PRISM

THE *PRISM* MODEL OF HUMAN BEHAVIOUR

A brief introduction to the *PRISM* system's biological roots

WE BELIEVE
IN MAKING
A DIFFERENCE

THE *PRISM* MODEL OF HUMAN BEHAVIOUR

"Learn as much as possible about how the brain works. This is the most important factor in getting smart and staying smart. Everything we think and everything we choose to do alters our brain and fundamentally changes who we are - a process that continues until the end of our lives."

Professor Richard Restak
Neuro-psychiatrist and Clinical Professor of Neurology
The George Washington University Medical Center

Background

Never before has the brain so vigorously engaged the imagination of the public. A major factor in that enthusiasm is the advances in brain imaging technologies which convert brain activities into the now iconic vibrant images we see almost daily on our TV screens as well as in newspapers and magazines

No human being is ever quite finished, until the last moments of life. At any given age or stage, they are still 'a work in progress'. Genes and environment continue to play their respective roles in shaping and reshaping our brain throughout our lifetime. It has been said that the next great journey of discovery for human beings will not be in outer space, but in the "inner space" of the human brain. In order to grasp what is happening in that inner space of our own brains, it is helpful to understand just a little of what neuroscientists have learned in recent years about how the brain enables us to interact with each other and the world around us. The idea that the brain does not change after initial growth ceases may be the greatest misconception that people have. Neuroscience has shown that brain

structure is not predetermined and fixed. We can alter the ongoing development of our brain and thus our capabilities.

Our brain, a three-pound organ, comprising mainly fat and water, is vital to our existence. It controls our voluntary movements, and it regulates involuntary activities such as breathing and heartbeat. The brain serves as the seat of human consciousness: it is the seat of our intelligence; it stores our memories, enables us to feel emotions, and gives us our personalities. The brain is like a committee of experts; all the parts work together, but each part has its own special contribution to make. The indisputable fact is that everything we hear, feel, smell and touch and see, and every thought we think, is the result of brain processes.

For centuries, scientists and philosophers have been fascinated by the brain, but until recently they viewed it as almost incomprehensible. However, in the last 30 years, neuroscientists have learned more about the brain than in all previous centuries combined because of the accelerating pace of research and the development of new research techniques. As a result, modern neuroscience is now sharing with the world many of its fascinating insights, and nowhere more than in the field of human behaviour.

PRISM takes its origins from an initiative known as 'The Decade of the Brain' which was launched in 1990 by President George H. W. Bush as part of a larger effort involving a wide range of agencies, including The National Institute of Mental Health of the National Institutes of Health, *"to enhance public awareness of the benefits to be derived from brain research".*

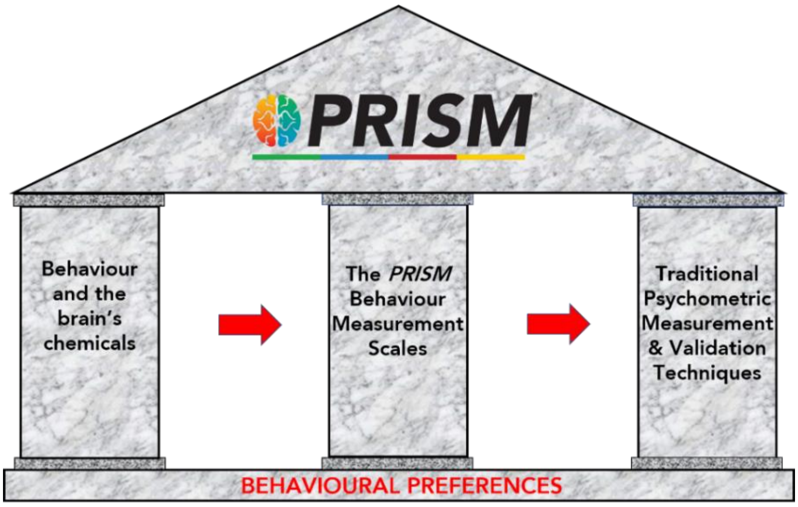
PRISM is based on the simple fact that all behaviour is created in the brain and that the brain's main role is to ensure that the species – animal or human – survives. To achieve this, our brain attempts to protect us from perceived threats to our wellbeing, but also looks for 'reward'. In this context, 'reward' can mean a range of benefits such as food and shelter, or social interaction with others. It is the brain's response to our external and internal world that results in what we call 'behaviour'.

Although *PRISM's* theoretical base is rooted firmly in the biological basis of behaviour rather than psychology, its developers have subjected it to independent academic scrutiny over the past twenty years to identify the psychometric properties of the instrument. Also, because most potential users are more familiar with psychometric terminology and measurement methods than they are with the language of neuroscience, psychometric comparisons and terminology help to enhance understanding.
The latest validity study in 2014 was designed to ensure that the *PRISM* Inventory worked effectively across a wide range of cultures and did not disadvantage individuals from ethnic groups.

Introduction

It is important to bear in mind that the validity of any assessment tool must begin with having a clear understanding of what the instrument is designed to do, as well as what it is not designed to do.

PRISM is an online integrated system that creates an inventory of a person's self-expressed behaviour preferences and how those behaviour preferences are observed by others. It is not a psychometric 'test' of personality that needs to be administered, scored or interpreted solely by people who are professional psychologists, neither is it intended for use in making clinical diagnoses, nor for dealing with mental health issues. Despite this, all *PRISM* users are required undertake to formal programme of training and successfully complete a practical and written assessment, approved by the publishers, before they can have access to it and use its applications.



PRISM has been developed in three distinct stages:

Stage 1: Identifying from published research studies into the four brain chemical systems that produce specific identified behaviours. It is important to note that all the information used during this Stage was obtained from a wide range of acknowledged experts in the relevant sciences and not from any one individual. The number and nature of those studies enhances both the validity of their own findings and the validity of the *PRISM* measurement scales which are based on those findings. Given that *PRISM* was created on the basis of the findings of published, peer-reviewed, scientific journals, brain-related texts, articles and books relating to neuroscience research, it follows that, to facilitate understanding by those without a background in neuroscience, the materials referred to are presented in good faith and are designed to be a layperson's interpretation of such research, not an exact academic or scientific description.

