during childhood is linked with a wide range of adult consequences facilitated by social processes such as cardiovascular diseases, stroke (Hemmingsson et al., 2007), early death (Deatry & Batty, 2007), and nonpsychotic mental disorders. Lastly, rather than attributing to neurodevelopmental processes, the premorbid deficit in IQ is an early sign of schizophrenia.

Furthermore, among all neurodevelopmental stages, the crucial development period of psychosis occurs during the adolescent phase because it is the stage where synaptic pruning and rapid decline in grey matter volume occur, both of which are associated with a high rate of psychosis occurrence (Paus et al., 2008). Also, adolescence seems to be a sensitive period for a particular risk factor, such as the use of cannabis (Arseneault et al., 2002). Independently studying cognitive areas can provide additional insight into the causes of these impairments, whether biological, psychological, or prodromal (Aas et al., 2012). Interference with the hippocampus's growth, for example, could damage memory, while disturbances in myelination could affect processing speed or reaction time.

Despite these claims from previous studies, no prospective studies measure the changes in cognitive functioning during the adolescent and young adult period with an age range of 13 to 18 years. Over ten

years, MacCabe and colleagues (2013) studied the Swedish population to have a historical cohort study that examined the relationship between cognitive changes during adolescence and young adulthood and the risk for affective and nonaffective psychosis. They conducted the study using four population-based cohorts of adolescent boys and young men born in Sweden in 1953, 1967, 1972, and 1977. A total of 10,717 individuals took part. The participants were followed until December 31, 2006.

The results showed that a decline in cognitive performance during adolescence and young adulthood, notably in verbal ability, is linked to a higher risk of psychosis in adulthood. Moreover, a decrease in verbal ability between 13 and 18 years is a strong determinant of psychosis compared to verbal ability at 18 years alone. Thus, the study shows that late neurodevelopmental impairment affects the development of linguistic abilities in adolescent boys and young men who acquire psychosis later in life.

Early signs of cognitive deterioration are alarming, with short-term and long-term consequences. Although most people attempt to manage cognitive impairment once at risk, early detection and intervention can result in substantial life-changing outcomes and improved diagnosis and treatment.

Cognitive Testing

Gou et al. (2022) emphasized the need to make neurological and neuropsychological evaluations available to patients who experienced cognitive problems due to COVID-19. Neurological evaluations involve evaluating the nervous system and are performed by

healthcare professionals. Neuropsychological assessments measure the evident changes in memory or thinking. Like neuropsychological testing, cognitive testing is a short and quick assessment to check brain functioning. Cognitive and neuropsychological evaluations examine memory, language abilities, math skills, visual and spatial abilities, and other mental abilities. Conducting these assessments would help healthcare professionals to diagnose the patient's condition.

The main difference between neuropsychological and cognitive tests are that neuropsychological assessments are more detailed, time-consuming, and require specialized training or certification. In comparison, cognitive evaluations are quicker to administer, not time-consuming and can be cautiously self-administered. Cognitive tests do not provide a specific diagnosis of a disease. However, it can help identify the underlying cognitive problem that requires more in-depth assessment. To clarify, cognitive testing offers an overview of an individual's cognitive functioning but is not enough to diagnose a particular condition. Typically, cognitive tests consist of simple questions that are enough to measure brain processes.

Because of the reported memory problems among COVID-19 patients, a cognitive test might be needed. A person whose family, friends or personally noticed visible signs and symptoms of cognitive decline or impairment might also require testing to check if they have problems with their mental functioning.

According to Cleveland Clinic (2022), cognitive screening tests may help to determine if there is a problem in some aspect of cognition but do not reveal any details about:

- The reason why there might be a cognitive impairment

- The part of the brain responsible for the impairment
- The medical condition that causes the cognitive impairment
- The severity of cognitive impairment

Receiving low or poor scores in cognitive testing indicates more than achieving good or high scores. Low scores mean a problem in cognition or brain impairment, while a good score means an absence of impairment. However, despite having a good score, problems in brain functioning are still possible.

Cognitive screening tests cannot provide a diagnosis. However, if the results of a cognitive test show a person needs in-depth testing, then the healthcare provider will require neuropsychological assessments.

If the healthcare provider requires additional testing or other imaging tests, referral to the neurologist would be the next step.

Can the Cognitive Test be Self-Administered?

The answer is yes, but with caution. Although the cognitive test does not provide a diagnosis, some people are prone to self-diagnosis. One of the cognitive assessment tests that can be self-administered and found on the internet is the Self-Administered Gerocognitive Exam (SAGE). Like other cognitive tests, it measures the basic orientation of date, month, year, reasoning, language, calculation ability, visuospatial orientation, problem-solving, and memory.

If there is visible evidence of memory, language, problem-solving, or thinking impairment, one of the first steps is to take a self-administered cognitive test. After taking the test, the next step is to schedule an appointment with a healthcare provider who can provide

the results and interpretation of the findings. They will conduct a physical exam and review medical and medication history and other tests that would rule out the problems that affect memory or thinking.

Cognitive testing is crucial since it can tell whether a person is experiencing cognitive decline. This stage is essential in reversing cognitive decline since the results provide substantial evidence on which medical professionals can depend. It is vital to determine whether the visible deterioration exists to reverse cognitive decline. If so, cognitive testing is needed to validate the cognitive impairments and establish whether additional testing is required to reach a conclusive diagnosis.

Reversal of Cognitive Decline

As discussed in the previous section of the book, there are contributing factors that cause cognitive decline in older adults and the younger age groups. The decline in cognition is one of the characteristics of dementia and its various forms, such as Alzheimer's disease. Although there is no cure for this neurodegenerative disease yet, there are treatments that can help reverse the debilitating symptoms of cognitive decline, applicable not only in older adults but also in younger adults.

Over the last 45 years, PISTA scientists have researched the effect of sound frequency on the brain. PISTA protocols have been developed to target different age groups and different cultures. Applying specific PISTA modalities can help individuals maintain mental functioning, control their behaviour, and slow disease progression. By combining physical exercise with PISTA's reversal and stimulation techniques, individuals can improve their ability to function. Importantly,

reversing the symptoms enables individuals struggling at their jobs or academic endeavours due to cognitive problems to improve their performance.

For older people, PISTA can help them to manage their daily lives despite having cognitive decline symptoms. One PISTA exercise that is effective in developing cognition and self-awareness is the Entry Point (EP). The PISTA coach provides the individual with a thought. The thought can be a statement, mental picture, or memory that an individual feels strongly about. An Entry Point (EP) may help generate integrated systems for daily brain entrainment construction. Research shows that benefits may be experienced almost immediately during the sessions. These benefits continue to be felt for months after the therapy.

Contributing Risk Factors of Cognitive Decline

The decline in cognition is an indicator that there is something wrong with our cognitive functioning. By educating ourselves about the factors that increase the chances of developing cognitive decline or dementia will help determine ways to avoid these memory problems. Although some risk factors are non-modifiable, focusing on the modifiable factors can delay, prevent, or manage the symptoms. Information about the risk factors of cognitive decline can also explain why a particular problem exists and why it is significant in diagnosis and disease prevention.

Ageing

There are different factors that lead to a decline in cognitive functioning, but the most common factor is age, which means the risk of developing dementia increases as we age. Research shows that the brain changes as we age; in particular, the loss of grey matter in the prefrontal cortex and volume decrease in hippocampal and temporal lobes cause several cognitive changes (Murman, 2015). The prefrontal cortex, hippocampus, and temporal lobes are the brain's regions in charge of higher cognitive functions, memory, and learning – a decrease in size indicates cognitive problems. A dopamine receptor in the brain regulates attention and modulates stimulus-response, which decreases with age (Deary et al., 2009).

According to Alzheimer's Society report (2021), around two in every 100 individuals between ages 65 and 69 have dementia. The risk of developing dementia increases as people age, almost doubling every five years. According to the report, around 33 out of every 100 adults

over 90 are diagnosed with dementia. Since dementia develops over time, the older a person gets, the more likely symptoms will manifest because age increases the risk of experiencing other diseases that damage the brain, namely Alzheimer's or vascular disease. Although it may take years for these diseases to cause enough brain damage that may lead to dementia symptoms, the longer a person lives, the more time dementia has to develop. Due to ageing, older people are also more likely to cope with other changes and health conditions that increase the risk of dementia.

Health Conditions

Researchers from Columbia University (2021) asserted that chronic health conditions contribute to mild cognitive impairment, specifically heart disease, depression, or diabetes. This is because these conditions increase the health burden that leads the individual to participate in less regular physical activities and social interactions, accelerating the decline of the brain's health. One research also revealed that heart problems in the 20s may affect cognitive functioning many years later.

According to the American Academy of Neurology (2021), people in their 20s and 30s with health problems such as high blood pressure, obesity, or high blood glucose levels are more prone to difficulties with their thinking and memory skills decades later compared to people who do not have these health issues. This study implies that the association between these health concerns and late-life cognitive abilities is critical in early adulthood. In addition, it is more common for people with lower IQ in childhood and early life to have various diseases that affect their cognition negatively. Lower IQ in childhood, for example, is linked to high blood pressure in middle life. Although

research implies that high blood pressure can lead to cognitive impairment, the evidence differs due to the influence of childhood IQ on cognition in later life. As a result, age-related cognitive impairment must be considered throughout a person's life (Deary, 2009).

Genetics

Genetics is another risk factor. Specific genes can be inherited from a parent or relative, increasing the risk of developing dementia. The familial and risk genes are two genes that can increase the likelihood of dementia. Familial genes are more likely to cause dementia when passed from parent to child. For instance, if one parent carries familial genes, their child has a 1 in 2% chance of inheriting and developing dementia, usually in their 50s and 60s. However, the majority of dementia is not inherited by children or grandchildren. In rarer types of dementia, there may be a genetic link. These genes, however, may cause one in every three cases of frontotemporal dementia, a less common type of dementia.

In contrast, risk genes increase the likelihood of acquiring dementia. These genes are more common than familial ones; however, they do not always cause dementia. So far, more than 20 risk genes have been identified, and the majority slightly increase the risk of dementia (Alzheimer's Society, 2021).

Researchers discovered a specific allele (a variant of a gene) that increases the risk of developing mild cognitive impairment by 18%. The risk gene is called the AP0E E4 allele. This genetic variation is involved in the production of protein and facilitates the transport of cholesterol and other fats into the bloodstream (National Institute on

Ageing, 2019). Consequently, AP0E is more likely to accumulate toxic protein residues in the brain and is the main contributing factor to Alzheimer's disease (Liu et al., 2013). The decline in cognition is apparent among people with Alzheimer's disease (AD), and the manifestation of decline is worse than in those with no AD diagnosis.

On the other hand, in heritability studies using data from twins, families, and adopted children, the estimated heritability of general cognitive capacity is greater than 50%. Even though heritability declines as people become older, the influence of genes on cognitive capacity stays at or above 50%. This implies that genetic factors play a role in both life-long traits of intelligence and age-related cognitive decline (Deary et al., 2009).

Psychological Factors

Psychological stress can have a short and long-term effect on cognitive functioning. For instance, in the short term, when an individual is preoccupied with thoughts from an argument or conflict that occurred during the day, it may result in decreased ability to give attention or perform tasks. As for the long-term effects, people who experience chronic or long-term stress manifest rapid cognitive decline compared to their peers of the same age who are less stressed (Scott et al., 2015).

People who have experienced periods of depression in their life have a higher risk of developing dementia. The risk is probably due to the prolonged harmful effects of depression on the brain and the individual's thinking patterns and coping mechanisms. Nevertheless, it is still unclear whether using antidepressants to treat depression

lessens the risk of dementia. The best prevention is to prevent the occurrence of depression in the first place.

Anxiety's Influence on Cognition

Anxiety disorders have a range of signs and symptoms, including hyperarousal and concentration issues. The disorders are a major worldwide health problem with substantial psychological, social, and economic costs (Beddington et al., 2018). Anxiety is the physiological, affective, and cognitive changes that react to a long-term, uncertain danger (Grillon et al., 1991; Grillon, 2008; Davis et al., 2010). Anxiety is distinct from fear. Fear is the response to acute, predictable, and immediate threats.

Cognition refers to the processing of information from stimuli within the environment and determining how to use that information. Without anxiety, processing information improves adaptive strength and reproductive success. But when anxiety influences cognition, it can promote a crippling focus on adverse life events, making concentration difficult.

Emerging research data highlights the importance of lifestyle choices in Alzheimer's prevention. Researchers from the Baycrest Health Sciences Rotman Research Institute published their findings showing that people with mild cognitive impairment (MCI) and high-stress levels are more likely to develop Alzheimer's. For instance, people who suffer from extreme anxiety have a 135% chance of developing Alzheimer's. When combined with other brain changes, anxiety can also exacerbate cognitive impairments.

Gulpers et al. [2016] reported the findings of their meta-analysis of six studies that showed older adults suffering from anxiety had a 57% higher risk of developing dementia. It is important to note that this meta-analysis included cognitively healthy samples and mild cognitive impairment samples. In a meta-analysis of cognitively healthy participants, researchers found that anxiety increased their risk of dementia by 29%.

Anxiety distorts information processing, clouding it with fear and negativity, leading to difficulties in social and work environments. In such circumstances, anxiety can be considered maladaptive (Robinson et al., 2013). On the other hand, there are times when anxiety is helpful and useful. Anxiety can heighten your ability to recognize and avoid danger. For instance, protecting yourself amidst the pandemic due to the fear of infection.

Dissociative Disorders

Everyone has experienced disconnection at some point in their lives. Examples of disconnection are daydreaming, zoning out in a lecture, and driving on “automatic pilot”.

There is a strong link between traumatic events and dissociative disorders. Dissociation can occur as a coping strategy. Long-term emotional, sexual, or physical abuse that is not dealt with properly can affect a person’s ability to cope, participate in life activities or engage with others. It can affect their lifestyle, personality, relationships, and ability to earn income. Exposure to natural disasters, military combat or violence can also trigger dissociation. Blocking out the traumatic memories may be permanent or temporary.

Unlike dissociation, dissociative behaviours involve an involuntary escape from life that interferes with a person's relationships, family, and their ability to work. The person's memory loss can range from forgetting details of the distressing event to forgetting their own name. Dissociative amnesia is a condition in which memory loss goes beyond normal forgetfulness and includes long gaps in the person's memory. The more severe the dissociative amnesia is, the more difficult it is for a person to function.

People with this condition may appear confused, not remember who they are or where they live, and suffer from depression or anxiety. Dissociative amnesia alters a person's consciousness and identity. Often the person's memory of the past is lost; however, despite cognitive impairment, their ability to learn new information remains.

With the proper treatment and intervention, the effects of the disorder can be reversed. PISTA modalities are designed to guide the person in dealing with the underlying traumatic pain that caused the dissociation. Under the supervision of a PISTA therapist, the person will be able to uncover and manage each piece of unconscious information as it is revealed. By developing healthy coping strategies and constructive thought patterns, the person can participate fully in designing and living the life they want.

Post-Traumatic Stress Disorder (PTSD)

PTSD is a disorder that develops in response to traumatic events such as abuse, serious car accidents, military combat, or natural disasters. It can affect the person experiencing it, as well as those witnessing the event. It is natural to feel afraid in certain circumstances; however, those diagnosed with PTSD continue to experience the effects of the

trauma even when they are no longer in danger. Those diagnosed with PTSD may experience flashbacks or nightmares, anxiety, memory difficulties, difficulty sleeping and angry outbursts.

Epidemiological studies in military and civilian populations have linked PTSD to developing dementia. In one study involving 50,000 participants, researchers found those with PTSD were twice as likely to develop dementia as those without PTSD.

Specific neurobiological pathways are affected by PTSD, increasing the likeliness of developing dementia. This includes altered activity within the hypothalamic-pituitary-adrenal axis which may affect an individual's response to stress. A reduction in the hippocampus volume affects learning and memory.

PTSD symptoms continually activate and reactivate a person's stress response system. Stress can damage the hippocampus, decreasing concentration and affecting short-term memory performance. Acute stress boosts the production of cortisol over a sustained period increasing the risk of developing dementia.

Though more research is required to fully understand the link between PTSD and the possible development of dementia, the current findings associating PTSD with doubling the risk of dementia have important personal, public and policy implications.

Cognitive Reserve

The person's ability to cope with brain diseases by keeping the brain active refers to cognitive reserve. This concept will be clarified in the next section of the book; however, cognitive reserve helps the

individual delay the onset of dementia symptoms for a prolonged period. Smaller cognitive reserve means a higher risk of dementia later in life, and it takes longer for those with greater cognitive reserve to develop dementia. The three critical factors that can lead to decreased cognitive reserve and thus increased vulnerability to dementia development are as follows (Alzheimer's Society, 2021):

- **Early abandonment of education:** not attending school or dropping out at an early age may result in less cognitive reserve than those who stay in full-time education or have a continuous learning process throughout their life. Although this notion may vary from person to person, continuous learning helps increase the cognitive reserve and decrease the chance of early development of dementia.
- **Reduced job complexity:** people who settle on less complex work that does not use a lot of mental skills such as memory, rational thinking, problem-solving, communication, and organizational skills are more likely to have less cognitive reserve.
- **Social withdrawal:** less human-to-human interaction during the lifetime may also result in a smaller cognitive reserve capacity, which is a risk factor for dementia. While much of a person's cognitive reserve develops during childhood and early adulthood, there are several things a person can perform later in life to enhance their cognitive reserve, for instance, staying mentally and socially involved.

Sex and Gender

In general, more women live with dementia than men because women live longer than men. However, the risk of having dementia is the same for men and women. A higher risk of dementia is more evident in women over 80 than men in the same age group. While the specific cause is unknown, the possible gap is due to differences in men's and women's lifestyles. Women in their 80s, for instance, may have less access to education or employment opportunities than men.

Aside from gender, the levels of sex hormones can also help predict the risk of dementia (e.g., the timing of menopause in women). The evidence is still unclear. However, when a woman reaches menopause, the oestrogen and progesterone levels drop, implying a higher risk of dementia. According to some research, the earlier menopause occurs in a person's life, the greater their risk of developing dementia. There have been clinical trials for hormone replacement therapy (HRT), which replaces the diminishing sex hormones; however, the results did not show an effect on the risk of developing dementia.

The New and Complex Phenomenon: Long COVID

COVD-19 is a health condition considered a risk factor for cognitive decline. Structural issues such as lung, heart, vascular damage, or other physical damage occur when suffering from the new and complex phenomenon, Long COVID (LC). Better understanding and effective treatments for Long COVID will take years of research and randomized control experiments. Post-acute COVID syndrome or post-acute sequelae of SARS-CoV-2 infection (PASC) differentiate

the specific category of Long COVID patients. Long COVID symptoms such as chronic pain and fatigue, exhaustion, brain fog, sensory hypersensitivity, insomnia, and more have been experienced by patients after they recovered from COVID. These new, recurring, or chronic symptoms or medical issues last four weeks following coronavirus infection. Despite the symptoms and health issues associated with COVID-19 complications, some reported complete recovery.

However, Long COVID is most likely due to "psychosocial strain" caused by pandemic lockdowns, according to an opinion piece by medical professors at Harvard and John Hopkins, published in New York Times. Several long-term COVID patients are met with scepticism by their physicians, who tell them that it is due to stress, worry, or that it is all in their heads because there is no medical indication of tissue damage. These instances stigmatize patients, particularly women, who present no identifiable symptoms through the biomedical investigation. Adam Gaffney, Harvard medical professor, and Zackary Berger, Johns Hopkins medical professor, stated that:

"*We must move beyond a false mind-body dichotomy that stigmatizes physical symptoms that are bound up with mental suffering."*

Mental suffering also occurs among Long COVID patients, and something must be done about it.

The neuroplastic response cycle that can be learnt and unlearnt might occur when the nervous system engages in "sustained fight-or-flight mode" after the immune system has fought an infection. In the film *This Might Hurt (2019),* neuroscience explores a lot of long-term

illnesses triggered by an initial infection that can be learned and locked in by the nervous system, causing disability. However, since the brain can change and adapt because of its plasticity mechanism, some illnesses can be unlearned and reversed by reducing fear, relaxing the nervous system, and brain training. The mind-body paradigm explored in the film helped Long COVID patients recover, implying that a considerable portion of the millions of individuals who suffered from Long COVID have a neuroplastic, reversible condition.

Many scientists are studying the mind-body paradigm, yet much is still undiscovered. However, the narratives in the film provide hope to individuals dealing with a frightening and upsetting condition. Mayo Clinic, an academic medical centre, also highlights the need to address the mind and body mechanisms in treatments for Long COVID. Dr Howard Schubiner in *This Might Hurt* also asserted that:

"We have this idea that when there's pain, there is something wrong with the body. It's not always that simple. The brain is powerful and can cause any symptom imaginable."

30% to 40% of people who received COVID-19 vaccination reported improvements in their symptoms. However, others are recovering using mind-body medicine methods, such as meditation and brain retraining.

Brain Fog after COVID Recovery

According to a study headed by Jacqueline H. Becker, PhD, published on Jama Network Open in October 2021, patients treated for COVID-19 still have significant rates of cognitive fog more than seven months after diagnosis. This study included 740 individuals treated as

outpatients, admitted to hospitals, or treated in emergency departments with an average age of 49 and no prior history of memory issues. Older people are more likely to experience cognitive impairment following a severe illness; however, this study has implications for the younger age groups as a considerable number displayed cognitive dysfunction several months after recovering.

Although most people believe they will be just fine and survive COVID, the study suggests that COVID has long-term cognitive consequences. COVID may affect individuals across various age groups with a range of disease severity, according to Becker. Helen Lavretsky, a medical doctor and professor in the Department of Psychiatry at UCLA and a geriatric psychiatrist, observed similar problems in her patients. She stated that the long-term consequences of COVID are notably distressing for young people who were in good health before contracting the virus.

Lavretsky added, “some improve right after COVID, but then memory lapse, brain fog, or cognitive impairment are the top three most common symptoms. Others include fatigue and anxiety”. The number of people who experience cognitive impairment is astonishing, hundreds of thousands of people, probably due to the high number of infected with COVID-19. The effect of COVID on cognitive function and memory is concerning, especially to young survivors (Frelick, 2021).

Several studies also emphasize the long-term effect of COVID-19 consequences on brain health. Although there is no need for medical treatment for brain fog, it should be addressed therapeutically to increase nervous system resilience. Initially, SARS-CoV-2 greatly infects the lower respiratory tract and causes lung damage. However,

increasing evidence suggests that it can infect the central nervous system (CNS) and induce neurological difficulties, such as cognitive impairment, in specific conditions. Early diagnosis and treatment of neurological manifestations in COVID-19 patients limit the long-term sequelae.

The post-experience of people infected by COVID-19 described their brains feeling ten years older almost overnight. Patients illustrated how difficult, almost impossible, for them to return to work because of brain fog. Although there is no treatment for brain fog attributed to COVID-19, there is a new clinical trial at the University of Alabama to test a proven rehabilitation strategy with a successful track record of restoring lost cognitive function. The strategy, created by Edward Taub, PhD, is known as Constraint-Induced Therapy (CI Therapy).

The effects of CI Therapy in stroke patients were demonstrated using MRI scans. After two weeks of thorough training in the clinic and continued practice at home, the therapy changed the brain. Taub claims that the improvement in function lasts years.

In the recent pilot study of six participants with cognitive problems after a stroke, CI Cognitive Therapy caused a significant improvement in the participants' ability to carry out cognitive tasks effectively. The participants stated that they were able to work, prepare their food, and play Scrabble again. Although the therapeutic principles are not specific to a particular condition or type of damage, Taub and his colleagues expect similar mechanisms to apply to strokes and COVID-19. This implies that brain training techniques provide hope in treating brain fog caused by COVID-19.

Marked Effect of Mild COVID-19 on the Brain

Researchers in the United Kingdom (U.K.) analysed the brain changes in adults aged 52 to 81 exposed to COVID-19, yielding new information about COVID-19's influence on the human brain. The research was published on March 7, 2022, in the journal *Nature*. The U.K. Biobank database holds brain imaging data of over 45,000 people in the U.K., dating back to 2014. The researchers used these brain images as baseline data of people before the pandemic. People with COVID-19 exposure and those without were compared; differences in grey matter volume in the brain were observed. Among people with COVID-19 exposure, reduced thickness of the grey matter tissue (neurons responsible for information processing) in the brain regions, particularly in the frontal and temporal lobes, were noticed. These grey matter tissue patterns differed in people who never contracted a COVID-19 infection. Although it is normal with ageing to have changes in grey matter volume or thickness, the changes were more noticeable in those infected with COVID-19. Increased cognitive decline was evident among infected participants.

From this research, COVID-19-related brain changes and their effect were evident. However, neuroplasticity helps the brain to overcome the impact of brain changes due to COVID-19 infection. Neuroplasticity is the brain's ability to change itself by establishing new neural connections, allowing it to compensate for injury or diseases, and adapting itself in response to new situations or changes in its environment. It is our brain's default protection against viruses or brain changes. For example, because COVID-19 causes changes in brain areas and grey matter volumes, the brain will adjust or rearrange itself to cope with the consequences of COVID-19-related brain changes.

In PISTA methodology, the notion of neuroplasticity (the ability of the brain to modify and rewire itself) is employed to address memory problems, stress, anxiety, and social isolation concerns by changing the brain through stimulation. The PISTA method uses various techniques, including brainwave feedback, brain stimulation, and self-regulation procedures, to enhance brain function and help correct unproductive mental activities. With the use of PISTA sound technology, different speeds of sound frequency are applied to the brain to deliver an altered state of awareness. PISTA's cognitive training promotes awareness of the person's condition, which helps improve an individual's overall emotional state.

Illness and life-threatening situations, such as COVID-19 infection, cause significant stress, anxiety, and social isolation aside from physical illness and brain changes. As a result, the immune system will take much longer to recover (Gupta, 2021). PISTA would help to manage these consequences.

The Influence of COVID-19 in Memory and Concentration

As previously discussed, memory is like a compartment in the brain where the information perceived by our senses is stored and retrieved. On the other hand, concentration involves the attentional process of having the capacity to focus on a task while completely disregarding distractions. Adverse consequences may occur when cognition and concentration are impaired due to a medical condition or age. This section discusses cognitive and memory problems from COVID-19 patients' experiences. The COVID-19 pandemic resulted in many

deaths worldwide, but those patients who fought for their lives to beat the virus are still at risk from lingering effects.

Søraas et al. (2021) studied the occurrence of self-reported memory problems in COVID-19 patients with mild cases and who were not hospitalized. Compared to the control group with a negative SARS-CoV-2 test, COVID-19 positive participants experienced higher rates of memory issues. Participants with memory problems also reported deteriorating health conditions. The findings revealed that SARS-CoV-2 adversely affects memory even eight months after recovering from a mild case. This suggests a link between memory issues, worsening health and post-acute sequelae SARS-CoV-2 infection (PASC). The study's results cast doubt on whether the home-confinement strategies are ideal for the long-term consequences.

According to a study by Guo et al. (2022), 70% of 181 adult COVID survivors experienced memory and concentration concerns several months after recovering from the infection. Of the 181 adults, 75% stated they encountered severe persistent symptoms that led to the inability to work, and 50% mentioned that medical professionals did not take their complaints seriously. The study recruited COVID participants from South Africa, New Zealand, Australia, the United States, Canada, Ireland, and the United Kingdom. However, most of the sample was White U.K. patients. Most of the COVID-19 survivors had been infected six or more months before the study start date; only a few had been hospitalized.

The study consisted of two parts. In the first part, the researchers discovered that the mild illness severity was a significant predictor of the existence and severity of Long COVID symptoms. The six primary symptoms, brain fog, limb weakness, chest pain, dizziness, cough, and

breathing difficulties, were associated with the progression of Long COVID. Also, severe lingering symptoms during the infection period were more likely to occur in those with severe fatigue and neurological conditions, including dizziness and headaches.

Among 126 participants with Long COVID:

- 77.8% described problems with concentration
- 69% reported brain fog
- 67.5% mentioned forgetfulness
- 59.5% experienced "tip-of-the-tongue" problems when trying to remember something at work
- 43.7% encountered struggles with saying or typing words correctly

Participants who had been sick for extended periods were more likely to report having cognitive symptoms throughout the illness and were still experiencing them. Also, according to Dr Muzaffa Kaser, one of the researchers of the study:

"Memory difficulties can significantly affect people's daily lives, including the ability to do their jobs properly."

Among those participants with ongoing symptoms:

- 54.6% reported extended periods of inability to work
- 34.5% lost their job due to illness
- 63.9% reported problems coping with day-to-day tasks
- 49.6% struggled to find a medical professional who would take their symptoms seriously
- 43.7% felt that they experienced a trauma

- 17.6% stated they had financial problems because of their illness

Moreover, Dr Kasser emphasized that the inflammation in the body caused by the COVID-19 virus can affect behaviour and cognitive performance in a way that is still unknown and not fully understood. However, researchers think it is related to an early excessive immune system response.

In the second part of the study, Guo and colleagues (2022) suggested that memory loss induced by COVID-19 may predict dementia. They examined the participants' performance on several tasks associated with memory, language, and executive functioning and observed a significant negative effect of COVID-19 infection on memory. Also, participants with severe ongoing symptoms reported lower valid answers, slower reaction time, and fewer correct words on the fluency test than non-Covid participants. Considering these findings, the researchers suggested that "objective" cognitive differences between COVID-positive patients and the non-COVID control group are evident.

Aside from poor memory performance, the loss of grey matter in the brain's temporal lobe is also evident, suggesting that people who have survived COVID-19 may be at a greater risk for future neurodegeneration and dementia.

Lastly, the researchers noted that self-reported memory complaints were closely linked to measurable declines in memory ability, which were also related to other neurological symptoms. Therefore, neurological, and neuropsychological evaluations should be more

extensively available to patients with Long COVID who have cognitive deficits.

What is Cognitive Reserve?

In the late 1980s, the concept of cognitive reserve emerged. Researchers noted that individuals presented no outward signs of dementia-related brain changes yet, when autopsied, had brain changes consistent with Alzheimer's. There is no relationship between the number of changes in the brain and the outward presentation of those changes. Meaning, that not all people are similar in terms of the onset and manifestation of cognitive decline despite having similar changes in a particular brain region due to ageing. For instance, numerous studies revealed that two individuals with the same degree of age-related brain changes perform vastly differently on cognitive tasks. Likewise, two people with Alzheimer's may have different changes in the brain but appear to have the same cognitive ability or vice versa (Stern, 2020). This concept explains why two individuals can have different manifestations of symptoms despite having the same disease (Stern, 2012, as cited in, Lojo-Seoane et al., 2018).

Researchers explained that individuals displayed no visible signs of Alzheimer's because their cognitive reserve compensated for the damage in the brain and allowed them to continue functioning in their daily lives (Stern, 2012). Likewise, numerous studies on ageing reported that around 25% of seniors who underwent neuropsychological testing before death. These tests show their cognitive ability is unimpaired, yet they meet the full criteria for Alzheimer's disease (Ince, 2001).

It should be noted that cognitive reserve develops throughout a person's lifespan. Cognitive reserve helps protect an individual against the decline that may occur because of ageing and diseases

(Stern, 2020). According to research, the main predictor of cognitive ability as an older adult was their cognitive ability at the age of 11. The study involved 70,805 students (50.6% boys) from Scotland. The students completed an intelligence test at age 11 and were retested 50 years later. The study suggested that students with high IQ scores, or better cognitive skills because of education, or worked in complex occupations, or were involved in mentally stimulating activities as they aged fared better than those who did not have these aspects (Underwood, 2014). Another important finding is clinical or functional impairments appear when the brain reserve capacity is exhausted beyond a certain critical threshold. Going over the critical threshold causes a weakening of synapses to the point that only a few remain, as in the case of Alzheimer's disease (Stern, 2009).

Brain Reserve

The adult brain can tolerate pathological changes without visible signs of disturbance. The remaining neurons in the central nervous system (CNS) can compensate for the damage or disrupted tissue, which refers to brain reserve. A higher brain reserve can withstand a greater volume of brain injury or weakening, than a lower brain reserve, before symptoms are exhibited. Brain reserve may sound similar to cognitive reserve because of the compensation mechanism of the brain, and often the two terms are used interchangeably; however, they are two different concepts.

Even though the theory of brain reserve has been influential within neurology and cognitive science, establishing empirical evidence has been complicated. It was first introduced to clarify the decrements in the intellectual abilities of Alzheimer's patients with extensive

amyloid plaques and neurofibrillary tangles in the brain. Since then, different forms of dementia, Parkinson's disease, and other neurological illnesses have shown similar distinctions.

The passive and active capacity mechanisms explain the distinction between brain and cognitive reserve. Brain reserve is the brain's passive capacity based on its structural features. Passive capacity refers to a latent phenomenon that only becomes visible as the surroundings change. On the other hand, cognitive reserve is the active mechanism in dealing with brain pathology. Active capacity refers to the brain's direct adaptation to cope with brain changes. Brain reserve is a passive entity. It only manifests as an overt representation of impairment when a person's cognitive ability falls below the critical threshold of the brain substrate. Brain reserve emphasizes the "hardware" or physical structure of some people with larger brains and more neuronal connections, enabling the brain to absorb more injury before the decline in cognitive function (Satz, 1993). In contrast, cognitive reserve is more of the "software" or the non-physical component of the brain. It focuses more on the brain's functionality, neuroplasticity, and adaptability (Stern, 2022).

According to empirical findings, individuals with similar brain reserve may express variable clinical consequences as a function of cognitive reserve, implying that cognitive reserve is independent of brain reserve. The concept of "cognitive reserve" is intended to signify the physiological robustness in functional brain networks, whereas "brain reserve" refers to variances in existing structural neural substrates (Stern, 2002).

How does Cognitive Reserve Develop?

Our brains are wonderful, complex, and rich with neural connections responsible for the cognitive ability and capability to change and adapt to demanding tasks, diseases, or brain damage. However, the vital brain mechanism that builds cognitive reserve is still unknown. What we do know is in many studies, education, high levels of social engagement, mentally stimulating activities, and working in cognitively challenging jobs have been linked to increased resilience to cognitive decline and dementia (Ridding, 2017).

For instance, according to the study by Weinstein and colleagues (2021), young people who grew up in a book-filled home – 11 to 25 books – were linked to enhanced immediate memory, verbal fluency, delayed memory, and lower global cognitive decline. Therefore, book exposure at a young age is an external factor that influences linguistic ability, increases cognitive reserve, and leads to better cognition and delayed cognitive decline.

Even so, scientists asserted that engaging in new complicated activities and learning experiences throughout life is preferable to doing the same things repeatedly. Learning new things challenges the brain; it initiates the brain networks to develop, contributing to mental well-being. Also, because of the brain's plasticity, our level of involvement in learning has a cumulative effect on us. The good news is irrespective of your age, you can take steps to do something for your cognitive health (Stern, 2009). Research also suggests that the level of intelligence that begins in childhood, together with the different experiences you encounter over your life, contributes to the

development of the cognitive reserve. These factors may vary, but the known factors can help explain our cognitive reserve differences.

Likewise, studies have constantly proved that life experiences, such as education, and engagement in mentally stimulating activities combined with leisure activities and social relations, are related to a slower rate of cognitive decline in normal ageing and lessens the risk of Alzheimer's disease by 35 to 40%. However, even when changes in the brain are evident, people with these engaging life activities and experiences cope better because they do not show any symptoms. As a result, because there are no apparent symptoms of the diseases, these people will not be diagnosed with neurodegenerative diseases (Stern, 2020).

Effects of having Cognitive Reserve

Research shows that building cognitive reserve protects the brain from cognitive decline and compensates for age-related brain changes. This research led scientists to investigate theories about the benefits of this cognitive reserve. How does small or large cognitive reserve capacity affect a person? According to the findings, those with a higher cognitive reserve will have some form of resistance to dementia, although symptoms may develop very late in life.

Cognitive reserve is relevant to a wide range of behavioural and mental health issues and brain processes that affect people of all ages. The unique differences among individuals' sub-networks and cognitive mechanisms influence task performance. Because of individual differences, the amount of pathology required for the initial appearance of various behavioural symptoms varies. Life activities

(e.g., higher education, strong social groups, and mental stimulation) strengthen the cognitive reserve, indicating a strong relationship between life activities and cognitive reserve. Consistently participating in cognitive reserve building activities can reduce the risk of dementia and slow the rate of memory decline in normal ageing. The said activities strengthen the reserve because they build the brain's capacity to withstand age-related changes and disease-related pathology that usually leads to cognitive decline (Stern, 2009).

The symptoms of a stroke, Parkinson's disease, multiple sclerosis, or other brain diseases can be avoided by increasing cognitive reserve. This allows people to live their lives without showing any signs of illness while enduring age-related brain changes without problems in their functioning. In addition, high levels of the cognitive reserve also protect the person's brain when under high-stress situations such as during surgery or dealing with environmental toxins (Kamhi, n.d.).

Previously it was mentioned that cognitive reserve protects the person's brain against degeneration. However, there are cases under highly educated individuals in which dementia progresses more rapidly once symptoms start exhibiting. The concept of cognitive processing helps to understand this paradox. The brain with a larger cognitive reserve can cope with the long-term effects of dementia, but the effort of managing the effects leads to the exhaustion of the reserve. As a result, rapid deterioration is evident because of the extensive damage to the brain's threshold; damage that even the most highly developed brain will fail to overcome. This suggests that memory decline can occur later in healthy older adults, and when it does happen, it progresses more rapidly in those with higher education (Ellison, 2021).

Likewise, a higher degree of brain dysfunction prior to the manifestation of clinical symptoms correlates to greater cognitive reserve, prolonging the start of diseases (Hu et al., 2017). But then, this does not rule out that cognitive reserve provides hope in fighting the effects of the ageing brain and neurodegenerative disorders.

Cognitive Reserve and Alzheimer's disease

Dementia causes impairments in older adults. It is also not part of normal ageing. Hence some people will live their entire life without developing dementia. The most common form of dementia is Alzheimer's disease. Alzheimer's is responsible for 60% to 80% of cases. The role of the cognitive reserve might be significant in compensating for progressive brain damage in dementia patients as greater levels of cognitive reserve shield the progression of symptoms until a specific threshold. However, cognitive reserve does not prevent dementia (Aghajan, 2021).

Alzheimer's is a progressive neurodegenerative disease that starts with mild symptoms but becomes more severe, leading to functional impairment. The earliest symptom is memory lapses (e.g., difficulty remembering a particular event and acquiring new information) due to the early damage to the hippocampus. The hippocampus is the part of the brain playing a role in day-to-day memory. During the early stages of the disease, memories associated with life events that happened a long time ago are not impaired.

The researchers from Yale University developed advanced imaging technology to confirm that the loss of brain synapses is the cause of cognitive problems among patients with mild symptoms of

Alzheimer's disease. The metabolic activity at the brain synapses of forty-five participants was measured using the new glycoprotein 2A (SV2A) PET imaging scan. The cognitive performance in five domains was also measured: verbal memory, language skills, executive function, processing, and visual-spatial activity. The result showed that the loss of connection between brain cells was strongly linked to poor performance on cognitive tests. The study also revealed that synapse loss was a stronger predictor of poor cognitive ability than the decrease in the overall number of neurons in the brain (Mecca et al., 2022).

As Alzheimer's progresses, severe memory loss and problems with communication, thinking, and orientation are evident, leading to the need for daily support from a family member or caregiver. Others may start to have false beliefs or abnormalities in thought content (delusion) or see and hear things that seem real but are not (hallucinations). The brain mechanism of an individual with Alzheimer's disease is significantly affected. During the lifecycle of the disease, plaque builds, and tangles in the brain's structure occur. As a result, the connection between nerve cells is lost, leading to the death of nerve cells and the loss of brain tissue. The lack of essential chemicals that sends signals in the brain is also evident, leading to ineffective transmission of signals (Alzheimer's Society, 2014).

Even with a diagnosis of Alzheimer's, brain and cognitive reserve may have a preventive or, at the very least, a moderating function against clinical worsening. People with higher levels of cognitive reserve have better brain linking networks, or they can employ alternate functional methods, allowing them to cope better with the symptoms of Alzheimer's disease without becoming disorientated. People with

greater cognitive reserve have better cognitive task performance, so it takes longer to receive an Alzheimer's diagnosis (Whitwell, 2014).

A study based on plaque accumulation in the brain following an autopsy was conducted on ten deceased cognitively healthy older women with Alzheimer's disease. These women had larger brains and more neurons than demented and non-demented individuals. Researchers hypothesized that larger brains and additional neurons provided "reserve" to assist them in coping with the plaque caused by Alzheimer's disease. In more recent studies, 25% to 67% of people classified as non-demented during comprehensive and repeated long-term assessments met diagnostic dementia criteria at autopsy, indicating the role of cognitive decline (Tucker & Stern, 2011).

The efforts of researchers to discover the association between cognitive reserve and Alzheimer's disease help us understand how our brain works and fights against dementia. The research findings would also lead to interventions that help slow cognitive ageing or reduce the risk of dementia, benefiting the individual affected by the disease, the family, and health care providers.

Life Course Model of Cognitive Reserve in Dementia Risk

Education helps improve the efficiency and flexibility of the brain's networks. According to research, minimal education levels influence cognitive reserve capacity and consistently elevate the risk of dementia (Karp et al., 2004). Aside from education, scientists have theorized that occupational characteristics affect cognitive reserve (Karp et al., 2009). For instance, mental exercise, motivation, and

continuous development of intellectual capacities provided by job roles are protective factors against dementia (Kröger et al., 2008).

Cognitive and social variables can influence the quality of education a person receives, as well as their vocational ability (Andel et a., 2005). Cognitive aptitude tests could be a more valid measure of cognitive reserve capacity. However, researchers would need to be able to access cognitive aptitude tests done in childhood to fully understand the effect. Unfortunately, this data is rarely obtainable in dementia studies.

Nonetheless, while the available data is limited, in studies, it has been observed that low early cognitive capacity increases the risk of dementia; however, it is unclear to what degree education or occupational complexity can continue to influence dementia risk.

To address the need for research evidence, Dekhtyar et al. (2015) examined how three factors affecting cognitive reserve can influence dementia risk, measured at distinct life phases, childhood, early adulthood, and mid-life. The study followed 7,574 people for an average of 21 years. The youngest participant was 79, and the oldest was 93 by the end of the study. Over the follow-up period, 12.5% or 950 people got dementia, while the participants who scored in the top 80% of their elementary school class had a lower risk of dementia.

