Optimal Human Performance

A beginner's guide to the psychology of human performance

1 THE BRAIN-BODY SYSTEM

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In this lesson, we explore the interoperative and cooperative nature of brain function and behaviour in human creativity and performance. You'll learn how the brain influences the body and vice-versa, how nutrition and sleep fuel both cognitive and physiological performance, and how you can take action and influence goal outcomes.

INTRODUCTION

Brain and mind are often used interchangeably to refer to the space between our ears, but they are not the same thing. The mind is immaterial. The brain, on the other hand, is organic – the site of an intense thunderstorm of bio-electro-chemical activity which appears to be the control centre of our human organism. But the length and breadth of research suggests that when we think, we do so with our entire body and not just our heads.

The gut, for example, is as much involved in our emotional processes as are the complex neural networks of the brain. There really is no separation of mind, brain and body – they are intrinsically connected. However, our language suggests otherwise. When we get down into the nitty-gritty of what it means to see, hear, taste, smell and touch, we may realise that these discrete concepts make little sense in isolation.

As I write these lines I wonder how to phrase the ideas that occupy my thought. While there is no little me living inside my head directing things, there does seem to be some element of automation. Many behaviours and processes seem to operate without my intent. My heart and lungs, my sight and hearing, for example, operate below the level of awareness. So what exactly is the engine of these apparent processes? Where do the language I speak and the words I write live? Where are the pictures I see? How does my body know how to do what it does?

There are no easy answers, in fact, thus far in our scientific exploration of the nature of reality and the human experience, it seems that there are no answers. All we seem to know is that the brain and mind constitute a complex and multifaceted arrangement of cognitive functions referred to in the literature as attention, perception, memory, thought, imagination and so on. Consciousness itself cannot be found in the brain. Perhaps we will need to drop the idea that it can, and indeed that brain matter somehow gave rise to consciousness. But that's not a discussion in which we will indulge here.

In this chapter of Optimal Human Performance, we are concerned with how both brain and body interact and cooperate in the execution of high performance. The body directs the brain, the brain directs the body – it is one system. Considering this, there is little doubting that the body structure, nutrition, and recovery limits performance output. Sleep, the timing of meals, what food is consumed, levels of hydration and so on, have each been shown to have an influence on cognition, behaviour and performance output.

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We will explore these and other factors affecting the brain and nervous system, closing with suggestions for how you can leverage these automatic brain-body processes, and by consequence, positively influence your performance. Let's first take an overview of the human nervous system.

THE HUMAN NERVOUS SYSTEM

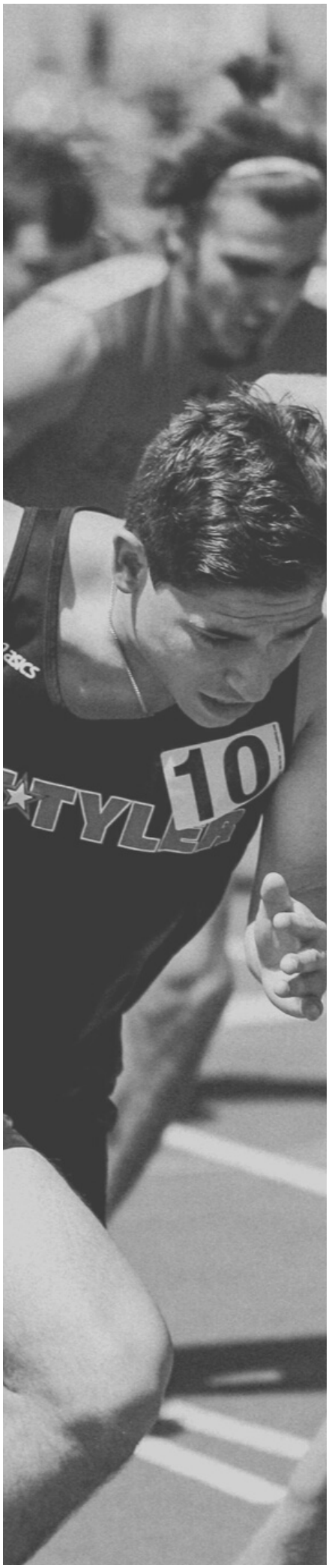
The nervous system (NS) of the human body can be said to consist of two subsystems; the central nervous system (CNS) consisting of the brain and spinal cord, and the peripheral nervous system (PNS) which extends out from the CNS to organs, muscles and our furthest extremities. The peripheral nervous system can be further subdivided into the somatic nervous system (SNS) and the autonomic nervous system (ANS).