Stage 2: Creating, from the data collected at Stage 1, the scales necessary to enable the instrument to become an accurate and reliable method of measuring the relevant behaviours identified at Stage 1.

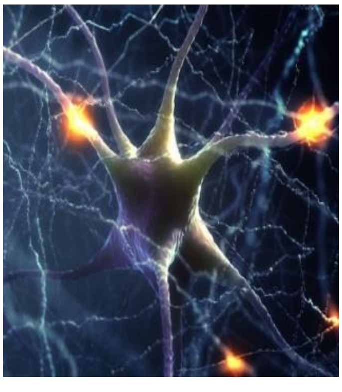
Stage 3: Using external sources to validate, by traditional psychometric methods, the measurement scales identified at Stage 2. It should be noted that, although this paper focuses primarily on Stage 3 activities, the publishers feel that it is also necessary, in the interests of clarity, to refer to some of the activities undertaken at Stages 1 & 2. It is accepted that much of the information relating to the biological underpinnings of the specific behaviours are already well referenced and validated. Moreover, the ipsative and normative measurement techniques used by *PRISM* are also already well known and widely accepted and need no further validation.

Why was *PRISM* created?

PRISM was created, in keeping with the principles of the 'Decade of the Brain' initiative, to make use of some of the more recent discoveries of neuroscience and to present them in a simplified and practical way to enhance both personal and organisational performance. Some of those discoveries have challenged traditional thinking on human behaviour. One of those key discoveries is 'neuroplasticity' i.e. the brain's capacity for physical self-change in the light of experiences.

For example, for decades scientists maintained that once the brain's physical connections were completed during childhood, the brain had become hardwired and remained like that for life. Now, thanks to the latest brain imaging technology, we now have proof that development is a continuous, unending process. All our experiences, thoughts, actions and emotions constantly change the makeup of our brain. This discovery has profound implications for both personal and organizational development.

For example, we can increase the power of our brain through our own effort. The brain's ability to change in response to experience is the key to understanding the brain's development. The good news is that no matter how old we are, we can still take an active part in influencing brain plasticity. The brain is dependent on our experiences and continues to evolve throughout your lifespan.



In order to improve our brain, it is necessary to understand how it works. If you decide to become a *PRISM* Practitioner, you will learn how the brain is organised, how it develops, and how messages are transmitted through the brain's electrochemical pathways. Neuroscientists say that "cells that fire together wire together." This is known as 'Hebb's Law'. Hebb, a Canadian psychologist, established a rule implying that changes of biochemical processes in one brain cell (neuron) can stimulate neighbouring neurons. Think of brain circuits like friendships: those that are maintained and enriched will endure, while those that are neglected disappear.

The brain's capacity to learn and to change is considerable, but one obstacle to change is that the brain's 'fight and flight' survival mechanism tends to adapt a negative approach to situations that are new or that create uncertainty. Indeed, the brain's resistance to change is well illustrated in 2007 by Dr Edward Miller, Dean of the Medical School at Johns Hopkins University. He pointed out that about 600,000 people in the United States have heart bypasses every year, and 1.3 million heart patients have angioplasties. Two years later, 90% of them had not changed their lifestyle. Even though they know they had a very serious illness and they knew they really needed to change their lifestyle they did not. The message is clear, if people are not prepared to make changes to the lifestyle when their lives are at risk, it is even more unlikely that they will willingly engage in change when they face fewer threatening circumstances.

Our resistance to change is influenced by our brain's primary role of protecting us from anything that potentially threatens our survival or wellbeing. As a result, our brain is wired to detect anything out of the ordinary that could be a potential threat. When it does, it gives us error signals which activate the fear centre in the primitive part of our brain and they fire up our animal instincts, That often means we adopt an emotional and irrational response to change. Doing something new also requires the brain to expend more energy than normal and the brain regards the increased use of energy as a potential threat to our survival.

Another key *PRISM* principle is that people function best when they can make the most of their natural preferences and abilities. When our day-to-day life prevents us from

using our natural abilities, our capacity for achieving our potential is diminished, as is our ability to find satisfaction in our relationships and work. When this does not occur, the brain is forced to spend large amounts of time functioning from areas requiring significantly greater expenditures of energy. In other words, the brain is forced to *overstate or falsify its strengths.* Indeed, falsifying natural behaviour is so costly that over time it can lead to stress, chronic anxiety, and exhaustion. Research by Professor Richard Haier, Professor of Psychology at the University of California, School of Medicine, showed that the brain needs to work much harder when not using the person's natural behavioural preferences. He estimated that the brain may need to work as much as 100 times harder when an individual is developing and / or using skills outside one's area of natural efficiency.

Such a demand on the brain requires huge amounts of energy and oxygen. Over time, this could also throw off the person's innate homeostatic balance in oxygen usage and distribution. Normally the brain uses approximately 20% of the oxygen taken in through the lungs. This leaves about 80% for the rest of the body where it is utilized in the process of metabolism and in providing energy at the cellular level and overall. As more and more oxygen is demanded by the brain that is falsifying type, less and less is available to keep the rest of the body up to speed. A variety of symptoms can result (e.g., fatigue, digestive problems, listlessness). Indeed, over time, the oxygen imbalance can contribute to the person's body shifting from anabolic to catabolic functioning.

Against the background set out above, *PRISM* was designed to help people to increase their self-awareness, and to help them to understand more about how the mind and brain can work in partnership to enable and motivate them to take better control of their lives and to enhance their performance. Clearly, it has much to offer businesses when used as part of interventions such as coaching for performance or enhancing leadership skills. After all, if the brain were not capable of changing itself or being changed by the intervention of the mind, all learning interventions would be pointless.

Why does *PRISM* measure behaviour rather than personality?