After 21 years of follow-up, the researchers discovered that individuals with higher childhood school grades had lower dementia risk. The researchers also confirmed that high occupational complexity reduced the risk of dementia. After accounting for childhood school performance, university education’s protective effects diminished when researchers included career complexity.

Lastly, the lowest risk of dementia was found among people who received high childhood school grades and worked in complex professional jobs. This result is consistent with literature that associates early-life cognitive aptitude with late-life cognitive dementia (Whalley et al., 2000; Snowdon et al., 1996).

The researchers used the cognitive reserve theory to explain the results further. This theory asserted that children with low grades are more vulnerable to dementia pathology due to lower brain network efficiency or flexibility. Childhood academic achievement represents central nervous system qualities such as processing speed and capacity, which might influence the rate of age-related decline and reduce the impact of pathology on the clinical progression of dementia (Richards et al., 2004). Also, evidence of functional reorganization of brain networks was employed by younger people when completing the same tasks performed by the elderly (De Ronchi et al., 1998), implying that there is a compensatory network at play to maintain cognitive functioning during age-related physiological changes. Therefore, early-life academic performance may be considered an indicator of the degree to which the functional reorganization will be effective (e.g., increased functional restructuring in the brain among older individuals).

Researchers emphasized another alternative explanation to support their findings. They asserted that low childhood school performance affects adult health behaviours and outcomes linked to dementia risk (Del Ser et al., 1999). This is because people with poor academic scores have challenges accessing health care, which makes them more vulnerable to avoidable conditions like heart disease and stroke, both linked to dementia (Batty et al., 2007).

Despite the claims that cognitive reserve may be a protective factor against dementia, three longitudinal trials have not shown protection against neurodegenerative and vascular neuropathology. However, cognitive reserve reduced the influence of pathology on the clinical manifestation of dementia before death, implying that neuronal efficiency and compensation pathways exist.

With that being said, the mechanisms of a "use it or lose it" model might relate to educational and occupational complexity (Orrell & Sahakian, 1995). Higher education's protective benefits are valid only when accompanied by continuous mental activity that fosters cognitive reserve. In the long-term prevention of developing dementia, the cognitive requirement of complex employment may be more relevant than schooling alone (Stern et al., 1995). A neuroimaging study provided evidence for this conclusion. In this study, mid-life occupational complexity showed a more substantial influence on the brain's grey matter volume than education (Suo et al., 2012).

Studies focusing on occupational complexity and dementia demonstrate that participants in data-driven occupations have a lower risk of dementia. This claim is based on the cognitive reserve model, which emphasizes the preservation of cognitive abilities facilitated by continuous intellectual demanding activities (Kröger et al., 2008). The favourable impact of job complexity on the cognitive reserve is now enjoyed by a larger proportion of the population than 30-50 years ago. Growth within information technology has transformed the terrain of modern professional workplaces by increasing the number of data-driven roles.

Overall, Dekhtyar and colleagues (2015) showed that the main protective factor against dementia is extended to individuals who use their good childhood school performance to build challenging professions in adulthood, demonstrating the synergetic qualities of reserve throughout life (Richards & Deary, 2005). Significantly, those who do not have a life stimulation in the context of high occupational complexity but have higher school grades at an early life are nonetheless able to get protection from the higher reserve. This idea indicates that cognitive growth in childhood has a significant impact on dementia risk than cognitive enhancements achieved later in life through education or increased job complexity.

Cognition and Cognitive Impairment

Cognition is the combination of mental processes which consist of the ability to learn, remember, and make judgments. It also denotes all processes wherein sensory input is converted, processed, refined, maintained, and recalled (Houwer et al., 2016). Moreover, cognition is also responsible for acquiring knowledge and understanding through our experiences, thoughts, and senses, encompassing various aspects of cognitive functions. Such factors include the formation of knowledge, attention, memory and working memory, reasoning and calculation, strategic planning, problem-solving, understanding, and language production. Problems in mental processes substantially impact various areas of brain function and general health since cognitive functions use existing knowledge and newly developed ones.

Cognitive impairment, also known as “cognitive decline”, refers to a limitation in mental processes such as difficulty remembering, acquiring new knowledge, concentrating, and decision-making difficulties. The term cognitive impairment is a broad term used to describe the condition of a person with problems in cognitive functioning, ranging from mild to severe. It is not a disease but can be caused by brain damage or other conditions (CDC, 2011).

For instance, a person with a traumatic brain injury will manifest cognitive impairments due to damage to the brain. Memory loss, inability to remember faces, and difficulty in solving simple tasks are manifestations of cognitive impairment that might occur suddenly or gradually. The severity of impairments may or may not worsen rapidly, depending on the underlying causes. When a person has been

screened and diagnosed with mild cognitive impairment (MCI), they may experience abnormalities in one or more cognitive domains but do not fulfil the full diagnostic criteria for dementia (World Health Organization, 2017). However, cognitive impairment may also occur as people age, implying a decline in cognitive functioning. As we age, the neurons also age; thus, the speed of brain functions decreases.

Family and friends of a person suffering from cognitive impairment may notice confusion, agitation, mood swings, speech difficulties, and behavioural abnormalities. The cause may come from various diseases such as Alzheimer's, stroke, traumatic brain injury, and developmental disorders. However, some curable illnesses imitate impairment in cognition, such as depression and excessive consumption of drugs and alcohol. Cognitive impairment comes with these health conditions (CDC, 2011).

Furthermore, a person with cognitive impairment requires support because of its impact on everyday life. According to research, the impairment among people experiencing mild cognitive impairment (MCI) leads to difficult experiences (e.g., neglect of personal hygiene and appearance) and changes in activity patterns (e.g., from work to more personal activities). But most people are still capable of coping on their own. Moreover, when interviewed, there is an observed difference in how everyday life is described between people with MCI and people with dementia. People with MCI tell their stories easily, while those with dementia require more prompting and follow-up questions (Johansson, 2015). This implies that, although both conditions manifest cognitive impairment, the severity of the decline in people with dementia is more severe than in those with MCI.

Cognitive Impairment among Young Adults

The human brain continues to develop and mature until the mid-to-late 20s. The frontal cortex, the part of the brain in charge of judgment, awareness, and logical reasoning, is the last to mature. Throughout the development process, young adults undergo new complicated changes in thinking and emotional regulation (Simpsons, 2018). However, though the brain reaches its peak size at the age of 25, this does not mean it will stop improving and developing; it is the brain size that stops growing, not its functionality. Brain changes during this development phase may affect how individuals' function in later life, particularly in the area of cognitive functioning. Once the individual fully reaches brain maturity, other factors still lead to impairments in cognitive functioning since youthfulness and freshly developed brains do not free a person from cognitive impairments.

Impairments in cognitive functioning are common among young adults experiencing major depression (Castaneda et al., 2008). According to research conducted among depressed young adults, people with depression show disturbance in the capability to perform and simultaneously sustain problem-solving strategies in working memory and set-shifting ability. Problems with the ability to perform and sustain problem-solving strategies cause the individual to struggle to identify a problem, provide a solution, and determine acceptable courses of action (Grant et al., 2001).

Moreover, young people experiencing cognitive impairment, particularly in verbal ability acquisition, predict psychosis in later life. Psychosis is when a person loses contact with reality and involves hallucinations and delusions. A population-based research study

utilizing measures of cognitive, scholastic achievement, and military conscription demonstrated that individuals who developed psychotic disorders in adulthood performed lower than their peers in childhood. According to the findings, adolescents, and young adults with a relative reduction in cognitive performance, notably verbal ability, demonstrated an increased risk of psychosis in adulthood.

The decline in verbal ability between ages 13 and 18 is a stronger predictor of psychosis than impairment in the verbal domain at age 18 alone. Meaning impairment in the development of verbal skills between the ages of 13 and 18 may result in psychosis since the length of the impairment increases the risk compared to impairment that occurs only at the age of 18 (MacCabe et al., 2013).

Lack of sleep can also disrupt attention, working memory, and other higher cognitive functions. One study demonstrates the link between sleep deprivation and cognitive impairment in younger persons at risk of hypertension. According to findings, young adults at risk of hypertension appear to have a decrease in higher cognitive functioning when sleep deprived. Sleep-deprived young adults at risk of hypertension seem to have impaired cognitive functioning because the cortical networks subserving attention and higher cognitive processes are disrupted (McCubin et al., 2012).

Sedentary activities, such as watching too much television, can also lower brain function in young adults. According to Northern California Institute for Research and Education, research participants who reported watching TV more than three hours a day and less than two and half hours of physical activity per week experienced a decline in cognitive functioning, even before the participants were middle age. More than 3,200 participants aged 18 to 30 participated in the 25-year-

long study in which data was accumulated and analysed. The research highlighted that people with less physical activity manifested poor cognitive functioning, such as weaker working memories, slower processing speed, and worse performance when planning and executing tasks than their more physically active counterparts who watched less TV. However, verbal memory was not affected (Luscombre, 2015).

Aside from major depression, sleep deprivation, and less physical activity, substance abuse disorder (SUD) is also associated with cognitive impairment, with prevalence rates ranging from 20% to 80%. Patients with SUD have problems with executive functioning, such as decision-making and emotional control. Therefore, cognitive impairment affects their quality of life and work-related capacities as they recover (Hagen et al., 2019).

Compared with older adults, younger people are more likely to suffer from cognitive impairments caused by complications from birth or by later factors such as psychological (e.g., depression, anxiety, psychosis, etc.) and medical conditions (e.g., hypertension, diabetes, etc.) as well as lifestyle factors (e.g., alcohol use, diet, smoking, etc.).

Internet Use and Cognition

The primary goal of the Internet in the 1960s was to provide information via computers. Yet nowadays, it is utilized for communication, research, online transactions, entertainment, and much more. The Internet has now become an integral part of most people's lives. From computers to smartphones, Internet access has become abundant and convenient to the point that the current

generation, or even the older ones who have adapted to technology, has created a world in which the majority of people are “online” (Perrin & Jiang, 2018; Anderson & Jiang, 2018). However, widespread Internet use has positive and negative consequences.

On the positive side, the Internet serves as a new platform for continuous learning, skills, and complex online and offline processes (Small et al., 2009). Also, extensive Internet use throughout the world allows many individuals to learn various skills while allowing them to interact with society. Internet use also results in neural changes in the brain. For instance, Internet use via smartphones results in cortical areas linked to hand and thumb motor processing, nurturing neurocognitive changes (Gindrat et al., 2015).

However, aside from the neuroplastic implication of Internet use in cognition, other environmental and biological factors can also initiate brain function and structure changes that may result in cognitive decline (Levy, 1994). For example, in research findings from older adults, cognitive decline due to ageing may be partly triggered by the mechanism of atrophy (progressive shrinkage or loss of neuronal connections). Internet use may lead to more sedentary behaviour (too much time sitting or lying down). Some studies have demonstrated that living a less engaging lifestyle may increase the loss of cognitive function (Hultsch et al., 1999) because of the lower cognitive reserve (Small et al., 2012).

Likewise, disengaging from the real world and spending more time in virtual settings may also induce adverse neurocognitive alterations, according to some emerging studies. For example, six weeks of online role-playing games initiated a significant decrease in the grey matter

within the orbitofrontal cortex – part of the brain responsible for impulse control and decision-making (Zhou et al., 2019).

The studies mentioned above emphasize the beneficial and adverse effects of Internet use on the brain and cognitive processes. The findings are significant to the developing brains of children and adolescents because several cognitive processes (social cognition and higher executive functions) are not inherent but are highly affected by environmental factors (Paus, 2005).

In this part of the book, the influence that Internet use has on our brain structure and functioning will be examined by conveying the present-day psychological, psychiatric, and neuroimaging findings that investigate hypotheses on how the Internet may be changing our cognition. Fifth and colleagues (2019) conducted a research study published in the World Psychiatry journal where they explored how the online world's unique features may affect attentional capacities, memory processes, and social cognition.

Cognitive Consequence of the Internet on our Attention

The Internet can often consume a large amount of our attention. Most adults go online daily, and over a quarter of them use the Internet constantly (Perrin & Jiang et al., 2018). One out of five American adults use the Internet via smartphone, and the number and frequency of usage is even higher among younger people. Many adults today have witnessed the transition from "Internet-free" to "Internet-everywhere" societies as the launch of mobile devices that can access the Internet has reduced the "digital divide" faced by lower- and middle-income countries in the past (Kay et al., 2011).

Multiple factors propel the rapid increase and widespread usage of Internet-enabled technologies worldwide. For example, education, travel, commerce, socializing, and most organizations are now highly dependent on the Internet for practical reasons. Also, the Internet provides an infinite selection of entertainment and recreational activities via podcasts, e-books, gaming, and video streaming which undeniably captures users' attention.

However, the quality of media content online is not the only reason the Internet can capture and hold an individual's attention. Rather, the attention is also motivated by how the online world is designed and presented to the users, explained by the self-evolving "attraction mechanism" aspect of the Internet. For instance, when specific media content does not capture the attention of the user, the sea of incoming information presented to the user will drown out the content (e.g., advertisements, articles, applications) until the algorithm is able to ascertain what content will catch the attention of the user (based on engagement, number of clicks, scrolls, and online shares). Because of this mechanism, renowned technology companies have been accused of intentionally capitalizing on the addictive potential of the Internet by studying, experimenting, and optimizing the attention-grabbing aspects of their websites or applications. Their goal is to drive advertising revenues based on remarkably high levels of engagement, with little regard for user well-being (Alter, 2017). Aside from biological factors (brain changes due to ageing), Internet use is a significant factor to blame for attention problems in older adults.

The Internet's incredible ability to capture our attention requires an immediate understanding of its impact on thought processes and well-being. Today, people responsible for educating children or youth are

starting to see the detrimental effects of the Internet on attention. For instance, according to Purcel et al. (2012) 85% of teachers endorse the statement that:

"today's digital technologies are creating an easily distracted generation."

The capacity of the Internet to influence attention lies in the hyperlinks, notifications, and reminders that deliver an unlimited stream of various forms of digital media. Hence, the behavioural mechanism known as media multitasking arises as it encourages individuals to engage with multiple inputs simultaneously (Ophir et al., 2009; Loh & Kanai, 2016).

The ground-breaking study by Ophir and colleagues (2009) was the first to examine the constant influence of media multitasking on cognitive abilities. Individuals who engaged in heavy or frequent media multitasking were compared to those who did not. Surprisingly, the findings show that individuals involved in intense media multitasking performed worse in task switching tests than those who did not engage in such behaviour. The findings contrast with the researcher's hypothesis that "extra practices" provided by regular media multitasking would provide cognitive benefits during task-switching scenarios. A closer examination of the findings revealed that the impaired task-switching ability of heavy media multitaskers was attributed to their greater susceptibility to distraction from insignificant environmental stimuli. Therefore, impaired task switching is not caused by the inability to multitask but rather due to the vulnerability to distractions.

Fortunately, some studies provide evidence on how media multitasking is linked to enhanced performance in other facets of cognition, particularly in multisensory integration (Lui & Wong, 2012). Nevertheless, the literature seems to suggest that those who engage in frequent media multitasking perform worse in cognitive tasks (e.g., sustained attention) than those who do not (Uncapher & Wagner, 2018).

Furthermore, brain imaging studies have provided neuronal variations that may account for cognitive deficits. For instance, findings show that people who engage in heavy media multitasking demonstrate poor performance in distracting attention tasks, despite exhibiting more significant right prefrontal region activity. The activated right prefrontal regions typically indicate a distractor stimulus response. Increased activation and poorer performance mean that heavy media multitaskers need a lot of cognitive resources to sustain concentration when confronted with distractor stimuli (Moisala et al., 2016). Also, decreased grey matter in prefrontal areas responsible for maintaining goals when facing a distraction was evident among individuals with high levels of Internet use (Kühn & Gallinat, 2015) and intense media multitasking behaviour (Loh & Kanai, 2014).

Overall, the evidence suggests that engaging with digital media does not enhance multitasking performance in other settings. It may even reduce this cognitive capacity by lowering the ability to avoid impending distractions.

The Internet and Memory Processes

The Internet has changed how information is accessed (Colley & Maltby, 2008). Because most of us live in a high technology world, we can access almost all the scientific research using our fingertips. For the first time in human history, the Internet enables the possibility of eventually removing and replacing the need for specific human memory systems. Replacing the need to memorize information mainly affects aspects of semantic memory, which is, to some extent, independent of other types of memory (Vhargha-Kadem et al., 1997).

Sparrow et al. (2011) provided the primary indication of information gathering via the Internet that affects the typical memory process. He shows that the capability of a person to access online information caused them to become more inclined to remember "where" the information can be retrieved rather than the "facts or content". In other words, we have become more reliant on the Internet for quick information access, and efforts to grasp the content have decreased.

Before the Internet, people would go to libraries and search for books, newspapers, or hardbound journals to gather information. Then they would write what they had gathered to retain the information or, in some cases, memorize it to retrieve it later. Although some people still visit libraries today, the Internet is more popular because it is more convenient, accessible, and faster. This is an example of how the online world acts as a form of external or "transactive" memory. Because instead of making efforts to store, memorize, and deeply understand the information, we are complacent, relying on the Internet to help in information retrieval when forgotten.

Transactive memory describes the collective process of encoding, storing, and recalling specific knowledge rather than trying to store all the information (Wegner, 1987). For example, someone could be good at remembering phone numbers but terrible at remembering directions. However, another person may be good at remembering directions but terrible at remembering phone numbers. Suppose each of them is aware of the other's fields of expertise and non-expertise. In that case, they can rely on each other in a similar way that people use diaries, alarms, and other memory aids to recall things they would not remember on their own (Wagner et al., 1985). This process is beneficial at a group level, yet, utilizing transactive memory systems does decrease our capability to recall the details of the externally stored information (Liang et al., 1995). This is because we are subject to transactive memory for cognitive offloading (the implicit reduction of the allocation of cognitive resources when remembering information). After all, they know that the information, if needed, will be externally accessible for future needs.

Remarkably, the transactional aspect integral to other types of cognitive offloading seems to be bypassed by the Internet in two ways. First, the Internet imposes no commitment on the user to remember important information for future reference, which is usually necessary for human societies (Wegner & Ward, 2013). Second, unlike other transactive memory storage, the Internet does not expect us to accurately recall the information stored externally or where it is located. The Internet serves only as an entity responsible for storing and retrieving all the information. There is no reminder that the information should be memorized, clearly understood, or written for future needs. The Internet provides us with the information we need, with no directives on how to use it. Thus, the Internet is evolving into

a “supernormal stimulus” for transactive memory, making other options for cognitive offloading inconvenient because there is a new and better way for external information to be stored and retrieved later (Dong & Potenza, 2015).

Regrettably, the faster ways to acquire and access information provided by the Internet may inevitably lead to inefficient use of the gathered information. For example, according to an experiment, individuals who were instructed to search online for a piece of certain information finished the task faster compared to those who used a printed encyclopaedia. However, they did not accurately recall the information they had researched.

During the information gathering task for the Internet and encyclopaedias, functional magnetic resonance imaging (fMRI) was utilized to analyse the activation of ventral and dorsal streams. These brain regions are responsible for the “what” and “where” streams because of their part in storing either the specific content (ventral stream) or external spot (dorsal stream) of incoming information (Dong & Potenza, 2015). There was no difference in dorsal stream (where) activation. However, the results revealed that there was weaker remembering of information gathered through the Internet compared to encyclopaedia-based learning was linked to decreased activation of the ventral (what) stream in online information gathering. Meaning, that information gathering using the Internet is faster, but people may fail to adequately recruit the brain regions responsible for storing the information on a long-term basis.

Moreover, several studies examine the potential consequence of online searching in producing a sustained impact on our cognitive processes. One example is young adults who were given an hour per

day to conduct Internet research. Before and after the training, an array of cognitive and neuroimaging testing was administered to them. The results revealed a reduction in regional homogeneity and functional connectivity in the brain regions involved in long-term memory formation and recall after the six-day Internet research training (Liu et al., 2018). The result means that relying on online searching may impair memory recall by diminishing functional connectivity and synchronization of related brain regions (Liu et al., 2018). However, after six days of training, the participants' self-reported impulses for using the Internet to resolve new questions increased. The students showed evident recruitment of prefrontal brain regions needed for behavioural and impulse regulation (Wang et al., 2017). The study shows that online information gathering rapidly trains people to rely on the Internet when encountering unknown issues.

However, aside from the adverse effects of constant "offline" memory, the six days of training provided to the participants enabled them to efficiently use the Internet when retrieving information because they became faster at research tasks without hampering the accuracy (Dong & Potenza, 2016). The search training resulted in a significantly higher white matter integrity of the fibre tracts joining the frontal, occipital, parietal, and temporal lobes than in the non-search control condition (Dong et al., 2017). Other studies have shown that cognitive offloading through electronic devices enhances people's capacity to focus on aspects that are not immediately retrievable, allowing them to recall them better in the future (Storm & Stone, 2015).

Overall, the findings appear to support the growing hypothesis that dependence on the Internet for factual memory storage may yield

cognitive benefit in some areas, which is in the manner of "freeing up" the cognitive resources (Bell et al., 2015). Lastly, the Internet can provide a "super stimulus" for transactive memory and is already transforming the mechanism of storing and retrieving information and the value of knowledge.

Social Cognitive Responses to the Online World

The shift from real-world to online social interaction and vice versa has an important implication for almost all aspects of people's lives. Talking about these would help us understand how social relationships operate in the real and online world. The important contributing factor to happiness, stress reduction (Fowler & Christakis, 2008), mental and physical well-being (House et al., 1998), as well as mortality (Holt-Lunstad et al., 2010), is social interaction. In the past decade, the number of people's online social interactions through social networking sites such as Facebook, Instagram, and Twitter increased dramatically (Grabowicz et al., 2012).

The neurocognitive responses to online social networks are related to real-life social connections. For example, increased brain activity in regions strongly associated with social cognition and real-world rejection is evident when online rejection occurs both in adults and children (Achterberg et al., 2017). Also, online social media is trying to break some rules within the "same old rules" of human socialization, which is potentially disadvantageous to users (Alter, 2017).

For instance, although real-world rejection and acknowledgement are frequently vague and open to subjective interpretation, social success

or failure is directly quantified by social media platforms through metrics like friends, followers, and likes (Crone & Konijn, 2018). A person may feel rejected if there are no likes or followers but feel acknowledged if there are a lot of likes and followers. Social media companies capitalize on the addictive nature of social media by using instant and self-defining feedback to increase engagement (Alter, 2017). However, according to studies, relying on the online response for validation or self-esteem may have adverse effects on younger people, especially those with low socioemotional well-being, because of the high rates of cyberbullying (Hamm et al., 2015), which causes higher levels of anxiety and depression (Vannucci et al., 2017), as well as increased experiences of social isolation and rejection.

In addition, the tendency to make a social comparison in both online and offline worlds is common to human social behaviour. Although this tendency may be adaptive and beneficial under normal environmental circumstances (Collins, 1996), the fake environment created on social media can hijack the implicit cognitive process (Verduya et al., 2017) and may result in hyper-successful individuals continuously pushing their best foot forward and may even use digitally manipulated images to exaggerate physical attractiveness.

Therefore, online social media can cultivate unrealistic expectations of ourselves due to drastic upward social comparison that may lead to poor perception of body image and negative self-concept, mainly among the younger age group (Twenge et al., 2017). To set an example, adolescents who spend more time on social media and smartphones have a high occurrence of mental health concerns, such as depression, compared to those who do not spend more time on non-screen or online activities, particularly females.

Notably, one of the protective factors of cognitive decline is having strong social connections. Some social media platforms enable people to socialize online, build relationships, and communicate, thus increasing their social connection despite the absence face to face contact during socialization activities. If online socialization affects the person adversely, despite having a good purpose, it possibly increases the risk or exacerbates the experience of cognitive decline.

Contrarily, research shows that for adults experiencing cognitive decline, the online environment may serve as a new source of positive cognitive stimulation. For example, Internet-savvy older adults, ages 55-75, who search the Internet build more engaged neural circuits than text reading (Small et al., 2019). Another example is from experimental studies showing that online computer games played through a smartphone can be utilized to decrease age-related cognitive decline (Oh et al., 2018). Therefore, the Internet may offer an innovative and convenient platform for adults to sustain cognitive function in old age. The sustenance was due to the learning and developing of cognitive strategies that can compensate for cognitive decline due to ageing.

As Internet-based technologies become more highly integrated into our daily cognitive processing (via smartphones, wearables, etc.), digital natives may be able to create aspects of "online cognition" in the developing brain. Older adults may progressively take full advantage of web-based transactive memory and other numerous alternative processes to fulfil (or even surpass) the usual capabilities of a younger brain (Firth et al., 2019.

Overall, the research findings do not imply that the Internet directs us to think poorly, passively or makes us lazy. Instead, the results

demonstrate that the way we gather and utilize information, as well as Internet usage behaviours, affects our brain wirings, thus, influencing our cognition. The easy access to information benefits everyone, especially if the purpose of learning is involved.

The Consequence of Noise Exposure on Cognitive Functioning

Noise can significantly affect our cognitive ability and brain activity, yet this is frequently overlooked (Basner et al., 2014). Noise may pose various adverse consequences ranging from obstruction of mental processing to detrimental and physical health effects (Stansfeld & Mathenson, 2003). Aside from the auditory effects of noise exposure, it may also result in perceived disturbance, cognitive impairment, annoyance, sleep disturbance, and cardiovascular disorder (Basner et al., 2014).

In the United States, noise exposure is a considerable concern in various occupational and non-occupational settings, with estimated 22 million workers exposed to hazardous noise (Tak et al., 2009). Also, 100 million people are subjected to adverse environmental noise because of traffic, listening to personal devices that produce sounds, and other sources (Hammer et al., 2013). Annually, in the highest western European income earning nations, with a population of around 340 million, at least 1 million healthy life-years are lost because of environmental noise, according to estimated data by the World Health Organization (WHO).

Workers must maintain efficient performance, particularly those in vital occupational roles that demand higher cognitive skills, while

exposed to conditions with a higher noise than desired Threshold Limit Values (TLV). Research shows that cognitive impairment and oxidative stress in the brain are caused by noise exposure. For instance, noise pollution resulting from urbanization and industrialization may be a risk factor for depression, cognitive impairment, and neurodegenerative disease (Wang et al., 2016). This is because noise has been observed to influence the central nervous system and may result in cognitive and memory deficits, emotional stress, and anxiety (Langguth, 2011).

The cognitive selection called “attention” has a significant role in daily activities, including physical activities, emotional reactivity, and perceptual and cognitive functions. When there is an inadequacy in information processing caused by noise, the attention system regulates human behaviour according to the environment, affecting performance by either impairing the information processing or triggering changes in strategic responses. However, in some cases, noise can increase general alertness and activation. Other studies have also demonstrated that noise enhances performance, particularly among sleep-deprived workers, because the noise serves as a sensory stimulus that increases arousal. Noise may also cause a decrease in the breadth of attention. This means that changes in performance requiring attentional factors caused by loud noises may result in altered cognitive functioning, eventually leading to human error, increased accidents, and decreased performance and productivity. Yet, noise does not affect performance speed (Jafari et al., 2019).

As a stressor, noise affects cognitive performance and brain signals (Jafari et al., 2009). The noise pressure level is essential to the brain’s impaired cognitive function and power spectral density, implying that

low noise levels are less effective than high noise levels. The impact of increased noise exposure levels on cognitive performance can be explained by the Poulton arousal model, which indicates that noise exposure initially improves cognitive performance. This is due to the increase in arousal to lessen the impact of noise on cognitive function. But then, the effect of arousal wears off gradually, and the adverse outcomes of noise exposure on cognitive function begin to manifest (Poulton & Masking, 1981). In addition, the arousal theory states that the level of the central nervous system, alternating from being asleep and awake, controls the human response to stimuli. By considering this theory, we can assume that performance will decrease when arousal is low or high or in both low- and high-stress conditions (Yerkes & Dodson, 1908).

However, previous research on the effects of noise on cognitive function yielded conflicting results. Several studies found that noise can enhance cognitive functioning, while others found that noise decreases cognitive function (Hoskin et al., 2014). The Jafari et al. (2009) study shows that the decrease in cognitive function and brain signals was only significant when exposed to noise with 95 dB level and not at 75 or 85 dBA. This can be explained by psychoacoustic factors, such as sound pitch, tones, length of exposure, and noise type. Nonetheless, other studies have emphasized the significance of noise pitch and its implications on cognitive function and brain activity.

Examining the adverse consequence of noise exposure on cognitive functioning would help understand what specific decibel or noise levels should be avoided. This also provides information about the desirable sound or noise levels significant for brain tuning.

Cognitive Impairment and Lifestyle Changes among Caregivers

Cognitive impairment affects not just the person suffering from it but those caring for the person - the caregivers. Most caregivers may encounter undesirable lifestyle changes such as less physical exercise, less time for social pursuits, and poor diet. Addressing these areas would help alleviate the cognitive decline and increase the quality of life of caregivers and in-care recipients suffering from cognitive impairment.

However, since care recipients regularly spend their day with their caregivers, Kleinman (2010, p. 1518) asserted:

"*Social suffering conveys the idea that the pain and suffering of a disorder are not limited to the individual sufferer but extends at times to the family and social network."*

This implies that being a caregiver is associated with negative effects that affect interpersonal relationships and lifestyle (Beesley et al., 2010). Improving health requires good interpersonal relationships - for example, the caregiver is reliant on others to do the caring while they make time for exercise. Therefore, addressing the health of caregivers and care recipients by considering their personal and cognitive condition is crucial and must be included in lifestyle-based interventions.

A lifestyle-based intervention can address the consequences of lifestyle modifications among caregivers of people with cognitive impairment. The effectiveness of lifestyle-based interventions is critical as the family members providing care play a significant role in

maintaining frail elders' well-being at home. Caregivers also need help and protection from the possible consequences that being a carer to those people with cognitive impairment can have on them. For example, during weekly intervention with telephone-supervised and home-based physical activity programs, improvements were evident in self-reported sleep quality, blood pressure reactivity to a laboratory-based emotional encounter, and psychological distress (King et al., 2002).

Likewise, physical activity research demonstrated positive benefits on caregivers' perception of burden (Hirano et al., 2011), anxiety, depression, and self-efficacy in handling negative thoughts (Waelde et al., 2004). Understanding caregivers' preferences and barriers to healthy lifestyle changes will clarify if they accept and perform well in behavioural interventions. The intervention preferences and obstacles are essential to determine as caregivers also have a significant role in interventions for people with cognitive impairment.

For instance, a study revealed that Chinese patients with early-stage dementia and their caregivers gained from physical exercise because it lowered their stress levels and improved their relationship quality (Burgener et al., 2010). This study compared the viewpoints of dementia and mild cognitive impairment (MCI) caregivers regarding lifestyle interventions related to cognitive and physical health. Lifestyle intervention for caregivers and their care recipients is vital in China due to the number of elders with cognitive impairment and their increasing dependence on informal caregivers within the community setting (Wu et al., 2009).

In addition, the findings show that both MCI and dementia caregivers perceived that a combination of physical activity, social interaction,

and a good diet is crucial in maintaining a healthy lifestyle, as well as musical and reading activities as ways of improving mental health. However, both groups of caregivers appeared to focus on physical exercise and diet in their perceptions of a healthy lifestyle. Regardless of their similar views on the forms of activities that would facilitate a healthy lifestyle, the two groups of caregivers differed in their perception of the kinds of lifestyle changes that would work for them.

The MCI caregivers group reported having hopes and ideas about performing lifestyle changes which showed they were in the preparation stage. Some could provide specific examples of the changes they wanted and their interest in continuing activities like exercise. Such individuals would benefit from programs that assist their transition into the engagement and maintenance stages of change, where they make active behavioural developments towards transformation. According to the change model, behavioural processes (e.g., adding cues for better behaviours, rewarding positive changes, and developing supportive relationships and social care) are advantageous to the lifestyle change intervention, which applies to the caregivers in this study.

On the other hand, dementia caregivers were more likely to be in the contemplative or pre-contemplative stages. This implies that they were not ready for standard action-oriented intervention programs, as behavioural mechanisms were only effective in the final stages of change (Marshall & Biddle, 2001). The experiential process, which aims to change caregivers' outlook and motivation, may be effective yet will not necessarily help the caregivers to have a healthy lifestyle change. This is because of the time constraints concerns and problems with performing physical activity.

Overall, people with dementia require more help from their caregivers due to their severe cognitive impairments. Caregivers have no time or possibility for change. However, MCI patients' caregivers are more often hopeful about change as the impairment in MCI is less severe, which does not require full-blown assistance from the caregivers.

Part II: Prevention and Protection against the Impact of Cognitive Decline

Some risk factors of cognitive decline are inevitable and unmodifiable. We cannot stop ageing or stop the gene mutation inside our bodies. Fortunately, there are interventions that can help prevent and protect us against cognitive decline. Although memory lapses are normal, it is still important to address them because this may alert us to something that can affect our lives later. Being young is not a free pass from cognitive problems. It is better to consider protecting yourself earlier than to act late. Although it seems hopeless to improve cognitive functioning among older age groups, the concept of the cognitive reserve provides hope.

Protecting yourself against Cognitive Decline

The changes in our brains as we age are inevitable, and they may include changes in cognitive functioning. When we compare older adults to younger adults, we can see that brain changes affect older adults differently; the changes may result in severe conditions, such as mild cognitive impairment to other forms of dementia. Although young adults may experience mild cognitive impairment, it does not greatly affect their functioning. For older adults, it poses a serious risk to their way of living and thinking capabilities. Yet, some protective factors can assist both young and older adults against cognitive decline.

Protective Factors

Protective factors protect a person from the possible adverse and long-term effects of cognitive decline, as well as other forms of dementia, such as Alzheimer's disease. This section of the book focuses on ways that aim to improve cognition and slow down or prevent cognitive decline.

Education and Cognitive Training

To start, let us remind ourselves of an earlier discussion in this book related to this topic. People with an average of 11.5 years of education are 5% less likely than those who completed ten years of school to acquire mild cognitive impairment. The time spent in education decreases the person's risk for mild cognitive impairment. This assumption can be explained by the relationship between education and higher economic status, as it leads to better access to a healthier lifestyle and health care (Meng & D'Arcy, 2012). Moreover, education stimulates the brain to create more neural connections as it involves mental resources. Building up more neurons and connections is essential for the brain to function healthily. Education could also help the brain accommodate the cognitive changes caused by minor cognitive impairment, such as memory loss (Sharp & Gatz, 2012). Some research studies further suggest that higher cognitive levels and slower cognitive decline are evident among older adults with more years of education (Zahodne et al., 2015).

Cognitive training highly influences the maintenance of cognitive function because it involves intervention or activities that aim to enhance reasoning, memory, and information processing speed.

Activities such as learning a new language and skill, reading books, doing crossword puzzles, or even teaching a new skill to someone can serve as an exercise for the brain to improve cognitive functions (Downey et al., 2017).

We may wonder why education and cognitive stimulation protect people from cognitive decline and other neurodegenerative disorders. It can be explained by the theory that education and constant cognitive training throughout life helps establish a cognitive reserve, allowing the individual to better adjust to neurodegeneration. Thus, sustaining normal cognitive skills longer (Meng & D'Arcy, 2012).

Physical Activity

Most people are aware that exercise is important and good for our bodies, but not everyone can explain how it benefits our bodies. Exercise is necessary and beneficial for our body, but it also improves our brain function. Our brain needs good blood flow and oxygen levels, which exercise provides. The protective factor of physical activity lies in its potential to increase blood flow, oxygen levels, as well as brain chemicals controlling the production of the brain cells in the hippocampus. The increased production of brain cells in the hippocampus leads to improvements in concentration and good cognitive ability. As a result, focus and cognitive ability improve, lowering the risk of mild cognitive impairment and degenerative cognitive disorders like Alzheimer's.

A study conducted in the Mayo Clinic Study of Ageing reports that moderate physical activities, such as swimming, yoga, martial arts,

and moderate use of exercise equipment in mid or late life can lower the risk of mild cognitive impairment (Geda et al., 2010).

It is advantageous to begin participating in physical activities at a young age. A group of researchers from Kobe University (2021) reported that physical activity during youth (up to age 12) is linked to better cognitive performance later in life. The findings imply that exercise can boost the development of the brain's network, which is linked to the maintenance and promotion of cognitive function in later life. According to the Institute of Medicine (2015), one of the specific actions an individual should take to maintain and nurture their cognitive health is to engage in physical activity.

People of any age can adjust their behaviour to become more physically active to delay or slow down the age-related cognitive decline, and this does not always require following a formal exercise program. Going for a walk or jog, taking stairs instead of an elevator, or even cleaning the house are some of the simple physical activities beneficial to the body and brain (Downey et al., 2017).

One of the most accessible ways of exercise is walking, as it does not need special equipment nor requires a training program (Morris & Hardman, 1997), and it is convenient and cost-effective (Lee & Buchner, 2008). According to the Centre for Disease and Control Prevention, a fast-paced walk for no less than 10 min at a time can help keep physical and cognitive independence in old age by inhibiting different health problems.

Consistent and Good Quality of Sleep

Sleep not only improves our overall health but is also a preventive factor against cognitive decline. Teenagers and young adults are vulnerable to sleep deprivation due to several factors, such as hectic after-school and work schedules, television and computer gaming that delays bedtime, and light exposure from smartphones and computers that cause a lack of melatonin production resulting in sleep disorders (National Adolescent and Young Adult Health Information Centre 2014). For older adults, changes in sleeping patterns can be attributed to their age and other health conditions.

Research studies reported that people who always sleep less than the suggested seven to eight hours have lower scores on tests for mental function. This can be explained by the brain's inability to integrate learning and memories during sleep (Harvard Health, 2021). Observational studies also reported that poor sleep increases the risk for cognitive decline and Alzheimer's disease. Therefore, having a healthy sleep appears to have an important role in maintaining the brain's health as we age and in Alzheimer's disease prevention (Spira et al., 2014).

Mediterranean-Style Diet

A healthy diet is strongly recommended as it protects people from chronic non-communicable diseases such as heart disease, cancer, and diabetes. Current research studied the role of specific dietary components and patterns, suggesting that improving the diet of older people may help delay the onset or reduce the progression of age-related cognitive decline (Deary et al., 2009). Diet can protect people

against moderate cognitive impairment and other neurodegenerative disorders like Alzheimer's.

The Mediterranean-style diet promotes eating patterns that lead to better cardiovascular health and lower risk for different types of cancer. This diet also claims to lower the risk of developing mild cognitive impairment and reduce the progression of dementia in people who have the condition (Harvard Health, 2021).

According to the study, the Mediterranean diet's essential features, such as MUFA, grains, and wine, function as a protective factor against cognitive decline. The specific micronutrients of the Mediterranean diet, such as dietary antioxidants and supplements, can also work with other protective factors (Panza et al., 2007). Increased adherence to the Mediterranean diet has been associated with improved cognitive function, decreased cases of cognitive decline, and a lower risk of Alzheimer's disease in nine out of twelve studies (Lourida et al., 2013).

Less Alcohol Consumption

Excessive alcohol intake has been linked to the development of long-term chronic disorders such as high blood pressure, heart and liver disease, and weak immune systems, according to research (Centres for Disease Control and Prevention, 2021), as well as affecting the brain and cognition. This contrasts with previous research studies, which hypothesized light to moderate alcohol intake is related to better cognitive function and lower the risk of developing dementia (Antsey et al., 2009).

Experts do not recommend consuming alcohol to prevent cognitive decline because numerous research studies claim that alcohol consumption is associated with early decline in all cognitive domains (Sabia et al., 2014), especially when taken in large amounts. Heavy alcohol use, for example, can harm the brain, ranging from memory, executive function, and general cognition impairment to an increased risk of dementia (Devere, 2016).

Although some people cannot stop themselves from drinking alcohol, especially on special occasions, it should only be in light to moderate consumption. But, if it is possible, do not drink alcohol at all.

Social Interaction

Strong social connection with family, friends or other people is as significant as physical activity and a healthy diet. Research studies suggest that people with strong social connections are less likely to develop cognitive decline than those who tend to isolate themselves. Loneliness experienced by individuals with depression is associated with a greater risk for cognitive decline. Therefore, strong social engagements serve as a protective factor on memory and cognitive functioning.

Evidence reveals that stress is one of the risk factors for cognitive deterioration. Strong social networks, on the other hand, reduce stress levels through social interaction and care, lowering the risk of cognitive decline. Also, social interaction requires continuous mental processes that reinforce cognition, such as attention, memory, and verbal and nonverbal skills. Likewise, regular social interaction

strengthens brain neural networks that slow down the normal ageing decline process (Harvard Health, 2021).

Numerous studies have also shown that increased social engagement, in terms of the size of your social network and frequency of interaction, enhances cognitive health and decreases the risk of dementia. This implies that being with friends, as well as experiencing activities with other people, is beneficial to your cognitive health (Howieson, 2015).

Social Engagement and Cognitive Decline

Determining the modifiable lifestyle (e.g., social engagement) links to cognitive decline and vulnerability to dementia is a complex process as only a few populations based-longitudinal studies examine this interconnected process. However, a decrease in the risk of cognitive decline and dementia is associated with social engagement and cognitive lifestyle activities (Valenzuela et al., 2006; Marioni et al., 2011). Due to their changeable nature, these factors are extremely promising for public health (Middleton & Yaffe, 2009).

Marioni et al. (2015) studied the relationship between late-life measures of engagement in activities, quality of relationships, and longitudinal cognitive change and dementia onset over 20 years of follow-up. The recruited participants were from the Paquid group studied from 1988 until 2014. This study demonstrates the complex relationship between social-environment factors, cognitive decline, and dementia.

For instance, increased levels of engagement in social, physical, or intellectual pursuits are linked to increased cognitive ability, not

decline. Also, decreased cognitive decline is related to increased self-perception and feeling well understood. In this sample, levels of engagement and feeling understood are also linked to a reduced risk of dementia. Overall, increased participation in social, athletic, or intellectual interests may result in a lower incidence of dementia.

According to Whitehall II's study, frequent social interaction at age 60 with friends, but not with relatives, is associated with lower dementia risk in comparison to someone who rarely saw their friends. People in their 60s who regularly saw their friends every day had a 12% lower risk of developing dementia in later life. Sommerlad and colleagues asserted that several findings proposed that regular social contact can protect the brain because it can help in building the cognitive reserve or reduce stress, promoting more healthy behaviours.

Furthermore, Gill Livingston, a professor at University College London, said that:

"People who are socially engaged are exercising cognitive skills, such as memory and language, which may help them to develop cognitive reserve — while it may not stop their brains from changing, cognitive reserve could help people cope better with the effects of age and delay any symptoms of dementia."