The somatic nervous system is that component of the NS that we can say is under voluntary control and consists of afferent and efferent nerves taking signal to and from our extremities to the CNS. The autonomic nervous system, as the name suggests, operates automatically regulating our response to internal and external stimuli. It is the ANS that is responsible for heightened arousal and the commonly referred to the phenomenon "fight-or-flight response" which we will cover in detail in lesson five.

The Human Brain

The human brain contains about 1 trillion neurons working to coordinate sensory and motor activity in the entire body. Nerve centres function across two similarly structured hemispheres to control opposite sides of the body. Each hemisphere then is subdivided into the frontal, parietal, occipital and temporal lobes.

It worth noting at this point that these areas of the brain are not discrete. They, in fact, overlap in terms of function and in certain cases have been found to take up the slack where the brain has been damaged through disease or injury. It can be said that we use our entire brain for conscious and unconscious thought, and not as pop-science suggests, merely 10%.



The Frontal Lobe is that area of the brain responsible for executive function and is associated with conscious decision making, learning and planning. This area of the brain is particularly sensitive to dopamine, the endogenous neurotransmitter linked to feelings of happiness and elation which leads to reward reinforcement.

The Parietal Lobe is located above the occipital lobe and behind the frontal lobe and is responsible for interpreting somatic sensory information and perception and spatial navigation. For example, letting you know where your foot needs to be before striking the football, or where your tongue is as you chew your food so you don't bite it.

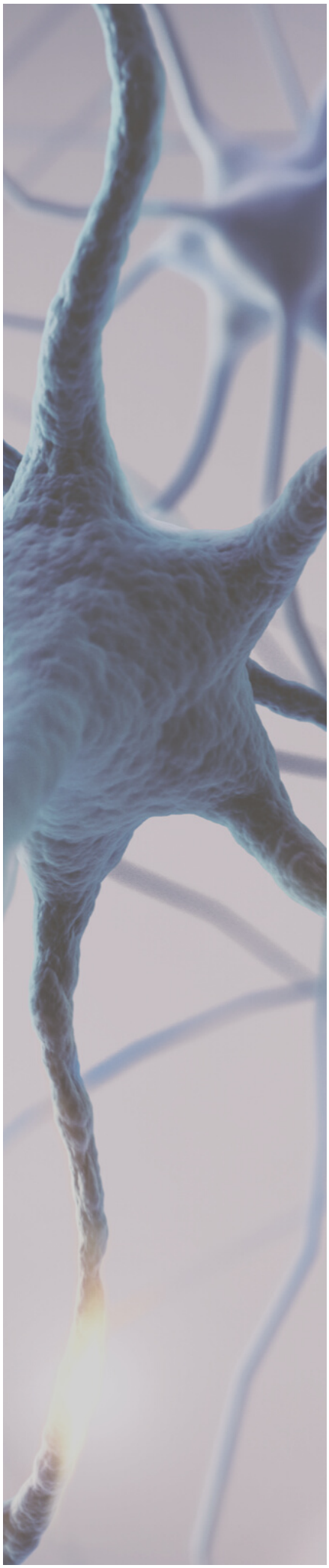
The Occipital Lobe is considered primarily responsible for visual data processing. is the smallest of the paired lobes of the brain and is considered primarily responsible for visual data processing. There are many sub-regions of the visual cortex which are specialised for different visual tasks, such as colour differentiation, and motion and depth of field perception.