People often treat personality and behaviour as being the same, but they are clearly different. Their relative difference is well summarised by Professor Robin Stuart-Kotze, an eminent Canadian organisational psychologist who has held Professorships or Visiting Professorships at several universities in Canada and at Warwick, Aston and Oxford in the United Kingdom. He says:

> *"It is absolutely critical not to confuse behaviour with personality. Personality is what you are; behaviour is what you do, and it's what you do that makes a difference.*
>
> *However, most people believe that personality determines how individuals act, and it's very difficult to shake that belief. Personality testing is widely used in recruiting, with the underlying assumption that it will predict how people will behave in a job, and therefore will determine their performance. But if personality were the key to performance, then how can you explain the success of three people with very different personalities?*
>
> *A critical difference between behaviour and personality is that personality is essentially fixed at an early age and after that it changes very little.*
>
> *The definitive research into the relationship between personality and behaviour was conducted by Stanford professor Walter Mischel.*

Studying the correlation between personality tests and people's actual behaviour, he found that less than 10 percent of the variance in a person's behaviour is explained by personality. The driver of people's behaviour, he observed, is in fact the situations in which they find themselves - and most importantly, that their behaviour changes as the situation changes."

Dr Meredith Belbin, who created the Belbin Team Strengths Inventory, is a visiting Professor and Honorary Fellow of Henley Management College. He says:

"A behavioural test investigates propensities towards certain kinds of behaviour and styles of interaction with others, rather than measuring personality traits. Behaviour is regarded as more changeable than personality, since we can adapt our behaviour depending on what is required of us in a given situation or role.

Behaviour is also observable. This means that it affects, and is affected by, those around us. This makes the process of understanding and adapting our actions a democratic one: whilst we wouldn't ask others to tell us about our personalities, we often remark on one another's behaviour."

https://www.belbin.com/about/behavioural-vs-psychometric-tests/

People accept that they are often faced with situations, or with some aspects of their jobs, that require them to modify, sometimes very quickly, their preferred behaviour. Perhaps they feel that they need to be more 'forceful' than they normally feel comfortable being, or maybe they feel they need to be more empathetic than normal when dealing with a sensitive relationship issue. The inescapable fact is that people can deal with the demands of their everyday life by adopting, or borrowing, behaviours that they feel will enable them to achieve their objectives. Most people do this without much effort. They fully accept that life is not always about living within their comfort zone all of the time, and that they have the ability to step outside their personal instinctive behaviours in order to be successful.

Ben Fletcher, Professor of Occupational, Organizational and Health Psychology University of Hertfordshire, says:

"Standard personality tests - which measure fixed personality 'traits' - do not represent how changeable and flexible an individual's behaviour can be in different circumstances. In my view the 'trait' approach advocated by many psychologists is regressive and represents people in a negative way. Our personalities need not be fixed, even if psychologists are happy to represent them in this way!"

Source: Jamie S. Churchyard, Karen J. Pine, Shivani Sharma & Ben Fletcher Construction by Interpersonal Context and Relationship to Psychological Outcome. Journal of Constructivist Psychology, 2013, Volume 26, Issue 4, 306-315

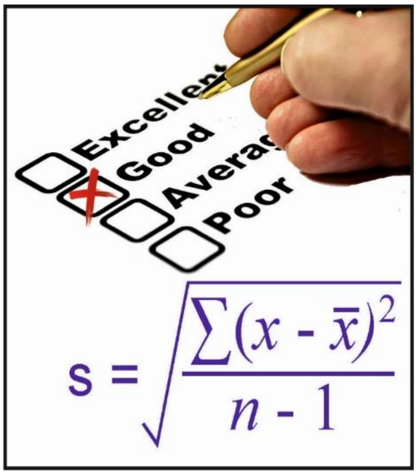
Writing in 'Psychology Today' in November 2014, Ben Fletcher said:

"My research shows that people who are behaviourally flexible are likely to be more effective at their job. And they are much less likely to be stressed because they can have the tools to cope with a wider range of situations. The flexible person has a larger toolbox to deal with the world. Our 'personality' can be a prison and a real barrier to our change and development. Many companies fail to see the importance of increasing behavioural flex. We need to help someone who is predominantly assertive to experiment with being non-assertive, or someone who is risk averse to try taking a small risk."

Types of Personality Tests

The aim of many psychometric personality tests is to acquire an accurate description of an individual's 'personality'. Over the years, popular commercial instruments have used two main measurement methods: 'normative' and 'ipsative'.

Normative Tests



Those known as 'normative', measure a specific personality trait so that it can be compared with established patterns of so-called 'normality' for other people's scores for the same trait. This was designed to enable recruiters and others to compare one candidate's results with other job applicants, particular groups and/or populations. A normative test is based on a Likert-type scale. For example, a questionnaire might present the candidate with a statement such as: *'I pay close attention to small details'* and then ask him or her to rate the statement on a scale of 1 - 5 (e.g., 1 = *Very accurate* – 5 = *Very inaccurate*) in terms of how accurately that statement reflects how he or she actually behaves.

One obvious problem with such tests is that they can inadvertently influence users to respond according to what they regard as being "socially desirable". Social desirability bias refers to the fact that in self-perception reports, people will often respond inaccurately to such tests to present themselves in the best possible light and to help them to achieve their personal objectives e.g. gain employment. Social desirability bias can take the form of over-stating 'good behaviour' or under-reporting 'bad' or ‘undesirable’ behaviour. For example, even though there are no ‘right’ or ‘wrong’ answers to such questionnaires, job applicants are much more likely to want to be seen to possess the personality traits that they consider would be favoured by the potential employer. In other words, the job applicants are likely to be motivated to select ‘socially desirable’ answers to increase their chances of being hired. This is sometimes referred to as ‘faking good’. It is very understandable for human beings to want to present themselves to others in the best possible light and that should be borne in mind when using normative self-perception profiling tools.

Clearly, there is likely to be a much greater tendency for people to use socially desirable behaviour when in a public setting, such as at work, than there is when in a private setting, such as at home with members of their immediate family.