In summary, the role of cognitive reserve is emphasized by Prof. Livingston, as well as the importance of engaging in social interaction because it serves as an exercise to increase cognitive skills. Furthermore, good mental health may begin with spending more time with friends and staying physically active, thus reducing the risk of developing dementia.

The Link between Brain and Gut

Experiencing “butterflies in your stomach” is a common feeling before or during a situation that makes us nervous. This is a normal reaction to a stressful event. According to Johns Hopkins Medicine (n.d.), this signal comes from the gut, our so-called second brain, buried within the walls of our digestive system, demonstrating the link between digestion, mood, thinking, and health. It is called as *enteric nervous system* (ENS), and it is made up of two thick layers of more than 100 million nerve cells lining the gastrointestinal tract from the oesophagus to the rectum. Although it is considered a little brain, it cannot perform the same function as the big brain in our skull, but it transmits signals back and forth with the big brain. The ENS oversees digestion, from ingesting to the discharge of enzymes that break down food through blood flow control, helping nutrient absorption and excretion.

According to Jay Pasricha, M.D., the director of Johns Hopkins Centre for Neurogastroenterology, the digestive-system activity may affect cognition, including thinking skills and memory, yet this area needs more research. The GI tract or gastrointestinal tract consists of all the major organs in the digestive system. Moreover, gastrointestinal functional disorder (GIFD) caused by ENS dysfunction may not only result in abnormal gastrointestinal function but also implies cognitive and mood disorders, particularly irritable bowel syndrome (Li et al., 2020).

People dealing with irritable bowel syndrome (IBS) and functional bowel problems (e.g., constipation, diarrhoea, bloating, pain, and upset stomach) are caused by emotional shifts triggered by the ENS.

However, Pasricha further stated that anxiety and depression play a role in these issues, which confirms the opinions of other experts and clinicians who have studied this mechanism for decades. It could, however, be the other way around. Research in evidence that the irritation in the gastrointestinal system may send signals to the central nervous system (CNS) that trigger mood changes is still in progress.

Researchers asserted that the gut might talk back when our brain sends messages all over the body. The research findings indicate that the bacteria balance in our gut microbiome can influence our emotions and how our brain processes information from our senses, including sight, hearing, flavour, and touch (Pathak, 2020). The trillions of microorganisms and their genetic information that lives in the intestinal tract are the gut microbiome – microorganisms that consist of bacteria involved in functions crucial to health and well-being. The gut microbiome is involved in metabolism, body weight, mood, and brain function and supports the immune system (Jacka, n.d.).

According to current research, altering the human gut microbiome may be a workable option for boosting cognitive processes and performance. Yet, the gut microbiota is sensitive to the changes and can be affected by a variety of factors such as stress (sleep quality, chemicals, extreme job-related stress), food (good vs unhealthy diet), and medications (Mackos et al., 2017). The microbiota profile can change or may have alterations in bacterial diversity due to external stressors. It is known as dysbiosis, which can potentially cause adverse health effects (Galley et al., 2014; Karl et al., 2017), such as increased intestinal permeability, inflammatory bowel diseases, coeliac, allergy, and, more recently, anxiety (Jiang et al., 2018) and depression (Chen et al., 2018).

The impact of gut bacteria on cognitive performance has still not been explored in detail because most current research focuses on alleviating stress, anxiety, mood, and depression by manipulating or enhancing the gut microbiome (Sarkar et al., 2018). Declines in cognitive performance are known to be a result of stressors and gut dysbiosis. As a result, stressful and demanding events may have a negative impact on the gut-microbiota-brain axis, impairing cognitive performance. Even though there were insufficient studies to reach a comprehensive conclusion, the current evidence indicates that gut microbiota is associated with cognitive performance and that modifying gut microbiota could be a promising avenue for improving cognition, yet additional research is needed (Tooley, 2020).

Considering Gut Health

The role of the gut, according to research, is evident in regulating mood, mitigating stress, mental health, metabolism, immune system, as well as cognitive functioning, although this domain needs further research. Thus, it is also important to consider gut health as it has a desirable and advantageous benefit to our overall health and well-being.

What do we Mean by having Good Gut Health in the First Place?

When there is a balance between the helpful and harmful bacteria and yeast in the digestive system, it indicates good gut health. Because the gut is also known as the “second brain”, if there is an imbalance, the brain will suffer as well (Helfgott, 2022). Therefore, what influences the gut often influences the brain and vice versa (Harvard Health,

2019). The immune system, serotonin, and hormones are also affected by gut imbalances.

The indicators of a poor or unhealthy gut include constipation, bloating, diarrhoea, brain fog, headaches, problems with concentration and memory, fatigue, chronic pain, sleep problems, and concerns with cravings or bad moods. Fortunately, some ways that can help balance the microbiome and restore gut health are by coping effectively with stress, practising mindfulness, a healthy diet, getting enough sleep, drinking lots of water, as well as exercising. Nevertheless, in some people, these ways require more supplemental approaches to improve their gut health, as not all people are alike. But there is no harm in considering the aforementioned ways to improve gut health (Helfgott, 2022).

Likewise, probiotics can also help to improve mood and cognitive functioning, as well as reduce stress and anxiety via the gut-brain axis. For instance, according to the study published by Frontiers in Ageing Neuroscience (2016), patients with Alzheimer's who drank milk made with four probiotic bacteria species for 13 weeks showed better results on tests that measured cognitive impairment compared to those who consumed regular milk. Also, based on the study reported in the Gastroenterology journal in 2013, compared to the control group, women who had yoghurt with a mix of probiotics twice a day for four weeks appeared calm when exposed to photos of terrified and angry faces. The yoghurt group also had decreased activity in the insula, the brain area that regulates internal body signals like those from the gut, according to MRIs.

It's too early to say what role probiotics play in the gut-brain axis because research is still ongoing. Yet, probiotics may help support not

only a healthy gut but also a healthy brain (Harvard Health, 2019). It would not cost much to consider gut health and protective factors against cognitive decline. Both serve the same objective of assisting everyone in dealing with cognitive changes and enhancing overall health.

Environmental Enrichment

Brain stimulation through physical and social surroundings is called environmental enrichment (EE). By providing motor, cognitive, sensory, and social stimulation, the environment is enriched, resulting in extensive alterations in the brain's neuroplasticity (McDonald et al., 2018). The living environment profoundly affects the brain's plasticity, particularly the hippocampus (part of the brain involved in learning and memory). Although this notion is mostly investigated and applied to animals, some human analysis has been conducted. Rodents raised in an enriched environment include the combination of running wheels for voluntary physical exercise, intricate non-living toys, nests, mazes, and a lot more – all of which encourage sensory stimulation and social enrichment. This environment improves learning and memorization abilities and lessens the anxiety of the animals (Stuchlik, 2017).

According to animal studies, environmental enrichment may aid in the treatment and recovery of brain-related issues, such as Alzheimer's disease and age-related alterations, as well as enhance cognitive reserve capacity. However, the absence of stimulation may impede cognitive growth. Studies on humans show that the lack of environmental stimulation interrupts and impairs cognitive development. Cognitive scientists are interested in the impacts of

environmental enrichment because daily experiences can increase or hinder cognitive plasticity and the ability to learn (Ball et a., 2019).

Enriched environments are a crucial experimental paradigm for understanding how the interplay of genes and environment alter the structure and function of the brain throughout an animal's lifetime. The regulation of adult neurogenesis (the production of new neurons) by environmental enrichment exemplifies this complex dynamic. Since each animal in an enriched environment will have distinct experiences, enrichment is not only an external source of rich stimuli but also offers an area for individual behaviour that shapes individual patterns of brain plasticity and function (Kempermann, 2019).

Environmental enrichment has been suggested as a treatment or approach for improving cognitive ability and well-being in rodents (Manosevitz, 1970) and among children in an educational context (Gruber, 1975). The nature of enrichment differs in animal studies (Nithianantharajah & Hannan, 2006), yet it usually involves access to larger, more stimulating environments with better chances for socialization and voluntary physical action (Van Praag et al., 2000). Environmental enrichment can also reduce stress and anxiety reactivity (Verman et al., 2012), enhance cognitive function, and improve learning and memory processes (Arai & Feigh, 2011).

From the notion of environmental enrichment, PISTA closely collaborates with clients to develop appropriate environmental enrichment training that can be effectively applied in daily activities. The benefits of training arise from being aware of the progressive changes to undesirable behaviour. PISTA also focuses on social interaction exercises to stimulate brain plasticity.

In the PISTA program, there are regular interventions and changes guided by PISTA coaches so that the benefits of brain stimulation will not fall into habituation. To put habituation simply, it is when a person gets used to a specific stimulus repeatedly presented in their environment. When habituation happens, it impedes the learning process. For instance, if the PISTA coach continuously uses the same methods every session, the client will tune out, lose their attention, and will get used to the repetitive methods.

Neurological Rehabilitation of Alzheimer's Disease

Animal research implies that environmental enrichment helps the recovery of certain neurological disorders and cognitive impairments. While most studies used animal subjects, primarily rats, researchers have noted that the disrupted parts of animal brains are most similar to human brains. Findings have confirmed that humans react similarly to enriched settings.

Researchers were able to enhance and substantially recover memory deficits in mice aged two to seven months with Alzheimer's disease-like symptoms using environmental enrichment when studying the effect of neurological rehabilitation for Alzheimer's disease. The performance of mice in object recognition tests and in the Morris Water Maze was significantly better under enriched environments compared to when they were in standard environments, implying that environmental enrichment enhances visual and learning memory for those with Alzheimer's disease (Berardi et al., 2007).

Before amyloid development (at three months of age), mice models of Alzheimer's disease were placed in an enriched environment and then

returned to their home cage for more than seven months. The mice demonstrated well-maintained spatial memory and reduced amyloid deposition at 13 months when they should have shown dramatic memory impairment and amyloid plaque load. The findings show the protective and long-term impacts of early life stimulating experiences on Alzheimer's disease pathology in mice and the tendency to represent the ability of an enriched environment to effectively enhance the cognitive reserve (Verret et al., 2013).

Neurological Rehabilitation of Autism

People with autism spectrum disorder (ASD) manifest cognitive strengths and weaknesses, such as problems with understanding others' behaviour based on their thoughts and feelings, difficulties in managing and controlling behaviour, and the inability to detect small parts or details of an object (Pellicano, 2010). Autism has a specific yet complex genetic basis (Freitag et al., 2010), and symptoms for some children show a link to gene mutation or chromosomal aberration, which imitated genetic variants generated in mouse models (Ey et al., 2007). Studies using an enriched environment demonstrated reversing or improving autism symptoms in animal models.

Nithianantharajah & Hannan (2006) asserted that decreased sensorimotor stimulation weakens neurobehavioral function. Consequently, increasing sensorimotor experiences can improve neurobiological function because the stimulation from the environment enhances dendritic branching (a biological process responsible for creating new synapses) and synaptic density (connections crucial for conveying brain functions), and neurogenesis (formation of new cells).

According to a study conducted in 2011, environmental enrichment improves the cognitive ability of children with autism who received olfactory and tactile stimulation combined with exercises that stimulated other paired sensory modalities. These children showed a clinical improvement of 42%. Children with autism who did not receive this form of stimulation, on the other hand, improved by only 7%. (Woo & Leon, 2011).

Another study demonstrated that children with autism classification based on the Autism Diagnostic Observation Schedule showed 21% improvement after six months of sensory enrichment therapy. While they continued on the autism spectrum, the criteria for classic autism were no longer met. The group that did not receive the enrichment therapy did not reach a similar level of improvement (Woo et al., 2015).

The Influence of Adversities on the Brain

Environmental enrichment can cause a positive effect on the brain by providing physical and social environment stimulation, including motor, cognitive, sensory, and social stimulation. What would happen, though, if an individual did not grow up with sufficient environmental stimulation and instead endured adversity?

Although there is still much to understand about the brain's complexity, the role of experience in brain growth cannot be overstated. Yet, studies show that genes (nature) alone do not define the individual because they interact with nature (experience) which helps define and build potential. The impact of experience is extremely high during early life, with most human development

occurring during the first six years of life. The developing systems, such as cognitive, physical, emotional, and psychological aspects, are especially susceptible to environmental influence. Even the functional property of the underdeveloped brain is shaped by early experiences.

Because the brain's potential to adapt declines with age, investing in the environmental inputs that help it develop properly (e.g., nutrition, health, fostering interaction, and a less stressful environment) during the early years of a child should be considered.

The brain's wirings are disrupted when the brain does not obtain the nutrients it requires during the vital first six years of life. Deprivation and adversities from environments including malnutrition, neglect, and toxic and stressful environments during the early years interrupt the normal biology and developmental paths, physical and mental health, and learning and behaviour in later years. The consequence of adversity in crucial development areas in life is worse during the spurt of development and sensitive periods where the plasticity of the brain is high. In later life, reversing the effects of environmental adversities and deprivation would be very difficult (Bendini, 2017).

To further understand this notion, Professor Charles Nelson from Harvard University studied the consequence of adversities on the brain through research and discussed the neurobiological development of children.

Nelson and colleagues (2010) conducted Bucharest Early Intervention Project, wherein the foster care infants in a bleak Romanian orphanage were followed until adolescence. The findings showed that early psychosocial and biological deprivation linked to institutionalization (as the participants grew in the orphanage) might result in profound

deficits in IQ, socio-emotional behaviours such as attachment, brain activity and its structure, changes in reward sensitivity and processing, as well as a higher risk of psychiatric disorders and impairment.

Those who spent six to 31 months in high-quality foster care, on the other hand, showed much greater development, though it did not include the executive functioning responsible for memory and cognitive monitoring. Surprisingly, noninstitutionalized children before age two indicated a critical stage; for those who were placed in foster care after the age of two, their brain function was less likely to improve due to severe psychosocial deprivation.

Nelson shared some findings from brain imaging studies that utilize neuroimaging tools to examine the cognitive development of children between six and 36 months old exposed to various types and levels of early diversities in Dhaka, Bangladesh. According to the results, the reduced cognitive consequence is evident for those children growing up in the most adverse environment. The neuroimaging result illustrates the impact of malnutrition in the brain that occurs as early as two to three months of age. Based on findings, stunted infants have less overall brain tissue, grey matter, white matter, and cerebrospinal fluid. Factors like maternal education, illness, and stunted growth attributed to long-term malnutrition contribute to these poor outcomes. Adversity and notable stunting affect children's brain anatomy, metabolism, and physiology.

From these studies, we can learn that environmental deprivation may lead to extreme consequences. Also, the type of adversity affecting the children in these studies is not unusual because worldwide, one out of four children is stunted. The incidence of neglect is high worldwide, not only in the case of the Romanian orphanage. Apart from severe

malnutrition and neglect, several aspects of poverty may have an impact on the brain. For instance, disease, toxic environments, inadequate stimulation, violence, and stress from these events.

The new neuroscience discoveries provided insights into the profound influence of adversity on children's biological development. Together with behavioural and anthropometric evidence, the findings can assist the professionals in this field in better identifying the most appropriate interventions to help poor children reach their full potential. It should be a priority to ensure that children's basic needs are met and that they receive better care to avoid serious consequences when they reach adulthood.

The Role of Gamma-Aminobutyric Acid (GABA) in our Cognitive Functioning

Gamma-Aminobutyric Acid (GABA) is one of the neurotransmitters in our brain that plays a significant role in memory (Millar, 2019). It also works as a message blocker that stops specific nerve signals in the brain to diminish fear, anxiety, and stress (Pugle, 2022). For example, the GABA conveys that the knife's edge is sharp and dangerous. The GABA will then block the neuron carrying the information, preventing the action from being carried out. If the GABA receptor does not provide a signal, the individual will act on the neuron that says "touch the knife's edge" since the brain did not receive a warning that the edge is sharp.

The control of cognition, memory, learning, neural growth, and adult neurogenesis are some of the physiological and biochemical processes in which GABA is involved (Govindpani et al., 2017, as cited in Murari et al., 2020). GABA can also work as a memory modulator as it influences the neurobiological process of establishing new information, working memory, memory extinction, and recall (Michels et al., 2012). From this notion, lower GABA levels in the prefrontal cortex, part of the brain in charge of cognitive control functions, have been linked to cognitive impairments and increased risk of dementia among older people (Kim et al., 2019).

Several findings suggest that abnormal glutamatergic and GABAergic neurotransmission may result in cognitive deficits. For instance, impaired working memory is associated with reduced cortical GABA due to insufficient gamma-band oscillations, a brain activity that plays a role in attention and memory operations (Bojesen et al., 2021). The

reduction of GABA levels may result in insufficient gamma-band oscillations and eventually cause impairment in cognition. Therefore, reduced GABA levels in a specific part of the brain may affect cognitive functioning.

According to the University of Florida's Centre for Cognitive Ageing and the McKnight Brain Institute (2017), as we age, GABA concentrations in the frontal and posterior cortices, parts of the brain essential for superior cognitive functioning, continue to decline mainly throughout the healthy adulthood stage. The study also suggests that reduced GABA levels in the frontal lobe are associated with poor test scores and may help predict neurodegenerative diseases. However, it is unknown to the researchers what causes the relationship between them because the cognitive assessment cannot identify the specific cognitive domains (e.g., attention or memory) that may be affected by decreasing GABA concentrations.

Ways to Increase Gamma-Aminobutyric Acid (GABA)

Previous research has demonstrated the importance of GABA in learning, brain plasticity, and cognition. Nonetheless, there are a few strategies that can be utilized to boost GABA activity in the brain. Increased GABA levels will not only improve learning and memory but also reduce anxiousness and mental and physical stress, decrease muscle tension, and induce calmness and sleep. In this section, the natural and synthetic ways to increase GABA will be discussed. Just to be clear, this book does not recommend or promote any GABA brand supplement or commercial GABA-related items.

Consuming Foods that Contain GABA

GABA is an amino acid generally abundant in the human diet produced by our brains. One way to increase GABA naturally is by eating foods that contain and support its production. Balanced glutamate-GABA is maintained by eating foods that are low in highly processed carbohydrates, high in healthy fats and protein, and non-starchy vegetables. Foods that contribute to inflammation, such as pasta, bread, and refined sugar, may contribute to GABA imbalances (Hand, 2020). GABA is created in the brain by glutamate; therefore, foods high in glutamate, such as fish, eggs, tomatoes, soybeans, walnuts, and broccoli, can be ingested.

Research studies show that a human gut microbiota can modulate the production of GABA, and eating fermented foods rich in probiotics (e.g., kimchi, miso, yoghurt, and sauerkraut) can also aid in increasing GABA levels (Duranti et al., 2020). Likewise, our brain synthesizes other co-factors in producing GABA aside from glutamate, such as vitamin B6. This vitamin is crucial in keeping the nervous and immune system healthy as well as in the normal development of our brain. Increased intake of vitamin B6 combined with a multivitamin or B-complex supplement could boost the GABA in the brain. Foods with high levels of B6 are spinach, banana, garlic, broccoli, and brussels sprouts. Avoiding alcohol use can also contribute to maintaining GABA levels, as chronic alcohol use may lead to vitamin B6 deficiency (Camp, 2021).

It is also important to consider the therapeutic benefits of various herbs because they act as GABA activators. Sleep is one of the most important physiological processes that maintain physical and

emotional health. Getting enough sleep is critical to improving cognitive abilities like attention, emotional response, learning, and memory. The neurotransmitter GABA oversees sleep regulation, and herbs can assist in the natural production of GABA by progressively activating them (Bruni et al., 2021).

Herbs like valerian are known to provide relaxing properties, reduce stress, and improve sleep. The active component in valerian that positively regulates GABA through various GABA receptor subunits is called valerenic acid. The valerian plant is ineffective at increasing GABA receptors without valerenic acid. Lemon balm (Melissa Officinalis) is also well-known for its soothing properties and ability to improve sleep quality.

The most active component that increases GABA levels by indirectly blocking the 4-aminobutyrate transaminase enzyme and converting GABA to L-glutamate is rosmarinic acid. Lemon balm is well tolerated, with no severe side effects, tolerance, or dependence effects. However, caution is advised (Yazdi, 2021). Herbs are also found in the form of tablets, capsules, powders, candies, beverages, and energy bars as a component in GABA supplements.

Food intake is part of our everyday life, yet we rarely consider the health advantages of the foods we consume. We should not take food for granted; instead, we should make the most of it.

Exercise

Exercise does not just protect us against cognitive decline, but it is also one of the ways to increase the GABA levels in our brains. Exercise or physical activity is not expensive, but it does require us to

be willing and make an investment in time to do physical activities. Having a regular exercise routine can help in boosting the GABA levels over time more than occasional exercise can. It has been proven through research studies that regular physical activity enhances GABA synthesis, increases calmness, improves stress coping, and reduces anxiety (Hill et al., 2008).

Physical activities can also trigger the release of brain chemicals responsible for the feelings of positivity and improved mental health, known as endorphins. According to the study conducted at the University of California - Davis Health System (2016), there was an increase in GABA among participants who exercised but not among those who did not. The researchers measured the GABA levels in two different parts of the brain before and after three sessions of intense physical activity lasting between eight and 20 minutes. There was a substantial increase in the visual and anterior cingulate cortex among people who participated in the exercise sessions compared to those who did not. The results suggest an association between the levels of glutamate or GABA in the brain and how much people exercise.

Meditation and Yoga

Meditation is the umbrella term for various ways to attain a relaxed mental state. This practice includes guided meditation, yoga, tai chi, and transcendental meditation, which all share the same purpose. Meditation is a set of practices that helps in maintaining attention, awareness of your thoughts and sensations, and keeping the mind focused. Meditation helps to focus and eliminate the wired and overwhelming thoughts due to stress. Meditation can also enhance the

GABA levels due to the decrease in the GABA-inhibiting stress hormone named cortisol.

Several studies have confirmed the GABA increase, stress, and anxiety-reducing benefits of meditation and meditative movement practices, such as yoga and tai chi. Meditation practices can improve attention and emotional regulation as it increases prefrontal cortex (PFC) activation, which leads to the stimulation of areas responsible for the production and delivery of GABA. Research suggests that meditation processes are related to the GABA mechanism for improving cognitive functioning and emotional regulation (Guglietti et al., 2013).

Likewise, meditation is associated with higher scores on selective attention, cognitive efficiency, and IQ tests in people who meditate. Meditation can also help a person focus on a tedious activity (Lazar, 2011).

Yoga can also be considered an inexpensive method with no side effects for effectively alleviating the symptoms of conditions with low GABA levels, such as depression, anxiety, and problems in memory caused by stress (Boston University, 2007). Meditation and yoga activities such as breathing exercises and posture-based yoga enhance overall brain functioning. Because performing these activities increases the proportion of grey matter and high activation in the amygdala and frontal cortex of the brain.

Intake of Supplements and Medications to increase GABA

Taking supplements can also help increase GABA levels. While some people can attain the recommended vitamins and minerals through

healthy eating, some need extra help to boost the nutrients in their bodies, which supplements can do. However, taking supplements differs from consuming foods that naturally contain GABA, as their production process is very different. GABA supplements are artificial and mimic the mechanism of natural nutrients or GABA in our bodies which is not the case in natural GABA production in whole foods. Despite the artificial side effects, research studies provide evidence to support the benefits of consuming GABA supplements. However, remember that relying on supplements is not enough to supply the needs of our body, and they should be taken in moderation.

According to research conducted on 30 healthy volunteers, GABA supplementation can promote enhanced thinking. The findings imply that daily consumption of 100 milligrams (mg) of GABA supplement enhances the person's ability to prioritize and plan actions (Steenbergen et al., 2015). In several studies, GABA has also been reported to impact brain protein production, increase several brain functions, such as memory and learning capacity, lower blood pressure and reduce stress caused by mental tasks (Yoto et al., 2012).

Several people take GABA supplements to reduce stress levels because GABA can induce calmness and relaxation. Too much stress may result in problems with thinking, judgment, decision-making, difficulties in attention, and the risk of memory loss. And the capacity to manage stress, anxiety and related mental disease is enhanced by having a working GABA system and other hereditary features. Likewise, an active GABA system contributes to the development of neurons by elevating brain-derived neurotrophic factors (BDNF). This protein stimulates the improvement and survival of neurons in the brain. Higher BDNF levels benefit learning, memory, cognitive

performance, and general brain health. Keeping BDNF levels can also help prevent and slow down the decline in age-related cognitive decline (Yazdi, 2021).

Ninety-seven milligrams of L-theanine combined with 40 milligrams of caffeine can also help to focus better during a demanding cognitive task (Giesbrecht et al., 2010). Drinking teas and supplements containing L-theanine have no significant adverse effects, but unlike medicines, the Food and Drug Administration (FDA) does not regulate supplements. Meaning FDA is not authorized to review the safety and efficacy of the supplements before their release on the market. The manufacturers are responsible for ensuring the safety of GABA supplements, and consumers should exercise caution before purchasing them.

On the other hand, some medications can help increase the supply of GABA or activate the same neurotransmitters in the brain. However, this requires a prescription from a doctor as it is commonly used to treat depression, anxiety, epilepsy, and high blood pressure. Although supplements and medication are synthetic ways to boost the GABA levels in our brain, both are helpful options.

Maintaining Brain Health

The concept of cognitive reserve, covered in the book's first part, is crucial in understanding the health of our brains as we age. To summarize, cognitive reserve is the protective feature of the brain against age-related brain changes, diseases, or damage. For instance, having a high capacity of cognitive reserve decreases the risk for dementia or slows the age-related cognitive decline. Cognitive reserve makes individuals unique concerning the onset and manifestation of decline in cognitive functioning. Building cognitive reserve helps the brain develop resilience and coping mechanisms to fight the effects of ageing.

What is Brain Health?

Up until now, there was no generally accepted definition for brain health. However, according to the World Health Organization, brain health is a new and growing concept that covers the brain's neural development, plasticity, functioning, and recovery throughout the lifespan. Maintaining good brain health may result in a state wherein a person can recognize their strengths and enhance their cognitive, emotional, psychological, and behavioural functioning to deal with adversities in life (WHO, n.d.).

Moreover, the US Centres for Diseases Control and Prevention (2009) refers to brain health as the ability to perform all the mental processes of cognition, including learning, making judgments, utilizing language, and remembering. From these two perspectives, it is safe to say that both are concerned with the brain's health and capability to perform all cognitive tasks without severe disruptions. Brain health is also concerned with other aspects of functioning, such as emotional,

psychological, and behavioural, explaining the significance of addressing brain health holistically.

Nonetheless, poor brain health may result in decreased cognitive and physical function, significantly affecting daily functioning once symptoms have been manifested or noticed. Maintaining our brains' health will result in prolonged life and lessen the risk of cognitive and physical problems associated with poor brain health. Poor brain health affects the body and quality of life (World Federation of Neurology, 2021). Thus, strengthening cognitive reserve is crucial in maintaining our brain health.

Some people may have better cognitive reserves because of the differences in their genetic makeup, life experiences, and other environmental factors. Regardless of the differences, each person can improve their cognitive reserve's capacity because it is not constant and continues to progress throughout their lifespan. Although it is better to build and enhance the cognitive reserve during earlier years, older adults are never too late. Because late-stage interventions can potentially increase cognitive reserve and, as a result, reduce the prevalence of Alzheimer's disease and other age-related issues (Tucker & Stern, 2011).

How can we Strengthen or Increase our Cognitive Reserve?

There is no step-by-step process on how to increase our cognitive reserve. But some factors contribute to the development of cognitive reserve that we should be aware of. From these factors, we can find ways to improve mental reserves and understand how it develops.

Dr Yaakov Stern proposed the idea of cognitive reserve in the mid-1900s, and according to him, life experiences and an enriched environment makes the most significant contribution to improving cognitive reserve. Cognitive reserve results from various types of mentally stimulating activities such as physical activity, new and complex learning, diet, and social connections, implying a holistic approach (Sullivan, 2017). The cumulative impact of intelligence, education, experience, and occupation significantly impacts how a damaged brain compensates and maintains its functioning (Ellison, 2021). The contributing factors for the development of cognitive reserve tell us that we should not rely only on one method when maintaining our brain health; combining several ways is better than one.

An enriched environment includes cognitively engaging activities that encourage the growth of larger brain volumes. Exercise, education, and social connections are some protective factors of cognitive decline discussed in the preceding part of this book. Similarly, these factors promote the increase of molecules in charge of enhancing the brain's ability to change progressively and form and strengthen the dendritic connection throughout the lifespan. This is called positive neuroplasticity.

There is also something called negative neuroplasticity. Negative neuroplasticity involves activities that should be avoided because they "negatively" affect the brain's health. Poor health, poor quality of sleep, poor diet, substance use, depression and anxiety are the factors that increase the chance of negative neuroplasticity as these decrease the cognitive reserve and connections of dendrites (Vance et al., 2010). Factors such as substance use, depression, and anxiety are

common mental health concerns among younger and adult age groups, and the importance of addressing these concerns is high. It is essential to promote positive neuroplasticity and prevent negative neuroplasticity throughout our lifespan to achieve optimal cognitive health and develop healthy cognitive ageing.

Also, the damage or loss of synapses is associated with cognitive decline in Alzheimer's because synaptic function plays a role in cognitive performance. The increase of molecules from physical and cognitive exercises facilitates the development of synapse, which is the structure that enables the nerve cell to send a chemical signal to another nerve cell. Therefore, an enriched environment promotes the formation of new cells and the creation of new connections in the brain, as well as different systems for thinking, problem-solving, and memory, all of which are necessary for cognitive reserve.

One of the factors contributing to positive neuroplasticity is cognitive stimulation activities. These tasks engage a person's mind to think and process information and may include mind games or puzzles, mental challenges, and educational and intellectual inquiries. Enhancing cognitive reserve does not necessarily mean that someone needs to enrol in an educational institution because of the learnings and knowledge that the institution can provide. Yes, it helps a lot. However, daily life challenges or events that require information processing and critical thinking can also greatly help enhance the capacity of the cognitive reserve and lessen the risk for early cognitive decline.

Having enriched social connections, whether between other people or animals or even online, is a significant need among humans, which can also improve brain health and memory. Although only a few

studies demonstrate the impact of social engagement on brain health due to possible ethical issues, the Experience Corps and Synapse Project will help us understand this notion.

The Experience Corps was conducted by researchers from the John Hopkins Centre for Ageing and Health from July 2006 to December 2011. (COAH). The goal was to discover whether the Experience Corps program was beneficial in preventing or delaying physical disability among seniors by understanding the impacts of volunteering acts on physical, social, and cognitive well-being. The study included 702 adults aged 60 years or older who were evaluated over two years. Experience Corps is a community-based health promotion that places seniors in a social engagement program by performing meaningful roles in public elementary schools. They spend time sharing their experience and wisdom that may help support the children academically and emotionally, providing social interaction in both age groups.

The findings suggested that older persons who participated in the intervention had higher levels of generative desire and a higher percentage of generative achievement than those who did not. During this stage of human development, older adults show more interest in contributing to the world through involvement in the community or at home. Exhibiting high levels of generativity meant that the older adults possessed a greater desire and need to care for and guide the elementary students in their academic endeavours and emotional concerns that would contribute to their future selves (Erikson, 1950).

Also, the more hours of engagement during the EC intervention, the more it benefited the children and seniors. The follow-up study revealed that seniors who participated in the Experience Corp

demonstrated a significant increase in hippocampal volume, implying a biological link between brain health and the Experience Corps intervention program that promoted social interaction. Hippocampal volume shrinks during late adulthood, leading to cognitive problems and increased risk of dementia; however, the follow-up result indicated that increased hippocampal volume signified an improved cognitive function and reserve. The outcome of EC sheds light on older adults' cognitive functioning, physical mobility, strength, and balance.

The second study, the Synapse Project, had a similar goal: to see if participation in cognitively challenging social activities would help older adults preserve their cognitive health. The Synapse Project aimed to hit "two birds with one stone" as it provided evidence on the implication of social engagement and mentally stimulating activities to brain health. The result showed that older adults who participated in cognitively stimulating activities, such as studying digital photography or quilting, for 15 hours a week for three months demonstrated improved episodic memory, supporting the benefits of sustained engagement in the brain health hypothesis. Therefore, sustained engagement and cognitive activities helped the older adults improve their capability to remember past events and perform tasks that need recall of relevant details.

But how can "sustained engagement" aid brain health?

According to research, mostly carried out on animals, neurogenesis and synaptic plasticity are more likely to occur under highly cognitive demanding situations. New neurons are formed in the brain during sustained engagement activities, benefitting brain health. Also, the prolonged learning periods would provide more protection for these

new neurons, resulting in enhanced cognition and cognitive reserve (Mintzer et al., 2019).

The abovementioned studies explained how social engagement benefits brain health and cognitive reserve. Experience Corps and Synapse Project also delineate why mental stimulation and social engagement are considered protective factors of cognitive decline due to increased cognitive reserve that leads to improved brain health.

Education, mental stimulation, and being physically active at an early age prepares our brain health in later years. During adulthood, continuous learning, social interactions, and engagement in challenging leisure and learning activities can strengthen our cognitive reserve and resist cognitive decline. However, in maintaining brain health, it is also necessary to consider the protective factors (e.g., good diet, good sleep quality, avoiding alcohol use, etc.) and risk factors (e.g., age, genetics, psychological stress, etc.) of cognitive decline. Although we cannot do something about the passage of time, our age and genetic factors, we have control over our lifestyle and how we use our brains.

Relevance of Situational Awareness in Cognitive Functioning and Daily life

Situational awareness is crucial in our daily lives as it enables us to be aware of what is happening in our surroundings and how the events may affect our present and future situations. Situational awareness allows us to recognize potential danger in our surroundings and compare that to what occurred in the past, what is occurring now, and what may occur in the future. Inadequate or poor situational awareness

is one of the major factors in accidents caused by human error (Hartel et al., 1991). Some individuals may suffer from a lack of situational awareness, especially when performing repetitive duties, exposure to stressful and unforeseen situations, fatigue, distractions, excessive workload, and poorly presented information. Poor decision-making, risk-taking, slower detection of problems and other dangerous behaviours may occur when situational awareness is lost. A person who experienced the loss of situational awareness, even briefly, needs extra time to reorient themselves in the present situation (Human Factors, 2022).

What enables us to be aware and understand the things going on in our surroundings can be attributed to our knowledge, experience, and education which implies individual differences in situational awareness. Situational awareness has been utilized in military and sports psychology to measure perceptual levels, influence decision-making abilities, and identify how behaviours of interest might be improved. Also, situational awareness may be an important tool for people of all ages experiencing an age-related decline in cognition.

Situational awareness has three levels, according to Dr Mica Endsley (1995):

Level 1: Perception

When forming an accurate picture of the situation, the ability to perceive cues or essential information is necessary. People determine the clues by looking at them (Caserta & Abrams, 2007). Level 1 focuses on seeing the important information, implying that a person needs access to and recognizes relevant information (Nini, 2020).

For instance, the snake island in Brazil is perceived as dangerous because it is the natural habitat of the endangered venomous snake, *Bothrops Insularis*. Once the person becomes aware of this information, the following step is recognition. The failure to perceive the threat may result in death.

Level 2: Comprehension

Perceiving the information requires understanding. Comprehension includes integrating, interpreting, storing, and retaining information. This requires the correct knowledge about how to deal with the perceived information. Performing in dynamic and constantly changing situations demands rapid integration of multiple information simultaneously, such as interpreting essential and irrelevant information (Caserta & Abrams, 2007).

From the example above, understanding how dangerous and venomous the *Bothrops Insularis* is would help increase awareness about snake island's dangers.

Level 3: Projection

The highest level of understanding is projection, consisting of the tendency to predict future circumstances and dynamics by utilizing the perceived and comprehended past and current information or knowledge (Caserta & Abrams, 2007). For instance, the inability to perceive and understand the situation on snake island would lead to a failed prediction about the possible circumstances. Existing knowledge on snake islands and newly acquired knowledge must be combined to estimate the degree of threat.

The cognitive components, such as the pattern of recognition, deliberate analysis, mental stimulation, and metacognitive process at each level, are utilized to form situational awareness (Endlsey, 2000). Age-related declines in each of the three situation awareness levels may occur due to these cognitive components.

What is the Relevance of Situational Awareness in our Cognitive Functioning?

Because age-related declines in cognition have a negative impact on older adults' ability to perform daily activities that younger and middle-aged people can perform quickly, situational awareness serves as a cognitive strategy to modify cognitive decline and improve performance in dynamic environments and physical activities. Situational awareness may also be relevant to cognitive ageing because the perception and understanding of the environment become increasingly crucial for daily functioning and physical activity, particularly among older adults.

For example, a lack of awareness regarding memory lapses can impede job performance or day-to-day tasks. Poor situational awareness may lead to accidents when driving as drivers may not anticipate the actions of other drivers. Facilitating situational awareness in older people may lessen the impact of age-related cognitive impairments as it will allow them to engage efficiently in a continuously changing environment (Caserta & Abrams, 2007).

It is difficult for older adults to deal with a dynamic environment because it demands frequent updating of conceptual representation – this task is made more complicated due to age-related declines in cognitive functioning.

For example, in a busy metropolitan city, numerous aspects of the situation are constantly changing, such as the number of people, traffic, weather condition, and noise from the crowd. The conceptual representation of the city is not the same depending on the place and time of the day (Korteling, 1993; Tun & Wingfield, 1997). Increased situational awareness may assist the construction of proper conceptual representations, reducing older adults' proneness to falling, injury, or getting hit by a car when crossing a street (Gales & Menard, 1995; Tinetti et al., 1995).

In older adults, it is unattainable to achieve the same amount of response speed and accuracy in performance outcomes compared to the younger age group (Baltes & Baltes, 1990). However, they may gain the same amount as younger adults through learning and practice. Older adults' previous knowledge can compensate for decreased cognitive reserve, enhancing situational awareness, particularly level three, by utilising pre-existing knowledge. Researchers examining the effects of cognitive training on the elderly recently determined that interventions significantly increase cognitive abilities such as processing speed, logic, and memory (Ball et al., 2002; Roenker et al., 2003).

When analysing each of the three levels of situational awareness, Level 1 could be easily mastered by using numerous approaches—picking up on a small, set of cues or information and delivering essential information about the possible outcome in any situation, regardless of how simple or complex the task is.

For example, information about which burners are still hot is made available after using the kitchen stove. The feature is simple yet relevant because, in situational awareness, there is a need to produce

quick and accurate decisions while managing the completion of a meal. The hot indicator helps make the appropriate decision not to touch it, preventing burns in older and younger people. Level 1 training may offer the most benefits for older adults' cognition as the focus is on the attentional aspects of situation awareness and age-related differences in working memory. Working memory conducts cognitive functions more efficiently when only relevant information is processed (Caserta & Abrams, 2007).

The benefits of Level 1 situational awareness training must be extended to Level 2 to comprehend the cues. Learning how to perceive the signals is not sufficient. Understanding them would provide more efficient situation awareness. Older adults must learn how to examine their surroundings efficiently to improve their attention, processing, and working memory, facilitated by Level 2 situational awareness training. Because when relevant cues are perceived, precise mental models are created, limiting the amount of threat that may be present in everyday activities.

On the other hand, Level 3 situational awareness may not be acquired through training, as it is built on prior knowledge and defines expertise in dynamic settings. Level 3 only develops via years of focused practice and experience. Yet, Levels 1 and 2 situational awareness training will convert situational processes from a conscious to an unconscious, automatic state, allowing Level 3 to take over. The attainment and maintenance of Level 3 situational awareness could be the most critical factor in reducing age-related outcomes on cognition as it relies on fewer resources and activates processes sooner (Caserta & Abrams, 2007).

Situational awareness benefits people of all ages and is a skill that can be developed to enhance the ability to spot potential risks and be more present and observant of our surroundings. Consider today's children or teenagers who simultaneously talk with their pals and use their smartphones. They are distracted. These behaviours are prone to dangerous situations as they are not aware of what is going on in their environment. Based on research, offenders took advantage of these behaviours when selecting their victims (Salama, 2020).

In younger and older adults experiencing memory lapses or symptoms of cognitive decline, situational awareness would enable them to receive a proper diagnosis and treatment, education, and psychosocial support.

Positivity Effect in Older Adults

Several research findings proved the relevance and benefits of physical activity and a healthy lifestyle, yet experts say that older adults are unaware of their benefits (Schutzer & Graves, 2004). Also, little research about interventions that focus on lifestyle modification and developmental changes in motivation is available in the literature despite the growing attention regarding tailored programs that target specific goals. In other words, most physical and lifestyle interventions focus on "why" a person wants to partake in an intervention rather than "what" motivates them. Motivation is essential to consider in interventions because, according to numerous findings grounded in socioemotional selectivity, there are reliable changes in motivation across adulthood, such as the shift from goal-related orientation to emotional meaning and savouring (Carstensen, 2006).

Socioemotional selectivity theory's (SST) basic assumption is that people prioritize different goals as they perceive future time, or time horizon, differently. The notion entails a shift in the goals mechanism. Perceiving time horizons as long and open-ended, familiar in youth and young adulthood, involves more motivation to engage in knowledge-related goals such as acquiring new experiences and building social networks that would be useful in the long run. Contrarily, a shorter and limited perception of time horizon, which typically happens as we age, may result in prioritizing emotionally meaningful pursuits like treasuring the present moment and having profound close relationships rather than pursuing new ones (Carstensen et al., 1999, as cited in Jiang & Fung, 2019).

Compared to the younger age group, older adults mentally represent social networks with emotional dimensions (Lang & Carstensen, 2002) and genuinely seek emotionally meaningful social relationships in choosing partners (Fung & Carstensen, 2006). In line with the socioemotional selectivity theory, age differences in goals change accordingly when time horizons are experimentally expanded (Fung et al., 1999). From this notion, findings from several studies utilizing distinct methodologies converge.

Goals influence cognitive resources, and changes in goals as people age have been related to cognitive processing in older persons. For instance, older adults seem to prefer, remember, and pay attention to positive information better than negative information compared to the younger age group (Reed & Carstensen, 2012). Older people tend to have an increased preference for positive information and avoid negative information in the positivity effect. Older adults remember positive images comparatively better than negative images when

exposed to positive, negative, and neutral pictures (Charles et al., 2003). This was due to the reduced amygdala activation in the brain among older adults when looking at negative images. In response to positive images, activation is equivalent to younger adults (Samanez-Larkin & Carstensen, 2011).