The Temporal Lobe is central to auditory perception and is home to sub-structure circuitry critical to long-term memory and recall. The hippocampal region is critical for memory formation, and the surrounding medial temporal cortex is considered critical for memory storage.

Recognition and processing of speech and music is also located here.Activities that are movement-heavy such as stage performance or sport, rely on the cerebellum, located beneath the cerebrum, for coordination, balance and fine motor movements. Its primary function is to manage and maintain coordination for the whole body.

Neurons & Transmission

Neurons are highly specialised cells forming the basic functional unit of the nervous system. The neuron consists of the cell body, dendrites, axon and terminal buttons. Synapses are the neuronal regions where the cells connect and transmit information to one another. More numerous by about ten times are Glia cells which surround and support the neurons. They comprise the myelin sheath which provides insulation much like the insulation on an electric wire, allowing for faster transmission between neurons.



Neurons possess the remarkable ability to process information and generate complex response and behaviour in often unpredictable ways. Connections between neurons strengthen, weaken and change properties depending on signals received from the body's extremities and processing regions of the brain itself.

Information processing is both linear and non-linear with neurons possessing the impressive capacity to adapt, self-assemble, auto-calibrate and manufacture chemicals required for healthy function. The result is that regions of the brain change according to the demands of the body in its environment.

Bioelectrical transmission throughout the complex neurocircuitry of the brain is fundamental to performance, but it is said to be limited. Signal transfer is restricted by time, nutrition and energy availability. The brain is perhaps the hungriest organ in the human body consuming comparably more energy than the heart (Ames, 2000), therefore, finding adequate nutritional balance is vital for optimal performance.

In adults, 20% of all energy consumption can be attributed to the brain. In babies, brain energy consumption is 60%, which reflects the demands of infant brain development (Hoffman, 1983). Of course, particular factors bear heavily on the efficiency of neuronal transmission in the human nervous system. Let's take a closer look at these.

NUTRITION & PERFORMANCE

The brain and body require a diverse range of nutrients and micronutrients to function and develop in a healthy and optimal way. Human cognition is particularly sensitive to deficiencies in our nutritional intake and high performance perhaps even more so. Carbohydrates, protein, fat, vitamins, minerals and trace elements all play their part in optimal human performance so getting the balance right is critical to producing your best. Here we will examine, in broad terms, the role of these components in performance.

Macronutrients

Macronutrients are so-called because they are required by the body in large amounts compared to vitamins and minerals. They consist of carbohydrate (glucose), protein (amino acids) and fat (fatty acids).

Carbohydrates are thus called because chemically they contain carbon, hydrogen and oxygen. Both simple carbohydrates (glucose, fructose, maltose for example), and complex carbohydrates (starches for example) are absorbed at different rates in different parts of the body.

Simple carbohydrates provide the quickest glycemic response and are the preferred source of energy by the brain. Complex carbohydrates are most abundant in the human diet and are converted into glucose and stored as glycogen in the blood and muscle tissue available to fuel increased demand.

Proteins are a category of macronutrient formed by strings of chemical compounds known as amino acids and are a vital component in the growth, repair and development of the body and brain. They are particularly important in domains heavy on physical activity such as demanding sports and stage performances.

The inevitable muscle damage resulting from physical exertion, for example, requires protein for repair and recovery. Proteins are also required for the construction of hormones and enzymes necessary for digestion and the immune system.

Fats, also known technically as fatty acids, although demonised over many years by certain quarters of the food industry, are beginning to find greater acceptance amongst performers and the general public. The reality is that fatty acids are an essential component in the diet of high performers. They are a source of energy, are required for nutrient absorption and assist the body to maintain core temperature. Essential fatty acids such as omega 3 are important for cellular function.

Water accounts for up to 75% of the human body and the average human being require between 2 and 2.5 litres of water per day to function properly. Athletes required probably twice that amount and often more depending on the domains of their sport and associated environmental conditions.

Dehydration is detrimental to performance with psychological studies showing that brain dehydration (2%) resulted in reduced performance on physical, visuomotor, psychomotor and mental performance tests (Szinnai, 2005). Dehydration of even 1% has been shown by research to negatively impact concentration and memory and increase levels of anxiety.