Ipsative Assessments

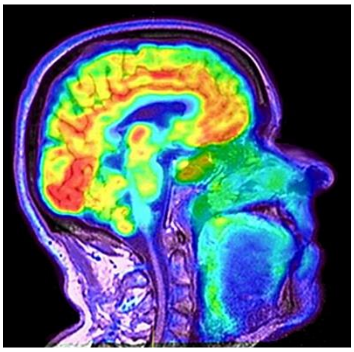
The social desirability weakness of the normative assessments led, in part, to the development of ipsative instruments that are based on what are known as forced choice questions and responses. Instruments constructed with an ipsative approach present users with options that are equal in perceived popularity, so that their choice is less likely to be influenced by social desirability. In this type of questionnaire, respondents are asked to choose between two or more equally positive or negative options. For example, they could be asked to indicate which items are ‘most like’ them and which are ‘least like’ them. As a result, by asking a candidate to select one of the two options, the question is more likely to ‘force’ out the ‘true’ behavioural preferences of the candidate. Because the candidate cannot make himself or herself ‘look good’ on both statements, the faking-good tendency is considerably reduced.

The results are typically presented in charts depicting the ‘most like’ scores as how an individual thinks he or she should, or needs to, behave to achieve their objectives: ‘least like’ scores as the individual’s true motivations, and a combined profile that identifies the difference between the ‘most like’ and ‘least like’ results to describe the individual’s likely normal behaviour. The selections of ‘most like’ and ‘least like’ are not measurements of different things, they simply reflect different aspects of self-perception. ‘Most like’ choices are more prone to be influenced by social desirability needs and ‘least like’ choices less so.

In addition to normative and ipsative assessments, there is now a growing interest in what is known as a 'nipsative' type assessment. This combines both the normative and ipsative assessment scoring methods into one assessment and requires the individual both to indicate their level of agreement with each statement, as well as to rank the statements in terms of their agreement with them.

The Brain's Role in Creating Behaviour

The *PRISM* model is a 'schema' of the human brain. A schema is a diagrammatic representation of a complex system (such as the brain) to aid understanding. The first use of schemas as a concept was in 1932 by a British psychologist, Frederic Bartlett, as part of his learning theory.



The *PRISM* schema provides a highly simplified, graphical representation of how the brain's functional architecture and four of its chemical systems: dopamine, serotonin, testosterone and estrogen, interact to create specific behaviour groupings. Brain chemical levels change from time to time for a variety of reasons, including diet, age, overall health and stress. As the chemical levels in the brain change, it follows that so too do the behaviours associated with those chemical changes.

Although behaviour is produced by the interaction of specific chemicals and networks, it is important to bear in mind that no one part of the brain does solely one thing and no one part of the brain acts alone. While many functions are, indeed, associated with particular areas, each function nonetheless depends on interactions in widely distributed networks involving many different areas. It follows, therefore, that *PRISM* does not subscribe to the once widely held belief that people are either 'right-brained' or 'left-brained'. This was commonly referred to as 'brain dominance' - a theory now totally discounted by neuroscientists.

The relationship between the mind and the brain is also important. The mind has great causal effects on how the brain functions. Research now shows that we can, through conscious effort, not only change the way we think, feel and behave when we are stressed, but we can also change the programming and chemistry of the brain. This knowledge is now being used to great effect in the coaching of top sports people.

The brain structures that give rise to the *PRISM* model are summarised below by Professor James E Zull, Professor of Biology, Biochemistry, and Cognitive Science at Case Western Reserve University, Cleveland, Ohio. In his book, '*The Art of Changing the Brain*', he states:

> *"The cerebral cortex of the brain has three key functions. They are: sensing, integrating, and motor (i.e. movement)."*
>
> *"The sensing function refers to the receipt of signals from the outside world. In people, these signals are picked up by the sense organs; eyes, ears, skin, mouth, and nose. They are then sent on to special regions of*

the brain for each of the senses. These signals come in small bits and have no meaning in their raw form. They are just little individual pulses of electrical energy coming in from the sense organs."

"Integration means that these individual signals get added up so that whatever is being sensed is recognized in the sum of all these signals. The small bits merge into bigger patterns that become meaningful things like images or language. For example, they get added up in ways that generate a plan for what action is needed and where the action is needed."

"Finally, the motor function is the execution of those plans and ideas by the body. Ultimately, motor signals are sent to the muscles that contract and relax in coordinated ways to create sophisticated movements. Importantly, we should realise that even speaking and writing fit in here because they involve some of the most sophisticated patterns of muscle contractions that the body carries out."

"There is a functional difference between the back and front integrative cortex. Sensory input to the brain, input from the outside world, goes predominantly to the back half. This part of the cortex is heavily involved in long-term memory - the past. It is the part where our knowledge of both the inanimate and living world is mapped. It is where we remember people and their personalities. And it is the part where connections are made between different past experiences. Much of what is there came from the outside world."

"The front integrative cortex is about the future. It is where we develop ideas and abstract hypotheses. New things appear, and plans are developed here. It is where we organize our thoughts into bigger pictures that seem to make sense. Things are weighed here; it is where we decide to do or not to do something. It is where we take charge. Creating takes place in the front cortex. This part of the cortex is most active in solving problems, creating ideas, and assembling those ideas into the symbolic form that we call language. In addition, this part of the brain oversees everything, makes decisions and monitors its own progress."

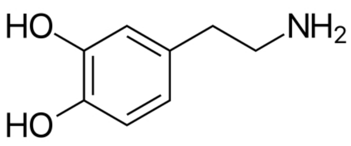
"It is clear that the brain is wired so that the front and back talk to each other and that evolution placed great value on these connections."

"Generally, the receiving and remembering part of the brain is located towards the back, and that which generates ideas and actions is in the front. Metaphorically, we might say that the brain turns its back on the past and points towards the future."