Moreover, positivity has been relevant in the field of health as well. To give an idea, compared to younger adults, older adults would choose health care brochures with positively framed information over negatively framed ones. Also, they can remember the information better if presented with positive information (Shamaskin et al., 2010). Unlike the younger age group, older people appear to consider positive aspects more than negative ones when deciding on healthcare choices, such as choosing healthcare plans and physicians (Löckenhoff & Carstensen, 2007).

Since cognitive resources are needed to relay information processing to goal-related stimuli and away from less significant stimuli, the positivity effect will be most apparent among individuals with better cognitive control. Nevertheless, if negative material is challenging to comprehend and positive information is preferred, people with low cognitive control might exhibit the highest preference for positive material (Reed & Carstensen, 2011).

Regarding the potential benefits of walking, research shows that educating older adults is more effective than warning them about the risks of physical inactivity. For instance, in making promotional health videos, it is better to describe information that is more focused on delivering the positive than scaring them about the potential negative outcome of physical inactivity. Therefore, older people who are informed about the potential positive results of walking can remember

and consider them more than the information presented negatively (Notthoff & Carstensen, 2014).

Physical activity is one of the elements that can help prevent cognitive decline, yet many factors that need to be considered exist. Corresponding to the findings, if the notion of positive effects is appropriately implemented, it can deliver a desirable outcome that protects people of all ages from cognitive decline.

The Positivity Effect in Cognitive Processing

The basic assumption of positivity effects, which describes that a person pays attention to and remembers positive information more than negative, raises a question. Does paying more attention to positive information than negative information results in poor decisions?

Current research on risky and non-risky decision-making asserts that the answer is no. Based on the study by Mikels and Reed (2009), older adults are no more likely than younger adults to make poor decisions. For instance, when making riskier decisions about losses against benefits, choosing an option with a lower expected value is apparent among older adults. One study, which included all age groups, found no evidence of maturity level interactions in risky judgments among all age groups objectively displaying superior decisions in gain versus loss trials. (Weller et al., 2011).

Some findings also imply that the positivity effect does not weaken and may even benefit the quality of subjective choices. In particular, older persons who wrote a pros and disadvantages list as a reference in making selections before purchasing actual consumer products such

as pens, mugs, flashlights, and whiteboards expressed better satisfaction with their purchases than the younger age group (Kim et al., 2008).

Contrarily, when participants did not make the pro-con lists before choosing a product, satisfaction did not differ in all age groups. Therefore, the prior evidence shows that attention to positive versus negative information does not impair adults' ability to make decisions and, in some instances, may result in better outcomes.

Considering that efficient interpersonal problem solving includes processing and acting on negative and positive information, some might anticipate that avoiding negative information is counterproductive to older adults. However, previous research pointed out the relationship between advanced age and inconsistent use of avoidant versus instrumental strategies (Blanchard-Fields et al., 2007), implying that problem-solving skills improve as people age. Compared to younger adults, older adults' overall preference for avoidant techniques means that they use a more comprehensive range of problem-solving ways more flexibly across situations (Blanchard-Fields, 2007).

The current theoretically based premise that positivity implies controlled cognition and persistent goal, driven by situational elements adaptable for daily functioning and well-being, makes the numerous scientific outcomes credible. Nevertheless, preferential processing of any stimulus, for instance, positive and negative, poses some setbacks due to ambiguous results. Yet the existing evidence does not show any red flags in decision-making and problem-solving (Reed & Carstensen, 2012).

How Brain Handles the Negative Statements

We are constantly confronted with positive and negative statements in our daily lives. To determine whether the information is true or false, we integrate the new with our existing knowledge and evaluate it. According to research, a sentence containing negative words, such as "not" in the middle of a sentence, is difficult for the brain to understand. To understand why positive statements are easier to comprehend and remember than negative statements, let us consider how the brain reacts to negative comments.

The researchers from Tufts University, Psychologists Mante S. Nieuwland and Gina R. Kuperberg examined how various types of negative statements are processed in the brain. The participants read statements containing critical phrases that determined whether it was true or false, allowing the researchers to assess the event-related potential responses (ERPs). ERPS recorded the electrical brain responses to what participants saw or heard through electrodes connected to their scalps. The ERP studies provided data on how language is primarily processed in the brain before any visible behaviour appears. Previous studies demonstrated that when reading favourable statements, enormous ERPs occur at the words that make the statement false.

The statements participants read were either pragmatically licensed (informative and sound natural) or pragmatically unlicensed (unnatural and not helpful). The results showed how the brain processed the negative statements depended on the structure of the sentence itself. False and pragmatically licensed negative sentences produced more ERPs than true and pragmatically licensed statements.

Therefore, when a person encountered a word that turned the statement false, there was more activity in the brain as it utilized mental resources to process the negatives. Also, when the negative phrase was useful (as in pragmatically licensed statements), the brain did not struggle to comprehend the statement's negative meaning.

The brain mechanism dealing with negative statements is similar to someone having negative thoughts. For instance, the prefrontal cortex (PFC) is overly developed and hyperactive among people with prolonged negative thoughts and depression. This may result in a reduced ability to think, reason, and form memories, as negative thoughts drain the essential resources in the brain (Small, 2018). Aside from increased brain activity, negative thoughts also affect the brain by reducing the activity in brain regions responsible for self-control, judgment, and planning (Amen, 2019).

Considering how negative statements or negative thinking are processed in the brain, research suggests that negative thinking increases the risk of dementia. Despite this, our brain's ability to restructure itself by forming new neural connections because of neuroplasticity may aid in breaking the loop of detrimental effects through various brain training techniques. With constant brain training, the activity in the left prefrontal cortex, which is responsible for positive thoughts, will gradually improve.

Trapped in Thoughts: Cognitive Distortion

"The world as we have created it is a process of our thinking. It cannot be changed without changing our thinking."

— Albert Einstein

Understanding cognitive distortion requires knowledge of the individual's usual way of thinking, perceiving, and interpreting events, either positively or negatively, which are referred to as thinking patterns. It can be called a lens that helps us see and relate to the world with the influence of our beliefs, culture, and personal experience (Dragomir, 2015). Thinking patterns may develop over time and often comes from personal experience from childhood to present experiences (Sands, 2022).

Cognitive distortion occurs when events or beliefs are perceived incorrectly or adversely. It occurs when our mind tricks us, tells us irrational things, and distorts our perception of ourselves, the world, and others.

"I am the worst person on this planet!"
"I will not bother to do my best in life because I'm hopeless."
"How come success only happens to smart people?"

The statements above are examples of cognitive distortions that trap our minds into a loop of negativity and thinking errors. The American Psychological Association defines cognitive distortion as "faulty or inaccurate thinking, perception or belief", and the defining characteristic is negativity. In some circumstances, we may momentarily distort our thinking. However, it does not significantly

affect the way we think in an event or situation because we do something to change our thinking, or we move on. On the other hand, cognitive distortions are reactivated each time a new event or situation, like the original event, occurs. Some people get away with triggered distortions, while others cannot because they have difficulty adjusting or redirecting their thoughts. The inability to readjust their thoughts interferes with their life and relationships with others. In such cases, cognitive distortion may lead to chronic anxiety, depression, and behavioural problems (e.g., substance abuse).

Cognitive distortions are not caused by single factors because the individual is influenced by a complex system of culture, family, and life events. Although it is difficult to identify why people distort their thinking, some factors have been identified as contributing factors. One factor, stress, plays an essential role in developing cognitive distortion (Legg, 2019). According to research, people develop cognitive distortion to cope with adverse life events, especially if it is prolonged and severe. Cognitive distortions are triggered in instances of high stress, leading to maladaptive and irrational thinking (Panourgia & Comoretto, 2017).

One theory even indicates that human beings developed cognitive distortions to survive. According to evolutionary psychologists, people evolved to think adaptively rather than logically to defend themselves from dangerous situations and survive (Gilbert, 1998). For example, you avoid dogs because you think they are dangerous. Although not all dogs are harmful, and some are well trained and regarded as man’s best friend, you are firm that you must avoid dogs because they are dangerous. It is better to avoid them than to get bitten. This firm belief then saves you from getting bitten.

Cognitive distortions in young adults are also apparent, especially in people diagnosed with depression, anxiety, and other mental health problems. Thought distortion can negatively affect our emotional state and encourage maladaptive behaviours, which may, later, increase the chances of developing and upholding depression and anxiety, affecting mental health. For example, your best friend deceived you, and as a result, you created the "trust no one" mindset. From then onwards, you push people away, rarely make friends, and avoid making attachments with others because of the fear of getting hurt and being betrayed again. Your work is affected, and so is your relationship with family and friends. Though logically, you know not all people will betray you, you still firmly believe that all people will. In this example, the thought of not wanting to trust someone again after a painful event is irrational, even though your thoughts and feelings are valid. However, it is crucial to recognize that distorted thinking robs you of your need to connect with others and attain happiness. This example also shows that our way of thinking will affect our emotions and behaviour maladaptively.

In everyday living, most people tend to distort their thinking without being aware of it, and all people may experience cognitive distortions because it is part of the human mechanism (Greene, 2021). Change is inevitable so are cognitive distortions. We can use the power of change to counter the effects of distorted thinking by first identifying faulty and irrational thinking patterns.

Types of Cognitive Distortion

One of the first steps toward changing cognitive distortions involves becoming aware of them. Remember, thoughts and feelings are valid,

but they can fool us. Identifying these thinking traps is crucial to getting out of the loop of negative thoughts.

Psychiatrist Aaron Beck (1960) pioneered the research on cognitive distortion. The researchers who continuously studied the concept identified ten common cognitive distortions an individual uses. While reading, identify the distortions that happen to you.

All-or-Nothing Thinking

This cognitive distortion is also called polarized thinking, wherein a person habitually thinks in the "black-or-white" category. For instance, a person believes that there is "good" and "bad" or "success" and "failure" in life. If things do not work out, then it is a total failure. Polarized thinking stops the person from seeing the complexity of the world, which is full of varying grey shades. Cognitive distortions can also lead to decisions without considering the consequences for ourselves and others (Litner, 2020).

Facts and events do not really support dichotomous thinking because life events are not *completely* disastrous or *totally* wonderful; instead, life consists of both good and bad aspects. In addition, all-or-nothing thinking misleads us by arousing emotions that cause over-dreaming, resulting in the type of thoughts present among people with depression. Ironically, people tend to get habituated to thinking and talking in an "all-or-nothing" manner as it excites them emotionally. It is difficult for them to give up this kind of thinking (Hossain, 2009).

Overgeneralization

This thinking pattern overgeneralizes things or situations by drawing conclusions based on one event. A person may see a single negative event, such as failed relationships or job demotion, as a cycle of defeat in life. For instance, a man who declared his love and got rejected believes the same thing will happen to him again and again. Why is that? Because of the tendency to see the new experience through the lens of old experiences, recognizing one event or detail that has happened before. Overgeneralizing may lead to severe negative thoughts about ourselves, others, or the world based only on one or two encounters.

Mental Filtering

People with this cognitive distortion concentrate on only the negatives and disregard the positives. A person may tend to ruminate on a negative detail, leading to an inaccurate and negative perception of a situation. By dwelling solely on the negatives, the filtered thinking instils a pessimistic view of the event. For example, a person dwells excessively on critical and negative feedback in the workplace while ignoring positive feedback and praise. This mental filter can worsen anxiety and depression symptoms because it causes feelings of hopelessness and triggers suicidal thoughts (Legg, 2021.

Discounting the Positive

A person who discounts the positive recognizes the positive experiences or feedback but chooses to reject them. There are similarities between the mental filter and disqualifying the positive.

They are both distortions that dwell on the negatives and involve negative thinking patterns. However, in discounting the positives, the positives are recognized and acknowledged, but the person rejects the positives by insisting that it is irrelevant.

For example, an employee may acknowledge that he did a good job but is preoccupied with thoughts like “I’m not good enough” and “I need to do better because every employee can do excellent work”. This form of cognitive distortion strips away the person’s happiness by instilling feelings of inadequacy and unworthiness.

Jumping to Conclusions

This cognitive distortion involves the negative interpretation of things without evidence to support the conclusion. This jumping to conclusions distortion may occur in two ways: mind-reading and fortune-telling. Mind reading is a false idea that a person can read another person’s thoughts leading to negative judgments. For example, assuming the person you just met has an unfavourable opinion of you because they pulled a face, even though there is no evidence to your claim. Or a friend doesn’t return your call, and you assume she is avoiding you.

On the other hand, fortune-telling predicts that things will go wrong despite having no evidence. You feel powerless to change the situation by assuming the outcome is inevitable. For example, assuming awful things will happen because you saw a black cat on the street.

Magnification

Minimizing the importance of your desirable qualities and exaggerating the relevance of negative events, problems, and shortcoming refers to magnification. It is also known as the "Binocular Trick" because this thinking distorts perspective negatively. We focus on something insignificant and exaggerate it. For example, a swimmer won a gold medal in a competition. But instead of focusing on his gold medal, he focuses on and exaggerates the mistake he made during the tournament.

People prone to panic attacks often use this distortion. They magnify their fear while minimizing their ability to cope.

Emotional Reasoning

Emotional reasoning is one of the more common types of cognitive distortion. This pattern of thinking is present among people with and without anxiety or depression (Berle & Moulds, 2013). In emotional reasoning, a person assumes that negative feelings are accurate and their feelings about the situation reflect reality. Any piece of evidence contrary to their emotions is ignored or rejected to fit their feelings of their perceived truth. Emotions disrupt the cognitive patterns in emotional reasoning. "I feel like I did something inappropriate because my friends left me out" is an example of this thinking pattern.

"Should" Statements

A negative thinking pattern that dwells on the "should" and "ought" statements about yourself often leads to guilt and frustration. People

may exhibit negative comments such as “I should study more”, “I ought to be a better person”, or “I must live my life with good intentions only”. These thoughts bring pressure and, if not met, may lead to guilt and disappointment because a person did not adhere to the expectations. “Should statements” can be aimed at other people. For example, when you expect something from someone, but that person fails to meet your expectation, this may lead to anger and resentment. “Should statements” are based primarily on reinforced family or cultural expectations.

Labelling

The extreme form of all-or-nothing thinking is called labelling because a person assigns judgments to themself, or others based on one experience or event. Instead of admitting, “I made a mistake by accident”, a person with this cognitive distortion will berate and negatively characterize themself by saying, “I’m so stupid”. Labelling can lead to feelings of anger, disappointment, and low self-esteem.

Personalization

Holding yourself responsible for an event out of your control refers to personalization. For instance, you feel responsible for other people’s happiness and pain. Another example is you experience feelings of inadequacy, shame, and guilt because of taking responsibility for your friend’s disappointment because her birthday cake arrived late, but the cake was not your responsibility.

Although there are various types of cognitive distortions, all have something in common it involves inaccurate and repetitive negative

thinking patterns and may lead to potential psychological problems (Ackerman, 2021).

Dementia and Repetitive Negative Thinking Patterns

As stated in the previous section, cognitive distortion involves repetitive negative thoughts that can affect the psychological health of an individual. What is the relationship between the decline in memory and negative thinking patterns? Why is it important to discuss the types of cognitive distortions? Aside from providing awareness about cognitive distortions, discussing the concept is relevant in understanding the link between repetitive negative thinking patterns and cognitive decline. For instance, repetitive negative thinking (RNT) plays a role in the development and sustaining of depression, anxiety, and post-traumatic stress disorder (PTSD), which have all been linked to cognitive decline and dementia (Schlosser et al., 2020).

People with Alzheimer's might develop psychological conditions such as anxiety and depression. Depression and anxiety are associated with cognitive decline. These conditions are vulnerable to repetitive negative thinking patterns. Previous studies have indicated that psychological factors, such as depression and anxiety, lead to the concept of cognitive debt. This concept is caused by repetitive negative thoughts. A recent research study published in Alzheimer's & Dementia conducted by Merchant and colleagues (2021) found that increased repetitive negative thoughts lead to faster cognitive decline. People categorized by this way of thinking are also more likely to have significant deposits of tau and amyloid proteins, which are also responsible for cognitive decline.

The researchers further suggest that specific cognitive processes associated with depression and anxiety could be one of the reasons why people with these conditions are at risk for dementia. Moreover, prolonged negative thinking patterns could increase the risk of memory decline. Therefore, it is likely that having a lot of negative thinking patterns also leads to Alzheimer's in other ways, most likely, due to the increasing stress levels. However, the probability that Alzheimer's disease causes negative thoughts should not be ignored. This study also suggested that mental health has the same importance when addressing cognitive decline or dementia. One of the authors of the study, Dr Chételat (2020), asserted:

"Looking after your mental health is important, and it should be a major public health priority, as it's not only important for people's health and well-being in the short term, but it could also impact your eventual risk of dementia."

Since thoughts can have a biological effect on physical health, whether positive or negative, mental training practices may help in promoting positive and down-controlling negative thinking schemes, according to the researchers.

Warning Signs of Depression

At times, most people may feel sad, isolated, or miserable; these are a natural reaction to low self-esteem, unpleasant difficulties in life, and grief. However, if these feelings overwhelm a person, they may cause physical symptoms that may last for a long period, preventing someone from living a normal and active life (Bruce, 2021). Depression may run in the family, yet people with no family history

are also susceptible. If the sadness or feelings of isolation interferes with daily functioning, it is crucial to seek professional help. Because if left untreated, it may worsen and lead to depression. The symptoms of depression are comprised of:

- Problem with concentration, memory, and decision making
- Exhaustion
- Emotions such as guilt, worthlessness, and helplessness
- Negative thinking and despair
- Sleep problems such as insomnia
- Sleeping too much or too less
- Irritability and strange behaviour
- Agitation
- Anhedonia or inability to feel pleasure
- Undereating or overeating
- Chronic pains, headaches, or cramps
- Constant sad, anxious, or empty feelings
- Persistent digestive concerns that do not get better
- Suicidal ideation and attempt

These symptoms are presented in this book to provide knowledge and awareness, *not* for self-diagnosis. If depressive symptoms cause problems in relationships, at work, or with family, and there is no improvement, professional help is needed. Consultation with a mental health counsellor or doctor may help prevent the symptoms from worsening, especially if the symptoms are persistent. Professional assistance is required to determine if a person is depressed by evaluating the condition through tests before making a diagnosis.

What can you do when facing emotional challenges such as anxiety, worry, or fear? There are situations that you will encounter where resilience seems impossible. To get through situations like this, you will need a deep awareness of your thinking styles, like cognitive distortions, and harmful behaviour patterns. The success of any therapy relies on your willingness to fully engage with the method.

Without motivation to apply your chosen therapy method, you will see no improvement. PISTA can help you in dealing with the symptoms of depression. PISTA therapy helps by helping your mind identify the obstacles and solutions to the situation. The PISTA modalities utilize daily sound intervention to deal with or reduce emotional disturbances such as feelings of panic and sadness. Even when you are experiencing confusion, overwhelming anxiety, or brain fog, PISTA will help you clear your mind so that you can have the motivation to discover and implement the right course of action.

Cognitive Restructuring

"Don't blame me if it rains."

"If it is a good morning, which I doubt."

"Don't worry about me. Go and enjoy yourself. I'll stay here and be miserable."

— Eeyore, *Winnie the Pooh*

Faulty and negative perceptions, beliefs, and thinking are traps that rob us from thinking outside negative loops. This is called cognitive distortion. The quotes from Eeyore at the beginning of this section are some examples of personalization, emotional reasoning, and cognitive distortions. Thinking distortions may result in diminished motivation, low self-esteem, and stress-inducing thoughts that may lead to serious mental health issues, such as anxiety and depression. If left unaddressed, cognitive distortion makes a person subject to irrational decision-making and may cause problems in relationships with family, friends, and others. Distortions in our thinking patterns may automatically occur as a habit, and some people are unaware of this tendency. Our distorted thinking may also result in negative feelings and abnormal behaviours.

People trapped in the loop of negative thoughts are not conscious of their power to break the cycle. Sadly, those trapped believe that is just the way things are and will passively accept their irrational thoughts without even trying to question and evaluate them. People sometimes utilize cognitive distortion as a coping mechanism, which is inadvisable because distortions are maladaptive. Despite this, it is

unhelpful to say, “it is all in your head; just get rid of it”, because it is invalidating. However, we do need to recognize and acknowledge faulty thinking so that we can move towards change.

Changing negative thinking patterns requires a willingness to accept and reconstruct the irrational and faulty thoughts that have lingered in the mind for so long. It is like letting go of a bad habit. Although changing these thoughts may bring new and unfamiliar thoughts and emotions that may seem overwhelming to accept initially, it is part of the changing process. The process is called cognitive restructuring, a technique used to change our thinking. Restructuring our thoughts does not immediately remove the negative, irrational, and faulty view but rather reorganizes the thoughts into more adaptive thinking until we are free from them.

Anyone can use cognitive restructuring. But some might find it helpful to work with a therapist or mental health professional. This technique allows the person to recognize and acknowledge their maladaptive thoughts when they occur and to practice reframing these thoughts more adaptively and healthily. Cognitive restructuring seems easy to comprehend, but doing it is not. It will take a lot of commitment, patience, self-awareness, effort, and, most importantly, “willingness” to go through the change process.

Cognitive restructuring, or cognitive reframing, is a technique derived from cognitive therapy that involves a systematic process in helping people identify, challenge, and reframe their negative thinking patterns and beliefs. Moreover, it also teaches us to stop believing in our automatic thoughts and the tendency to accept these thoughts without actively assessing them. This technique is based on the theory that our thoughts, behaviour, and emotions are interconnected, and the

key to changing maladaptive behaviour and emotion is to change our negative or self-defeating cognitions.

Cognitive restructuring is highly effective in helping people cope with various stressful events and mental health conditions such as depression, Post-Traumatic Stress Disorder, addiction, anxiety, phobias, and relationship issues. This strategy, however, is only one of several techniques used in treatment. There are other techniques utilized in addition to or alongside cognitive restructuring. In therapy, the techniques are facilitated by a therapist, but there are methods that we can use to reframe our thoughts on our own.

When we learn to recognize and acknowledge our irrational thoughts, we can use cognitive restructuring techniques to help ourselves to reframe them. However, if you think that you cannot do it alone, then self-help cognitive restructuring techniques will not help. As your thoughts already greatly affect your emotions and behaviour, it is better to consult a mental health care provider.

In our everyday lives, we consciously or unconsciously utilize some cognitive distortion. Yet these distortions are less severe than individuals clinically diagnosed with depression and anxiety. For example, reframing can be used to deal with self-sabotaging thoughts before a presentation or to improve an unpleasant mood. Reframing leads to more positive thinking, preventing self-sabotaging thoughts, and overcoming irrational fears.

Cognitive Restructuring Step-by-Step Process

The significant advantage of cognitive restructuring is that it provides a systematic procedure for evaluating and modifying cognitive

distortions. There is no universal step-by-step process to reframe our faulty cognition, and there are experts who have their techniques in utilizing this method, but they all serve the same purpose.

1. Self-Monitoring

Changing negative thinking patterns requires self-monitoring or checking in with yourself to determine the distorted cognition. The first step in changing our distorted thinking is to be aware of them, as restructuring will depend on the ability to recognize the irrational thoughts that trigger the negative feelings and state of mind.

Part of self-monitoring is to see how irrational belief contributes to emotional and behavioural disturbance. It is also necessary to determine when and where the thoughts come up, as there might be certain situations or places that trigger cognitive distortions. This may help you to prepare yourself in advance.

For instance, you may feel uneasy and uncomfortable because your friends fought at a dinner date that you didn't go to.

In self-monitoring, it is crucial to identify what makes you feel bad. To do that, check in to your thoughts and emotions. Some people find it beneficial to write down their thoughts since they are prone to forgetting things when their minds are overwhelmed by feelings and racing thoughts. Writing down or journaling will serve as physical evidence of your thoughts.

If possible, write down when and how frequently you feel and think this way.

At first, not all people will be able to determine their triggers, but by jotting things down, patterns emerge.

Identifying your irrational and faulty thinking is not a sign of vulnerability; it is one step toward self-improvement.

2. Evaluating the Assumptions

Questioning our thoughts and assumptions is one of the essential parts of cognitive restructuring. After determining and acknowledging the distorted beliefs, the next goal is to evaluate how the belief becomes irrational by cross-questioning it.

To continue the example in number 1, the irrational thoughts of why you feel bad might include *"they fought because I'm not there to stop them. I am the one who is responsible for stopping my friends from fighting"*. This is an example of personalization. You blame yourself for the event that you cannot control. These thoughts are attacking you, which leads you to feel bad. Therefore, you need to counterattack and challenge your beliefs by asking yourself some questions.

Socratic questioning is used to evaluate irrational and faulty beliefs, which include questions such as:

"Are these thoughts based on emotions or facts?"

"Did someone tell me this in the past?"

"How will I know if these thoughts are accurate?"

"What if my thoughts are inaccurate?"

"How could I test my belief?"

"Am I relying too much on myself and incorrectly assuming responsibility for this situation?"

The Socratic questions may vary from person to person as not all people have the same cognitive distortions. However, it is important to note that our cognition is distorted because the thinking patterns automatically generate "negative" and "irrational" thoughts. In examining our thoughts, the goal is to "disprove" and "challenge" them.

3. Gathering Evidence

Collecting evidence to confirm the assumptions is part of evaluating automatic thoughts. The evidence can be gathered from your thoughts and beliefs, other people's assertions, or the conditions that cause the distortion. Cognitive distortions are biased and irrational yet deeply rooted in our beliefs. However, the occurrence of irrational and faulty thinking patterns does not mean that a person's rationality is lost.

To continue the example, you need evidence to support your assumption that your friends fought because of you. You could ask your friends if your absence caused the argument.

Some people are afraid to gather evidence that confirms or disputes their thoughts as the possible outcome is too overwhelming for them. The fear might probably be rooted again in their thoughts and their incapability to handle the aftermath of the assumptions. However, it is a crucial element of cognitive reframing; the individual must challenge these irrational and faulty beliefs by proving how they are unsupported by facts.

4. Balancing the Pros and Cons

This method helps us consider the advantages and disadvantages of maintaining faulty and irrational beliefs. After recognizing, evaluating, and gathering some evidence, the next step is to decide whether to keep the cognitive distortions or not. Once the proof is available, we must be able to distinguish between irrational and rational thinking. Since being aware of and challenging our thoughts has consequences, balancing the advantages and risks of keeping the distorted cognition would help manage the possible outcomes.

For instance, you confirmed that you are not the reason your friends fought, but you are still worried and continue to hold onto your thoughts. The evidence is useless if you do not try to acknowledge and weigh the pros and cons of keeping his irrational thoughts. Again, your thoughts need to be challenged by asking yourself some questions such as:

"What do I get for thinking like this?"

"How does this kind of thinking affect my emotions and behaviour?"

"What would I get in the long run if I kept thinking like this?"

"How do my thoughts affect the people around me?"

These questions may help balance the pros and cons of keeping false beliefs. Although these questions may vary, knowing how to weigh the consequences or harm of holding our cognitive distortions for a long time is important. Letting go of false beliefs is not an immediate

process. Some people can manage their thoughts, yet not everyone can let go of their false beliefs immediately.

5. Generating Alternatives

Generating alternative thoughts may come along with balancing the pros and cons of cognitive distortion. It can be described as "What if I think another way?" thinking. Cognitive restructuring focuses on assisting people in finding new ways to look at situations which were influenced by automatic negative thought patterns. As part of the reframing process, we are to think of alternate explanations. Of course, if the thought is negative and irrational, the individual should think of a rational and positive alternative to replace the distortion they kept for a long time. It is crucial to be more open with other alternatives to reframe the negative thinking pattern successfully.

Continuing the example: Since you still do not believe that you are not the reason why your friends fought despite the evidence, you need to consider other alternatives. The alternative thoughts could include:

"They are not little children on the playground that needs an adult to 'police' them."

"I am not their mother/father; therefore, I am not responsible for their behaviour."

"They are adults and are responsible for resolving the argument."

"If I try and sort the argument out, I will make it worse because I wasn't present when it started, so I don't know the whole story."

By looking at alternative thoughts, we may realize that the incident had nothing to do with us.

Seek Out Help

Speak to a professional if you are struggling to identify and reframe harmful thought patterns on your own. The distorted thought patterns often start as a coping strategy; however, when it becomes habitual, it changes how you perceive yourself and the world. Anything that feels real (because we have thought it or felt it) and is automatic can be hard to change without professional intervention. In the PISTA program, your PISTA therapist will guide you to identify distorted patterns and construct new and helpful habits. Through the guided PISTA exercises, you can independently assess your thoughts, behaviours and attitude for harmful communication and thought patterns. With this insight, your will be able to construct helpful responses and assessments of situations.

Reframing distorted cognition is a continuous process of evaluating the identified maladaptive thoughts. Identifying and reframing negative thinking patterns has many benefits, such as clear thinking, low-stress levels, increased self-esteem, self-confidence, and interpersonal and intrapersonal skills. It may also result in healthier relationships and mechanisms and alleviates anxiety.

It is important to understand that new and productive ways of thinking can replace maladaptive and restricting beliefs. When fear is triggered, the overactive state of the brain makes the brain perceive and recall events negatively. The PISTA stimuli enable your brain to move from an overactive brain state to a calmer, more rational state. By accepting new and useful thoughts aligned with what is desirable, you can break cognitive distortions and have an enjoyable life.

One of the main reasons this method works is its ability to improve and hone your mind. The stimuli (e.g., sound) can boost brain functioning and help develop an adaptive mental state relevant to the daily management of emotions. In changing distorted thinking, thoughts must be understood and managed because if not, the maladaptive thoughts can trump our mind's power, leading to physical and psychological consequences. For instance, distorted belief may result in wrong decision-making and overthinking, leading to sickness. The stimuli PISTA therapy applies to the different modalities enhance your mental process and sharpen your mind.

You can rewire your mind to reach your personal goals and desired mental and physical states.

PISTA also works in treating some psychological disorders in a safe and non-intrusive way. The PISTA approach employs Transcranial Magnetic Stimulation, the PISTA sound tool, art, play, and rhythm as stimuli. These methods stimulate a specific brain region responsible for the conditions experienced by the person. Stimulation activates those areas, triggering them to send messages to the nervous system. This mechanism produces a relaxed state of mind and sets the path for good psychological, bodily, and emotional changes (Beguin et al., 2018).

The Left and Right Brain

The human brain is a complex organ that weighs approximately 3 pounds and comprises 100 billion neurons and 100 trillion connections. It acts as a command centre of thoughts, feelings, and motor behaviour divided into two hemispheres. Although the two brain hemispheres appear identical, they perform different functions and information processing abilities, but this does not necessarily imply that they act independently. This is because the lack of integration may cause an impairment in functioning. Also, the brain continuously modifies itself to adapt to environmental changes (Hammond, 2022).

There is a hypothesis that people are either right- or left-brained, meaning that only one side of the brain is dominant when executing a specific activity or function. For instance, people who are more analytical and methodological thinkers are more left-brain, and creative and artistic people are more right-brain. This concept was introduced because the two brain hemispheres work differently. Psychobiologist and Nobel Prize winner Roger W. Sperry (1996) was the one who theorized this concept.

Handedness is the most evident indication of the localized function of the two brain hemispheres. For example, about 90% of people have a better mechanism in fine movements using the right hand than the left hand and prefer their right hand for most activities. In contrast, the remaining 10% are left-handed or ambidextrous people. Language is the first and most well-documented evidence of brain asymmetry in mental functioning. The association between language and brain asymmetry was studied 150 years ago by Dr Paul Broca, who observed

that stroke or left brain-injured patients often have disturbances in their speaking ability. This was due to the disruption in a particular region in the left frontal lobe responsible for speech production called "Broca's area". Likewise, Carl Wernicke found the specific area in the brain, namely the left hemisphere, responsible for the capability to comprehend language. This localized region in the left hemisphere is known as "Wernicke's area" (Sukel, 2020).

The left brain is usually known as the digital brain as it is more analytical, systematic, and verbal than the right brain. According to Sperry's research, the left hemisphere focuses more on reading, writing, calculation, logic, facts, sequencing, and word thinking. On the other hand, the right brain is referred to as the analogue brain, which emphasizes visuals, intuition, and creativity but less on organized thinking. The analogue brain helps people with imagination, intuition, holistic thinking, visualizing emotions, nonverbal cues, daydreaming, arts, and rhythm. From these principles, it is evident that our brain functions differently, but does this indicate that we have a dominant brain?

To answer this question, a group of neuroscientists conducted a study in 2013 to investigate this notion and discovered no evidence that it is true. The findings from magnetic resonance imaging (MRI) of 1,000 people show that the human brain does not favour one side over the other and the connections on one side are not generally dominant over the other connections on the other side. The bundles of nerve fibres connecting the two hemispheres create the information relay function. The two sides may function differently, but they work together and accompany each other. Meaning no human utilizes only one side of their brain. Whether a person performs a rational or creative function,

the input of information is processed on both sides of the brain. For example, speech structure and articulation are processed in the left brain but understanding the context and tone of language are for the right brain. The same is true for mathematical equations; the left brain conducts the function, but the right brain performs comparisons and preliminary estimates.

Personal preferences or learning methods do not transfer into the assumption of left-brained or right-brained. Nevertheless, the two sides of the brain are distinct, with specific sections having specialities. Also, the precise locations of several functions may differ slightly from person to person. Therefore, individual differences should not be disregarded.

Conceptual Age: The Era of Creativity and Learning

Humanity has undergone many changes over time, from the agricultural era led by farmers to the industrial era powered by factory workers and the information age that circles the labour of knowledge workers. These eras have specific instructions and algorithms on how things should be done in that period to survive, adapt, and progress. Before the more advanced ages, human beings experienced Prehistory, Ancient History, the Middle Ages, and so on; they did not have a lot of machinery, advanced technology, and easy access to information. Yet people at that time were able to manage and live their life. Regardless of differences, the human species continues to progress and adapt to the era in which they live.

In the information age, some jobs, or tasks that individuals can accomplish are now being done more efficiently by robotic devices

and computer software. Robots, machines, and computers are taking over jobs, affecting human employment. The changes imply that to adapt to a world where robots can do human jobs, we must think differently about our professions and identify long-term work prospects that only humans can do.

Information is abundant nowadays, and the future is not all about how much information we know. The future is about utilizing that knowledge (Brinson, 2015). For instance, reading books about creative writing does not make a person a good writer, and learning painting fundamentals may not always result in aesthetically pleasing art. Being able to know many things is beneficial, but having creativity makes things better. This is what the rising conceptual era is trying to convey, but not everyone has reached this point.

The conceptual age focuses on how people use their natural abilities to operate, restructure, and reinterpret their reality. There are continuous changes in this era, and the process involves redefining existing elements, finding subtle patterns, and determining the aesthetic and coherent relationships between unknown things.

Therefore, the conceptual age is the era of having amazing, highly creative ideas and inventions sketched from unknown areas or things. This term was popularized by Daniel Pink (2006) in his book “The Whole New Mind”, in which he drew out six right brain functions that were crucial to the conceptual age: design, story, symphony, empathy play, and meaning. Pink also highlights that right-brainers are in the lead of this period of creativity and higher-order thinking (Grey, 2019). Keep in mind, however, that the two hemispheres integrate to perform higher-order brain functions.

Moreover, the relevance of possessing a sense of empathy, having the ability to identify beauty, as well as capability to find meaning from neutral objects and ideas were also emphasized by Pink because these are the things that only humans can do.

The freshly in-demand skills in the 21st century consist of higher-order thinking and creative problem-solving. Higher-order thinking focuses on innovative methods to use schemas and systems to integrate new information (Brinson, 2015).

The six brain functions that Pink (as cited in Grey, 2019) believed are relevant to the conceptual age can be summarized into two core skills – creativity and empathy. However, although it was not emphasized, logic and analysis are also crucial in the conceptual age.

Creativity

"Bringing something into life" is one of the main concepts of creativity. The verb "create" means "to make something new". Nevertheless, in the conceptual age, the word creativity is more complex than its dictionary meaning. It is not just about creating something but also about introducing something creative while simultaneously solving problems in ways that could never have been imagined. The conceptual age has advanced creativity to make life easier, more aesthetic and enticing. Some humans are trapped in the cycle of routine experiences while the world continuously changes and seeks fresh and different experiences. The conceptual age equates to a need to explore more to foster a creative mind.

The Core Idea of Conceptual Age is Creativity. But why?

Because of what happened in the previous ages and the innate blessings humans experienced, the main focus of the industrial period was on results as humans sought to discover something new from the environment, evaluate the situation to find solutions to pressing concerns, and bring convenience to life. Therefore, machine-generated results are crucial as the data is a great help to troubleshoot problems and find solutions. Before the industrial and information ages, humans were born with imagination, creativity, and resourcefulness that helped them survive. Given that in the past high-tech machines and access to information were not abundant, yet humans were able to live; the current era should be rich with creative ideas.

The Information Age was formed by results directed to data and facts, allowing humans to produce numerous results and solutions. However, there was an evident need to sort these results and the problems that accompanied them. This was when the world started to value those people with statistical proficiency who could examine and analyse facts and data. People who flourish in the Information Age have remarkable technical skills in operating and controlling computers and expertise in evaluating and processing data and facts. Because of the industrial and information age, humans have a better lifestyle with a wealth of results, data, and facts. Therefore, there is a need for something that will redefine what the said era has produced to help humans understand and cope with it, which creativity can provide.

The abundance of information will lose its relevance quickly without creativity. For instance, researchers produce a lot of data and facts from their research studies. However, if these results remain as results only, then it is not very meaningful. It will stay as data if it is not delivered to the public or applied in a real-life situation. Also, if the findings are vague and too hard to comprehend, this will not attract the readers' interest. This is where creativity comes in. To make data more comprehensible and appealing, creative charts, posters, and infographics can be used to deliver information from complicated research findings.

While some may argue that humans are not creative, they are intrinsically drawn to aesthetics or what is pleasing and beautiful. Employees who can deliver creativity gain an additional advantage in the workplace or in an organization. According to Daniel Pink's emphasis on abundance, humans no longer settle for substandard results since there are so many options and information to choose from, making the appearance and design more favoured as it conveys a message and creativity brings more innovative ideas. For instance, the innovation of mobile phones to smartphones, from 90's box Televisions to Smart TVs, and from a simple watch to a smartwatch.

To flourish and reach the top in the conceptual age and all fields, one must continuously invest in boosting creative thoughts and talents to deliver incredibly innovative results.

Empathy

Another core skill in the conceptual age is empathy. The basic definition of empathy is "putting yourself in someone else's shoes". For Daniel Pink, empathy refers to:

"The ability to imagine yourself in someone else's position and to intuit what that person is feeling. It is the ability to stand in others' shoes, to see with their eyes, and feel with their hearts. It is... the ultimate virtual reality — climbing into another's mind to experience the world from that person's perspective."

Like creativity, empathy is an innate skill. However, if not fostered, it will not flourish. The industrial and information age, where most people are still oriented, is probably why some lack empathy because this core skill in the conceptual age is not encouraged and relevant in the era of figures, data, results, and facts. Producing results and data is more critical, making empathy a hindrance to achieving the core of the industrial and information age.

Then again, the world is constantly changing, and empathy has gradually taken over a person's worldview, and the lack of this aspect will make it quite hard for them to create progress.

For instance, there are branded products and services designed for the needs of consumers. Organizations solicit feedback because if their brand does not meet the needs of their customers, they will go for another brand that does, causing the first brand to lose clients while the latter wins them. Organizations or companies that facilitate understanding and empathy to their customer are one step ahead of those companies who barely consider it or do anything about it at all.

Both empathy and creativity are the core skill of the conceptual age. Yet, empathy is the core virtue of human development, where people seek solutions to solve problems that would help themselves and others.

Moreover, according to several types of research, empathy is strongly associated with creativity (Kalliopuska, 1992). Carlozzi et al. (1995) even emphasize that:

"*Empathy... is positively related to creativity and expressiveness and inversely related to dogmatism."*

Hence, high creativity correlates to greater expressiveness, while low creativity equates to higher inflexibility, implying empathy reinforces creativity. Positive outcomes and solutions are achieved by combining the two core skills.

Logic and Analysis are also Crucial

Despite the emphasis of the conceptual age on creativity, logic and analysis are still relevant in this era. In fact, in all ages. Because the left and right hemispheres are hardwired to complement each other, highly efficient people engage in activities that enable both hemispheres of the brain where and when necessary. The main point here is that a person must take advantage of the brain's capabilities and should not neglect the activities that would allow both hemispheres to complement each other. In this new era that requires high levels of creativity, logical facts and data should not be overlooked, as our need for thinking is similar to our need for emotions and vice versa (Grey, 2019).

Knowing the core value of conceptual age and other ages is crucial as it determines the activities that help nurture the mind, intellect, and brain function. Considering the benefits of cognitive reserve, activities, jobs, or tasks that involve creativity, empathy, logic, and analysis can help increase the capacity of cognitive reserve, thus preventing the early development of cognitive decline.

What is Passion?

Knowing what your skills, interest, and path to take is good, but having a desire to invest time and pursue these areas is even better. This is the foundation of passion; finding something that is important enough that you want to put energy and time into improving or mastering it. However, what is the difference between liking an activity sufficiently to participate and passion? Every individual has a subjective meaning of passion, whether they feel like they have a passion or not. To help us understand better, we can look at the theory and associated concepts related to the word “passion”.

A related concept, the Self-Determination Theory, might help us understand how a specific activity or phase leads to passion (Deci & Ryan, 2000). People participate in various activities across their lives to fulfil basic psychological needs of autonomy (need to feel a sense of personal initiative), competence (need for effective interaction with the environment), and relatedness (need to stay close to significant others).

While people may not have much choice in some of the activities they engage in, such as in school or the workplace, people have a choice in other activities, particularly during leisure time (e.g., sports, arts,

music, etc.). Activities that are or are not against the will of an individual may involve periods of trial and error that eventually lead to a preference for that activity, notably if it is enjoyable and satisfies the needs for competence, autonomy, and relatedness. Although only a few activities are vital to an individual's self-perception, some pursuits will become passionate ones.

The strong inclination toward a self-defining activity that you like or even loves that leads to an investment of time and energy refers to passion (Vallerand et al., 2003). Meaning, that activities that are not initially enjoyable or relevant may have the potential to be engaging or meaningful if they become so self-defining that they represent the primary characteristics of an individual's identity. People who begin without much enthusiasm to reach a specific goal may have a different level of passion from those who have already mastered it. However, what matters is that passion arises.