Micronutrients

The human body and its nervous system are remarkably capable of finding balance even when our dietary intake is less than optimal. Eventually, under stress of poor diet our bodies will begin to show cracks, but generally, it is immensely resilient to the abuses we inflict on it.

However, if we wish to perform at elite levels in business, sport or the arts, we must give our bodies the best nutrition possible. And micronutrients play a critical role in the body's ability to perform at maximum capacity.

Underpinning efficient communication within the human nervous system are a variety of vitamins and minerals. They influence blood flow delivering oxygen and fuel to the brain and muscles, assist cell-reproduction and the release and absorption of neurotransmitters involved in complex cognitive and biological function.

Deficiencies in vital vitamins such as Vitamin A, B, C, D & E and calcium, and minerals potassium and sodium can limit blood flow and the brain's ability to communicate within itself and to the wider body structure.

Stuart Cotterill in his 2017 book Human Performance: Theory & Practice offers the following analogy; imagine the brain of a performer provided with sufficient micro and macro nutrition via an optimal diet – it's like a high powered fibreoptic broadband connection. Compared to a poor diet deficient in the necessary nutrients for high performance, the latter is like a dial-up connection.

Vitamins & Minerals and Their Impact

Vitamin	Impact
Vitamin B1	Cognitive function
Vitamin B3	Concentration, fatigue, headache
Vitamin B6	Neuronal communication
Vitamin B12	Memory, concentration
Vitamin C	Neuronal communication
Vitamin D	Cognitive function
Vitamin E	Cell membrane health

Mineral	Impact
Calcium	Neuronal communication
Sulphur	Cell health, linked to depression
Iron	Cell development
Potassium	Neuronal communication
Phosphorus	Brain health
Magnesium	Deficiency can cause muscle
Sodium	spasmNeuronal communication

Research on Nutrition & Performance

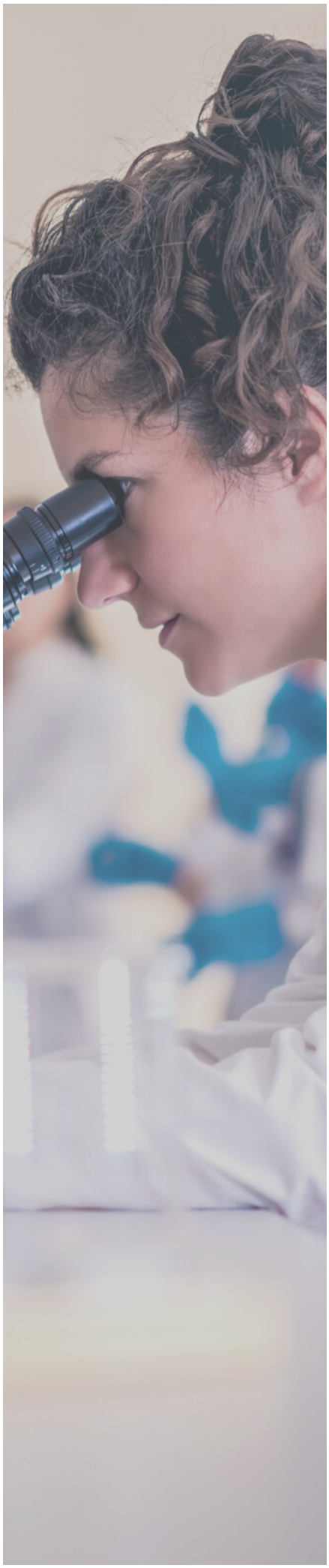
Although the relationship between food intake and performance behaviour is complex, the idea that nutrition has a measurable impact on cognition has had broad empirical support from psychological research (Cotterill, 2017). In addition to the reduction in cognitive impairment from an improved diet, scientists believe that nutrition can be employed to help bring performance above standard levels.