The brain's chemical mix that relates to *PRISM*

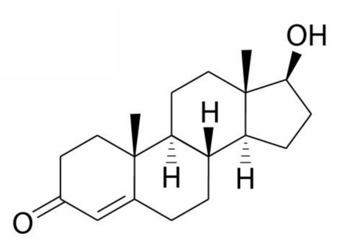
PRISM is based on the principle that human behaviour is produced to a large extent by the interaction of specific chemicals and networks in the brain. This principle is, however, complicated by a number of factors: different levels of these chemicals can produce different effects; these substances do different things in different brain parts; each interacts with others in different ways under different circumstances, and each harmonises with many other systems and brain circuits, setting up complex chain reactions. These chemical substances released by neurons are received by specifically targeted cells through neurotransmitter receptors, and appropriate responses are distributed throughout the body. As far as the relationship between brain chemicals and human behaviour is concerned, almost all the behavioural patterns are regulated by various circuits and inter-linking processes in the brain. Drawing links between brain chemicals and behaviour is a fascinating and complicated exercise, with potentially far-reaching social implications. The following paragraphs highlight just some of the complex issues arising from the interaction of the four brain chemical systems that form the basis for the *PRISM* measurement scales.

The four chemical system groups that underpin *PRISM* are: dopamine, serotonin, testosterone and estrogen.



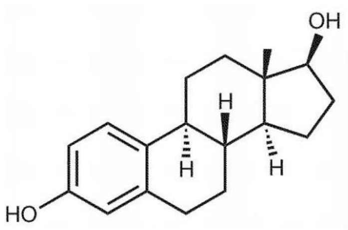
Dopamine [including norepinephrine] are both neuromodulators and studies show that they largely overlap in multiple domains. The *PRISM* model combines dopamine and norepinephrine within the same behavioural grouping because, chemically, they are both very similar. They are closely linked because they are both synthesized from the amino acid tyrosine. The dual involvement of dopamine and norepinephrine in brain frontal arousal reflects two complementary types of arousal modulation: one based on perceived stimulus importance (dopamine), the other one based on stimulus novelty (norepinephrine) and in tasks requiring mental flexibility. During short-term stimulation dopamine levels increase. Subconsciously, our brain constantly scans the environment looking for things that will help to ensure our survival. When it does identify something appropriate, the brain releases dopamine, which excites us and urges us to go and take advantage of that survival opportunity. What is often overlooked is that dopamine is actually released in anticipation of reward. In essence, dopamine signals the perceived desirability or dislike of an outcome, which in turn propels the individual's behaviour towards or away from achieving that outcome. Although one of dopamine's best-known roles is in learning about rewards, it is important to remember that relief from an unpleasant event can be considered by the brain as a reward. High levels of dopamine activity are associated with enthusiasm, and energy. In the brain, norepinephrine increases arousal and alertness, promotes vigilance, enhances formation and retrieval of memory, and focuses attention; but it also increases restlessness and anxiety. Norepinephrine pathways are abundant in the right hemisphere and dopamine pathways are abundant in the left hemisphere.

Estrogen [including oxytocin] are typically regarded as female hormones in the same way

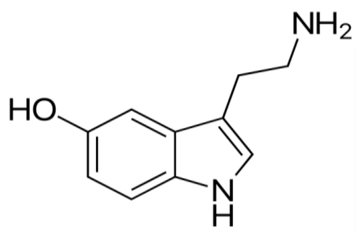


as testosterone is regarded as a male hormone. That is not entirely accurate because both are present in everyone's bodies. The *PRISM* model combines estrogen and oxytocin within the same behavioural grouping because they have similar influences on behaviour. Research shows that a strong correlation exists for the role of oxytocin and estrogen in the regulation of maternal behaviour. Estrogen has the direct effect of raising the levels of serotonin. Estrogen can improve mood and the recognition accuracy for facial expressions. It can also affect emotional arousal and change the intensity of emotional experiences. Oxytocin is produced in the hypothalamus region of the brain. The hypothalamus is an extremely important area of the brain, as it is responsible for keeping the body in a state of homeostasis. When the hypothalamus produces oxytocin, it sends the oxytocin down to the posterior lobe of the pituitary gland. From there, the pituitary gland releases oxytocin directly into the bloodstream. In addition to its hormonal functions, oxytocin also acts as a neurotransmitter. Oxytocin has a calming effect on people because it acts as a reliever of stress and anxiety, while inducing a peaceful and calm state of mind. Controversy, disputes and debates make those with high levels of estrogen uncomfortable. As a result, they look for agreement, to accommodate others, to live in supportive networks free from competition and discord. Their emotional stability is based on how others react and interact with them. In terms of wellbeing, oxytocin has also been found to improve general health by encouraging the body's healing process and by reducing blood pressure and cortisol levels.

Testosterone is often labelled as the 'aggression hormone' due to its presumed



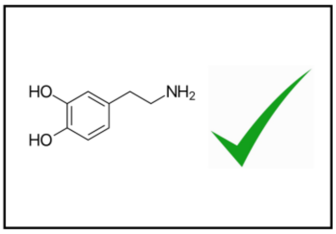
relationships with such negative, antisocial behaviours. That view is unduly simplistic. Hormones such as testosterone, do not directly change behaviour; they influence the expression of behaviour within appropriate environmental and social contexts. Although it has been widely believed that testosterone promotes aggression, this is only partially true. The best research suggests that it is more related to a desire for social dominance and power, rather than aggression per se (although desire for power may lead to aggression at times). Indeed, research shows that testosterone is also implicated in behaviours that help to foster and maintain social relationships, indicating that its effects are more nuanced than previously thought. In terms of helping us understand the relationship between testosterone and aggressive behaviour, the current evidence suggests that the relationship is nonlinear. For example, when testosterone converts to estrogen, it elevates serotonin activity, reducing aggressive behaviours. Aggressive people often have underactive frontal lobes which would normally supply sound judgement and help to restrain impulsive action. Testosterone initiates the need for action and adventure. It can also enhance sensation seeking because it elevates the impact of dopamine. Testosterone and dopamine interaction play a crucial role in increasing testosterone levels. Dopamine influences the secretion of gonadotropin-releasing hormone (GnRH) from the hypothalamus to the pituitary gland. GnRH is the first step in the hormone signalling process that stimulates testosterone production.