People who have passion do not merely engage in activities that they like. For instance, people with a passion for basketball, playing the guitar, baking, or writing a novel put their highest value on their interest as it motivates and meets their personal needs (Aron et al., 1992; Csikszentmihalyi et al., 1993). Likewise, activities that people enjoy are internalized in their identities to the degree that these activities are highly valued and significant. However, how these passionate acts are internalized into your personality has consequences and can be divided into two opposing categories based on the dualistic paradigm of passion: obsessive and *harmonious* passion.

Obsessive Passion

This passion results from a controlled internalization of an activity into your identity. Obsessive passion creates internal pressure to participate in a pursuit that you like. The internalization process fosters incorporating the values and regulations associated with the activity into your identity. Internalizing the "I need to be the best" mindset may lead to internalizing an identity outside the integrating self (Deci & Ryan, 2000). In other words, the ideal self and true self start disintegrating to the point that the person loses their identity.

The internalization is driven by the activity's intrapersonal or interpersonal pressures. For example, intense feelings of social acceptance or self-esteem may be linked to the activity (Crocker & Park, 2004). Another example is the fierce, uncontrollable feelings of excitement experienced by engaging in the activity. The uncontrollable urge to participate in an activity perceived as enjoyable is common among people with obsessive passion. The person is controlled by desire, and they cannot resist the urge to partake in the activity. Thus, it places them at risk of experiencing negative, affective, and behavioural consequences during and after engaging in the activity.

Because people with obsessive passions are compelled to engage in their passionate activity, they rigidly commit to it. They are stuck in the process of investing in their ego (Hodgins & Knee, 2002) rather than being independent of the activity. While persistence and perseverance may yield some advantages (e.g., excellent performance), due to the lack of flexibility, they may also come with unwanted costs such as injury, broken relationships, and poor health,

which results in less-than-optimal functioning within the constraints of the activity. Obsessive passion enables the person to move forward; however, this type of passion handcuffs them because of the external and inside pressure of uncontrollable urges.

The uncontrollable need, the internalization of the activity, and the self-identity of a person with obsessive passion are contingent on them being socially accepted. The negative emotions, rumination, physical and psychological tension, and problems in maintaining relationships diminish their self-esteem (Mageau et al., 2009).

Unfortunately, obsessive passion is usually cultivated through less positive developmental experiences. For instance, the demands and expectations of parents and teachers control the child or adolescent's behaviour. The intense pressure is contingent on being accepted by a teacher or parent. For example, a child's passion for becoming a pianist is driven by the compulsive need to be accepted and not by the child's genuine interest.

All these aggravate an identity formation that would lead to obsessive passion. Obsessive passion is also linked to early insecure attachment formations. People with obsessive passion have a passion within them; however, they are driven by an "obsessional need" to be acknowledged, valued, and accepted, making them lose their internalized sense of autonomous self (Mageau et al., 2009).

Harmonious Passion

Harmonious passion manifests when we freely engage and accept the activity as significant but without any possibilities, contingencies, and conditions attached to it. Compared to obsessive passion, harmonious

passion may sound promising because, according to the theories, obsessive passion seemingly puts us in the wrong lane. As a reminder, obsessive passion is controlled internalization leading to obsession. In contrast, harmonious passion results from an autonomous internalization of the activity into our identity. Harmonious passion's internalization is derived from the intrinsic and integrative tendencies of the self (Ryan & Deci, 2003), which creates a motivational urge to engage in the activity. This urge establishes a willingness to pursue the activity while promoting feelings of desire and personal encouragement.

Instead of uncontrollable urges and pressure to participate in an activity, harmonious passion promotes freedom in choosing what to do. Engagement in the activity does not overwhelm our identity or other aspects of life. Simply put, authentic self-integration is evident if we have a harmonious passion (Dei & Ryan, 2000), enabling us to have positive experiences and openly engage in a passionate activity (Hodgins & Knee, 2002). As a result, with a harmonious passion, we can fully concentrate on the activity and enjoy the benefits of participating in it.

There is also no conflict or strain between our passion and our other activities. When we stop participating in the activity with a harmonious passion, we can adjust and successfully divert our attention and energy to other things. Lastly, harmonious passion lets us control the activity and choose when to and when not to participate in that activity.

Performing artists such as musicians, singers, dancers, or actors shape a part of their identity around the activity they are passionate about (Kogan, 2022). The things they love and are significant to them are

internalized into the identity that enables them to sustain and search for meaning in other interests and relationships with others. In contrast, people with obsessive passion experience conflict when they are required to engage in other activities.

Earlier studies identified two different pathways for talented individuals. For instance, a young child who keenly pursues to play the violin: At such a young age, early exposure allows the child to devote time to play the violin well. Suppose the child is in an autonomy-supportive social environment. In that case, the family and teachers who value and support the child's interest contribute to fostering interest that grows into a passion integrated freely into self-identity. Thus, the child becomes a violinist. These early positive and repeated experiences are seen in the development of performing artists' interests and talents. The autonomy-supportive environment guides them to have an integrated, harmonious sense of self and passionate love for the art, allowing them to have a life filled with artistic aspects (Mageau et al., 2009).

Harmonious passion promotes and reinforces positive emotions, while obsessive passion drives negative emotions. These types of passion describe two pathways: one that directly moves us toward goal mastery, intentional practice, and successful performance, while the other one leads us to goal avoidance, ineffective practice approaches, and poor performance (Vallerand et al., 2008). Harmonious passion can positively predict subjective well-being and adaptive performance (Bonneville-Roussy et al., 2010). In comparison, obsessive passion is associated with perfectionism, eating disorders, and low self-esteem (Padham & Aujla, 2014). Also, high internalized perfectionism, dysfunctional ways to pursue achievement, and higher levels of

burnout are found among performing artists with obsessive passion (Hall & Hill, 2012).

Research into the rehabilitation progress of dancers noted that dancers with harmonious passion were more likely to use problem-focused and health-promoting strategies keeping them more flexible. These dancers also actively worked on future injury prevention skills. On the other hand, dancers with obsessive passion tended to have prolonged injuries and usually developed chronic injuries. The dancers did not address early signs of pain and discomfort. As a result, they encountered difficulty accepting their injury and suffered from a loss of psychological self-esteem (Rip et al., 2006).

The research findings show that harmonious passion is the desirable pathway to success. Harmonious passion improves innovative cognitive styles (Luh & Lu, 2012). It is also associated with the Big Five personality trait of openness. Openness refers to curiosity, willingness to try new things, and creativity. On the contrary, obsessive passion is associated with the personality factor neuroticism. Neuroticism involves the inability to self-regulate, unable to deal with stress, and have strong reactions to perceived threats. The excessive need for control is also associated with obsessive passion.

Although harmonious and obsessional passions have been established as intrinsic motivating elements, they are also significant personality variables (Luh & Lu, 2012). Early attachment experiences and early childhood developmental effects greatly influence these two passions.

It is not always about Passion

"Follow your passion!" This concept has gained in popularity but is an overstatement. Yes, passion can be a powerful motivator for accomplishing career objectives, personal goals, and achieving life aspirations. However, following your passion does not always lead to fulfilment. Following your passion is not always the solution to problems. Finding a fulfilling career, activity, or relationship is not just simply a matter of pursuing your desire. Although it is beneficial to have an intense yearning or compelling aspiration for something or someone, passion is merely one of the hundreds of attributes needed to reach a specific goal. Following your passion entails finding your interest, seeking occupations that fit your desire, mastering the skills required to progress and then pursuing those careers regardless of what happens (Todd, 2007).

According to research, the number of hours an average person spends in their career is 80,000 (Todd, 2017). Choosing a career is a complex problem. If a person takes up the wrong career path, that is 80 000 hours spent learning, skill building and interacting with projects and people. Therefore, it is crucial to do enough reflection and research to utilize the said number of working hours. Relying solely on passion is not always the key.

Benjamin Todd is the CEO and co-founder of 80,000 Hours, a non-profit organization in London that provides research-based career advice. According to him, most people from the previous generation stick with the same career advice and follow what their parents did.

People from the 1980s, for instance, may have believed that "greed is good" and focused on career opportunities that increased their

potential to earn more. However, growing up with this career advice, “follow your passion”, leads to different career goals. The use and application of this phrase increased dramatically from the mid-nineties, and Todd asserted that this generation needs to step outside the “follow your passion” belief.

Then what should people think or follow as career or life advice?

For Todd, instead of focusing too much on determining personal interests and the things we are passionate about, we should focus more on what we can contribute to others and the world to make it a better place. It sounds overwhelming, but Todd goes in-depth to explain this with data.

Todd asserted that following your passion would probably lead to failure. The survey results from 500 Canadian students showed that 90% were passionate about sports, arts, or music. However, in the consensus data, the job market for sports, arts, and music is only 3%. Therefore, if even one out of ten Canadian students followed their passion, the majority would still not achieve success. Even if a person pursues their passion, finds a role in a relevant field, and works hard to succeed, there is still a chance that they will feel unfulfilled because the day-to-day work may not be meaningful to them. Some have successfully followed their passion and are involved in meaningful work; however, this is more the exception than the norm.

Todd quotes the Terman research into salespeople to back up his claims. The study demonstrated that people who were highly passionate about sales and took on a sales role were more likely to experience burnout. The researchers also noted that those passionate about sales died younger than their counterparts who were not

passionate. For decades research studies have tried to demonstrate a strong relationship between interest, success, and happiness. Yet, they failed to do so. Todd noted that when it comes to making career decisions, interest is not an influential factor; nonetheless, he does not discount the relevance of interest; it is just that other factors are more important. For instance, the skills and mindset. He added,

"We think our interests matter a lot more than they do because we really underestimate how much they change throughout our lives."

If it is not about your interest or pursuing your passion, then what is it about? What is the secret to a fulfilling career? Todd collected all the career advice and put it into a single slogan:

"Do what's valuable."

He implies that a person should focus on getting good at something by learning the skills required and cultivating the right mindset that would genuinely help others, making the world a better place. People have known for decades that the secret to fulfilment and happiness is through helping others. Todd provided a quote,

"A man's true wealth is the good he does in this world."

Todd's statement is not merely a good quote. The book, *Flourish*, encapsulates the empirical research from the last couple of decades, providing data on what causes people to feel fulfilled and happy in their lives. The compiled studies were published by Martin Seligman (2011), a Psychology professor and the father of Positive Psychology. Todd uses the fundamental factors from Seligman's suggestions to support his claims. The first factor is achievement or mastery, which

refers to working hard to be good at something. The second factor is meaning or purpose. This factor is about the striving mechanism of an individual to do something big aside from making yourself happy, thus making the world a better place. Putting all these together, Todd advises doing your best to be good at something valuable and something that would make the world a better place.

How can people determine what is valuable and contributes to a better environment through their chosen careers? Todd answered the concern by illustrating how to accomplish and find what is valuable in a practical way.

First, *explore.* This involves learning and testing yourself in different situations. Knowing what is valuable requires discovering what is happening in the world. Thinking is not enough to determine what is useful. Thinking plus action is required. You need to go outside, perhaps, even outside your comfort zone, to discover if your idea is relevant and valuable. Regardless of how simple or complicated your interest is, it matters. Anybody can think of something interesting, but to discover if it is valuable, you need to explore.

Second, *identify and learn skills and work hard to be good at them.* It is crucial to learn and develop in-demand skills useful in various situations – this is where the passion comes in. For instance, learn a skill that would help resolve a problem, even if that problem is not the most significant. Knowing how to find issues that have been overlooked is a valuable skill. Why? Because that is where you can have the most meaningful impact. The aim is to know where your skills can make the most difference.

Undoubtedly, altruism, or the unselfish concern to help others, is a skill and strength you will never regret. Achieving fulfilment in your life or career involves doing things for others and not focusing too much on your interests. Therefore, do not just pursue your passion, do what is valuable to find fulfilment in life or your work.

Grit: The Perseverance and Passion in One

Many personality characteristics serve as a significant predictor of success. However, the strongest predictor is grit, which enables the person to work hard and maintain focus for an extended period – even for years. As a personality trait, grit was extensively studied by Angela Duckworth, a Psychology Professor at the University of Pennsylvania and author of the New York Times best-selling book "*Grit: The Power of Passion and Perseverance*". Duckworth's several years of teaching led her to conclude that there was a need within the education field to understand the needs of students from a motivational and psychological perspective. For instance, IQ measures students' cognitive ability while providing a score based on the student's intellectual potential. Yet, Duckworth raised a question:

"But what if doing well in school and life depends on much more than your ability to learn quickly and easily?"

To find the answers, she studied adults and children participating in challenging events, such as the West Point military cadets, the national spelling bee participants, rookie teachers in challenging schools, and salespeople in private companies. Duckworth and colleagues conducted their study with the same question: "*Who is successful here and why?"*. One quality emerged as a major predictor of success from

each distinctly different situation. That predictor was not social intelligence, good appearance, physical health, or intelligence; it was grit.

According to Duckworth (2013), grit entails stamina, passion, perseverance, and hard work to turn future long-term goals into reality. Grit is being adept at sticking to the plan for your envisioned future, not only for a day, week, or month but for years. Meaning a person must work on it consistently. Grit is living your life like a marathon, not a race.

Duckworth researched “grit” in Chicago public schools. She asked thousands of high school juniors to answer questionnaires on grit. Ducksworth then waited over a year to see which students would graduate. The results showed that grittier kids were more likely to graduate. From this research, Duckworth expressed her shock about “grit” and how little we and science know about developing it. At this stage in her research Ducksworth is unable to answer the questions of parents, “How can I help build my child’s grit?”, “What work ethic do my children need?” and “How do I keep kids motivated for a long time?”. Yet, she contends that talent does not make a person gritty.

According to their data, many talented individuals do not pursue their commitments. Grit is also not associated with measures of talent. Although people are born with varying levels of grit, Duckworth believes that it is a quality that develops with time and experience. One of the elements of improving determination is shifting your perspective from a fixed to a growth mindset.

The notion that the capability of the brain to learn is not fixed and that it can change with effort came from Dr Carol Dweck, an American

Psychologist and Professor at Stanford University. Dr Dweck has demonstrated that when children study how the brain evolves and develops in response to challenges, they are far more inclined to persevere when they fail because failure is no longer a permanent situation.

Therefore, while a growth mentality helps develop grit, it is not sufficient.

Growth Mindset

Carol Dweck is one of the most well-known researchers who study the concept of "mindset". Through her research, she identified two mindsets, fixed and growth. According to her, a fixed mindset is *"believing your qualities are carved in stone",* while a growth mindset is *"the belief that your basic qualities are things you can cultivate through your efforts"* (Dweck, 2006).

The two mindsets lie on a continuum. However, having a growth mindset does not mean an absence of a fixed mindset or vice versa. People do not have either a fixed or growth one; you can have a fixed mindset in one aspect of life while having a growth mindset in another. Although, it is impossible to approach a task from a fixed and growth mindset simultaneously.

A core idea is that some people perceive intelligence as fixed, while others believe it continues to change. If you have a fixed mindset, you will assume that your intelligence, talents, and other abilities cannot be changed or altered. A fixed mindset will lead you to believe you are not talented or intelligent enough, nor is there anything you can do about it. This mindset would lead you to engage exclusively in

activities where you excel because your fixed mindset keeps you from trying new things.

According to Dweck and her colleagues, there are some brain differences among people with different mindsets. Higher brain activity was observed among people with fixed mindsets when they were told their answers to a series of questions were right or wrong. The higher brain activity resulted from focusing on whether they succeeded or failed. However, they showed no interest when the researchers offered to help them learn from their mistakes. These participants believed they could change and therefore were not motivated to try or learn (Dweck, 2007/2010). The research implies that because of high activity in the participant's brains, their brains were functioning normally; however, their fixed mindset involved beliefs that they could not improve and, therefore, they did not.

On the other hand, some people believe that effort, perseverance, and drive can help them develop their natural qualities. This is a growth mindset. If you have this mindset, you can accept feedback and mistakes as an opportunity to improve. A growth mindset also allows you to consider the learning process enjoyable and productive. Having a growth mindset makes you more engaged in every aspect of learning and development, which Dweck calls "purposeful engagement".

The interaction of genes and the environment leads to the development of intelligence. Nature versus nurture has been a hot debate for decades. However, it is crucial to consider both factors as the environment influences the activation of genes throughout the lifetime (Gottlieb, 1998). Even though the concept of nature vs nurture within personality development is a major topic of discussion, according to Dweck, people may develop their skills, abilities, talents, and

intelligence through experiences, learning, and training. You can continue to grow, overcome obstacles, learn from experience, work harder, and try again through purposeful engagement. Even though a person may not be "smart enough", having the right mindset results in continual improvement in skills and beliefs needed to succeed.

By applying the theory of neuroplasticity, Dweck believes that you can adopt a growth mindset at any stage of life. You can realize your potential through continuous learning by developing a growth mindset. She also asserted that praise focused on the individual's result reinforces a fixed mindset as they learn that trying does not matter. When someone does well, giving them recognition based on their effort encourages growth as this recognition rewards the learning process, resulting in more motivation to strive hard toward goals.

Dweck (2016) pointed out the three areas of confusion that some people raise about her research. First, having a growth mindset is sometimes confused with open-mindedness and positivism. People think that because they have a growth mindset, they will continue to have it. They are confident that the growth mindset will not fade away. Second, some people believe praise and reward matter the most. However, Dweck demonstrated that acknowledging the process of finding an answer is vital. The motivation to attempt more complicated and complex problems comes from the praise focused on the method used to find a solution. Lastly, people think being vocal about having a growth mindset or putting up posters is enough. Dweck asserted that fostering and creating a growth mindset culture or environment requires effort and strategy.

Part of having a growth mindset is the understanding that even when you take calculated risks, you may still fail. The difference between a

fixed and growth mindset is the ability to perceive failure and recover from it. People who constantly improve and maintain a growth mindset have the following characteristics (Dweck, 2006, p. 245):

- Can embrace challenges
- Persistence when facing setbacks
- Ability to see effort as a route to mastery
- Open to learning from criticism
- Being able to find lessons and inspiration from the success of others

To sum up, shifting our perspective from fixed to growth is a desirable strategy to achieve our goals in life despite our limited abilities. However, because of the complexity of the human brain, relying on a single concept to achieve short- and long-term goals is not enough. We need a growth mindset, but we won't achieve our goals without the grit to keep going and the resilience to withstand knock-backs.

Importance of Grit and Resilience in Growth Mindset

Grit is described as a persistent, unwavering effort toward a goal, even when experiencing temporary struggles and failures in life. On the other hand, the ability to bounce back or get back on your feet after a setback or failure requires resilience. Some people have more resilience and grit; however, these qualities can be developed if you are not strong in this area. According to the contributors of *The Road to Resilience* by the American Psychological Association (2012), resilience is,

"The process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress — such as family and relationship problems, serious health problems or workplace and financial stressors."

However, the engine that propels us to move toward our goals is resilience, and the oil that keeps the engine running is grit (Miller, 2022). The difference between these two highly connected character traits is resilience is the optimism to move forward despite setbacks and failures, even when others see the situation as futile or impossible to overcome. Grit, on the other hand, is the force that allows a person to persevere in difficult circumstances over time (Lechner, 2016). Building grit and resilience facilitates the development and sustenance of a growth mindset.

The combination of the character traits, resilience, and grit may contribute to growth mindset development. Grit and resilience are often referred to as crucial aspects in coping with mental health pressures and are used to illustrate the capacity to persevere in a difficult situation to meet goals (Stoffel & Cain, 2018). For instance, according to Dweck's (2014) study, students' math scores showed improvement when they learned about the mechanism of the brain to form newer and stronger connections which over time could make them smarter. Therefore, they started to believe in their capability to grow and develop, which calibrates them to have a growth mindset. Yet, improving and developing yourself is not easy as you may experience setbacks and challenges. To strengthen the growth mindset requires unwavering persistence and effort (grit) and the ability to stand up and stay positive despite the obstacles (resilience).

Goal Setting

The Harvard Authors Spotlight features Angela Duckworth in their Harvard Crimson Article published on April 2022. In the article, she talked about goal setting. Duckworth used a simple metaphor to explain how achievable goals allow us to find a pathway to a more fulfilled life:

"The paramecium is a single-celled organism, one of the most primitive on earth… And when it hits an obstacle, it backs up, it changes its angle, and tries again."

Duckworth wanted to convey to the readers that instead of restricting ourselves to a life-long passion based on our current decisions and plans, we need to regularly step back and think of ourselves as a paramecium that moves with genuine interest and curiosity in the face of obstacles. For Duckworth, changing your plans is not a lack of progress but rather growth.

Ducksworth used herself as an example. She had a goal she wanted to achieve; however, she stepped back, thought about her life choices, and eventually changed her plans. Originally, Duckworth wanted to attend medical school after graduating from Harvard with a bachelor's degree in Advance Neurobiology. On reflection, she decided to take a PhD in Psychology at the University of Pennsylvania.

Another metaphor to explain this concept is the north star. Our ultimate or top-level goal is similar to a north star - that overriding desire that guides all decisions. Duckworth's experience does not cancel out the value of having a purpose. Knowing your goals and having a strategy to achieve them brings a sense of satisfaction.

However, she asserted that people labour under intense pressure to find a remarkable passion or their "north star" when they should rather delve into various interests and values. How do we find our values? Duckworth advised that we find them by looking for patterns and themes in our lives that motivate us to take or avoid action. For example, does the value of safety drive your efforts more than kindness? In Duckworth's example, she knew she was interested in human nature and loved words. She valued kindness and excellence. In deciding whether to continue her original PhD plan or change, she looked for the intersection of her interests and values.

Once you find the intersection of your interests and values, it is important to remain hopeful and goal-oriented in the face of adversity. Duckworth said:

"My recommendation isn't just, 'Hey, be gritty!' I'm convinced that pep talks don't do very much for anyone."

Ducksworth further stated that we need to "notice" the feelings of exhaustion, burnt-out, or hopelessness. Then we need to ask ourselves this question:

"I wonder why that is? What's going on in life that makes me feel this way?"

When we encounter failure or external challenges, Duckworth said we must do deep, personal reflection. By reflecting, we can have "agentic hope", which is a belief that *"I can do this if I try"*. Therefore, in goal setting, it is important to determine our interests and values in life, where they intersect and to notice what we feel during difficult times. Setting goals is not an "Aha!" moment that springs from nowhere.

This process necessitates a careful assessment of ourselves and our traits (e.g., grit, mindset, and passion) that help in difficult situations.

Part III: Increasing the Power of the Brain - PISTA and its Application

Our brain is involved in all aspects of our life and our daily activities. It allows us to control our actions and reactions, think and feel, and have the privilege of having memories and emotions. The complexity of our brain and its functions make us human. However, as we age, our brain also ages, and it is a sad fact of life that as we age, our brain's performance will decrease, notably in the area of cognitive functioning.

Although the effects of brain ageing, such as a decline in cognition, vary from person to person, no one can stop its progressive degeneration. However, there are things everyone can do to prevent the severe consequences of cognitive decline by taking care of ourselves early. As for older adults, some interventions can help them improve the quality of their life despite the effects of cognitive decline. The importance of self-awareness and prioritizing brain and mental health is highly encouraged to lessen or manage the potential repercussions of cognitive decline and to increase brain health.

The Brain does not Slow Down until the 60s

In an earlier section of the book, we mentioned a study conducted by researchers from the University of Virginia showing that cognitive decline starts in our 20s. The research suggested that our cognitive skills, such as making rapid decisions, remembering unrelated

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information, and detecting relationships, peaked in our late 20s to early 30s and then began to decline slowly. However, newer research studies indicated that the earlier research never considered decision caution or slower non-decision processes.

According to a study published in *Nature, Human Behaviour*, authored by Krause et al. (2022), overall mental speed levels do not reduce until later in life. The researchers gathered data from 1,185,882 individuals between the ages of 10 and 80. They used an online tool to collect information about their perceived gender, race, and other biases they held. The test helped the researchers analyse the response time and accuracy of the participants according to their age. The test activity demonstrated that the processing speed of deciding which answer was correct slowed when participants reached 60 years old. In other words, although response times did slow after the 20s due to decision caution, the mental process of making a decision did not slow until age 60.

With the help of machine learning, the analysis tells us that 20-year-olds make quicker decisions when answering the test as they focus more on speed than accuracy. A person's processing speed peaks at about age 30 and then declines very slightly between the ages of 30 and 60. The individuals in the study also committed fewer errors as they got older, at least until they were around 60 years old.

What Exactly is this Research trying to Tell Us?

The research tells us that as we age, our mental speed slows. Our mental processing speed slows down because we become more cautious and concerned with avoiding mistakes. However, our speed of making decisions does not slow until we are 60, nor, according to

the research authors, does it affect us for much of our lives. We also tend to slow our thinking as we become more cautious of our decisions and actions, indicating that our healthy brains remain effective until old age.

James Giordano, a professor from Georgetown University, said in an interview with Healthline (2022) that a healthy brain can function at full capacity throughout our life. Giordano stated,

"In reality, as we become older, the brain nodes and networks that have been established throughout our lives can get more efficient at associating and relating former and current experiences to predictive predictions."

Furthermore, he asserted that two crucial sayings describe the brain's network capabilities' effectiveness and efficiency. Firstly, "*nerve cells that fire together, wire together"*, meaning the brain nodes and networks are intended to engage and be used together. Secondly, *"if you don't use it, you tend to lose it".* This implies that as we age, our life experiences form and strengthen a specific neurological network, but the other network connections weaken if not used.

Periods of inactivity do not mean the brain cannot recover. A healthy brain holds on to its ability to restore and form node and network connectivity throughout old age. The brain just requires appropriate stimuli to maintain these mechanisms, implying the importance of lifelong brain health

PISTA
Processing Inner Strength Toward Actualization

Since 1969, researchers have been studying the use of sound and light frequency to treat neurological and cognitive diseases. New techniques involving sound, light, and vibration frequency are constantly being developed and utilized to modify behaviour. The modalities and protocols applied throughout the treatment period stem from 45 years of PISTA evidence-based research. The PISTA Institute emphasizes the philosophy of stimulating the mind to create new neural pathways crucial in brain training.

PISTA for All Ages

The PISTA method applies to all age groups. Intervention to prevent cognitive decline in old age starts in primary school. Teaching students to build a strong inner self enables them to manage their complex emotions, make good decisions, resist peer pressure, and remain academically motivated. Between the ages of 8 and 10, PISTA focuses on teaching students concrete thinking strategies to help pre-teens develop self-confidence, resilience, and self-awareness. Other important skills are learning, memory, social skills, and organisation. PISTA helps pre-teens develop motivation, good study habits, concentration, and attention through the PISTA learning modality.

Between 11 and 13, children enter a critical developmental phase. Children change schools, say goodbye to familiar surroundings and friendship circles, navigate a new school system with more complex work and establish new friendships. They start developing their self-

identity based on social interactions while undergoing physical and hormonal changes.

Developing healthy coping strategies such as being aware of negative thinking patterns, cognitive distortions, managing peer pressure, bullying and changes in appearance allow students to practice and build correct behaviour patterns. Students need strategies to deal with the varying intensity of emotions they experience so they can remain focused and motivated in their studies. These strategies promote cognitive equilibrium as they manage the complex demands of finding their study, family and career path that will challenge and satisfy them.

The PISTA method guides individuals of any age to know themselves, their desired outcome, and the behaviour required to achieve their goals. It provides a way to build inner strength and resilience to protect against factors such as depression, anxiety and cognitive distortions that increase the risk of dementia**.**

The Science behind PISTA

Research findings have documented the efficacy of PISTA. The data gathered from numerous studies, including longitudinal research over three generations, demonstrates the effectiveness of the PISTA modalities. Research has focused on applying sound and vibration to different experiences, such as memory and learning, cognitive decline, panic attacks, and traumatic experiences. Using sound and vibration within a psychological framework encourages the brain to process memories and emotions correctly. The results found that research participants gained deep insight into their situation. Together with a trained PISTA coach, they could use this insight to make the necessary

changes to overcome anxiety, reverse cognitive decline, and reframe trauma.

PISTA uses a complete system of healing that incorporates mechanical, psychological, bio-force, and biochemical aspects into its modalities. The PISTA modalities are different approaches based on a person's specific needs. Each modality uses stimuli and the guidance of a licenced PISTA coach to help a person reach deep within themselves and identify the real issues and the corresponding resolutions.

All the modalities encourage a person to question and self-examine their reoccurring thoughts to reduce stress and change thinking patterns. The modalities are applied to help a person manage their symptoms, ensuring the individual can function correctly at work, at home, or in society. Using these modalities, a person can identify incorrect patterns of behaviour causing pain and practice corrective habits that lead to a more fulfilled life. Instead of feeling demotivated and uncertain, we can wake up energized and motivated, feel good about ourselves, and use this momentum to move towards our goals.

The core of PISTA modalities is based on neuroplasticity - the ability to change how our brain works by modifying thought patterns which result in significant changes to the brain's structure. To achieve the desired outcome, PISTA utilizes brainwave feedback, brain training, brain entrainment, stimulation, self-regulation procedures, and coaching to change the mechanism of the brain and improve inefficient mental activities.

Neuroplasticity

During our lives, we will face environmental changes or situations that require us to adapt, for example, growing up and moving away from home, forming a relationship, getting married, the death of a loved one, or entering retirement. We need to change and adapt as circumstances change throughout life. In response to our life experiences, our brain changes by reorganizing its structure and function. This is called brain plasticity or neuroplasticity.

Technically, neuroplasticity refers to the capability of neural networks in the brain to restructure and adapt to environmental changes. Neuroplasticity comprises changes in the brain's circuit and network due to learning, environmental factors or influences, and psychological stress. *Neuro* means the building blocks of the brain and nervous system, which are the neurons, while *plasticity* is the brain's capability of being shaped, trained, or controlled. To better grasp the concept, consider neuroplasticity as Play-Doh clay that can be shaped and changed into various forms.

Although research suggests that over time the brain experiences a decline in neurogenesis - the ability of our brain to grow new neurons - our brain can still manage because of its plasticity. Brain plasticity can reorganize pathways, build new connections, and in some instances, even generate new neurons (Cherry, 2022). Scientists thought that neuroplasticity only manifests in childhood, yet 20th-century research demonstrates that various aspects of the brain are "plastic" and can be corrected during adulthood. However, the brain's degree of plasticity is higher in the developing brain, until our 20s, than in the adult brain.

The Origin, Research and Discovery of Neuroplasticity

In 1890, William James first used the term plasticity in his book explaining behaviour, *The Principles of Psychology*. He suggested that the brain and its function are not fixed throughout adulthood. However, the notion was generally neglected until the 1970s. Neuroscientists and researchers from different fields have also broadly applied the term. Ramón y Cajal, the father of neuroscience, also used neural plasticity to explain nonpathological changes in the structures of adult brains. His neuronal doctrine defined the neuron as the fundamental unit of the nervous system, which later served as an essential foundation for improving neural plasticity.

In 1923, plasticity was demonstrated through changes in neuronal pathways among rhesus monkeys. Despite the evidence from this experiment and other research that proved the concept of plasticity, neuroscientists continued to reject the notion of neuroplasticity. Justo Gonzalo, in 1945, further hypothesized that the central cortical mass was a "manoeuvring mass" that could restructure its functions with its neuroplastic properties. Marian Diamond, from the University of California, produced the first scientific evidence of anatomical brain plasticity. Her research was published in 1964. Studies from individuals recovering from strokes also demonstrated evidence for neuroplasticity. This area of research was pioneered by Shepherd Ivory Franz, who asserted that destroyed brain functions are compensated by brain regions that remain healthy.

For over three decades, neuroscientist Michael Merzenich pioneered neuroplasticity by providing the most ambitious claims for the field. He claimed brain exercises might be as efficient as medication in

treating severe disorders such as schizophrenia because, regardless of age, plasticity allows dramatic changes in cognitive function, even in the elderly.

David Hubel and Torsten Wiesel's research on kittens impacted Merzenich's research. Their experiment first recorded the cortical brain maps of a kitten, and then they sewed the kitten's one eye shut. They noticed that the kitten's brain region linked to the closed eye was not inactive, as they had expected. Instead, the part of the brain responsible for the closed eye processed the visual information from the open eye *"it was as if the brain did not want to waste any cortical real estate and had figured out a method to rewire itself".*

Merzenich further implied that the neuroplasticity occurred during the critical period (maturation stage) and extended beyond the critical period. He and Clinton Woosley conducted an experiment based on observing the brain when one peripheral nerve was severed and later regenerated. In their investigation, they micro-mapped the hand maps of monkeys' brains before and after slicing a peripheral nerve and sewing the ends together. Eventually, the hand map in the brain they believed to be tangled returned almost to normal, providing a substantial breakthrough. Therefore, the idea that we are born with a hardwired system is incorrect; the brain map can correct its structure in response to abnormal input, indicating that the brain is plastic.

Types of Neuroplasticity

To understand how our brain changes its biological, chemical, and physical capacity, we need to understand its ability to change its

structure and function. There are two main types of neuroplasticity, functional and structural plasticity.

Functional plasticity is the brain's tendency to redirect functions from a damaged area to an undamaged area (Gamma, 2021). When brain functionality is lost due to injury, the existing neuronal pathways that are inactive or used for other functions will compensate. Our brain will try to look for unused functions in the brain to compensate for the loss. For instance, in brain injury caused by strokes or accidents, the unaffected brain areas will adapt and perform the functions of the damaged or affected area of the brain. The unaffected brain area serves as a proxy.

Conversely, structural plasticity is when the brain changes its physical structure and reshapes individual neurons because of learning (Gamma, 2021). Multiple cross-sectional imaging methods, such as magnetic resonance imaging (MRI) and computerized tomography (CT), are utilized to study the structural changes in the human brain. Structural plasticity usually examines the effect of different internal or external stimuli on the brain's anatomical restructuring. Two examples are the grey matter proportion and synaptic strength changes in the brain.

During infancy, the brain undergoes significant growth in the number of synaptic connections (the direct connection between neurons). The number of synaptic contacts between neurons grows because developing neurons are sent out to various branches, resulting in stronger synaptic connections. In younger years, the structure of our brain changes because we have many things to learn from educational, personal, and environmental experiences. Yet, as we age, the connections we do not use are deleted, and the frequently utilized ones

are strengthened (Purcell & Zuckerman, 2011). This process is called neural pruning, and it continues throughout our life.

Although plasticity occurs throughout life, developing senses, language, and other skills is vital during the critical early years when brain plasticity is still active. One form of functional and structural neuroplasticity that can substantially affect healthy development, learning, memory, and recovery from damage is the activity-dependent plasticity that occurs from cognitive functions and personal experiences. Thus, activity-dependent plasticity is the biological foundation for learning and memory formation.

Activity-Dependent Plasticity

Activity-dependent plasticity is a type of structural and functional neuroplasticity that involves cognitive function and personal experiences. Activity-dependent plasticity develops from intrinsic activity rather than extrinsic factors, such as brain training or drug-stimulated neuroplasticity (Ganguly & Poo, 2013).

The brain's mechanism to restructure itself forms the basis of the brain's capability to keep memories, develop motor function, and increase comprehension and speech, thus helping a person function daily. Changes in gene expression caused by cascading signals activated by several molecule signals such as calcium, dopamine, and glutamate during increased neuronal activity result in active-dependent plasticity (Flavell & Greenberg, 2008).

Because of the brain's ability to adjust to active functions, humans develop specific skills through relative use and activity. For instance,

a left-handed person may have poor handwriting using the right hand, but with constant practice, it may result in ambidexterity.

An example of active-dependent plasticity is rewiring the brain to alleviate the effects of neurological dysfunction among people born with a neurological disorder (e.g., autism). Brain rewiring may lead to the capability to retrieve the loss of function caused by the disorder through practice, interventions, or therapy.

Significant Role in Learning

Active-dependent plasticity is crucial in learning and comprehension as it is responsible for assisting the brain to adapt correspondingly to the required amount of usage and functioning. The brain's capability to keep and form memories based on the activities that make changes in synaptic strength may result in more knowledge acquisition. The ability of the dendritic spine to grow and adapt is the foundation for synaptic plasticity linked to learning and memory (Sala et a., 2008).

Consequently, current studies discovered that the microRNA 132 gene (miR123) has a significant role in synapse growth and activity-dependent plasticity. This gene can enhance dendritic growth by activating the cAMP response element-binding (CREB) protein pathway. Hence, the mri132 gene is another element responsible for the brain's plasticity and plays a role in establishing stronger links between neurons.

The Development of Brain Plasticity

During childhood, substantial development and changes in the brain's anatomical structure and connectivity take place, presenting striking

evidence for plastic brain changes at an early age. A marked increase in synaptic density peaking significantly above the level found in adults occurs during early postnatal brain development. However, as we age, the synaptic density undergoes pruning (deletion of old connections). From adolescence onwards, the primary sensory and motor regions mature earlier than regions that serve more complicated functions (Rapoport & Gogtay, 2007).

Part of normal development in childhood is the active development of neuroplasticity which is an essential process for children in terms of risk and resiliency (Masten, 2011). Trauma is seen as a significant risk because it affects numerous areas of the brain and causes a strain on the sympathetic nervous system because of continuous activation. Stress affects the connections in the brain, causing children exposed to trauma to become hyper-cautious or highly stimulated (Schore, 2001). Despite the adverse effects of trauma, a child's brain can cope through the actions of neuroplasticity (Cioni et al., 2011).

According to transcriptional profiling (a process to quantify gene expressions) in the frontal cortex of individuals aged 26 to 106, a set of genes will have a reduced expression after age 40 and even more so after age 70. In synaptic plasticity (changes in synapses that occur between neurons to permit them to communicate), age significantly affects the genes by showing reduced expression over time (Lu et al., 2004).

Moreover, as people get older, weaker synaptic connections are deleted. Yet, the stronger synaptic connections remain and are strengthened because of synaptic pruning. Experience determines the process of enhancing or pruning neural connections. The most frequently activated connections are retained. Neurons that have

weaker synaptic connections or are not effective will be deleted through the process called apoptosis. Neuroplasticity enables the brain to adapt itself to its changing environment through pruning and apoptosis.

The brain's ability to change and adapt during learning and memory retention also contributes to the development of plasticity. The changes in the brain during the learning process involve changes in the internal structure of neurons and an increased number of synapses between neurons (Durbach, 2000). Learning rewires the brain, which allows it to adapt to new environments.

For instance, learning more than one language leads to better cognition due to neuroplasticity, according to research. The beneficial effect of multilingualism is also well-known on people's behaviour and cognition because research demonstrates that people who learn more than one language display better cognitive functions and flexibility than those who speak one language. Longer attention spans, enhanced skills analysis, organisational skills, and a better theory of mind are found among bilinguals.

Leaning multiple languages restructures and boosts the brain's capacity for plasticity, affecting the brain's grey matter and white matter associated with learning and communication. Neurolinguistics used the diffusion tensor imaging (DTI) scanning method to compare the intensity of white matter between monolinguals and bilinguals. Bilinguals who used both languages showed enhanced myelination in white matter tracts. Because of the demand for speaking more than one language, the brain requires more efficient connectivity, resulting in increased white matter density among multilinguals.

Injury or damage can also induce plasticity in the brain. Plastic changes in the brain after an injury are focused on maximizing function. In experiments, brain cells surrounding a damaged section of the brain in rats experienced changes in function and form that allowed them to take over the roles of the damaged cells in tests. Even though this phenomenon is not yet extensively explored in humans, data suggests similar (albeit less effective) modifications occur in human brains after damage (Pliatsikas et al., 2015).

The Power of Neuroplasticity: Examples and Applications

Our brain does not have a fixed or permanent neuronal circuit - cortical and subcortical rewiring occurs in reaction to training and injury. For instance, according to research, neurogenesis is mainly restricted to the hippocampus and olfactory bulb. However, current research also shows that the birth of brain cells occurs in other parts of the brain, particularly the cerebellum. The theories of brain functioning influenced by the concept of neuroplasticity include the general idea of mind and neural Darwinism. Moreover, brain plasticity is also crucial in explaining memory and learning associated with experience-driven changes in synaptic structure and function in classical conditioning studies.

Brain Damage Treatment

The brain activity associated with a specific function that was relocated to other areas during the process of recovery from a brain injury is a remarkable outcome of neuroplasticity. The brain is working to compensate for the unperformed function by the injured

area by transferring the functional activity to different locations. The brain will restructure or change itself to heal.

The scientific basis for treating acquired brain injury using goal-directed experiential therapeutic programs in rehabilitation settings relies on the notion of neuroplasticity. In fact, the mechanism of change, such as constraint-induced movement therapy, functional electrical stimulation, supported body-weight treadmill training, and virtual reality therapy, are supported by evidence suggesting these rehabilitation techniques cause cortical reorganization (neuroplasticity). Although there is a need for more data to define the precise mechanism of change when employing robot-assisted therapy, it is regarded as an emerging method speculated to comprehend the mechanism of neuroplasticity.

Increased progesterone injections in patients with brain injury were a treatment developed to reduce oedema, inflammation, and neuronal death and enhance spatial reference memory and sensory-motor recovery. After three days of progesterone injections, according to a clinical trial, a group of severely injured patients had a 60% reduction in mortality. However, a study published in the New England Journal of Medicine in 2014 shows that using the hormone progesterone to treat acute traumatic brain injury provided no substantial assistance to the patients compared with a placebo. There is currently insufficient research confirming the efficacy of progesterone in treating brain injury.

Binocular Vision

For decades, scientists believed that people had to develop binocular vision, specifically stereopsis (depth perception), in early development, or they would never acquire it. Binocular vision is the ability to hold visual attention to a particular object using both eyes to generate a single visual image. Usually, binocular vision is absent in infants; however, it may cause distortions in in-depth perception and optical measurement of space in adults. Successful changes in people with amblyopia (poor eye vision in one eye), convergence insufficiency (inability of eyes to work together while seeing a close object), and other stereopsis anomalies have become clear examples of neuroplasticity in recent years (Maino, 2009; Vedamurthy et al., 2012; Hess & Thompson, 2013).

Phantom Limbs

It is oddly common for 60-80% of amputees to have sensation or discomfort in the part of their body that has been amputated. Meaning, amputees still feel like their missing limb is attached to their body. This sensation is known as the phantom limb. The concept of neuroplasticity helps to explain this phenomenon. Phantom limbs happen because the cortical maps of the body's removed limb are thought to remain involved with the area around them in the postcentral gyrus, the sensory receptive region of the brain for the sense of touch. As a result, the information in the cortex encompassing the amputated limb is misinterpreted by that part of the cortex responsible for the amputated limb.