Studies which examined the impact of breakfast on performance found that the absence of breakfast meals can lead to impairment of reaction time and short-term memory on cognitive tests (Smith, 1994). And it doesn't only apply to professionals, because school children's cognitive performance can also be hindered through the omission of breakfast meals.

Kennedy & Scholey (2000) examined the effects of micronutrients and herbal supplements on performance. Smith et al. (1999) examined effects of caffeine and other stimulants, and Messier (2004) in a review of recent studies showed how carbohydrates are a key component in the moderation of memory performance.

The research is convincing, however, when applying the principles laid out here, we must caution against making blanket assumptions. Results may apply to the majority of people most of the time, but they may not apply to you specifically. So always make yourself the guinea pig in your own experiments.

Trial a new idea for a while and if it fits your lifestyle, dietary requirements and produces desired results then keep doing it. If it doesn't then drop it and try something else. That said, glucose is the favoured fuel source for the brain and without it, cognitive function suffers.



If you can't concentrate, are irritable and focus is blurred, then it's likely that you need a meal, or a rest or both. A 1986 study found that human performance follows particular rhythms throughout the day and following these rhythms is important. This might explain why some people perform better in the evening rather than first thing in the morning.

Our timing of meals and of what food those meals consist seems to be an important factor also. High, medium or low carbohydrate breakfasts do not improve performance according to a 1994 study by Lloyd, Green & Rogers. However, they did find that mood was positively effected by the high carbohydrate breakfast. Fatigue and restlessness were also positively affected.

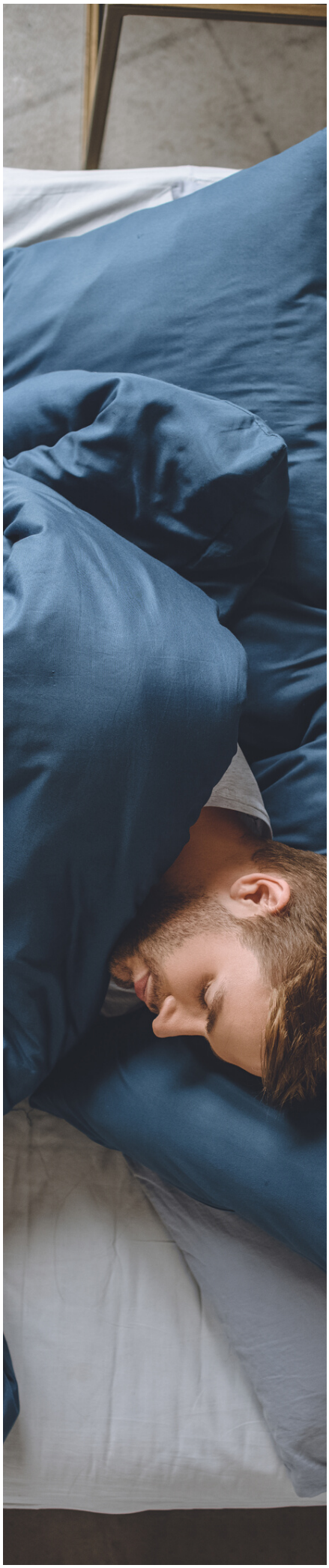
Interestingly, high carbohydrate lunches appear to have a negative impact on performance when compared to high fat meals, high protein, or no lunch at all. These and other studies suggest that what foods we consume and the time of day we consume them has a significant impact on performance.

SLEEP & PERFORMANCE

It is broadly accepted through the findings of studies on sleep, that the neurobehavioural function of sleep is restorative. With only one night of sleep deprivation, research has shown that brain activity, alertness and cognitive performance is significantly impaired.

Sleep is also a biological necessity not only for the brain but for the entire body. Any of us can attest from a subjective standpoint, that trying to function through the day, even when work processes are well established in our behaviour, can be very difficult without adequate sleep.

Productivity, efficiency and safety can all be compromised. From the point of view of performance at the highest level, Cotterill (2012) found that it is one of the most important factors in recovery, training and performance. Morin (2006) in a study on the psychological impact or insomnia, reported that the restorative nature of sleep is vital for coping ability, and adjustment to the physical, emotional and neurological stressors associated with daily work and other demands.