Serotonin is made from an amino acid called tryptophan, which undergoes several stages of chemical change to produce serotonin. The chemical name for serotonin is 5-hydroxytryptamine, or 5-HT. Serotonin comes from breaking down tryptophan, an important amino acid that we need to acquire from our diet, as our body is unable to produce it. The brain makes melatonin from serotonin. Melatonin plays an important role in regulating our circadian rhythm – our body clock – and this rhythm controls aspects of our body's sleeping pattern. In the previous section we look at the characteristics of dopamine. Neurotransmitters do not act independently; they interact with and affect each other to maintain a careful chemical balance within the body. There are strong links between the serotonin and dopamine systems, both structurally and in function. Serotonin has long been known to exert inhibitory and excitatory influences over the activity of dopamine. In some cases, serotonin appears to inhibit dopamine production, which means that low levels of serotonin can lead to an overproduction of dopamine. This may lead to impulsive behaviour; due to the role that dopamine plays in reward seeking behaviour. Higher levels of serotonin are associated with good social skills and alliance building behaviours which together create a distant but calm demeanour. Lower levels of serotonin are associated with the opposite: impulsiveness, aggression and conflict seeking behaviour. When serotonin levels are low, it may be more difficult for the brain's prefrontal cortex to control emotional responses to anger. Also, an increase in dopamine and norepinephrine can cause serotonin levels to fall. Our sense of well-being including our capacity to organise our lives relies to a significant extent on the serotonin system.

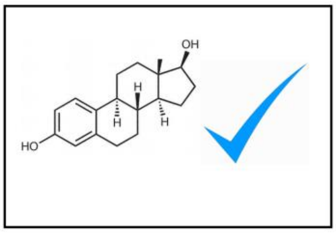
Now that we are aware of the biological basis for the above four behavioural groups, let us look at the core behaviours that are frequently observed within each of those groups.

Dopamine



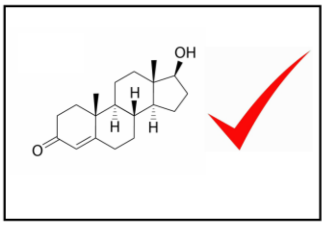
Dopamine-related behaviour tends to focus on what is possible rather than what is happening currently. It experiences boredom easily when not absorbed in something that is intriguing or exciting. Although not necessarily motivated by risk, it produces a willingness to take risks to enjoy new and exhilarating experiences. Intensely curious and creative, it dislikes complying with rules or policies, and becomes distracted easily. At very high levels, or when under pressure, it can become over optimistic, hyperactive, impulsive and disorganised. Restless, energetic and spontaneous, its lack of attention to detail can produce a scatter brained approach to tasks that are not mentally stimulating. It has a tendency to promise more than it actually delivers because it becomes side-tracked by something more exciting.

Estrogen



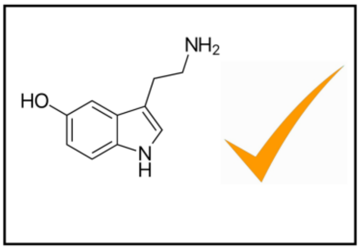
Estrogen-related behaviour tends to assume the role of caretaker takes that responsibility very seriously. Its own self-esteem is directly tied to, and influenced by, the quality of its relationships with others. Although fundamentally compassionate, unassuming, loyal, idealistic and genuine, it can also be hypersensitive, overly emotional, judgmental and self-absorbed when dealing with emotional issues. Normally, polite, agreeable and tactful, it dislikes conflict and is keen to create environments that will encourage people to be valued and comfortable. It tends to approach any kind of change with trepidation until they fully understand the implications and the impact the change will have on others. It is very uneasy when dealing with conflict and arguments or abrasive people create a source of discomfort for it.

Testosterone



Testosterone-related behaviour tends to be highly competitive, independent, self-reliant and very results-orientated, with a communication style to match. This behaviour makes decisions quickly and can work very effectively in stressful, fast-paced, uncomfortable environments. It enjoys a challenge and loves achieving personal success against the odds, but this can have a negative effect on relationships with other people. Very practical and goal-oriented, it therefore focuses intensely and narrowly on work. As a result, its communication style tends to be outspoken and at times blunt. It has little time for social or political correctness if it gets in the way of personal goals. If forced to observe a tradition that makes no sense to it, it will comply very grudgingly. In social settings when this behaviour is not in task and results mode it can become charming, generous and entertaining.

Serotonin



Serotonin-related behaviour tends to be highly analytical, guarded, conscientious, thorough and competent. It believes in itself, its capabilities and its intellectual abilities. It feels a strong need to be well organised and accurate, and it knows that if it puts its mind to it, can accomplish almost anything. Once it determines the best way that something should be done, it will then move forward without distraction until the task has been fully completed. It is very self-critical and takes personal criticism very seriously. Loyal and conscientious; it thinks concretely and is often literal, detail-oriented and orderly, as well as cautious. It prefers to follow a prescribed process and dislikes unpredictability or working at a fast pace because of the increased risk of errors. It is not at all comfortable making small-talk with strangers or discussing matters of a personal nature.