In the early 1990s, Ramachandran, an Indian American neuroscientist, hypothesized that phantom limbs result from cortical remapping. Our brain creates a new cortical map when an existing cortical map is affected by a stimulus such as amputation or changes in neuronal characteristics. For instance, if the hand was amputated, the existing cortical map for that hand is no longer relevant and will be remapped by the brain.

Herta Flor and her colleagues further argued that cortical remapping happens only among patients with phantom pain. Flor and colleagues said that brain changes resulting in negative or maladaptive outcomes, called maladaptive plasticity, were evident. This notion asserted that a signal mismatch is interpreted as painful because the adjacent body parts occupy the missing area. For instance, when a person loses an arm, the representation in the brain for the missing arm is claimed by adjacent body parts such as the lip or the opposite hand (e.g., the pain received in the hand may be interpreted in the area of the amputated arm).

Another experiment also demonstrated that the brain indeed manages to alter itself. In 2009, Lorimer and Peter Brugger conducted a study where they urged arm amputee subjects to utilize visual imagery to distort their phantom limbs into impossible configurations. Seven amputees with phantom arms perform a wrist movement with the phantom limb that is impossible with an actual wrist, implying that the participants changed the neural representations of their phantom limbs and created motor instructions required to perform impossible movements without body feedback.

Chronic Pain

Neuroplasticity may play a role in managing and treating chronic pain. People who suffer from chronic pain may experience persistent pain in areas that have been previously injured but are now healthy. Neuroplasticity is related to this sensitization phenomenon because of the maladaptive reorganization of the peripheral and central nervous systems. The maladaptive reorganization, or maladaptive neuroplasticity, amplifies the pain signal transmission to the brain.

The components making up the central nervous system include the brain, spinal cord, and nerves; they may experience a central sensitization, a condition liable for the progression and maintenance of chronic pain. It occurs when the nervous system begins to adjust negatively to pain signals after persistent stimulation of pain receptors (nociceptors), leading to changes in the processing of pain signals. The nervous system will then undergo a process described as wind up. The process involves increased responsiveness of our "warning system" to less stimulation (activities, sensations) and increased pain signals. Correspondingly, the pain volume increases, leading to more sensation of pain (Carter n.d.).

The volume of grey matter in the brain, specifically in the prefrontal cortex and right thalamus, is reported to decrease significantly due to chronic pain (Apkarian et al., 2004). Yet, the abnormalities in cortical restructuring and grey matter, as well as their symptoms, are resolved after treatment, which is also documented for phantom limb pain, chronic low back pain, and carpal tunnel syndrome.

Deafness and Loss of Hearing

The brain areas of people who are deaf or have hearing loss show compensatory plasticity in the auditory cortex and other associated areas. For example, the auditory information is usually processed in the auditory cortex, but this area can be redirected to serve other functions, particularly for vision and somatosensorial.

Enhanced peripheral visual attention, improved motion, effective visual search, and quicker response time for visual targets are more evident among deaf individuals than hearing individuals. This is because, in congenitally deaf patients, brain areas that receive auditory information have been rearranged to process somatosensory information. They have a better sensitivity to detect frequency changes in vibration over the threshold and more extensive activation of the auditory cortex when stimulated with somatosensory stimuli. Deaf adults, on the other hand, do not have a faster response to tactile stimuli (Pavani, 2014).

Blindness

The visual cortex in blind people may also go through cross-modal plasticity due to vision loss, resulting in substantial abilities of other senses. Various research has also revealed impaired hearing abilities in auditory distance evaluation, proprioceptive reproduction, and threshold for visual bisection, all of which support the latter theory (Cappagli et al., 2017).

Therefore, the brain is rewiring to make functional changes to compensate for the deficit sensory in blind people by allowing the

unaffected brain regions to perform the function of the damaged sensory area.

For instance, blind people use their learned ability to sense and navigate their environment and be aware of their surroundings in detail. This ability is called human echolocation. Functional magnetic resonance studies show that the new skill of echolocation is associated with the parts of the brain associated with visual processing (Arnott & Goodale, 2010-2011), indicating neuroplasticity is at work. Moreover, click-echoes heard by blind patients were also processed by brain regions in charge of processing the vision rather than the auditory area (Arnott & Goodale 2011).

Attention Deficit Hyperactivity Disorder (ADHD)

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MRI studies were conducted on 1713 participants, comparing those with ADHD to those without. The study found that children and adults with attention deficit hyperactivity disorder (ADHD) have smaller volumes in some areas of the brain (e.g., nucleus accumbens, amygdala, caudate, hippocampus, putamen, cortical and intracranial volume). Those with ADHD also had less surface area and cortical thickness than those without ADHD (Hoogman et al., 20017). Moreover, peer reviews of electroencephalography (EEG) and MRI studies assert that long-term stimulant treatment of ADHD, such as amphetamine or methylphenidate, reduces brain structure and function abnormalities. The long-term stimulant treatment also enhances function in various brain parts (e.g., right caudate nucleus, left ventrolateral prefrontal cortex, and superior temporal gyrus). Contrary to other conditions, stimulant medication helps the brain

plasticity compensate for the structural deficit in the brain of people with ADHD.

Depression and Anxiety

Neuroplasticity is an important feature of the brain that responds to internal and external triggers, including stress and depression. Several studies have researched the link between neuroplasticity and depression. The effects of depression on neuroplasticity may cause damage to the brain, which discourages healthy and adaptive pathways and allows unhealthy and maladaptive ones to form. For instance, the essential process of neuronal adaptation, which is neural plasticity, is disrupted in depression. Stress and other negative stimuli (e.g., pain and cognitive impairment) induce changes in neural plasticity, which significantly affect the onset and progression of depression (Liu et al., 2017).

On the brighter side, some treatments for depression appear to aid the damage and may reverse it with the help of brain plasticity. Neuroplasticity studies found that daily activities can majorly impact brain structure and function, allowing for healing and recovery from psychiatric diseases (Hellerstein, 2011).

The principles of neuroplasticity are also applied to manage and treat anxiety disorders because of the brain's ability to rewire and remodel itself, helping us improve our ability to manage anxiety. Understanding neuroplasticity allows you to overcome anxiety by employing customized neuroplastic therapies. Neuroplasticity emphasizes how some coping methods or management techniques can

cause changes in the brain, making it easier to cope but more challenging to recover completely.

Hence, achieving permanent brain changes to reverse anxiety takes time and effort. Modifying and adjusting thinking patterns, retrieval, and memory planning, breathing exercises, eye patterning, modifying postural habits, enhancing body awareness, and targeting sensory perception are all ways to produce more permanent brain alterations (Cleary, 2015).

Neuroplasticity, Meditation, and Exercise

Meditation is one of the strategies to enhance GABA levels to improve learning, brain plasticity, and cognition. This relationship has been explored in previous sections of the book. Exercise is proven as a factor in the brain's network development and as a way to increase GABA levels. This section will discuss the role of meditation and exercise in neuroplasticity.

Meditation

The more we meditate, the more mindful we become, leading our brain to adapt to this aware state as a default state. Hence, practitioners who habitually practice mindfulness meditation acquire positive influence even when not actively meditating. They have trained their brain to be attentive, peaceful, and grounded in the present time (Ackerman, 2022).

Researchers from the University of Wisconsin took advantage of neuroplasticity. They discovered that meditation positively increases

the neural grey matter thickness of specific brain regions, causing our brains to be larger, sharper, and faster.

Likewise, continuous meditation stimulates neuroplasticity, lessening age-related brain degeneration and increasing cognitive functions. Due to the altered brain connections among meditators, the outcome of meditation was associated with improvements in attention, working ability, spatial abilities, and long-term memory. Also, there are long-term changes in structural connectivity due to the constant practice of meditation, which may cause neural plasticity (Lardone et al., 2018).

Meditation practice is also related to differences in cortical thickness or density of grey matter. Harvard University's Sara Lazar and University of Wisconsin's Richard Davidson led the experiment that demonstrated the benefits of meditation on the brain. They collaborated with the Dalai Lama and the school of Tibetan Buddhism in the year 2000. The results suggest that different levels of activities in brain regions related to attention, anxiety, depression, fear, anger, compassion, and the ability of the body to heal itself are associated with the long-term and short-term practice of meditation. The functional alterations may lead to changes in the physical structure of the brain (Greischar et al., 2004; Begley, 2007; Davidson & Lutz, 2008; Frith, 2007).

Physical Exercise

Exercise has an undeniable benefit to our body and brain, and it can enhance neuroplasticity and slow down Alzheimer's disease. Physical activity can help the brain make functional and structural changes in the brain. Aerobic exercise fosters adult neurogenesis (the formation

of new neurons) through increased production of neurotrophic factors. These compounds boost the development or survival of neurons (Tarumi & Zhang, 2014). The formation of new neurons in the hippocampus due to exercise is also associated with measurable improvements in spatial memory (Erickson et al., 2014).

Moreover, several months of constant aerobic exercise significantly increases executive functioning (i.e., cognitive control) and grey matter volume in multiple brain regions, notably those that give rise to cognitive control (Gomez-Pinilla & Hillman, 2013).

In response to aerobic exercise, the brain structures exhibiting the highest increase in grey matter volume are the prefrontal cortex and hippocampus. There is a clear moderate increase in the anterior cingulate cortex, parietal cortex, cerebellum, caudate nucleus, and nucleus accumbent, all related to cognitive functioning. Higher levels of physical fitness (as measured by VO2 max) are also associated with improved executive function, quicker processing speed, and increased hippocampus, caudate nucleus, and nucleus accumbens volume (Erickson et al., 2014).

Brain Training

The advancement of the concept of neuroplasticity has led to the era of cognitive training. Cognitive training, also known as brain training, is a non-pharmacological method that entails different mental activities intended to maintain or improve cognitive functioning and mental fitness. Some brain training activities focus on mental abilities such as attention, flexibility, problem-solving, reasoning, and working memory. Brain training can take place in various modalities, such as

physical exercise, playing video games, dance, art, and music, maintaining social engagements, and participating in learning activities (Cherry, 2021). The concept of neuroplasticity is at the core of brain training. Research reveals how the brain structure changes when an individual undergoes cognitive training activities. For instance, experts in music and London taxicab drivers demonstrated an increased volume in certain brain areas, indicating that being an expert in a particular field is significant in the brain's plasticity (Imfeld et al., 2009).

During early childhood development, the human brain has substantial plasticity that needs appropriate stimuli for proper growth. However, plastic adaptation, the ability to acquire new knowledge or skills, is slower in the adult brain. Yet, through magnetic resonance imaging (MRI), London taxi drivers demonstrate an enlarged posterior hippocampus compared with people who do not drive taxis (Maguire et al., 2000). The volume changes in the posterior hippocampus, the part of the brain linked with spatial navigation, is positively related to the time spent as a taxi driver. Thus, more time spent on driving leads to an enlarged hippocampal volume, explaining the capability of taxi drivers to learn an enormous number of routes to perform their job. The enlargement of the hippocampus has a significant role in taxi drivers' learning despite the slower adaptation among adults. (Leventhal, 2009). The study shows how brain plasticity (e.g., the enlargement of the hippocampus) works through brain training (driving a taxi).

In a 2008 study conducted among older adults trained in juggling, an increase in grey matter volume was evident (Draganski et al., 2004). In older people, cognitive training has been found to cause

neurological alterations such as increased blood flow to the prefrontal cortex and decreased bilateral compensatory recruitment (Reuter-Lorenz & Cappell 2008).

According to research, cardiovascular fitness is the most effective form of cognitive training because decreased cardiovascular fitness is associated with brain atrophy – the progressive deterioration of reduced muscle or nerve tissue. This implies that older adults who participate in a cardiovascular fitness activity have an increased volume in the prefrontal and temporal brain areas and improved memory function (Colcombe et al., 2006).

What are the Potential Benefits of Brain Training?

Cognitive training can help us because the activities enhance learning, problem-solving, and reasoning mental abilities. Several brain training activities aim to improve memory or concentration and increase attention. These cognitive abilities enable people of all ages to perform simple or complex tasks and function in life (Cherry, 2022). These qualities are associated with IQ, academic achievement, and general life success (Katz et al., 2018).

Mental abilities such as processing speed, reaction time, decision-making, short-term memory, and planning skills tend to decline with age. Brain training may be beneficial in improving these abilities and lowering the risk of age-related memory impairments. People should consider cognitive training as it slows down cognitive declines, helps older adults to maintain independence, and sharpens mental skills crucial in life (Williams & Kemper, 2010). For instance, training

focused on enhancing processing speed decreases the susceptibility to developing dementia a decade later (Edwards et al., 2017).

Cognitive reserve demonstrates the capacity of an individual to meet the various cognitive demands in life and the capability to integrate information, understand relationships, and develop reasonable assumptions and strategies. Therefore, regular training might help maintain and improve cognitive reserve (Scarmeas & Stern, 2003).

Is it Effective?

The efficiency of brain training is a highly debated issue and poses a growing public concern, particularly regarding brain training apps and games. The real problem stems from the aggressive online marketing of brain training games and apps, which claim to be beneficial for the elderly despite the lack of data to support this assertion. As a result, in 2008, a group of neuroscientists released a letter warning the public about the lack of research evidence on the benefits of brain games in older adults (Underwood, 2014).

It is necessary to discuss the "transfer effects" when discussing the effectiveness of brain training programs. Brain training abilities must be translated or applied to daily life and real-world activities to be effective. For instance, can that math formula that a brain training mobile application is helping you memorize be used in real-life situations? If yes, it is helpful for you to use that particular brain training application.

Some studies provide evidence about the transferability of brain training to daily life functioning. In one large-scale study, brain training was found to improve the cognitive performance of the

elderly, leading to long-term improvements such as remembering when to take their medications (Tennstedt & Unverzagt, 2013).

Another research study suggests that improving younger individuals' executive skills, such as working memory and processing speed, is attributed to brain training games (Nouchi et al., 2013). Likewise, according to a recent study, cognitive training programs for pre-schoolers are more effective among developmentally vulnerable children (e.g., ADHD or low socioeconomic status) compared to children with no risk and who experience normal development (Scionti et al., 2020).

Why does some research find brain training effective while others do not? The outcomes may differ because several factors must be evaluated (Hampshire et al., 2019).

Firstly, not all research studies look at the same thing. For instance, some research studies focus on examining the effectiveness of brain training in enhancing attention and some on memory retention. Since these two mental abilities are different, the brain training approach is different, and so is their effectiveness. The various types of brain training employed in research have varied results in the lab and how those skills are eventually transferred in the real world.

Secondly, it is also important to note the individual differences of the research participants. However, not all researchers consider this factor. Brain training may help some more than others, and for some, the training may not help at all. Memory training may benefit those with specific memory deficits but may have little to no impact on people with normal memory ability.

Lastly, brain training may have limited effects. While brain training is helpful, it is likely to be most successful for tasks identical to the training activity. It also suggests that prolonged brain training may bring more favourable outcomes.

PISTA and Brain Training

PISTA does not use applications or games to train your brain. PISTA uses modalities that include sound and vibration stimuli that stimulate your brain into a learning state. In this learning state, you can train your brain to activate new thinking systems by deactivating the maladaptive ones. When you deactivate harmful thought patterns, you are able to gain clarity about your emotions or situation. This clarity enables you to make better decisions. The PISTA modalities focus on transferable training that can be used in different situations (such as at home, in a meeting, or waiting for help on a customer helpline) to manage emotions, anxiety and behaviour. PISTA combines the concepts of neuroplasticity and brain training to reverse cognitive decline and improve a person's quality of life. Of course, in older adults, the reversal may not completely cure the cognitive decline.

Brainwave Entrainment:
Inducing Alterations in the Brain

PISTA is based on the science of brainwave entrainment, which activates and deactivates thought systems as part of the self-regulation process to produce desirable brain states. To better understand the use of sound within PISTA modalities, it is crucial to understand the concept of brainwave entrainment

What Is Brainwave Entrainment?

Brainwave entrainment is an approach to stimulating the brain to enter a specific state by utilizing a pulsing sound, light, or electromagnetic field. The brain's frequency following response is produced by pulses, encouraging the brainwaves to align to the frequency of a particular beat. A binaural beat is created by using the PISTA machine, enabling the mind to reach a specific altered state. It is like listening to music, except in brainwave entrainment, the sound with low-frequency vibrations (LFV) is hacking the brain's rhythm to induce a state of altered consciousness that may aid in the reduction of symptoms related to various health concerns. The vestibulocochlear is a nerve that serves as a pathway that links the ears to the brain to attune the numerous types of audio stimulation and brain waves. Since this pathway only requires sound, audio stimulation is the most accessible type of brainwave entrainment.

PISTA facilitates two different tone frequencies presented separately to each ear, resulting in a third tone, called binaural beats. Simply, binaural beats are the sound perception created in the brain that allows the mind to enter and experience an altered state that is usually

difficult to reach. And when the binaural beat is sustained, the frequencies resonate across the brain system (Padmanabhan & Laws, 2005). This causes an alteration in the brain's state from an overactive to a learning state. Within this learning state, individuals can assess their thoughts and behaviours to discover their inner strength, encourage self-empowerment, and develop new and adaptive ways to cope with life. What makes the PISTA program unique is that the PISTA stimuli tool is combined with specific modalities that encourage individuals to engage in a self-problem-solving manner guided by PISTA coaches.

A binaural beat is a well-known method in facilitating brainwave entrainment that has undergone several investigations. A Monroe Institute of Applied Sciences researcher, Robert Monroe (1988), utilized an EEG machine to examine his subject's electrical brain wave patterns. The findings illustrate that Monroe could entrain brain wave patterns using binaural beats.

The waveforms of both hemispheres of the brain had equal frequencies, amplitude, phase, and coherence, with the effect not limited only to the hearing area of the brain but the entire brain. Likewise, the impact of listening to an engineered cassette tape that creates binaural beats in the brain was highlighted by Dr Arthur Hastings, PhD (1975), in a paper entitled *"Tests of the Sleep Induction Technique"*. The engineered cassette tape slows down the brain wave patterns from a typical waking beta wave pattern to a slower alpha wave pattern, then to an even slower pattern (the brain wave pattern of deep sleep), and eventually to a delta wave pattern – the slowest brainwave sequence of dreamless sleep.

The Brainwaves

Research stresses that listening to a specific binaural beat frequency can increase the strength of particular brain waves. There are four brainwave pattern categories operating at different speeds: beta, alpha, theta, and delta waves. Remarkable effects are evident when brainwave patterns are slowed to alpha, theta, and delta ranges, as it increases electrical fluctuations in the brain, modifies the neural structure, and forces the brain to reorganize itself at greater complex levels of functioning. This process was presented by a scientist named Ilya Prigogine, the 1977 Nobel Prize winner in chemistry.

Beta is the most rapid brain wave pattern with a range of 14 Hz to over 100 Hz, indicating a pattern of normal waking consciousness, and is related to concentration, arousal, alertness, and cognition. However, high beta levels are associated with anxiety. In a relaxed state, the brain wave slows down to the alpha range of 8 to 18.9 Hz, which signifies the twilight state or deep relaxation between sleep and waking. Yet, compared to beta, the higher end of alpha represents a more relaxed and focused state. On the other hand, theta waves, the second slowest category, occur between 4 and 7.9 Hz. Theta waves are associated with increased creativity, super-learning, integrated experiences, and memory. Delta, or dreamless sleep, is the slowest brain wave pattern, with a frequency of less than 4 Hz. Although most people are asleep in delta, evidence shows an ability to stay alert in this trance-like, non-physical state. Our brains are triggered to release large amounts of healing growth hormone when we are in delta (Hutchison, 1994).

Also, a corresponding increase in balance between the brain's two hemispheres is evident as the brain wave patterns from beta to alpha to theta to delta slow down. This brain state is known as brain synchrony or brain synchronization. The brain waves in deep meditative states shift from the typical irregular patterns, with one dominant hemisphere over the other, to a stable state of complete brain integration. These different brain wave patterns induce various mental abilities and experiences naturally. The amplitude increase from alpha to theta and delta indicates the number of fluctuation increases, implying that the brain reacts by reorganizing itself at a higher, more complex level of functioning (Prigogine, 1977). From this, the brain responds by changing itself to a better and more complex degree of functioning, producing new neural pathways and enhanced communication between parts of the brain that were previously not connected. This mechanism is called synchrony, which according to Lester Fehmi (1980) from the Princeton Biofeedback Research institute:

"Synchrony represents the maximum efficiency of information transport through the whole brain."

Low Frequency Vibration (LFV) and Dementia Management

Since dementia is a growing concern in modern society, non-pharmacological interventions such as music are recommended as the prime intervention for managing the symptoms of the disease. Likewise, the sound/mechanical low-frequency vibrations (LFV) share the same core characteristics and healing potential of music, though this is less well understood.

It is common to utilize pharmacological intervention to manage the behavioural and psychological symptoms of dementia (BPSD). But medications should only be administered in severe cases and only if the psychosocial intervention alone is not enough to manage the symptoms (Livingston et al., 2020). Unfortunately, in treating neuropsychiatric symptoms of dementia, there is no FDA-approved medication due to the reported side effects and potential harm, including a high mortality rate (Pharmacological Management of Neuropsychiatric Symptoms of Dementia, 2021).

Hence, non-pharmacological and non-aggressive interventions, such as music and sensory interventions based on tactile low-frequency stimulation, must be created. Usually, these two types of intervention are used together, known as vibroacoustic therapy. Although the underlying mechanisms of such sensory interventions are not well understood, the theories on the healing mechanisms of music may help us understand how a person with dementia reacts to low-frequency vibration.

According to Bruscia (2014), music therapy is a purposeful, music-based intervention conveyed within a therapeutic relationship. However, music medicine (Dileo, 2013) more appropriately depicts music listening provided by other (e.g., medical) experts. The efficacy of music interventions is known when it comes to managing the behavioural and psychological symptoms of dementia, such as disruptive behaviours, socio-emotional skills, anxiety, apathy, and depression, and improving cognitive functioning. Individual 12-week therapy administered by a qualified music therapist is more successful than group interventions (Campbell et al., 2021).

Understanding and creating music involves several cognitive processes that influence memory, attention, planning, and communication. Also, it affects emotion processing and control (Uhlig et al., 2013). Pitch, rhythm, and amplitude—commonly referred to as the "components of music"—play an essential part in how music is perceived through auditory or tactile (such as vibration) senses.

Because music is sound, and sound and pitch are related to frequencies (Hz), music is tied closely to vibration (Dostrovsky, 1975). Furthermore, tempo and rhythm are sensed in the brain's most simplistic neural centres, which trigger a thalamic reflex that causes spontaneous tapping to the beat, allowing these features to link with movement, such as walking (Grocke & Wigram, 2007).

Numerous brainwave frequencies have been linked to various sensory, motor, and cognitive processes and synchronization with external stimuli (e.g., auditory stimuli). The synchronization with auditory stimuli in beta and gamma ranges in the brain is projected to contribute to rhythmic entertainment for cognitive domains related to memory and learning tasks (Will & Berg, 2007).

Similarly, to produce similar neural entertainment from rhythmic auditory stimuli like music, tactile stimuli vibrations using frequencies are used to target a specific bandwidth in the brain (Bartel et al., 2017). Because of the evident link between music and vibration, the influence of various electrical activities produced by the brain, spinal cord, and neurons on dementia must be considered.

Application of Binaural Beats

The primary purpose of using binaural beats may vary among individuals. Some may use it as a self-help method to increase their concentration and meditate. However, using binaural beats for therapy requires professional help to guide you in resolving your cognitive and mental health concerns or other related issues. When using this method as self-help or therapy, an audio file with binaural beats or tones and a set of earbuds or headphones are required.

Although some self-administered brainwave entrainment devices are offered on the market, and there are audio files available online, utilizing binaural beats to address serious health concerns entails professional help. PISTA can provide modality-based training with 24/7 support to individuals dealing with daily life tasks, anxiety, depression, long-term illness, and grief by allowing them to take control of their bodies and mind.

Enhanced Learning

Increased learning ability or super learning is one of the observed outcomes of sound-induced brain synchronization. The concept of super learning began in the late 1960s and early 1970s and is based on the work of Georgi Lozanov, a Bulgarian Psychiatrist. According to Lozanov, combined synchronized rhythms in the brain and deep relaxation allow the production of alpha waves among his student participants. In this state, the students learned over five times more information with less time spent studying per day, with above average and long-term retention.

Suzanne Evans Morris, PhD, a speech-language pathologist, explained the link between various brain wave patterns and learning and the other related states such as focus, problem-solving, receptivity, and creativity. She asserted that a specific conscious state is related to openness to learning and predominant brainwave patterns in various awareness states. For instance, 13–26 Hz beta frequencies are linked to concentration and alert problem-solving, and theta (4–7 Hz) is associated with deep relaxation and high responsiveness to new experiences and knowledge.

To maintain this theta period of openness for learning, Morris also explores the use of binaural beat soundtracks. She further explained that introducing theta signals in a learning environment hypothetically permits a more extensive and deeper processing of the information, increased attention, and builds a mental set of open receptivity (Morris, 1989).

The maintained theta states may result in more relaxed learning responsiveness. In the brain, these signals generate synchronicity. The right and left hemispheres, and subcortical areas, are actively in sync, producing an internal physiological learning environment that encompasses the entire brain.

Addiction

The chronic and primary disease that affects the brain circuits responsible for the reward system, motivation, and memory is addiction – problems in these circuits may result in biological, psychological, social, and spiritual consequences. Addiction is characterized as a disorder with concerns in behavioural control,

craving to consume, avoidance in recognizing the underlying issues and ineffective personal relationships and emotional reactions. This disorder's healing cycle frequently includes recurrence, much like other chronic diseases. Disregarding rehabilitation or treatment may contribute to the progressive manifestation of maladaptive behaviour resulting in disability or early death (American Society of Addiction Medicine, 2011).

There are various treatments or rehabilitation activities that can help in the recovery of people with addiction. For instance, people dealing with addiction who are in their quitting and recovering phase have increased positive emotions and reduced anxiety with the help of musical therapy sessions (Khorrmabadi et al., 2012). Also, utilizing active and passive music therapy programs in the drug recovery stage can ease the mood and anxiety concerns of addicts (Punkanen, 2007). As a complementary therapy, music therapy also helps people enhance their overall attitude toward mental and social performance (Khorramabadi & Asadi, 2016). People can improve their general attitude toward mental and social performance by combining music therapy with other therapies. The stimulation of alpha waves in the brain while listening to relaxing music enables the release of endorphins and dopamine and reduces the secretion of catecholamine, resulting in a relaxed condition, and reduced depression, anxiety, and anger (Salmani & Senobar, 2015).

Moreover, Dr Eugene Peniston and Dr Paul Kulkosky from the University of Southern Colorado showed that alpha and theta states result in addiction recovery. They trained a group of alcoholics to enter the alpha and theta states. According to their study, trained alcoholics showed higher recovery rates than the control group. The alpha-theta

group of alcoholics exhibited “sustained prevention of relapse” thirteen months later, and a follow-up study after three years confirmed this finding. The researchers also noted that within the alpha-theta group, personality transformation was evident. Changes included increased warmth, stability, conscientiousness, confidence, creativeness, self-control, and decreased levels of depression and anxiety (Peniston & Kulkowski, 1989).

According to numerous scientists, these incredible mental and emotional shifts are due to the diverse brain wave patterns connected to the formation of various neurochemicals in the brain linked to relaxation, stress relief, learning, creativity, memory, and other beneficial outcomes. Beta-endorphins, acetylcholine, vasopressin, and serotonin are among the neurochemicals involved.

Meditation

Meditation includes relaxation practice of the mind, proven to reduce stress and anxiety, decrease the rate of brain ageing and memory problems, foster mental health, and increase the attention span. Because of its advantages for mental health and cognitive performance, meditation is highlighted in the previous section. However, binaural beats and brainwave entrainment are two phenomena that can swiftly produce the same mental state and brainwaves as traditional meditation. For instance, frequencies ranging from 1 to 30 Hz have the same brainwave pattern as meditation. Listening to a sound with a specific frequency allows the brain waves to synchronize with it (Cafasso, 2021).

According to experts, 70% of the 70,000 thoughts we experience per day are negative, which may cause chronic stress and eventually lead to changes in the brain's function and structure. It is important to recognize that chronic stress produces countless mental and physical health concerns.

However, helping the mind to calm down quickly is possible with the help of binaural beat technology, as this method induces a distinct type of brainwave condition similar to meditation. When specific music or tones are presented to both ears, the brain will produce waves that mimic the same vibration that occurs during meditation. The neural pathways in the brain and the mechanism of the brain chemicals change with every thought we have, whether positive or negative, creating a surge of effects on mental and emotional well-being. And one of the most effective methods to control negative thinking is meditation practice.

By applying electroencephalogram (EEG) during meditation to Buddhist monks, who were expert meditators, researchers found the monks could produce a gamma state during meditation. Gamma state produced focus, concentration, and exceptional productivity (Alban & Alban, 2021).

Better Sleep

Sleep is undeniably relevant in our daily lives. It significantly influences our physical and brain health. Having enough sleep every night is critical for maintaining our quality of life (Lee et al., 2018). Sleep is linked to several brain functions such as memory, performance, and cognition. Disrupted sleep affects our ability to

process memories, learn, make good decisions, and manage our emotions.

Despite knowing that sleep is essential, 25% of people reported that they experienced poor sleep quality (Lee M. et al., 2019). In the U.K., 31% of the population say they have insomnia. Research indicates that around 4% of Americans suffer from clinically significant nightmares, leading to lack of sleep, fatigue, alcohol use, or suicidal ideation. And about 70% to 80% of people with PTSD experience co-occurring nightmares. Nightmares are prevalent in people who experience trauma. People with nightmares are commonly treated with psychotherapy, off-label use of antipsychotics or sedatives, or a combination of the two.

Because lack of sleep is a communal problem that results in significant health, social, and economic effects (Hublin et al., 2001), different methods have been studied and established to improve sleep quality (Basedovsky et al., 2017). Inducing sleep by utilizing auditory stimulus is one of the current methods to address this problem (Lee et al., 2019), as previous research indicates that binaural beats can help people sleep better.

Binaural beats at a delta frequency of 3 Hz generate delta activity in the brain, leading to the prolonged deep sleep necessary for restoring physical energy and regulating hormones. In a survey conducted among soccer players, listening to binaural beats ranging from 2 Hz to 8 Hz improved the player's sleep quality (Abelm et al., 2014), reduced feelings of drowsiness, and increased comfort on waking up. Also, it can lessen anxiety resulting in improved sleep (Garcia-Argibay et al., 2019).

Further Research about Binaural Beat Therapy

Current studies and subjective reports assert that binaural auditory beats can influence mood, performance, and anxiety. The hypothesis that listening to tapes with embedded tones that create binaural beats daily for one month reduces anxiety was evaluated.

In a study conducted in 2001, the participants listened to one of three music tapes containing tones that yielded binaural beats in the electroencephalogram delta/theta frequency range at least five times per week for four weeks. After listening, they were also instructed to write a journal about their experiences using the tape, their tape preferences, and their anxiety ratings. The result indicates a significant decrease in the anxiety score based on their daily journal report. The study suggested that people with mild anxiety benefited from binaural beat therapy, yet it warrants further research to support the conventional treatments for anxiety (Scouarnec et al., 2001).

Padmanabhan and Laws (2005) conducted a study that included more than one hundred patients who would receive general anaesthesia for elective surgery. The participants listened to binaural beats for thirty minutes before surgery and reported a drop in preoperative anxiety after listening to a delta wave binaural beat. The researchers suggested that listening to binaural beats for up to one hour before administering anaesthesia may help the patients reduce the elevated levels of preoperative anxiety.

Lastly, a meta-analysis study performed in 2019 found a significant association between prolonged exposure to binaural beat tapes and low anxiety levels.

How the PISTA Methodology Improves the Health of our Brains

Commen
PISTA

Scientists are making breakthroughs in understanding the complexity of the human brain through brain imaging diagnostics, improved genetic risk profiling, and detecting dementia-related biomarkers in blood, urine, and spinal fluid (Pirie, 2021). Brooks Kenny, the vice president of UsAgainstAlzheimer's, asserted that from understanding cognitive decline to determining steps that reduce the risk of dementia to developing new treatments for Alzheimer's, brain research in the past five to 10 years has accelerated in all areas. Kenny further asserted:

"I think this is because the public, doctors, policymakers, and private-sector leaders are all recognizing that brain health is essential to individuals' health and public health in today's ageing society."

Although there are still many things to discover, early detection of Alzheimer's, drug treatment for dementia, and new ways of thinking are thrilling areas of development in brain research – all these are relevant to brain health. Since October 2020, a simple blood test can detect the presence of Alzheimer's disease. PreActivityTM is the first FDA-approved test made commercially available to doctors and clinicians to test for amyloid proteins in the blood; abnormal levels imply more testing, and diagnostic imaging is recommended. This blood test is less invasive and costly than the diagnostic methods before PreActivityTM approval.

Even though there has been a breakthrough in detecting Alzheimer's early, over the past 18 years, there has not been an FDA-approved

Alzheimer's disease treatment; Aducanumab medication is often prescribed. This medicine may not be able to cure Alzheimer's, but it is a crucial step toward a better life. However, recognizing brain health is a huge step forward in research as it also focuses on well-being, social connections, and daily routine (Pirie, 2021). The founder and chief director of the Centre for Brain Health from the University of Texas Dallas, Sandra Bond Chapman, affirmed that:

"When people talk about brain health, they talk about it as the absence of disease and injury, but that's not the same as making your brain healthy."

To maintain and enhance brain health, the self-dialogue modality of PISTA focuses on helping the mind develop a new way of thinking by guiding you on how to solve certain feelings, emotions, or thoughts that disturb the mind daily.

Why is it Important to find Someone willing to Listen to Us?

Surrounding ourselves with people who pay attention to us, especially when we can share or vent our stories, is a superb approach to building cognitive resilience (Salinas et al., 2021). However, finding a good listener who can provide the genuine support and empathy we need is not easy. That is why the PISTA method built a system of self-dialogue to help you engage in the process of talking and hearing yourself. Likewise, the PISTA approach also captures affective well-being, defined by the frequency and severity of positive and negative feelings and moods influencing your thoughts and behaviours. This can be done through exercises in the PISTA workbook, designed to establish how positive and negative effects are connected to daily life events and social interaction.

The decline in cognitive functioning caused by dementia, dealing with life adversities, and other stressors may lead to mental health problems that affect brain health. In approaching these concerns, PISTA coaches promote a self-directive approach that utilizes self-dialogue, allowing you to determine the key elements that trigger your adversities and treat your own emotional and psychological challenges. This means you look and talk to your inner self during self-discovery rather than talking to the therapist. Coaches guide the clients to help them modify their way of thinking by considering healthy habits tailored to the client.

Does it mean that Mental Health Conditions and Dementia are Reversible?

Researchers from the University of Nottingham (2021) have identified that reversing the change of chemical messages at the synapses in the human brain may lead to reversible mental health problems such as anxiety and cognitive diseases such as dementia. This study would help classify new treatments for neurological and psychiatric health concerns. It would also help us understand how brain cells send messages to each other.

In synapses, the molecules are released to send messages to the next cell, showing how the nerve cells in the human brain talk to one another. Signalling is strengthened when an individual learns or remembers certain information. However, when synapses interact incorrectly, the circuits are damaged, resulting in alterations in how people think and carry out tasks. This process is evident in cognitive disorders such as dementia and various mental illnesses.

According to research, proteins derived from genetic material known as RNA are necessary for nerve cell and synapse function. Because some form of synaptic tag signals the appropriately active synapse, RNAs are positioned where and when they are needed for synaptic communication. Scientists have discovered that one of the RNA bases can have a methyl group/molecule added to it, which "marks" the RNA message. With the addition of methyl groups to proteins, their ability to bind to DNA or RNA is affected, and as a result, proteins are not produced. Unfortunately, the results suggest toxic protein clumps may form if this pathway is compromised, causing synapses and nerve cells to malfunction. The implication of this new study indicates that RNA marking can be reversed at synapses and thus may act as a synaptic tag.

Although this research did not uncover exactly how mental health conditions and forms of dementia can be reversed, it shed light on the possibility.

Through research and longitudinal case studies, PISTA understands this mechanism in the brain and the impact of neuroplasticity. Therefore, PISTA modalities focus on the remedy and solution by capturing psychological recovery, enhancing sociability, and addressing the effect of isolation on an individual using technology.

PISTA Sound Methodology and Brain Health

All the PISTA modalities include applying the PISTA sound technology to improve brain health. Various PISTA treatment modalities utilize visual arts, music, dance, and drama to help you tune in to your thoughts and emotions. However, PISTA's sound

methodology also focuses on the different speeds of sound frequency to direct the brain to an altered state of awareness while concentrating on a specific goal during the process. The most beneficial frequencies (alpha, theta, and delta) can regulate your brain waves and assist in the general intellectual ability for growth, increased cognitive functioning, and mental health.

As mentioned before, Processing Inner Strength through Actualization (PISTA) employs a brain entrainment method that involves binaural beats to improve cognition and relieve conditions that can adversely affect the quality of life. Guided by a PISTA coach, clients can achieve their desired brainwave frequency by using the PISTA sound machine to enter a brain state where their brain can change.

One of the goals of PISTA coaches is to guide clients in identifying their mindset and improvement areas. The PISTA coach will provide specific images or statements to focus on while using the machine. The thoughts, notes and insight from each focused exercise are recorded and reported daily to the coach. This method of self-dialogue allows clients to develop better communication with themselves and others and have an improved mindset.

Guided self-dialogue and the sound modality employ non-judgmental and deliberated awareness of the present moment that strengthens the regions of the brain responsible for memory, learning, attention, and self-awareness. As a result, there is a noticeable improvement in memory, cognition, and attention and a decrease in emotional reactivity, stress, and anxiety because of the brain's capability to develop new neural connections.

According to Kristoffer Rhoads, a psychologist at Harborview Medical Centre (as cited in Bolton, 2020):

"The brain is a wonderfully plastic organ that responds to your activities. The more you practice something, the more developed that region gets."

Therefore, constant use of the PISTA sound tool strengthens the neural connections responsible for thoughts, sensations, feelings, and actions.

Perceptual Learning

PISTA modalities also facilitate the concept of perceptual learning in delivering change. Perceptual learning is the process of improving the sensory systems' capabilities to react to stimuli through experience. It occurs due to sensory engagement with the environment and when performing certain sensory activities.

Moreover, visual, auditory, tactile, olfactory, and taste are the sensory modalities that help form crucial foundations of complex cognitive processes (Kellman, 2002; Goldstone et al., 2000). Changes in the neural circuitry underlie perceptual learning retained during life (Kami & Sagi, 1993).

As PISTA uses the speed of sound frequency as a modality, the client engages the sense of hearing to achieve neural tuning with the guidance of PISTA coaches. Perceptual learning happens when frequent exposure improves the ability to differentiate between two (or more) stimuli (American Psychological Association, 2013).

PISTA provides the client with an Entry Point (EP) to assist them in focusing on a single concept or memory. After that, they are repeatedly exposed to two different tones (the stimuli) in both ears to help them process the disturbing thoughts or memories, resulting in new ways of thinking and understanding. This method may also significantly help reduce stress and fear, relieve pain, and modify maladaptive behaviours.

Personal Development

There is a common assumption that personal development is only for those who want to climb the corporate ladder, open their own business, or are overly ambitious. However, we must constantly work on and improve our minds and attitudes to enjoy a sense of satisfaction and build our self-esteem.

Through the PISTA method, we can explore our values and identify what is important to us. The PISTA Entry Point (EP) allows us to discover the obstacles preventing us from achieving our full potential. The EPs are designed to highlight issues that emotionally entangle us so we can identify why we feel "stuck". The insight gives us the courage to stop mentally fighting for issues and goals that hurt us and focus on the important goals.

By applying the PISTA method, we gain a deep and clear understanding of where we are, where we want to be, and the skills we need to rebuild our lives according to our values and choices. The technique teaches us how to use the power of our minds to bring our behaviour in line with the goals we want to achieve. An example of this is a client who uses food to deal with feeling insecure and feelings of anxiety. As a result, of this behaviour, over time, she became obese. Denial of food she craved resulted in panic attacks. Before the PISTA intervention, the client had no way of managing the intensity of the anxiety, panic or craving and kept giving in and eating unhealthy food. When the client started implementing the PISTA panic modality, she could calm the intense anxiety and cravings she was experiencing. More life-changing was her ability to make better decisions and stick to her goal of only eating healthy and nourishing food and not letting

anxiety control her. By dealing with stress, pain, fear, and bad habits, we can persevere in the face of challenges our way as we move toward our goals.

Self-development requires bravery, inner strength, and resilience. Because the PISTA method strengthens our ability to have an accurate self-concept, we can build stronger self-esteem, self-respect, better relationships, and the ability to think clearly about our emotional hurdles.

Personal Development for Caregivers

Cognitive impairment does not only affect the person suffering; it affects the person's family and friends. Caring for a dementia patient requires the ability to manage behavioural and psychological symptoms that can be challenging, distressing and disruptive. Many caregivers feel trapped as they adjust to unexpected lifestyle changes. Providing care for a patient with dementia costs money, potentially causing financial stress or poorer quality of life. Carers need to address their sense of self-worth, well-being, and relationships as they navigate the unexpected lifestyle changes and the added pressure of caring for a dementia patient. Many carers find managing the effects of dementia - memory loss, mood swings and changeable emotions - challenging and stressful.

One of the challenges most caregivers experience is finding time for themselves. It is easy to become so absorbed in juggling work, family and caring that the carer gives no priority to their personal care. However, personal growth and development are critical to finding strategies to reduce stress and pressure. The carer's original life plans

may have changed or been on hold for a while, but it is important to create new achievable goals to maintain their overall well-being. Carers who set goals - no matter how small - have better health and relationships and feel less burdened.

If you are the primary caregiver, the burden of responsibility falls on you. Therefore, addressing your brain, physical, emotional, and social health is very important. Without good coping strategies, managing the symptoms, financial burden, and loss of future plans can cause resentment leading to psychological distress such as anxiety and depression.

Importance of Personal Development

Constant learning is necessary for brain development. For our brains to continue developing, new neural connections must be created by learning new things and engaging in mental exercises. This learning process is continuous throughout life unless we choose not to learn.

Personal development is crucial since it affects the health and development of the brain. There are several advantages to personal growth. For instance, it allows us to discover our purpose and values, reach personal and professional goals, improve strengths and talents, and achieve fulfilment in life. Participating in a program like PISTA enables us to learn how to harness our capabilities and develop resilience to manage our physical and mental pain and fear. Enduring difficult times is possible; getting through the daily challenges requires self-knowledge and an understanding of how our mind works. When we know how our mind works, we can use it to our advantage.