Studies on sleep have reported two stages within the human sleep cycle; Rapid Eye Movement (REM) sleep, and non-Rapid Eye Movement (non-REM) sleep. REM sleep usually happens about 90 minutes after drifting off to sleep. The first period of REM lasts about 10 minutes with each subsequent stage getting longer. The final stage of REM sleep can last up to an hour. In REM, heart and breathing rate increase and intense dreaming occur. This is because the brain is in a similarly active state as when it is awake.

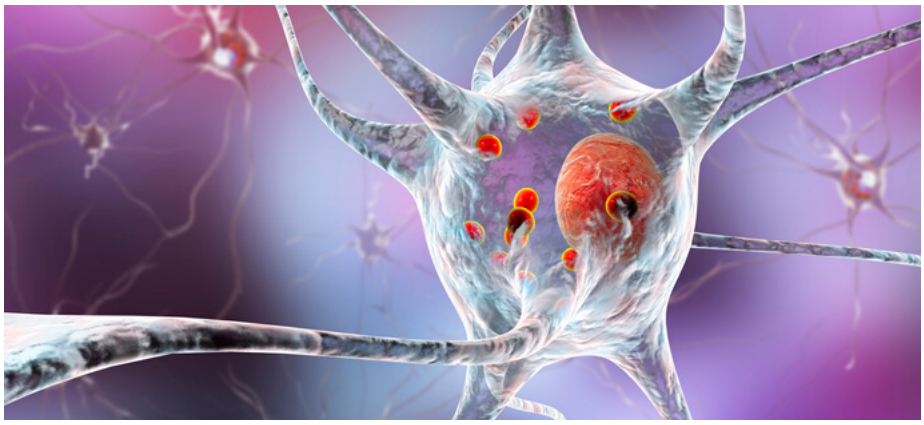
Studies have shown that when we are under stress, we dream more and spend more time in REM sleep than non-REM. This is detrimental to recovery and can leave us feeling tired after a night's sleep.During the deeper stages of non-REM sleep, the human body repairs itself, regrows tissues, builds bone and muscle, and strengthens the immune system. It's like the conscious waking self recedes into the background and the unconscious self can take over without hindrance. However, taking stress and anxiety to bed with us may impair this regenerative aspect of sleep. Therefore Optimal Sleep is critical for high performers.

Achieving Optimal Sleep

Achieving a good night's sleep is often contingent on the place where we lay our heads. A familiar and comfortable environment is important, the absence of which can affect the amount and quality of sleep. In turn, this impacts psychological, emotional and physiological recovery (Samuels, 2008).

The inability to find sleep is classified in the research literature as insomnia, and defined by Roth (2007) as "the presence of an individual's report of difficulty with sleep". Insomnia can be a real threat to performance and particularly so for those who travel in their business, sport or art. Therefore, establishing routines and interventions that combat insomnia and sleep-related challenges can be effective. The following steps can be employed to enhance sleep.

1. Only stay in bed for the time you are sleeping. In other words, for example, don't watch TV in bed.
2. Don't *try* to sleep – it's counterproductive.
3. Remove the clock from your bedroom.
4. Exercise in the evening. This is conducive to sleep.
5. Avoid caffeine, alcohol and nicotine.
6. Choose a regular time to retire and to rise.



A Final Word on The Brain-Body System

The relationship between brain and body is not in question. What is in question for all elite and aspirational performers is; how is it possible for me to perform to my best? We have established in this lesson the necessity for the brain to perform optimally as a prerequisite to elite performance, indeed everyday performance. But perhaps what is missing is a broad base understanding.

There are limits to performance, but as athletes continue to excel and business people become more creative, these limits are expanding. Fuelling the body and brain with optimal nutrition, and providing adequate rest and recovery is critical to this growth in human performance. The key for you as a performer, is a balanced, measured and consistent approach. Positive results are not achieved overnight.

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