The Development of *PRISM*

The instrument now known as *PRISM* has been in a state of ongoing development, or evolution, since 1992. The original prototype was called the Personal Performance Improvement Inventory (PPI). The *PRISM* trademark was approved by the Trade Marks Registry in 2004. By that time, the *PRISM* measurements scales had been developed from the following 19 academic studies:

	Dopamine	**Behaviours**
	Goreman & Wesman. 1974; Cloninger et al. 1991 and 1994; Zuckerman. 1994; Depue & Collins. 1999.	Energy, social assertiveness, motivation, mania, sensation and novelty seeking, enthusiasm, exploratory excitability, impulsiveness, and disorderliness.
	Estrogen	**Behaviours**
	Hall. 1978; Rotter & Rotter. 1988; Pedersen et al. 1992; Carter 1998; Blaicher et al. 1999; Taylor et al. 2000	Emotion recognition; empathy, nurturing and pro-social skills; the drive to make social attachments; forming social attachments.
	Serotonin	**Behaviours**
	Soubrié. 1986; Linnoila et al. 1994; Zuckerman. 1994 Manuk et al.1998	Self-control and self-regulation; sustained attention; conscientiousness; concrete thinking; Low impulsiveness and exploratory behaviour
	Testosterone	**Behaviours**
	Wingfield. 1990; Harris, Rushton, Hampson & Jackson,1996; Dabbs, 1997; Mazur, Susman & Edelbrock 1997 Chance et al. 2000;	Drive for rank, the creation of dominance hierarchies; aggression; low social sensitivity; Less polite, respectful, considerate or friendly.

As already highlighted above, *PRISM* is not the work of any one individual. The *PRISM* publishers had neither the expertise nor the resources to carry out the research on the scale to which *PRISM* was developed. Initially, the four primary dimensions of *PRISM* behavioural traits were identified and extracted from the scientific studies referred to above. Each dimension was associated with one of four broad brain chemical systems: dopamine, serotonin, testosterone and estrogen. Over subsequent years, the findings of almost 130 additional studies were reviewed and the *PRISM* scales were refined as the relevant new literature became available. It is important to state the all the research referred to was conducted in the absence of any knowledge, or commercial or financial relationships with the *PRISM* publishers that could be construed in any way as a potential conflict of interest.

The *PRISM* quadrant model provides users with a useful schema that they can refer to when they are visualising how their brains are organised. The model is, therefore, based on scientific principles and facts which have been simplified into a workable model to facilitate understanding.

The model represents the right and left hemispheres of the brain, plus the frontal lobes and the posterior lobes. The 'maps' that are overlaid on the model are designed to show the intensity of a respondent's self-expressed preferences for the relevant behaviours and not the precise location of those behaviours.

In some respects, the *PRISM* method of presenting behaviour by using 'maps' that are visual representations of a person's behavioural preferences is in keeping with the principle of Gestalt psychology. This principle maintains that '*the whole is different from the sum of its parts'*. *PRISM* emphasises the study of behaviour as a whole rather than simply focusing on independently functioning, disparate parts.

It is, however, important to bear in mind that the brain is a dynamic, electro-chemical system. All our thoughts, emotions and actions are the results of many parts of the brain acting together to create patterns of activity. Despite this, areas of the brain do have specialised functions, and the *PRISM* model reflects, in particular, the activities associated with the right and left hemispheres, and the frontal lobes and the posterior lobes.

The longitudinal fissure divides the brain into the two hemispheres and the central and lateral sulci divide the frontal lobes (including the motor cortex) from the parietal, occipital and temporal lobes (including the somatosensory cortex). These four blocks are represented in the *PRISM* model by the Green, Blue, Red and Gold quadrants.

On a broad level the brain lends itself to partitioning, based largely on its anatomical structure. All proposed divisions within the brain are, however, highly artificial and are created in response to the human need to separate things into neat, easily understandable units.

The information provided below is provided to give an insight into how the *PRISM* concept was developed.

The brain's hemispheres

The different functions of the two hemispheres are well summarised by Dr Iain McGilchrist, a Fellow of the Royal College of Psychiatrists and former Research Fellow in neuroimaging at the Johns Hopkins Hospital in Baltimore. He highlights some of the key differences between the two brain hemispheres as follows:

The left hemisphere: is not impressed by empathy needs certainty and to be right applies linear, sequential analysis to achieve clarity is competitive and its concern, its prime motivation, is power is, by comparison with the right hemisphere, emotionally neutral focally suppresses meanings that are not currently relevant tends to deal more with pieces of information in isolation takes the single solution that seems best to fit what it already knows and latches onto it.
The right hemisphere: is involved in the experience of emotions of all kinds is especially important for flexibility of thought is constantly searching for patterns of things has by far the preponderance of emotional understanding is in general more intimately connected with the limbic system deals with incomplete information and tolerates uncertainty is particularly well equipped to deal with passions, sense of humour, metaphoric and symbolic understanding, and all imaginative and intuitive processes

Dr McGilchrist adds:

> *"What is new must first be presented in the right hemisphere before it can come into focus for the left. Not just new experiences, but the learning of new information or new skills also engages the right*

hemisphere attention more than the left. The right frontal lobe is especially important for flexibility of thought.

Empathy, social understanding, humour, metaphor, more subtle emotional understanding, the appreciation of individuals, the reading of faces, and much else go on in the right hemisphere. Fascinatingly there is clear evidence that the left hemisphere alone codes for machines and tools – even in left-handers, who would be using their right hemisphere to use tools and build machines in daily life.

The two hemispheres are linked by a 'bridge', known as the corpus callosum that has an 'excitatory' function i.e. it enables the two hemispheres to communicate with each other. However, the main purpose of a large number of these connections is actually to inhibit - in other words to stop the other hemisphere interfering. The corpus callosum's excitatory and inhibitory roles are, therefore both necessary for normal human functioning."

Source: 'The Master and His Emissary' Yale University Press; 2nd edition (15 Jun. 2012)

It is important to bear in mind that the brain is not only divided into hemispheres, it is also asymmetrical. There are clear, subtle but significant, observable differences at every level. The two hemispheres are different sizes, shapes, and weights (the right hemisphere is bigger and heavier in all social mammals); have different gyri (ridges) conformations on the surface, and in places different arrangement of the cells (cytoarchitecture); different proportions of grey matter to white, different sensitivity to neuroendocrine influences, and rely on different preponderances of neurotransmitters. And in psychometric testing they consistently yield different results, which is in keeping with something any neurologist will point out: when there is damage to one hemisphere or the other, through injury, tumour or stroke, there are consistent differences in what happens to the subject and his or her world depending on which hemisphere suffers the lesion.