Attitude is the psychological construct that characterizes a person. It is the complex combination of our emotions, beliefs, ways of thinking, and behaviour directed toward a specific person, object, or event. Our attitude determines how far we will go in life. By embracing personal development, we can create an attitude that allows us to achieve our goals.

Being smart, talented, and hardworking are essential traits that will guide our focus during personal development. However, talent and intelligence will take us nowhere without the right attitude. The right attitude fosters confidence levels and belief in ourselves. Moreover, personal development is essential if we want to bring out the best in ourselves, others, and the world (Landesman, n.d.).

Maslow's Theory of Motivation

Pursuing personal development entails planning and motivation. Maslow's hierarchy of needs explains which actions based on our most significant needs will play a role in our personal development goals plan. The hierarchy of needs indicates that people are motivated to satisfy basic needs before moving on to more advanced needs. The fundamental premise of the theory is that if lower needs are met, addressing higher wants becomes possible. However, this notion might seem inflexible; hence, Maslow clarifies that a person can still progress to the higher needs despite not meeting the lower ones.

Maslow explored some aspects of what makes people achieve their happiness and the things they will do to reach that aim. He believed that it is innate for a person to want to be self-actualized, that is, to realize their full potential, to have full development of abilities, and to

have an appreciation for life. People are born with a striving force to be all they can be.

However, some basic needs must be met (e.g., food, safety, love, and self-esteem) to achieve the ultimate goal of self-actualization (Lester et al., 1983). Personal development is crucial in moving from a basic to a higher need. Meeting the requirements from all layers of the hierarchy requires evaluating the things that work at each level and making decisions that would help to improve things. Pursuing every human need means getting closer to being the best version of ourselves, leading to better health and life. Also, it facilitates empowerment to do more to protect and improve health, personal growth, and development (Veterans Affairs, 2022).

The hierarchy of needs characterizes two types: deficiency and growth (Noltemeyer et al., 2021).

- *Deficiency needs:* lower-level needs such as physiological, security, social, and esteem arise because of deprivation. Fulfilling the deficiency needs is essential to avoid unpleasant feelings, consequences, or maladaptive behaviour.
- *Growth needs:* refer to the highest level in the pyramid of needs that is not rooted in deficiency or lack of something but rather in the need to grow as a person.

As previously mentioned, the theory is generally viewed as rigid because of the need to achieve lower needs before satisfying higher ones. Maslow noted that the process only sometimes follows this order. For instance, some individuals desire to fulfil their self-esteem

needs more than their need for love. For others, creative fulfilment is more important than their most basic needs.

Too much or little satisfaction with the *deficiency needs* will decrease their importance, which may result in us directing our activities towards meeting the next set of unmet needs. As needs at a particular level are met, the next stage of needs becomes more crucial and compelling. *Growth needs* remain desirable, and the desire to meet them may even become stronger once we begin to get involved in activities satisfying those needs.

It is important to note that *growth needs* arise from the desire to grow as a person, not from the lack of something. When the *growth needs* have been reasonably or completely satisfied, a person may achieve the highest level of Maslow's hierarchy of needs: self-actualization. Every person has the capacity and the desire to advance and find their true selves. Unfortunately, failure to meet the lower level of needs disrupts personal development.

Maslow's (1943, 1954) hierarchy of needs includes five levels. He stated that some people are motivated to achieve a specific need (such as love), and some needs take precedence over others (such as safe shelter). The basic need for physical survival is the first need that motivates our behaviour. Once this level is satisfied, the following needs in the hierarchy will then motivate us, and so on.

1. ***Physiological needs*** are the most essential needs yet become secondary once met. Biological necessities include the need for air, food, water, shelter, clothing, warmth, sex, and sleep. Unsatisfied physiological needs often result in optimal dysfunction of the human body.

2. ***Safety needs*** become salient once the physiological are satisfied and may include security, order, predictability, and control in life. These are needs met by our family and society. Examples include emotional and financial security (e.g., social welfare and employment), law and order, freedom from terror, social solidity, property, health, and well-being.
3. ***Love and belonging*** are human needs involving feelings of belonging to family, peers, and community. Belonging is an emotional need for interpersonal relationships, affiliation, connection, and group inclusivity. To satisfy our need for belonging, we must experience friendship, intimacy, trust, acceptance, and love.
4. ***Esteem needs*** consist of self-worth, achievement, and respect. This fourth level in Maslow's hierarchy is divided into two categories:

   (1) esteem needs that include dignity, achievement, mastery, and independence
   (2) the desire for respect from others which includes status and prestige

   These two categories focus on our inward and outward needs to boost our self-worth or esteem. For children and adolescents, the need for respect or reputation is most important as it fosters their self-esteem or dignity.
5. ***Self-actualization need*** is the highest level that refers to the realization of potential, self-fulfilment, a quest for personal growth, and peak experiences. At this level, we desire to achieve everything that allows us to become the best version of ourselves. Some of us may prioritize this need according to

our roles. For instance, we may have an intense need to become ideal parents. In some, the desire may be expressed academically, athletically, or creatively through paintings, pictures, and inventions.

Upon progressing from lower to higher needs, notice that personal development naturally occurs, and the energy or motivation directed from one level to another is different. We do not always use the same approaches to satisfy our needs because each stage is different and necessitates a different approach. As a result, we need personal growth and development to navigate and meet the needs of each level.

Self-Actualisation and PISTA

The PISTA method is a person-centred therapy that considers the tendency of all human beings to progress, develop, and reach their fullest potential. PISTA takes the concept of self-actualization and makes it practical and achievable. When you move toward self-actualization, it may lead to:

1. Acceptance of our own and others' flaws
2. Development of independence and resourcefulness
3. Cultivation of healthy friendships and loving relationships
4. Ability to make better decisions
5. Clarity of mind, even in stressful situations
6. Constructive and helpful thought and behaviour patterns in line with achieving goals

The PISTA method helps you develop deep self-awareness. Self-awareness is knowing when your emotions and behaviours do not align with your internal standards. Research has shown that when we

see ourselves more clearly, we can be more creative, make sounder decisions and communicate more effectively. PISTA allows us to evaluate ourselves, our thoughts and our beliefs to understand our flaws. In understanding our imperfections, we are better positioned to differentiate between what we can change and what we need to manage. This knowledge allows us to mentally stop fighting what we cannot change and build the skills (such as communication, social skills, and managing emotions) to change what we can. PISTA trains us how to identify thoughts triggering unwanted emotions. During the EP sessions, we can explore these unwanted or painful emotions for deeper understanding and insight. The insight allows us to classify our feelings to deal with problematic issues correctly. PISTA takes us through the process of examining past events that affect our perception so that we can take control of our lives. As our minds become calmer and less full of painful thoughts and emotions, we can identify appropriate reactions and behaviours in the "heat" of the moment. By continually reflecting on situations and our behaviour, we can actively build attitudes and behaviour patterns towards ourselves and others. The PISTA method develops emotional stability within us that we need to deal with life events. Importance of Insight

Insight is an essential concept within the PISTA method. It is our capacity to gain an accurate and deep understanding of past experiences and our emotional connections to them. Insight is understanding how past feelings, thoughts, and beliefs influence our present behaviour. Our ability to have insight impacts our thinking and behaviour, which aids in changing our understanding of our situation and awakens the motivation for change that we have repressed. An example by Béguin et al. (2018) involves a middle-aged man who joined the PISTA program. He grew up with an emotionally abusive

father. He was depressed, angry and unmotivated. To manage daily life, he started using alcohol as a coping mechanism. Through the PISTA program, he worked through the painful memories and emotions related to his father. He gained insight into how his past experience affected his ability to relate to people. As he continued to work through his situation, he realized that his emotionally abusive supervisor triggered his unconscious feelings toward his abusive father. With this realization, the man could address the connection between his past and present. His past experience triggered maladaptive behaviours in the present (e.g., alcohol use). With the help of PISTA, the man applied the insight he gained to unlock new possibilities for change that involved learning to differentiate his perception and behaviour towards his emotionally abusive father from the emotionally abusive supervisor at work. This process allowed the man to work on emotions, fears, and perceptions that he may not have been aware of previously or continuously rejected. Previously, when unknown and rejected feelings appeared in his consciousness, he dealt with them by drinking alcohol to numb his mind. His new insight allowed him to correctly classify his feelings and emotions to the point where alcohol became unnecessary. When we are willing to allow our insight to change us, we can accept greater responsibility for our feelings and behaviour, leading to positive changes or self-actualization.

Overall, the facilitation of self-actualization and the concept of insight enables individuals who undergo the PISTA therapy program to develop the necessary skills to independently deal with various situations and events that come their way.

The self-directed learning taught by PISTA allows program participants to take responsibility for their progress and set personal growth goals. They are driven and empowered when they adhere to the PISTA self-help program, where they learn to make the necessary changes to meet their needs in each stage of life (Béguin et al., 2018).

PISTA Story: Redesigning Life through Personal Growth

A 60-year-old lady joined the PISTA program to gain support while caring for her parents (mother, aged 80 and father, aged 82), who had both been diagnosed with dementia. She was the primary caregiver, and her parents lived with her. She found caring for her parents exhausting and emotionally draining. As her parents aged, managing their emotional outbursts and disrupted sleeping patterns became a full-time "job". Because of the unpredictability of her parent's behaviour, she stopped inviting people to visit. At the same time, she did not feel as though she could leave her parents alone at home, so she stopped going out and socializing. She became isolated, struggled with anxiety, and bordered on depression. She felt trapped and could not see any hope.

PISTA Intervention

The first requirement was for the caregiver and her parents to use the PISTA approach day and night. This included using the PISTA sound and vibration tool during daytime activities and at night while sleeping. Using the PISTA tool at night improved the quality of sleep for the caregiver and her parents. With the caregiver feeling more rested, she could start thinking about small goals she wanted to

achieve. The caregiver was also encouraged to set goals for her parents.

The PISTA coach taught the caregiver how to do a 15-minute emotion control modality. She used this modality to manage any strong emotions triggered by her parents or her situation. Within 15-minutes, the caregiver returned to a state of calmness, regardless of the intensity of the feeling. The carer reduced her anxiety, frustration, and disappointment through this emotion control modality. She also used this modality to manage her parents' anxiety.

The caregiver also started practising a 15-minute reflection exercise. Two to three times a day, the caregiver would reflect on specific situations, memories or experiences related to her situation. Each reflection gave her insight that she used to develop an action plan. The caregiver stopped feeling guilty about taking personal time out to develop herself. She recognized that she needed to look after her health to better care for her parents.

As part of the program, the caregiver met weekly with her PISTA coach for PISTA Intervention sessions. During these sessions, the coach gave the caregiver specific EPs to complete. The EP insight allowed the caregiver to work through the feelings of loneliness, the sense of grief and loss, and sadness about her parents' health. The EPs also gave the caregiver an opportunity to understand how to have a new and different relationship with her parents. As the caregiver continued exploring specific topics, she became motivated to take the necessary action to look after her brain's health, exercise, eat correctly, socialize, and learn. By breaking her goals down into reasonable and achievable steps, the caregiver could implement things that would fit into her schedule.

As part of the ongoing care, the PISTA team established a routine for the parents to decrease their frustration caused by change and uncertainty. The team encouraged the parents to participate in daily physical exercise. The combined use of daily PISTA vibration, routine, exercise and a good diet reduced the parent's anxiety, boredom and argumentativeness. The PISTA team also monitored the parents' mood changes to ensure any underlying ailments, such as pain, were diagnosed and treated. The continued use of the PISTA sound technology allowed the parents to sleep calmly at night with no nightmares and few sleep interruptions. The caregiver noticed other changes in her parents' behaviour. Her parents stopped having abusive outbursts, their mood swings were controlled, and they had more capacity for pleasure.

PISTA and the Concept of Protopia

As discussed earlier, PISTA incorporates the concept of neuroplasticity into its modalities. When the PISTA stimuli and modalities are applied, the brain is trained in new ways of coping and thinking by developing neural connections that promote healing and resilience. These lifelong learning processes are associated with delaying the onset of cognitive decline as people age.

The PISTA method is a holistic method. It addresses a person's specific issues while ensuring that other parts of their lives are healthy. For example, many PISTA participants who join because of depression struggle with negative thoughts and feelings. However, most of these participants have also isolated themselves or reduced social connections, participate in little or no exercise and are not engaged in any learning endeavours that build cognitive reserve. From

research into cognitive decline, activities facilitating cognitive flexibility, social interaction, exercise, and good nutrition slow cognitive decline and support the maintenance of the cognitive reserve.

Though there is no known cure for dementia, there is much we can do to build cognitive reserve. Maintaining our cognitive function is essential for day-to-day activities. Issues affecting cognitive function, from illness to depression, can affect us at any age. Learning how to manage those things that can affect our cognitive function now and in later life is important. Even though dementia and cognitive decline may be unavoidable, there are things we can do throughout our life to reduce the risks. PISTA allows individuals to develop strong minds that allow them to face uncertainty with constructive coping strategies.

PISTA research focuses on finding practical solutions (e.g., managing emotions, healthy relationships, and career progress). An example: The relationship between education and cognitive impairment has been widely researched. Research shows that children who attend school, complete their education, and achieve a university education have a lower risk of developing dementia later in life. For children and youth, PISTA aids in focusing, learning, and performing at their best by teaching youth how to resist internal and external distractions.

Another example: A growing number of reports show the relationship between slower cognitive decline and social engagement, social activities, learning and complex careers. During mid-life, adults face challenges because of responsibility. Adults may be juggling financial payments, career, children, and their own health. If adults have not developed healthy coping strategies, they may experience stress, burnout, anxiety or even depression. Stress, anxiety, and depression

have been linked to the onset of dementia in later life. PISTA aids adults in building emotional structures that support the stage of life they are in.

The PISTA method emphasizes taking baby steps, one at a time and practising the concept of protopia, which is an orientation that "today is better than yesterday". PISTA assists individuals in realizing that no matter where they are starting, they can be better today than they were yesterday. And by doing their daily PISTA exercises and completing daily reports, they can see their improvements and review their achievements first hand.

Living in the Conceptual Age of Creativity

The world and its demands on us are constantly changing. It is essential to be aware of how our mind interprets these changes so that we can adapt and remain flexible. PISTA intervention challenges the fear that can easily consume us – fear of recession, illness, war, and children dropping out of school – and gives us strategies to face uncertainties and take calculated risks to achieve our goals. Unless we feel we are making progress in our careers, family or interests, we are not happy. Even when we reach a point of temporary satisfaction, we continue to imagine new ways that things can be set right and improved.

Understanding the difference between working hard and obsessive passion takes self-knowledge and self-awareness. Becoming aware of problems we were initially unaware of means we can address and rectify the issues. With the right program, such as the PISTA program, we can become brave and tackle the challenges we face while

developing our passion. Through the program, our minds are trained to benefit from our creativity. We can combine our creativity and desire for improvement to envision the person we would like to be without criticizing our current state. For any of our ideas to work, we must clearly understand the problem and our desired outcome. The next phase often requires research to create a step-by-step plan that will allow us to persevere despite the obstacles. Learning to work towards something while managing anxiety, fear and failure are essential life skills. We cannot underestimate the importance of maintaining our brain's health from childhood. Children, adolescents, and adults need to learn how to build their cognitive reserve to increase mental resilience leading to better cognition.

PISTA Story: Redesigning Life through Personal Growth

As humans, we experience many of our positive emotions in relation to the achievement of our goals. When we measure our progress towards something we desire, we realize our potential, strength, and value. When two graduates reflected on their desire to bring about change and impact their environment, they defined a goal that aligned with their values. The two graduates from the School of Advanced Engineering in France desired to contribute to a circular economy while meeting sustainability goals. With this goal in mind, they joined the PISTA program to develop a mindset that would enable them to achieve their goals.

PISTA Intervention

The graduates became more self-aware during the first phase of their PISTA program. Through the different PISTA exercises, they

explored their values, their attitudes, and obstacles causing anxiety. As they worked through the set EPs, the graduates gained insight into their weaknesses and strengths; and how those strengths complimented the project.

They also reflected on areas they would require outside support. Their PISTA coach gave them specific topics to reflect on that provided the graduates with a set of requirements they could evaluate opportunities against as they researched their options.

Through their daily PISTA exercises, the graduates clarified their goals, identified their tasks, and implemented a plan of action. The insight they gained through self-directed and guided exercises attuned their senses to the environment around them and the possibilities present.

By following the PISTA program, the graduates learnt to deal with the stress, the uncertainty of success, the obstacles imposed by rules and regulations and the setbacks. They could gain clarity in their minds and understand the consequences and risks of different actions.

The PISTA business experts guided the graduates through advice and PISTA exercises to conceptualize and execute their action plans.

Individually, the graduates worked on their own minds and emotional obstacles that prevented them from having an attitude allowing them to succeed. No two people are the same - therefore, each graduate received specific EPs (PISTA Entry Points) based on their individual needs. Both graduates learnt to face their fears, identify suitable answers, accept uncertainty and be confident in their decisions.

The Next Phase of Development:

They identified the environmental problem caused by students leaving university who abandoned their furniture on the streets. At the same time, new students arrived needing that furniture. They aimed to clean up the streets by recycling abandoned furniture. The students could clearly define their business goal: to reduce the environmental pollution caused by abandoned furniture by promoting the recycling of furniture for students who need it for their apartments.

Two and a half years later, the business idea has become a profitable and expanding business. The graduates have continued using PISTA techniques to expand their projects and have now set new goals - to use their experience to support students who want to start their own projects or start-ups. The graduates, and the Nova Palm Foundation, one of the organizations involved in PISTA therapy and research, guide young entrepreneurs to identify needs within their community and build a business around them. The young entrepreneurs are taught to set goals, create scaling plans, and formulate strategies for growing a well-managed company.

PISTA helped the graduates uncover their needs, emotions, and desires by applying the concept of self-actualization. The students were then able to evaluate opportunities that presented themselves. By understanding what motivated them, the graduates put aside emotional attachment to an idea and developed a plan around a problem that needed to be solved. The option they chose motivated them when there were setbacks, satisfied the desire to impact the community and environment, and opened the opportunity to support other young entrepreneurs. PISTA provided a way for the graduates to become

self-aware. They understood what skills they needed to develop. The graduates examined past events (affecting the perception and power of their minds) to understand how those situations affected their present so that they could control their lives. By practising PISTA daily, the graduates developed insight into how their thinking impacted their ability to achieve and grow their goals.

Individuals participating in the PISTA method can identify emotional entanglements towards ideas and goals. It becomes easier for the person to understand which issues will result in a no-win situation and which problems need a committed action plan. Even though the person may feel very attached to a project or idea, when they know the concept will not succeed, no matter how much time, effort, or money they put in, it gives them the ability to stop mentally fighting for it.

People who recognize and quit their unattainable goals experience physical, emotional, and psychological benefits. The PISTA researchers noted that those individuals who stopped fighting for something impossible to achieve had fewer depressive symptoms, lower cortisol levels and lower systemic inflammation.

Panic Attacks

Though panic attacks and anxiety attacks will cause an increased heart rate, shallow breathing, and a sense of distress, they differ in intensity. The physical symptoms of panic attacks include headache, racing heartbeat, breathing difficulties, weak legs, dizziness, stomach pain, and vomiting. Another difference is that a perceived threat triggers anxiety attacks, while panic attacks are often more intense and can occur with or without a specific cause. Anxiety and panic attacks affect people's daily activities. According to the PISTA approach, fear is part of a human's survival mechanism; therefore, fear is not an emotion that should be removed but can be harnessed when managed correctly. The individual needs to find techniques to adjust, replace maladaptive coping mechanisms with adaptive ones, keep track of developing their innovative way of embracing fear, and match the fear with a specific physical reaction.

Panic attacks may start as a response to trauma or a traumatic event, affecting the individual's behaviour and emotions. These instances may lead to feelings of anxiousness, defensiveness, difficulties in developing relationships, avoiding connection with others, reducing social contact, doing fewer activities, and not accepting responsibilities.

PISTA Treatment for Panic Attack

PISTA's theoretical approach to treating panic attacks facilitates the notion that physical symptoms caused by shocks from experiences accumulate over time, leading to feelings of increased vulnerability in dealing with daily events. To explain via an example: you experience

a difficult situation such as your friend being in a serious car accident. The shock of the incident causes your heart to race. Heart palpitations can be alarming, invoking concerns about having a heart attack. Your friend's unexpected accident unleashes sombre thoughts on human frailty and how vulnerable life can be. Soon after hearing the news, you visit your friend, but the hospital car park is full, causing stress.

The stress causes your heart rate to rise and your breathing to become shallow. Each time this type of experience is repeated, your anxiety levels increase which activates a feedback loop that triggers the "fight or flight" system. Eventually, over time without intervention, this anxiety can become panic and disrupt normal daily functioning. With PISTA modalities, intervention reduces the panic attack, allowing the person to control their panic, identify the trigger and have the clarity to take the right action.

The PISTA intervention also enables the person to become aware of emotional detractors in daily situations and respond appropriately to resolve conflict before anxiety levels can increase. PISTA's panic treatment modality starts with a specific Entry Point, a word or short phrase that will help guide an individual's brain to focus on a particular memory. Then the sound will assist in processing the Entry Point by sending a message to the brain to do a reality check, leading to new insights. Eventually, the message from the Entry Point will form a newly developed insight that sends correct messages to the neural pathway. The PISTA treatment process facilitates two to three Entry Points (EP) and a daily written report. For intervention before or during a panic attack, there are three steps to stop the panic using the PISTA sound tool:

1. First, set the sound tool at high speed for 30 seconds, medium speed for 30 seconds, and low speed for 30 seconds.
2. Alternate the speed until the symptoms subside.
3. Repeat this daily to practice anticipating the occurrence of the panic attack.

These steps are only an overview of the process. Initially, clients are guided by a PISTA coach, but eventually, they are trained and encouraged to do it independently. Even after the client has learnt to complete these steps alone, the PISTA coach will continue to supervise them throughout the healing process.

PISTA Story: Overcoming Panic Attacks

A young lady, in her mid-20s, was required to travel to a particular country. Travelling presented two issues for her; the first problem was the country. Her anxiety levels increased when she heard which country she would be visiting. She had lived in that country for a year, and while there, she had a very emotional and challenging experience. Returning to this country and, more specifically, to the city she had lived in induced anxiety and panic.

The second problem was the long-haul flight. Every time the client flew, she panicked. On long-haul flights, she usually experienced several intense panic attacks that caused her to become very irrational, driven by her emotions and fear.

PISTA Intervention

She enrolled in the PISTA program a month before flying. The one-month program focused on retraining her brain to have healthier

thinking and behaviour patterns to prevent any potential panic attack. During this month, the client did regular EPs related to fear, anxiety, flying and the trauma she experienced. Under the supervision of her PISTA coach, the client explored the sensations of panic to reduce the effect panic had on her. This training enabled the client to become aware of, identify, and take intervention when the unsettled feeling leading to a panic attack started.

The client was also instructed to use the PISTA vibrations during the day, varying the speed from high intensity to low intensity. These speed variation exercises were part of her training to calm herself down when she experienced intense anxiety. The combination of PISTA exercises reprogrammed her brain to associate the destination country and flying with positive memories and feelings and to think more rationally about the trip. As part of her training and preparation for the flight, the young lady learnt specific techniques that could reconnect her with reality, such as blinking in time to the PISTA machine sound.

The program also managed her expectations which induced fear and panic whenever she thought of the upcoming trip. Using the PISTA vibration and sound daily kept her rational in her thinking as she planned the trip.

The Client in Action

During the trip, the young lady experienced the start of three panic attacks. She felt the symptoms of panic rising in her body – sweaty palms and face, anxiety, rapid heart rate, irrational thinking, shaking, and feeling very uncomfortable. Each time she immediately switched to the PISTA fastest sound and vibration speed. She used the

techniques she learned to connect her with reality and dismiss the sensation of "losing her mind". By implementing the PISTA techniques she had learned, she could monitor the panic sensations and control her brain. She understood that she could control her life when she managed her thoughts and reactions to those thoughts. This experience taught her that she was in control and no longer needed to be controlled by fear, sadness, anxiety, or emotions.

After returning from her trip, the young lady enrolled in a three-month program to continue working on anxiety and panic, as well as personal and career development.

Post-Traumatic Stress Disorder

The two PTSD frameworks (discussed in Part I of this book) demonstrate the interaction of nature and nurture in developing memory deficits caused by PTSD and the increased risk of PTSD due to pre-existing memory deficits. In other words, exposure to trauma can rewire the brain, affecting daily functioning. Trauma causes new neural connections in the brain to accompany each newly formed memory or thought, thus rewiring it. Whether these memories are painful or not, the brain will modify itself to adapt.

How can Trauma Rewire the Brain?

Trauma affects the hippocampus, amygdala and prefrontal cortex which means a person's brain can become hypervigilant, suppress memories, reduce impulse control, and trap you in a state of emotional reactivity. People who experience traumatic situations or relive traumatic childhood memories tend to feel excessive stress despite the absence of a stressor. Whether the trauma is experienced in the

moment or through memories, there is excessive secretion of cortisol (the stress hormone in the brain), which may lead to the activation of the amygdala (responsible for emotions, fear processing, and threatening stimuli), which then results in further cortisol secretion (Shilson, 2012).

Psychology Associate Kimberly Shilson (2012) further explains in an interview with the New York University's The Trauma and Mental Health Report that:

"The amygdala of traumatized individuals is often overly sensitive, resulting in extreme alertness. These individuals may appear aggressive, as they might be overly sensitive to perceived threats (words or gestures from peers) or withdrawn due to fear of being close to others. It is a self-perpetuating cycle that leaves an individual with heightened sympathetic arousal (fight or flight response)."

The traumatized individuals thus end up in a self-defeating cycle with heightened sympathetic arousal. Regardless of trauma, such as natural disasters, war, car accidents, violence, sexual assault, or abuse, the brain and body will change. The alterations happen because every cell records memory, and every ingrained, trauma-related neuropathway has enough potential to trigger multiple times. Sometimes, the changes are momentary (e.g., a minor blip of disturbing dreams and moods that fade after a few weeks). Yet, if the changes progress into immediate and observable symptoms, they can disrupt the individual's functioning and interfere with their occupation and relationship with family and friends (Rosenthal, 2019).

Linda Olson, a licensed Psychologist and Childhood Domestic Violence Advocate, agrees with Shilson's statement. Working with

children and adults who survived domestic violence, she asserted that the survivor is in a constant state of hyper-arousal or hypo-arousal due to the collective effects of trauma. Hyper-arousal is when a person experiences overly consistent irritable, angry, or paranoid feelings and behaviour or simply an overreaction. Hypo-arousal is the opposite, where individuals tend to numb, shut down, withdraw, or isolate themselves. The high cortisol secretion alerts the brain to threats that do not even currently exist.

Fortunately, if trauma can adversely rewire our brain, it can gradually modify itself into more adaptive functioning with the help of therapy. The therapy can bring changes to the brain, such as relaxation of the amygdala and restored hippocampus leading to proper memory consolidation. Also, the nervous system can resume its natural mechanism between reactive and restorative modes. Hence, the crucial part of reaching the state of neutrality and eventually healing lies in helping the body and mind rewire themselves (Rosenthal, 2020).

The awareness of the potential of our brain to adapt, according to Shilson, provides a sense of hope not only to the treatment providers but also to individuals enduring trauma. Particularly, treatments that utilize the brain's neuroplasticity can help reverse the aftermath of trauma. According to Olson (n.d., as cited in Kippert, 2016), this means that:

"The only way we can feel better is to befriend what is happening inside of ourselves regarding emotional regulation. Resolving traumatic stress means restoring a proper balance between the rational and emotional brain so that you can feel in charge of how you respond and how you conduct your life."

Olsen further emphasizes that we sometimes push ourselves outside our capacity or "window of tolerance" when triggered into states of hyper- or hypo-arousal. Because of that, we tend to be more reactive and disorganized, where even the sounds and lights in our environment bother us. When unwelcome memories from the past intervene, we panic and explode. Although being aware of triggers can send a person suffering from trauma into a flight or fight response, it is the first step toward change because revisiting traumatic memories allows those memories to be cleaned out and dealt with. It may be difficult for most survivors, but if they overcome those traumatic memories with the help of treatment, they can rewire their brains and learn new non-traumatic responses (Kippert, 2016).

A PISTA Story: Overcoming Adverse Childhood Trauma

A female client in her mid-30s struggled to maintain a healthy relationship with herself, friends, family, and colleagues. She had been neglected and verbally abused as a child. She also experienced a traumatic event that left her permanently physically scarred, which resulted in other children teasing and bullying her. Inside, she felt emotionally numb. Her inability to comprehend her experiences caused her to deny her pain and shut people out of her life. She trusted no one. The brain fog she experienced made daily tasks difficult. She often felt like things that should be quick and easy took her half the day because of clumsiness. She felt like there was a disconnect between her brain and her limbs.

PISTA Intervention

The PISTA trauma modality was applied to the client's situation. This modality deals explicitly with the underlying painful memories that cause anxiety and mental obstacles preventing living a fulfilled life.

Under the guidance of her PISTA coach, the client continued to do specific EPs and reflection exercises to "clean out" any memories that caused anxiety or pain. With each "clean out" session, the client noticed she felt calmer, safer and more assured. Through the self-discovery process, she built resilience and inner strength to manage everyday life and the inevitable uncertainty of life.

Combining EPs and specific reflection exercises allowed the client to gain a deep insight into her situation. The toxic stress she experienced as an adult originated from her childhood. She had developed unhealthy coping mechanisms to cope with parental abuse and bullying from school kids and unsympathetic adults. Adverse childhood experiences are important determinants of psychiatric disorders. Exposure to fearful circumstances affected the areas of emotions and learning in her young and developing brain.

As her PISTA coach gently guided her through specific memories, the client was able to untangle the web of toxic emotions and thoughts connected to her childhood experiences. She continued to use the PISTA vibrations throughout her day to help maintain rational thoughts as different situations occurred. The client reconnected with her emotions and moved out of her "zombie" state.

As the PISTA program is self-paced, the client was able to direct the process according to her comfort levels. When the client was ready,

she started exploring her concept of “relationships”. She worked through the cognitive distortions that led her to get involved with abusive partners. As the client worked through resentment, anger, and betrayal, she could release her feelings of insecurity and worthlessness.

The client learned to put boundaries in place to ensure she was respected. Through continued use of PISTA techniques, the client started dealing with the jungle of emotions inside her. She could explore the pain she had been denying and understand how that pain was rooted in the complexities of her situation.

The client is on a new path. She works on her mindset every day, practising healthy coping strategies. For her to move out of depression, deal with the long-term effects of trauma and change her thinking patterns, she needed to rewire her brain. Telling her (or anyone) to get rid of their trauma is an invalidating act and is impossible without the help of therapy because it is not “only in the person’s mind”. Biological changes occurring in the brain are out of a person’s control. However, change is possible with the help of the brain’s mechanism to reorder itself.

The client learnt that dealing with her traumatic experience was an important step to having a healthy mind. She learned to have sympathy for herself and not to hide the scar. The client stopped avoiding people and stopped playing the blame game. The PISTA trauma modality released her from the painful memories stored in her body so that she could focus on the present.

Learning Brain and Survival Brain

As already discussed, trauma is a complex concept that affects the brain structure, emotion regulation and ability to participate in life. Comparing the difference between the learning and survival brain can help us understand trauma, its effect on the brain and how it affects cognitive functioning. Understanding what happens in the brain, particularly in those suffering trauma, helps us better comprehend the person's behaviour and experiences. Knowing what trauma is, how the brain interprets it, and how it affects a person provides us with the awareness we need to support victims and survivors in the immediate aftermath and decades later.

According to clinical Psychologist Dr Jacob Ham (2017), the learning brain is more open to new knowledge, information, ambiguity, vagueness and can see the bigger picture. On the emotional level, the learning brain is calm, peaceful, curious, excited about new learnings, and not afraid to make mistakes. The learning brain understands that obstacles and ambiguities are part of the learning process. The learning brain has confidence in picking up the things being learnt. For example, some people may try new things and learn from their experiences despite the possible negative consequences. They take challenges and consider every outcome as part of the learning.

On the other hand, the survival brain is the opposite. Instead of focusing on learning, the brain is hyper-focused on the threat, cannot deal with ambiguity and is subjected to black-and-white thinking. Emotionally, people with survival brains feel panicky, afraid that things might go wrong, obsessive, not open to learning new things and have difficulty calming down. People with survival brains hate

making mistakes and looking stupid. For example, people with a survival brain are hesitant to try new activities because they are afraid to fail. These people are sceptical about their abilities to learn new things and how others will perceive them if they fail.

Dr Ham added that the survival brain consistently outperforms the learning brain because it focuses on threats and thus strives to save our lives. For instance, the brain's survival mode turns on when something threatens us. However, this mechanism is hard to turn off when the brain is constantly in survival mode for extended periods. The survival brain has difficulties interacting with the learning brain.

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Parents and teachers must be aware of the signs that indicate students are operating from the survival brain. When a child's brain is in survival mode because of extreme stress or trauma, the brain's ability to operate in the executive functioning capabilities is disrupted. As for students, their survival brain may show hostility, impulsivity, outbursts, and irritability. They may exhibit inattention, forgetfulness, low self-awareness or capability to self-evaluate, inability to create and maintain goals, and poor organizational skills. Therefore, a setting that promotes safety and growth is imperative to their learning (Berringer, 2020). When children feel safe or supported, learning will occur.

For people who experience trauma, stress is a harsh and extreme feeling, and a minimal level of stress can cause them to slip back into the survival brain. Through the PISTA trauma modality, PISTA program participants can identify when they misinterpret ambiguous situations as stressful and threatening. Participants develop coping strategies that reduce the stress they experience by dealing with emotional baggage. By varying the PISTA sound speeds, participants

learn how to activate the learning brain, thereby reducing stress and the impact of the survival brain. With lighter emotional baggage from the stress, learning is more straightforward.

A PISTA Story: From survival brain to learning brain

The client, a woman in her 40s, struggled with the effects of a traumatic childhood experience. Between the ages of 9 and 11, she was sexually abused. Though she knew the abuse had happened, she only had vague memories. The client described periods of her youth as “missing” - she had no memory of “good” or “bad” events. There were gaps in her memory, and many details were forgotten. As an adult, she noticed her memory was not as good as those around her, and she seemed to forget experiences.

The client often described herself as feeling like a “zombie”. In situations of stress, her mind would go “blank” and devoid of any thought. The client reported that she often felt “stupid” because of this fog that clouded her thinking and decision-making ability. She also noticed that fear and anxiety increased in intensity as she got older.

In her 40s, she lived with undiagnosed depression. She experienced a deep sense of isolation and the need to protect herself from everyone. When she spoke about herself, it was very negative and full of self-criticism. The client was lethargic and lacked energy or motivation. Her sleep was disrupted. She had nightmares and regularly woke at 3 am with strong anxious sensations. Her relationships with her family and her husband were breaking down. The client felt stuck and trapped in negativity, self-criticism, insecurity, and resentment.

PISTA Intervention

The PISTA Trauma Modality focuses on helping individuals dealing with trauma to understand their situations and rebuild their lives according to their values and choices.

With this client, a three-pronged approach was applied to her situation. The first prong covered her sleeping patterns. The client was constantly exhausted from broken sleep. The exhaustion increased her tendency to have negative thoughts and feelings of being overwhelmed. The second prong involved setting up support structures that sustained the changes she was making daily. The last prong involved managing the trauma and its effects on her self-esteem and relationships.

The client was directed to use the PISTA sound and vibrations at night to manage nightmares and anxiety to improve sleep quality. Lack of sleep causes memory loss, lack of emotional control, and an inability to engage with people. Sleep is essential for memory consolidation and overall health. At night the client used a slower sound frequency conducive to sleep. Her brain absorbed this frequency, enabling her to sleep without waking from nightmares or anxiety. As her sleep quality improved, her habit of sleeping during the day disappeared. Within two weeks, her energy levels had increased. Her sleep pattern adjusted, allowing her to stay up later and get up earlier without affecting her energy levels during the day.

During the day, the client used the PISTA vibrations to manage anxiety, insecurity, lack of motivation and harmful negative thoughts. The speed of the sound or vibrations depended on the client's activity. By becoming aware of her habitual responses, she could recognize

trigger points and create structures to support her. When she experienced a strong emotional reaction, the client implemented the "emotion control" exercise. This specific exercise last 15 minutes and is used to manage intense emotions such as fear, anger, pain, grief, etc. She changed her internal response system by applying the insight she gained during these sessions. Through continued practice, the client worked through her emotions and associated triggers.

The trauma modality uses specific images relevant to the client's experience while applying different stimuli to facilitate memory reprocessing. Her PISTA Coach assigned the images or phrases as an Entry Point (EP) that enabled the client to explore complex topics in a safe environment. The client would focus on this specific Entry Point over a fixed number of sets. After each set, the client would record her thoughts. Combining this self-questioning technique with the PISTA stimuli made the client's brain more susceptible to change. With each session, she gained new insight into establishing healthier relationships with herself and others.

When the client was ready to deal with the trauma, she was given specific EPs to complete. After her third EP session, she reported a release from fear, anxiety, and negativity. In her third EP, one of the images she saw was of herself no longer enslaved by fear. In the hours following this EP, she noticed a marked decrease in anxiety. During the following week, she noticed she could participate in activities and conversations that she would previously avoid. She also noticed that her daily thoughts were no longer fearful or focused on pain and embarrassment. She recognized she had been abused but was no longer a victim. Shame no longer limited her.

Part of the client's journey was recognizing that she was now safe. As a child, when the abuse happened, she felt unsupported. It was only by accident that she discovered that her dad had put a stop to the abuse. However, at no time did the adults in her life speak to her or stop contact with the abuser. There was no punishment for the abuser. The client recognized how her survival brain had developed to protect her from perceived threats and affected her ability to learn within and outside school.

Six months into her journey of developing a learning brain, the client reported:

- she engaged more with people
- she had taken up creative pursuits again
- she was exercising consistently and signed up for her first race
- she had turned her vision into a business plan
- she had started running workshops for students
- she was managing her fear
- she no longer had nightmares

The client reported that she was attending a variety of different meetups, from business to art. She no longer felt inferior to her friends or strangers. She could share her opinion without "repurposing it" to suit the person she was speaking to. She was working on a healthier relationship with her husband and feeling more engaged in life. The client also noticed she could speak more freely about being abused in relevant situations without any sense of shame.

PISTA Memory Building Modality

During ancient times, music and sound have been a crucial part of both culture and healing methods, particularly among Greeks and Egyptians, to name a few. Nowadays, the use of sound in a therapeutic setting provides aid in treating a wide range of trauma concerns, such as physical pain, PTSD, anxiety, depression, sleep difficulties, and addiction (Landis-Shack et al., 2017).

Our sympathetic nervous system controls the fight or flight response, which is activated during stress or fear. Its partner, our parasympathetic nervous system, is a network of nerves that controls our body's ability to calm itself after stressful situations. When confronted with a traumatic or stressful event that overwhelms the nervous system, energy is invested by the body in response to the event, resulting in disharmony and physical imbalance.

PISTA uses sound to offer change or healing by creating vibrations and tones that can induce rest and relaxation and guide the person to an altered and meditative state. Also, the sound and vibration from the PISTA tool help the individual resonate with their body and mind, promoting balance and harmony.

Because of distressing feelings, traumatic memories are buried in the unconscious of trauma survivors. It is a natural reaction to trauma to want to forget. However, forgetting does not result in healing. One approach that facilitates relief from pain is to bring the contents of the traumatic memories into the conscious mind in a controlled and guided manner. Paradoxically, this approach can help heal old wounds from the traumatic event by reliving the distressful memories in a safe environment. PISTA sound therapy enables a person to recall and

understand those unwanted memories and disconnect from the painful emotions associated with the event.

One PISTA trauma modality combines the PISTA sound tools with music that the PISTA participant can resonate with, helping them remember their past and present emotions to reach a resolution and better understand the traumatic event. PISTA allows the individual to choose music that will help them evoke the emotional state from the past and discover its association with the present state, enabling the self-learning process.

With the help and guidance of the PISTA coach, the individual may utilize this process to develop a better understanding of past events.

PISTA Story: Overcoming Trauma

In her early 40s, the client requested help because she no longer wanted to feel depressed and helpless. During the initial interview, the client stated she had been physically and emotionally abused as a young girl and had received no intervention. The client had few memories of her childhood, but she remembered the intense emotions of fear, hate and resentment. As an adult, she was aware that she responded defensively when she felt her memory, or her decisions were challenged. She found it very embarrassing being in her early 40s and forgetting things. The client experienced “brain fog” daily. She struggled to make good decisions, read social situations and regularly felt disoriented.

The client laboured under severe inferiority and insecurity. Her thoughts and conversations were negative, judgemental, and self-critical. She became easily offended by people’s behaviours,

conversations, or facial expressions. Often, she would respond so "badly" to a person or group that she would cut them out of her life. As a result, she could not build or maintain friendships. The client admitted she treated her husband the same way, and their relationship had deteriorated. Through the PISTA program, the client desired to establish a healthy relationship with herself and her husband. She wanted to move out of the victim mentality she was trapped in and become a functioning contributor to her family.

PISTA Intervention

When applying PISTA modalities, it is essential to consider the person's age, personality, and culture. Culture affects how a person should behave, what values and beliefs they hold and how they adapt to different situations. Age and culture influence how a person approaches or avoids their environment. It also affects their desire, career, personal, and family goals. The client became more open to managing her thinking and behaviour patterns by doing cultural and age-specific EPs. The trauma modality allowed the client to put the insights gained into practice. As she practised the insights and reflected on her actions, she discovered her inner strength and made the necessary progress.

During the day, the client used the PISTA vibrations and sound to identify trigger points and manage the variety of emotions she experienced. She experimented with the different PISTA machine speeds to control her moods, memory, and creativity during her daily activities. The client incorporated 60 minutes of walking daily (30 minutes twice daily) using the PISTA sound. She noticed it reduced her anger and made her feel more energetic. The client used the PISTA sound at night to manage her sleep quality and eliminate nightmares.

As part of the PISTA exercises, the client was asked to track her mood, energy, feelings, exercise and eating. By recording these each day, the client started seeing patterns of behaviour that she could change but also what she had achieved.

The client completed a 15-minute intervention modality (P15) whenever she felt emotional and "out of control". She noticed a decreased emotional intensity each time she utilized the P15. The technique helped her change her mental process from reiterating shame and negative self-talk to an honest, balanced view of the situation. Through the P15 exercises, she realized that the intense emotions would pass and that she could break the established response patterns.

With each Entry Point (EP) given by her PISTA Coach, the client recognized that her perceptions were based on her runaway emotions. As the client worked through each EP, she gained insight with minimal intervention from her coach. The PISTA method allowed the client to engage in the process of talking to and hearing herself. She understood her limiting beliefs, stories, and future unfounded fears through her insights.

She recognized her potential; she was not trapped but could make the changes she wanted. As the painful memories and emotions were dealt with, she gained more motivation, was no longer lethargic and stopped procrastinating. The brain fog lifted, and she felt a clarity she had never experienced. Her decision-making process improved, and as a result, she had fewer arguments with her husband. She started studying again to start her own business.

She recognized her trigger points for depressive bouts and set up a system to reduce their effects. The client felt empowered to make healthy lifestyle changes. She established a healthy sleep routine, exercise, interest group meetups and healthy eating.

PISTA in Action

By applying the theory of binaural beats, neuroplasticity and brain entrainment, clients dealing with trauma can monitor their thoughts and behavioural responses in real time and construct new healthy responses.

During structured EP sessions, the clients receive specific images or words to think about. By understanding their thought patterns and beliefs that motivate them, the clients learn how to deal with traumatic experiences, gain compassion for themselves and deal with shame. This modality moved clients away from blame to the regulation of daily emotions. The clients no longer felt trapped by unhelpful thoughts causing suffering.

Anxiety

Fear is the ability to notice and react to immediate danger. On the other hand, anxiety is a fear response to a *potential, uncertain or unknown* threat related to undesirable future outcomes. Potential and immediate real danger evokes the same flight or fight response system, causing blood pressure and heart rate to increase. Anxiety can disturb our ability to focus and concentrate because our mind is distracted by anxious thoughts. In some situations, the physical symptoms of anxiety or fear can interfere with our ability to perform tasks, and unmanaged symptoms affect our ability to learn and remember things.

In research presented at the Alzheimer's Association International Conference, the effect of stress on the brain was evaluated, showing that every stressful event was equal to 1.5 years of brain ageing. Not only is stress caused by real events, but perceived stress also contributes to brain ageing. A variety of events across a lifespan can cause stress and anxiety. Researchers believe that stress causes inflammation in the brain. The management of anxiety and lifestyle choices to reduce the chances of dementia or Alzheimer's are vital and should start at birth.

As children and adults, we need to learn to deal with fear and anxiety correctly. Living with constant anxiety affects our awareness of what is happening around us, our ability to make good decisions, flexibility in our thinking to solve problems, focus and memory. We need to know how to differentiate between reasonable and unreasonable fears. Learning how to calm down is a vital life skill. Anxiety is a common yet treatable condition but poses a significant risk to our brain's health, positioning us at a higher risk of developing dementia.

Fear of Public Speaking

Public speaking is an example of a highly stressful event that generates high levels of anxiety in many people. Public speaking is one of the most common phobias, affecting three out of every four people. For some, the thought of a public presentation reduces them to an anxious, trembling mess. Presentations, especially during more formal events, regardless of the audience size, can create such intense anxiety that the speaker can become physically ill. When you consider that each stressful event ages your brain, then learning to properly manage the fear of public speaking is an important part of maintaining brain health.

When anxiety drives our perceptions and beliefs, we can get trapped in negative thinking loops. Earlier, this book discussed cognitive distortions in detail. Distorted views can make us feel unmotivated, lower our self-esteem, and create more stress-inducing thoughts that can lead to health issues. In this case study, the young male teenager's unmanaged cognitive distortions exemplify how negative thinking can lead to irrational decisions. Without intervention, these thinking patterns could become habits, resulting in negative feelings and abnormal behaviours that will continue to affect him throughout his life. The case study examines how the student learned the valuable skills of managing anxiety and the distorted thinking it invoked.

A PISTA Story: Dealing with a Debilitating Fear of Speaking

The 15-year-old male client needed to do an important presentation in front of an audience consisting of peers and adults. There were 42

adults invited to the presentation. In the two weeks leading up to the event, the mother reported that his behaviour deteriorated with an increasing number of angry outbursts. His sleep was disrupted. He regularly woke around 3 am with intense anxious sensations in his stomach. He was tired and felt unwell. His thoughts were in a negative loop of self-criticism. He believed he would fail, be laughed at, and be humiliated. His intense emotions affected his ability to memorize information and prepare for the presentation. The situation also affected his ability to concentrate in school and complete homework. His teachers commented that he was misbehaving in class or sleeping during lessons.

PISTA Intervention

The client's age and culture must be considered when applying PISTA intervention. This student's areas of concern that required intervention included anxiety, lack of sleep, inability to learn, and negative self-talk. He also needed focus and creativity to complete the presentation preparation. The first step was for the student to commit to using the PISTA vibration to study and sleep, allowing him to focus on his work, control his emotions, and manage his nightmares.

With his PISTA coach, he did three structured EP sessions using the image of presenting. During the first session, he had strong impressions of death associated with public speaking. By the third session, he could see himself speaking in front of the audience without embarrassment. With the anxiety reduction, his sleep quality improved. His coach then applied the modality to help him structure his thoughts, create a presentation, and memorize it.

Cognition, knowledge, memory, and attention are critical to creativity and learning. In a state of anxiety, the student could not tap into his ability to create something that he thought was "good" enough to present. He felt dumb. He felt like a cloud had descended on his brain, making him forgetful, clumsy, and incompetent. He was struggling to make decisions. He kept second-guessing himself. By allowing his brain to focus on the event and process the associated fear, he became more open to the experience. This openness increased his tolerance to uncertainty and allowed him to concentrate fully on the preparation he needed to do.

The final area his coach worked with him on was regulating his self-talk. By allowing him to explore different imagery and beliefs, he gained insight into his strengths. He evaluated his weaknesses honestly and determined the skills needed to help him manage these. Data emerging from the *Psychoneuroimmunology* (*PNI)* field of study shows how exposure to stress causes changes in the immune system. The intensity of this student's fear of speaking resulted in poor health, including headaches, upset stomach, feelings of nausea, and a high fever. The symptoms cleared as the student dealt with his fear, and his fever broke. He was also able to advocate for the support he needed to ensure his best performance.

The client continued coaching sessions through the PISTA English program. Through the English program, he continued learning how to manage anxiety. He learned emotional control to manage his thoughts and expectations of different events. After a year in the program, the student noted he no longer had issues speaking in front of any size audience, which opened new opportunities for him, such as being the master of ceremony at one event and a DJ at an educational event

attended by 2500 people. He also noted that he no longer experienced moments of “blankness” or forgetting work during exams. He had more clarity in his thoughts, and he could make connections between different ideas and concepts.

Social Anxiety

Fear, anger, love, and sadness are all emotions. Though we use the word “emotions” interchangeably with “feelings”, they are different. Emotions, like anger and fear, trigger physical sensations in our bodies. On the other hand, our mind assigns feelings to our emotional experiences to give them meaning. Kendra Cherry, a Psychology expert, gives an outline of the five reasons she believes we have emotions:

- Avoid danger by fleeing or fighting
- To keep us alive
- To act
- To make decisions
- To understand others

Emotions have the ability to influence our thoughts. They often happen before thoughts appear. Our emotions motivate us to respond to environmental stimuli, improving our survival chances. When our emotions are triggered, our body’s stress response system is activated. The stress response is deactivated once the distressful event is over. However, the stress response will continue as long as the threat is present. Stress affects the nervous system, which is significant in performing the primary function of learning and memory.

Most of us have been taught from young that some emotions are “good”, and some are “bad”. Fear, anxiety, sadness, and anger are often referred to as “bad”. Emotions exist because they serve an important role in communicating needs, discomfort, or desire. Usually, emotions are temporary; however, feelings can endure for many years. If no action is taken, the feelings triggered by emotions can trigger more negative emotions. When emotions become maladaptive, they produce behaviours that prevent us from adapting or participating in different aspects of life. Social anxiety is an intense fear of social situations. This anxiety is more than shyness; it can be overwhelming and interfere with daily activities such as phoning or shopping. Excessive anxiety can exhaust the body and lead to physical symptoms such as headaches, backache, forgetfulness, and hypertension. It can impair performance at school or work and interfere with relationships.

Importance of Social Engagement

Social interaction has been linked to increased resilience against cognitive decline. Though the association between social interaction and cognition is less understood, good social connections result in lower mortality rates, better health, and improved quality of life. Intervention in young people (and adults) with social anxiety is essential. Children with unhealthy coping strategies related to social situations will grow into adults unable to participate and connect socially. One research project conducted over two years showed that social isolation resulted in lower cognitive reserve and poorer cognitive functioning.

A PISTA Story: Effects of Social Anxiety

An eight-year-old client was struggling with an overwhelming fear of interacting with anyone. The young girl struggled with any social situation outside her immediate family. She would cry or freeze if anyone spoke to her. At school, she sat alone, played alone, and worked alone. She was afraid to say anything that would cause embarrassment. Group work was so overwhelming that teachers stopped including her and allowed her to work alone. She found school traumatic, interfering with her ability to learn, recall information, and achieve good marks on tests and assignments.

Working memory is essential for solving problems, managing chunks of information, and making good decisions. When this memory is not working at its optimal level, it can lead to concentration difficulties, mistakes, and struggles to complete tasks. The student worked hard at school, but her marks often did not reflect her effort, affecting her motivation and how she viewed herself.

PISTA Intervention

The first step to managing the young client's fear was directing her to use the PISTA machine at home, especially while doing homework. She was also encouraged to use the PISTA vibration cubes while she slept and use the PISTA sound in the morning before school. By using the sound and vibration, the student felt more relaxed and focused on her tasks. She slept better and was less tearful about going to school. By reducing the anxiety, the student reported less confusion and more capable of following instructions at school.

After a week of continuous use of the PISTA machine, the client did her first session with her coach. She was given an Entry Point related to fear. Over the 11 sets, she had no thoughts or images related to fear but “felt” the fear. By the end of the 11th set, she felt a release of tension. The release was so great that she felt “like she had overeaten on sugar” for a couple of hours before falling sound asleep.

By the end of the session, the change in her was noticeable. Over the following week, the student continuously reported to her coach with excitement about everything she had been able to do, from raising her hand in class to ask a question to playing with a couple of other students during her lunch break.

As the student started exploring her relationship with fear and what made her afraid, she started blooming. She started participating in class more, voicing her concerns and problems, working within groups, and challenging herself in personal, social, and public speaking situations. By constantly practising the specific exercises the student was given, she trained her mind to build healthy thinking circuits. She created healthy emotions and behaviour patterns by having healthy ways of thinking.

After the initial coaching sessions, the student continued with the PISTA English program. The program continued to train her to manage her fear during group work and presentations. During the workshops, she learned new social skills and was able to practice these skills in a safe environment. The student was able to transfer these skills to school and started building a friendship circle. She became more accepting of social “rules”, which allowed her to participate in team discussions, playtime games, and understand group dynamics.

Through specific tasks and projects, the student learned to accept that mistakes were not things to criticize and belittle herself about but stepping stones to improving and learning. With the continued use of the PISTA vibrations and EPs, the student became less fearful of embarrassing herself and more willing to step into leadership. She embraced the challenges of public speaking, teaching other students, hosting events, and participating in drama and theatre productions.

By working through the intense anxiety within a structured psychological framework, the student was able to manage fear and use that fear to gain forward momentum. Fear stopped being her enslaver. She turned fear into her bodyguard – an emotion that protected her instead of keeping her trapped.

Unmanaged anxiety and fear in children can establish patterns of thinking and behaviour that continue to affect the person into adulthood and old age. Anxiety affects learning, memory, concentration, and attention. Stress affects a person's ability to understand and take the right action.

Without intervention, cognitive distortions can underpin the child's core beliefs. Children experience irrational thoughts and emotions about their world, themselves, and others through these cognitive distortions. Their thoughts and minds can become trapped in negativity and anxiety, which can interfere with their daily lives and ability to build relationships moving forward into adulthood.

Grief

Grief is a profound sorrow brought on by the passing of a loved one. The process of mourning is normal and natural. Mourning is when our ties to our loved ones gradually withdraw as we review our thoughts and memories.

Grief is a very complex emotion. It is an emotion without a finite ending. There is no set length of time to return to normal. Grief is a life-changing experience that is often accompanied by an array of changes. We can no longer reach out and touch, hug or talk with our loved ones. Chronic mourning can lead to depression. Disordered mourning can cause poor physical and mental health.

Research into grief as a topic of study emerged in the 20th century. Researchers noted that although grief resolves within a specific period, it may still negatively affect our health. Grief can cause anxiety, increased risk of suicide and a decline in cognitive thinking. Memory, concentration, and cognition are affected as our brains fill with overwhelming thoughts and feelings of grief, loneliness, and sadness. As a result, the brain focuses on the emotions of grief, leaving little room for the activities that require the use of cognitive functioning.

From the emerging data, people can experience complicated and unresolved grief because they have difficulty dealing with the loss. Prolonged Grief Disorder (PGD) produces prominent symptoms that remain elevated for six months or more beyond the loss. These symptoms impair normal day-to-day functioning. Several studies have investigated the relationship between acute grief and cognitive

decline. The data shows that grief affects memory, causing immediate and delayed recall decline.

For some people, death's devastation results in them never regaining their psychological equilibrium. Those who do not allow themselves to explore the varied emotions that grief brings often suffer the consequences later. Without intervention, the loss of a loved one can result in prolonged grief, intense feelings, and problematic reactions.

A PISTA Story: Overcoming Grief

The client's initial reaction to the news of her father's death was shock. She experienced disbelief and refusal to accept what she was being told. Alternating emotional outbursts and numbness followed this initial reaction. The client experienced clenched fists, tense shoulders, and deep stabbing pain that took her breath away. Her sleep patterns became disrupted, and her quality of sleep worsened.

The intensity of emotion did not dissipate after the funeral. Instead, as different milestones were reached (such as anniversaries and birthdays), there was an increased sense of loss, anxiety, and fear of forgetting. The intensity of the grieving experience also caused the client to withdraw from social interactions as she found these draining and isolating experiences.

PISTA Intervention

This PISTA Modality allowed the client to find a way of grieving and healing that made sense to her. The modality facilitates self-expression and emotional control. It helped the client to adapt by finding relevant images from the past to create a sense of hopefulness.

The client's coach used specific images and memories associated with loss, fear, and the unpredictability of life as various EPs (Entry Points). During each EP session, the client focused on the prompt while using the PISTA sound and vibration. With each session, she gained a deeper understanding of the concept of grieving. She could face intensely sad memories while creating positive memories. She was able to reconceptualize loss.

By entering a guided self-dialogue, the client could acknowledge her deep sense of loss and the fear that loss brought. She gained insight into managing the sensations of uncertainty and unpredictability of life.

The EP sessions were combined with daily 15-minute modality (P15). The daily P15s allowed the client to manage the intense emotions she felt. It allowed her to accept the vulnerable feelings of grief which helped her to regulate her emotions during the day. By allowing herself to be open to the complex emotions of grief, she could find a new state of equilibrium.

Through the application of the PISTA grief modality, the client transformed her attachment to loss into an empowering internal experience. The modality allowed the client to broaden her understanding of loss. As the client reached a state of equilibrium, she found the courage to experience and engage with sadness.

Death changes us. However, by applying the modality, those who are grieving are trained to identify new opportunities to create beautiful memories. Working through the grieving process properly allows us to evaluate what our new relationship with our loved one looks like in the present and let that inspire us.

Sadness is Actually Good

Sadness is one of the universal emotions experienced by people worldwide; however, the causes and perceptions of sadness vary across cultures. In general, sadness is experienced because of a loss - loss of a relationship, loss of a loved one, loss of expectations, loss of something important. Though the concept of sadness varies across cultures, the symptoms of sadness are generally the same: low mood, lethargy, social withdrawal, periods of crying, and distraction.

Sadness describes a family of emotions ranging in intensity from mild disappointment to anguish. It can also vary in duration and fade regardless of intensity. It is natural to judge emotions that make us feel bad, such as anger, fear or sadness, as "negative" emotions. However, all emotions play an essential role in our personal and social environments.

In earlier times, feeling sad or moody, known as mild dysphoria, was a regular aspect of everyday life. Historically, ancient Greek mythology and, later, Shakespeare's tragedies educated the audience to acknowledge and deal with the misfortune of human life. Similarly, the works of great artists such as Chopin and Beethoven's music or Chekhov and Ibsen's literature depict the scenery of sadness as enlightening and significant. For ancient philosophers like Epicurus, it was important to exercise wise judgment, restraint, self-control, and recognition that hardships are an inevitable part of life. Lastly, according to Stoic philosophers, learning to foresee and accept adversities such as death, sorrow, or injustice is crucial.

In Psychology, the study of feelings and behaviours asserts that all affective states, such as moods and emotions, play a significant role in

alerting a person to a world that needs a response. The spectrum of human emotions involves far more negative than positive emotions. Fear, anger, shame, or disgust are all valuable emotions because they enable us to identify, prevent, and overcome potentially dangerous situations.

Nowadays, most people aim to achieve happiness and tend to avoid sadness because of its social stigma. It is clear from history and psychology that sadness is something we need to value. It is, indeed, okay to feel sad. However, it is also crucial to know the difference between sadness and depression, as people tend to use these terms interchangeably.

Sadness vs Depression

Regardless of the uncomfortable feeling sadness evokes, it needs to be recognized as a normal and practical aspect of human life. Sadness signals something is wrong, and we need help or comfort. Mild and temporary sadness or bad moods have a crucial and adaptive purpose: they assist a person in coping with difficult situations. Sadness alerts us that something is wrong. It can signify a breakdown in communication between us and others or alert us to unfulfilled goals. Experiencing sadness can also act as a protective factor by reducing judgmental biases. Sadness reminds us to reach out to others for support. (Clark et al., 1987).

Negative moods, such as melancholia (feelings beyond sadness) and nostalgia (a sentimental state of yearning to return to the past), may serve as a road map to guide the individual in future planning and help drive motivation. Sadness can also improve empathy, kindness, a sense of connection, moral and aesthetic sensibility, and facilitate

artistic expression (Lehrer, 2010). In research, the benefits of mild bad moods include automatic and unconscious alarm signals, enabling a more attentive and detailed thinking style.

On the other hand, depression is a severe and debilitating disorder that involves intense and enduring states of sadness. Sadness will fade with time; however, depression can endure for many years if left untreated. Depression impairs a person's ability to function in personal, social, work, financial and other important areas of life.

The Good Thing about "Sadness"

Research shows that negative emotions, such as sadness, have mental health benefits. To illustrate this, researchers measured the changes in performance in people performing cognitive and behavioural tasks after exposure to happy and sad movies. Feeling sad or having a bad mood delivers some benefits to an individual.

A mild poor mood reduces biases and distortions while developing an impression of someone, implying more accurate judgment. For example, slightly sad judges made more reliable and accurate impressions of others because they processed details more efficiently (Forgas, 2011). Also, bad moods diminish gullibility, improve scepticism when assessing urban myths and rumours, and improve the ability to recognize deception more precisely (Forgas & East, 2008).

According to one study, those in a negative mood performed more challenging mental activities than those in a good mood. They spent more time on tasks, answered more questions, and provided more accurate answers, showing increased motivation (Parrott, 2014).

A “bad” mood can promote better communication. Research shows that people in sad moods have more efficient persuasive arguments to persuade others (Forgas, 2007), can better understand ambiguous statements, and communicate better when talking (Koch et al., 2013). Lastly, some studies have found that mild “bad” moods can cause people to give more attention to social assumptions and norms and treat others less selfishly and more fairly.

What can the PISTA Modality do about Sadness?

Every day we encounter different situations that require us to adapt and change. Our brains are involved in every aspect of life, making us aware of our surroundings, problem-solving and making good decisions. As we change, our brain modifies and reorganizes its structure. PISTA incorporates this concept of the brain’s ability to transform into its modalities. Through guided self-reflection, PISTA participants can understand the real cause of their sadness. By applying the PISTA modalities, individuals rediscover their inner strength and courage to manage the situation causing the sadness.

Understanding sadness, its impact on us and the source of the sadness is the first step to healing. However, to deal with sadness, an individual needs healthy coping strategies to manage the intensity of the feelings associated with sadness. The PISTA modality of mood transition helps the individual to contain and capture the underlying emotion of sorrow.

PISTA modalities have specific exercises that individuals can do when the feelings of sadness are overwhelming. The PISTA sound tool assists individuals in resonating with their emotions and altering them.

Listening to the sound helps create mental imagery that can assist them in navigating quickly from sadness to a neutral mood and then to a happy mood.

The shift in mood can be done by listening to the PISTA sound tool with eyes closed for 5 to 15 minutes, as often as required. Applying the PISTA stimuli within a psychological framework allows a person to work through their strong emotions, find healing in their pain, and build resilience to manage the uncertainty of life.

A PISTA Story: Managing Sadness

A client joined the PISTA program because of the continuous overwhelming feeling of sadness she was experiencing every day. She could not identify any specific reason for the sadness. Some days she only felt sad; on other days, the sadness led to tears and lethargic feelings. The sadness was affecting her work, social and personal life. It was also affecting her creativity and desire to engage in her passions. During her interview, the client commented that she continuously felt a tightening in her chest and a lump in her throat. She had been to her local GP (general medical practitioner) to rule out any underlying deficiencies or illnesses.

The client also noted that the sadness could sometimes be so overwhelming that she would cry in public places, which she found embarrassing.

PISTA Intervention

As part of the program, the client used the PISTA sound and vibration tool during the day to manage her day-to-day emotions and at night to

improve her quality of sleep. She also kept a record throughout the day of her moods. By noticing her mood, she became aware that she did not only experience sadness but a range of other emotions. She also identified emotions she could change by taking action. Through monitoring her moods, she also became aware of her energy levels. She started planning her schedule around the times of day she had the most energy.

Through her daily 15-minute PISTA exercises, the client recognized her triggers, thinking styles and cognitive distortion. She realized her sadness controlled her relationship with herself, her husband, and her friends. She used her sadness as a way of obtaining sympathy from others. During her PISTA exercises, she realized that sympathy was a way of connecting with others on a deeper level. However, to maintain the level of sympathy needed for that sense of connection, she had to keep escalating the stories of sadness or find new friends who would sympathize with her. Her coach provided EP prompts so the client could use the self-talk technique effectively. By “talking” and “listening” to herself, she could focus on helping her mind develop new ways of thinking to solve her emotions and thoughts that disturbed her daily. She also recognized the skills she needed to learn, such as conflict management, conversation, and negotiation skills. By having weekly goals, she could track her progress.

With the awareness that sadness was not a “bad” emotion but rather an empowering feeling, the client could harness the goodness of sadness.

Mental Stability and Happiness

Mental stability can influence happiness and vice versa. Some people may:

- pursue happiness by focusing on earning money
- work hard to achieve a promising career
- pursue fruitful relationships
- move to new cities to live independently
- do things that would make them happy based on what society portrays as happiness

However, while you may do these things to pursue happiness, your mental stability or mental health is also affected. For instance, moving to a new city may mean freedom and independence. However, living alone is not that easy. Research shows a relationship between common mental disorders and living alone, and the primary driver is loneliness, which affects all age groups and sexes (Jacob et al., 2019).

The adage “money cannot buy happiness” may probably be true for some and not for others. According to the U.S. Happiness index, the average score in 2020 was 6.95 out of 10, implying that overall happiness and well-being rely on mental stability more than any other aspect, such as money or material possessions (Hart, 2021).

Happiness is an abstract concept, and each person gives it their own meaning. Yet, researchers in the field of positive psychology determined that happiness is general satisfaction with life. Mental stability has a significant role in achieving long-term happiness. Although mental pain is usually not manifested physically, it can be

as detrimental and hurtful as physical pain. It affects the individual's emotions, cognition, and other cognitive processes.

Being mentally stable relates to having control over your thoughts and behaviours, being able to care for yourself and others, working consistently, having good relationships with family, friends, and others, and maintaining a social life. On the other hand, people grappling with their mental health experience withdrawal, isolation from people and their usual activities, sleeping and eating problems, alcohol and substance abuse, or hopelessness about life. All of these are signals that there is something that needs to be dealt with. These warning signals affect daily functioning and deprive an individual of experiencing good things in life and feeling happy. Also, these signs may result in more severe mental health concerns, such as anxiety or depression, if left unchecked.

In Makki and Mohanty's (2019) study, the link between mental health and happiness shows how people dealing with mental illness are more likely to have lower levels of self-and job- satisfaction. Also, sadness may result from persistent mental instability. Based on the abovementioned findings, it is clear there is an association between mental stability and happiness and that awareness and addressing mental health is crucial, particularly since numerous factors may affect happiness and mental health.

Happiness and Cognitive Decline

Ongoing research into the effects of anxiety, depression, and PTSD on cognitive decline. Though more research is required, a link has been established between long-term anxiety, depression, and the onset of

dementia later in life. However, research into the concept of happiness and its impact on cognitive impairment has been largely neglected.

Cognitive decline is a significant health issue in a society that is ageing. Improving the mental well-being of older adults improves their quality of life and reduces the financial burden related to cognitive impairment. With most developed nations being concerned about their ageing demographic, there is more focus on how to age successfully.

Knowing what contributes to lower happiness levels among individuals with cognitive impairment requires a holistic look at multiple psychological, social, and environmental domains. By examining these domains, we can better understand the relationship between happiness and cognitive impairment.

In the Chinese longitudinal longevity study, participants were followed over twelve years. The study explored healthy longevity determinants and included data from centenarians. A subset of the data found that cognitive decline was slower in those participants who were optimistic about life.

A study published in 2021 by the University of California suggests that happiness in early adulthood could protect against dementia. The study also showed that depression in early adulthood could lead to an increased rate of cognitive decline in old age.

Research is beginning to understand the protective health benefits that happiness gives individuals. Lyyra and colleagues [2006] conducted a ten-year study of Japanese octogenarians. They showed that

happiness, a key marker of higher emotional well-being, could be associated with lower mortality rates.

How to Foster Mental Stability

Since mental stability and happiness are related, cultivating mental resilience helps to increase happiness. There are ways to foster mental stability, according to Hart (2021):

1. Never Hesitate to Seek Professional Help

Despite the abundance of access to mental health services and professionals nowadays, there are still individuals who hesitate to ask for professional help. Probably because they do not know whom to ask or what type of professional help they need, financial concerns, or because of stigma. Mental health professionals, such as psychologists and psychiatrists, are accessible in schools, community centres, rehab clinics, and hospitals. Their backgrounds and understanding of human behaviour allow them to help people with mental health concerns. Asking for help is beneficial in fostering mental stability and may motivate the individual to take the necessary steps toward recovery.

Programs like PISTA are non-invasive and self-paced. PISTA is focused on implementing methods that are scientifically tested and approved. The PISTA program allows you to receive the help you need from the right professionals, such as trained and licenced coaches, psychologists, business specialists or the Medicare team.

2. Learn How to Manage Emotions

Emotions can trump our rationality. Emotions can be tricky and complex; some people have problems managing and expressing them. For instance, if your anger is not correctly handled, it may lead to hostile behaviour that can damage your relationship with family, friends, or others. Feelings of sadness, denial, and isolation can also make it harder for you to connect with people who can provide support and care. Therefore, it is necessary to develop good coping strategies when dealing with overwhelming emotions. This will help keep you on track without being driven by emotions. The PISTA program gives you the tools to understand how your emotions affect your relationships, career, finances, and attainment of your goals. It trains you to be self-aware and use your mind's power to cultivate a constructive attitude to deal with daily events.

Those experiencing intense emotions that have a significant impact on your mental health should not hesitate to seek professional care.

3. Be Aware of Life Choices

We all have times when we cannot control our mental states, yet we have significant power over our life choices. We always have the option to care for our health and wellness regardless of how we feel, which may lead to holistic happiness. Therefore, it is critical to exercise regularly, follow a healthy diet, and take the initiative to stick to these healthy habits. Engaging with people and participating in social gatherings also benefits our overall well-being. Investing in an environment and routine beneficial to mental stability will also positively affect happiness.

It is important not to lose hope when struggling with mental health concerns or instability. The solution may vary from person to person. Some people find the answers they need to change their thinking and behaviour patterns by joining coaching programs like PISTA. Others attend behavioural therapy or take medication to regain their mental stability. Despite the different approaches, all solutions are valid because of individual differences in personality and experience. Nevertheless, the first step for everyone is acknowledging the situation and emotions and being open to seeking help (Hart, 2021).

Summary: PISTA – An Approach to Assist Persons with Cognitive Decline

Cognitive health refers to our ability to think clearly, learn and remember. It is an important component of managing everyday activities. Aspects of brain health include:

- **cognitive health** – remember, think, make decisions, learn
- **motor function** – the ability to control our movements, ability to balance
- **emotional function** – how well we manage and control our emotions
- **tactile function** – how well we respond to sensations of touch, such as pain or pressure

On the other hand, cognitive decline is the brain's response to changes in brain function that involves a noticeable decrease in mental abilities such as thinking and memory skills. The degree to which brain function declines with age varies from person to person.

What happens when we get older? Brain ageing includes changes in the structure, white and grey matter volume, and neurotransmitter systems.

Cognitive decline is a normal part of ageing and becomes more noticeable from age 60 onwards. Even though cognitive decline is normal, dementia is not part of the normal ageing process, as not all elderly experience the onset of dementia. Though cognitive decline is

thought of as only occurring in old age, younger people are also susceptible to it.

Mild Cognitive Impairment (MCI) is not treated as a medical illness. Early detection is essential for long-term planning. In different studies, MCI patients over the age of 65 took part in a six-month aerobic exercise program. The results suggested that aerobic exercise can reverse or decrease the impact of MCI. Reversing MCI symptoms does not mean the symptoms will completely disappear.

Over the last four and a half decades, PISTA research has focused on systematic studies to create scientific evidence-based modalities to help us build the resilience we need to navigate life with clarity of mind. While PISTA cannot stop the natural changes taking place in the brain as we age, the method focuses on strategies to improve controllable factors such as decision-making ability and memory training. The PISTA programs encourage building lifestyles that support a person's emotional and mental wellness, physical health, and social engagement.

Focusing on modifiable factors that can be implemented from childhood means we can take preventive measures and participate in activities building cognitive skills and cognitive reserve.

Why Should we Maintain Brain Health?

- To build cognitive reserve, which is an important protective feature of the brain against age-related brain changes and disease
- High capacity of brain reserve decreases the risk of dementia and slows cognitive decline

- It results in stronger cognitive, emotional, psychological, and behavioural functioning
- Improves ability to learn, make judgements, use language, and remember

Protective Factors:

Steps we can take to improve cognition and slow down or prevent cognitive decline.

Education:

- For those under 20: stay in school, finish your education
- For those over 20 and under 25: finish university or higher-level study
- For those over 25: continue studying professionally and for interest

Why is Education Important?

- Those who completed 11.5 years of school had a lower chance of acquiring mild cognitive impairment
- Time spent in education decreases the risk of cognitive impairment
- Education helps the brain accommodate cognitive changes caused by minor impairments
- Older adults with more years of education show evidence of higher cognitive levels and slower cognitive decline

Cognitive Training

Cognitive training influences the maintenance of cognitive functions such as reasoning, memory, and information processing speed.

Activities such as:

- Learning a new language
- Crossword puzzles
- Reading books – especially more educational books (historical stories, autobiography, philosophy etc.)
- Learning a new skill: knitting, woodwork, computer programming, painting, debate etc
- Teaching a new skill to someone else

Education and cognitive training throughout life help establish a cognitive reserve, sustaining normal cognitive skills longer.

Physical Activity

- Start participating in exercise during youth – this is linked to better cognitive performance later in life
- People of any age can include exercise to slow down and delay age-related cognitive decline
- We are all aware that physical activity is good for our health
- Exercise improves brain function
- Exercise improves memory, focus and concentration
- As cognitive ability improves, it lowers the risk of mild cognitive impairment and degenerative cognitive disorders

Some Examples of Exercises

- Walking up the stairs instead of taking the elevator
- Going for a walk
- Taking part in Zumba or other social exercise classes
- Jogging or running or rollerblading
- Swimming, aqua aerobics, kayaking
- Cycling
- Playing with a dog: chasing, tug of war, throwing balls

A fast-paced walk for no less than 10 minutes at a time can help keep physical and cognitive independence in old age by inhibiting different health problems.

Cardiovascular training is the most effective form of cognitive training.

Sleep

- Teenagers and young adults are at the greatest risk of sleep deprivation
- Older adults sleeping pattern changes can be caused by age, health conditions, responsibilities
- People who sleep less than 7 to 8 hours score lower on tests for mental functions

Why is Sleep Important?

- Good quality sleep improves our health
- It is a preventative factor against cognitive decline

- Sleep helps form and create new neural pathways improving the brain's ability to integrate learning and memories
- Sleep improves brain health
- Sleep improves focus and concentration

Eating Habits

Food provides the nutrients we need for the body's functioning, from breathing to digestion.

However, not all food we put in our mouths is equal. Some food will nourish our bodies and aid us in remaining healthy.

Other food will cause high blood pressure, cancer, cardiovascular disease, and diabetes and affect our brain's health.

Create a lifestyle that includes a balanced diet that nourishes and helps protect your body.

Why are Good Eating Habits Important?

- Good nutrition helps fight disease
- It helps us move well as we age
- Protects our mental health
- Keeps our skin healthy
- It supports our muscles and strengthens bones
- Helps maintain weight

Gut Health

Emotional shifts caused by the *enteric nervous system* (ENS) can cause functional bowel problems such as constipation, diarrhoea, bloating, pain and upset stomach.

Our gut regulates mood, mitigating stress, mental health, metabolism, immune system, and cognitive functioning.

Gut health means maintaining a balance between helpful and harmful bacteria and yeast in our digestive systems.

By eating food that nurtures, nourishes, and promotes good gut health, we ensure that our immune system, serotonin and hormones stay healthy and regulated.

Alcohol

Alcohol intake has been linked to developing long-term chronic disorders such as high blood pressure, heart and liver disease, and weak immune systems.

Alcohol also affects the brain and cognition.

Even light to moderate drinking of alcohol has now been associated with harming the brain, causing general cognition impairment. Study results have linked alcohol drinking to a decline in memory and executive function and an increased risk of dementia.

For the health of our brain, we need to limit our alcohol intake and, if possible, avoid drinking it.

Social Interaction

Strong social connections with family, friends, community, and others are as significant as physical exercise and a healthy diet.

Research has shown that people with strong social connections are less likely to develop cognitive decline.

Whereas, those who isolate themselves or have poor social connections are more at risk of depression, resulting in a greater risk of dementia.

It is Important to Build your Social Network:

- Strengthen ties with family, friends, and colleagues (where possible)
- Create new social connections
- Attend social exercise groups
- Participate in meetups, community events
- Participate in online communities
- Increase the frequency of your interaction with your connections
- Be part of volunteer groups visiting those at risk of isolation

Types of Enrichment

There are five main types of enrichment which offer a range of health benefits to you.

Nutrition

- A proper nourishing, balanced diet
- Add texture to food, e.g., crunchy and soft
- Add different tastes, e.g., sweet and sour

Social Interaction

- Meet different people with different interests
- Attend different interest classes or groups
- Take part in social activities such as volunteer work, yoga, Zumba or hiking

Cognitive Enrichment

- Learn new skills or languages
- Advance skills you have, e.g., practice speaking to a native speaker in the language you are learning
- Reading autobiographies or biographies

Habits

- Change your routines
- Rearrange your furniture or cupboards
- Create novelty for your brain
- Exercise

Meditation and Yoga

Meditation is the umbrella term for ways to enjoy a relaxed mental state.

Practice Includes:

- Yoga
- Guided Meditations
- Tai Chi
- Colouring in
- Eating food slowly and focusing on the flavour and taste

Why is having a Relaxed Mental State Important?

- Keeps the mind focused
- Eliminates the looping pathway that increases stress thoughts
- Increases attention and cognitive efficiency
- Helps maintain focus when tasks are tedious

Psychological Factors

Stress is one of the risk factors for cognitive decline.

Stress, poor sleep, depression, unhealthy coping strategies, cognitive distortions, trauma etc., increases the chance of neuroplasticity and decreases cognitive reserve.

Depression and anxiety are common mental health concerns – it is essential to address these to achieve positive neuroplasticity and achieve optimal cognitive health.

Prolonged negative thinking patterns increase the risk of memory decline.

Specific cognitive processes associated with depression and anxiety increase the risk of dementia.

Cognitive Distortions

- Affect the way we think, perceive, and interpret events and are referred to as thinking patterns
- It is a lens we see the world through that affects how we relate to the world.
- Distortions occur when we misunderstand an event or belief.
- Our mind tells us irrational things.
- Increase the risk of depression and anxiety

Dealing with Distortions is Important

- Use the power of change to identify distorted thinking
- Keep a journal of your experience of events and situations. Take an entry and see if any of the cognitive distortions apply to it.
- Once you identify the most common distortions you use, you will be able to recognise when that distortion is at work in your mind and be able to counter it.

Managing Psychological Factors

- Facing emotional challenges requires resilience
- Develop deep awareness of your thinking patterns to identify cognitive distortions and negative thinking patterns
- Seek help if sadness or isolation interferes with your daily functioning

- Participate in social situations, keep in contact with your social connections
- Continue to exercise to manage tiredness
- Create a good night routine that helps you relax before bed to promote good sleep.

Without motivation, change does not happen. We need to be motivated to look after and protect our brains and bodies' health.

The PISTA program will help you deal with symptoms of depression, anxiety, stress etc. It will help you identify obstacles and solutions to situations. You will develop a clear mind through the program to make good decisions and implement the right course of action.

Regardless of our genetic makeup, life experiences or other environmental factors, we can improve our cognitive reserve capacity. It is not too late to start.

If you or someone you know is struggling with stress, depression, PTSD, or trauma, speak to someone who can help you.

Meet the Authors

Dr André Stang

PISTA Specialist – Neurotoxicity in Sports and Corporate Sales

Dr André Stang pioneered research in the field of cell study. His research includes developing and performing high-throughput methods for screening assessments with genotoxic impacts on human beings. He is an expert in toxicity and has broad knowledge of on how modern-day chemicals and lifestyle create an imbalance in the human body and wellness.

With his extensive understanding of neurotoxicity, Dr Stang supports the PISTA Integrative Brain Entrainment research team in discovering new approaches to promote best practices in daily work-life management. He introduced advanced research methodologies to study and measure the level of toxicity accumulated in the body and its effect on emotional wellness. One of his key contributions is the PISTA in Business Program, which he developed to train people how to manage stress and productivity in the workplace.

Dr Stang also combined his expertise on human toxicity with his professional table tennis career and designed the PISTA Table Tennis Program, which helps professional table tennis players learn different techniques easier and faster. This program increases alertness and the ability to manage stress level for top performance in competition and for keeping balance during life challenges.

Dr Stang graduated with a Diploma Degree in Biology and a Doctorate in the Natural Sciences. He has authored scientific papers on

biochemistry, environmental science, genetics, and toxicology, among others.

Selina Chan

PISTA Specialist – Business Soft Skills Management

Selina Chan specializes in the application of PISTA Learning in conducting business. Her excellent training and extensive experience in PISTA Integrative Brain Entrainment allow Selina to help managers, business owners and associates handle the daily challenges of doing business.

Selina understands the most common emotional and psychological needs of individuals in the corporate world. Using the PISTA Learning System, she trains managers to overcome the fear of making presentations and attending meetings. She has helped employers, managers, and executives meet targets, handle stress, and resist procrastination.

Since she joined the PISTA Team in 1985, Selina has been supporting the Chinese and English communities in Hong Kong and China and continues leading volunteers who give aid to the less privileged. Her expertise in the practical use of PISTA in daily life also helps patients cope with the challenges of studying and in managing interpersonal relationships. She also works from homes and the aged by helping the elderly cope with dementia.

Selina has a Bachelor's Degree in Psychology from the university of Calgary and a Post-Graduate Diploma in Counselling from Herm College.

Kerry-Ann Edge

PISTA Specialist – Learning and Mental Well-being

Kerry-ann Edge is a certified and licenced PISTA coach. She completed the three-year certification program, followed by an intensive two-year specialization program. During the three-year program, she applied the training to her students and herself, documenting the changes of the PISTA intervention on their emotional responses and their thinking and behaviour patterns.

Using this experience Kerry-ann, designed programs incorporating the PISTA Integrative method for primary, secondary, and tertiary students to improve their academic performance by improving concentration, motivation, and memory. The students are trained to manage social and exam anxiety, advocate for themselves and handle the daily challenges of school and home life.

Kerry-ann specializes in the practical application of PISTA to manage conditions that affect people's quality of life and relationships, such as panic, anxiety, depression, memory loss, and trauma. She has applied her knowledge to run personal programs and group workshops to train individuals to build a strong inner self that enables them to manage their complex emotions.

Kerry-Ann graduated from the University of Essex, UK with a Bachelor of Arts Honours Degree in Graphic Design.

Dr Tan Cheng Woi
PISTA Specialist – Corporate Coach

Dr Tan brings with him many years of corporate and business experience. He has played varied roles in his career, ranging from Entrepreneur, Business Owner, Director, Consultant, Coach, Trainer, and Researcher. He began his career with Citibank Malaysia and was Assistant Vice President when he left.

Since leaving the banking industry in 2001, he has started his own business venture and has since grown a successful brand development and brand management company supported by a strong domestic and global distribution network. He believes in serving the community and being a responsible corporate citizen. His life mission is to harness the power of commerce to benefit people and the environment.

In 2017, he founded LEVerne - a female antimicrobial underwear brand with the mission to be the guardian of the most intimate part and yet fragile part of a female's body. He has expanded his portfolios to cover a myriad of innovative products that offer inbuilt antimicrobial protection to consumers.

Dr Tan enjoys being a part of the consulting and coaching practice. He is conversant in Finance, Business and Leadership Coaching, Human Performance Improvement and Strategic Enterprise Risk Management Projects.

Dr Tan Cheng Woi has an Honours Degree in Laws (LLB Hons) from Leeds University in England; a Master of Art in International Economics (MA) from the International University of Japan in Niigata, Japan, and a Doctor of Business Administration (DBA)

degree with the University of South Australia. He holds a Certificate in International Management with Stern Business School, New York University. He is also a Chartered Financial Analyst (CFA) and a Certified Coaching and Mentoring Professional (CCMP).

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