Despite these differences, the bottom line is that neither *PRISM* nor neuroscientists subscribe to the popular theory of brain dominance. A study in 2013 led by Dr. Jeff Anderson, director of the fMRI Neurosurgical Mapping Service at the University of Utah, concluded that:

"It's absolutely true that some brain functions occur in one or the other side of the brain, language tends to be on the left, attention more on the right. But the brain isn't as clear-cut as it has sometimes been made out to be."

For example, most people have a preference for using either their right hand or their left hand, but that does not prevent them from using both hands.

The brain lobes

The following comments by leading neuroscientists reflect some of the fundamental theory that underpins the *PRISM* graphic model: -

Professor John J Ratey, Clinical Professor of Psychiatry, Harvard Medical School

> *"The back of the brain is the sensory or input half, which receives input from the outside world and sorts, processes, and stores all of our sensory representations. In the front of the brain, the cortex is devoted to the processing of motor programs or output - we use this area to react to the input data. It is here we plan, strategise, and sculpt our responses to the world, and it is this area that has been adapted for use in abstract thinking and planning."*

Professor Elkhonon Goldberg, Clinical Professor of Neurology at New York University School of Medicine and Director of the Institute of Neuropsychology and Cognitive Performance

> *"The frontal lobes perform the most advanced and complex functions in all of the brain, the so-called executive functions. They are linked to intentionality, purposefulness, and complex decision making. Motivation, drive, foresight, and clear vision of one's goals are central to success in any walk of life. All these prerequisites of success are controlled by the frontal lobes.*
>
> *Our ability to accomplish our goals depends on our ability to critically appraise our own actions and the actions of those around us. This ability rests with the frontal lobes. In a complex society such as ours, a different talent comes to the fore, the leadership talent. Of all the forms of talent, the ability to lead is the most mysterious and the most profound. In human history the leadership talent has had the greatest impact on the destinies of others and on personal success. There is an intimate relationship between leadership and the frontal lobes.*
>
> *Intelligence and creativity are inseparable yet not the same. Each of us has known people who are bright, intelligent, thoughtful and barren. Creativity requires the ability to embrace novelty. The frontal lobes play a critical role in dealing with novelty.*

Frontal lobes define us as social beings. It is more than coincidence that the biological maturation of the frontal lobes takes place at the age that has been codified in virtually all developed cultures as the beginning of adulthood. But poor development of, or damage to, the frontal lobes may produce behaviour devoid of social constraints and sense of responsibility."

Professor Richard Restak, Clinical Professor of Neurology at George Washington University Medical Center, Washington DC

"Extensively linked to the emotion-mediating limbic system is the prefrontal cortex, which controls fear and aggression. This dual function is useful because fear and aggression are intimately connected. Recent brain research indicates that the prefrontal cortex and the limbic system coexist in a delicate balance. When emotions threaten to get out of control, the prefrontal cortex springs into action and restores the balance. In fact, activity in the prefrontal cortex is an indicator of an imbalance between the limbic system and the prefrontal lobes."

Professor Joseph Le Doux Professor of Neuroscience and Psychology, New York University

"The sensory - or input - regions of the cortex are located posterior to the central sulcus and the Sylvian Fissure, in the parietal, temporal, and occipital lobes. This 'back of the brain' large region, encompassing three cortical lobes, is not simply a site for processing sensory information. It is also the region of the cortex for associative processes, where information from the various senses is 'bound together' for higher order processing."

Professor Sam Wang, Professor of Neuroscience and Molecular Biology, Princeton University

All in all, the left side of the brain seems to have an intense need for logic and order – so intense that if something doesn't make sense, it usually responds by inventing some plausible explanation.

The right side is much more literal and truthful when it reports what happened. It controls spatial perception and the analysis of objects by touch, and excels at visual-motor tasks."

Neural correlates of the four primary *PRISM* dimensions

In 2002, the *PRISM* developers created a self-perception questionnaire which was developed for both online and paper & pencil administration. The 32-item measure contained four 8-item scales to investigate the behavioural characteristics associated with testosterone, estrogen, dopamine and serotonin systems, which are labelled for ease of understanding as Red, Blue, Green and Gold respectively. A Likert-like 4-point scale was used, providing participants with the options: 0: strongly disagree, 1: disagree, 2: agree, 3: strongly agree.

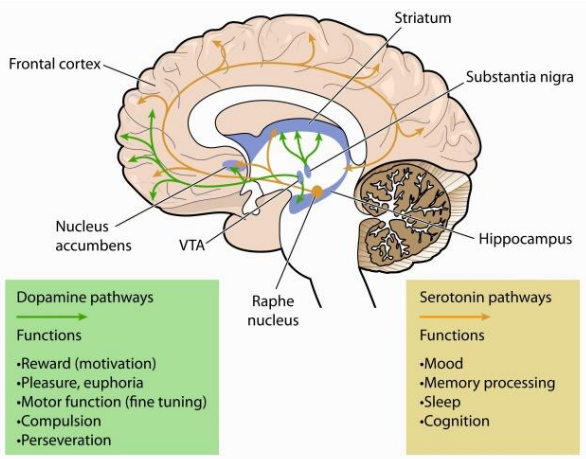
The initial questionnaire was completed anonymously by 4,237 anonymous men and women whose ages ranged from 19 to 60 years of age. The Cronbach's alpha internal consistency coefficient scores obtained from the sample averaged 0.8 for the four groups.

Having re-examined the results of their initial survey in 2003, the *PRISM* developers identified two distinct clusters of behaviours within each system. Using factor analysis, each primary scale was broken down into two sub-scales:

(1) Dopamine (Green):	'innovating' and 'initiating'
(2) Estrogen (Blue):	'supporting' and 'co-ordinating'
(3) Testosterone (Red):	'focusing' and 'delivering'
(4) Serotonin (Gold):	'finishing' and 'evaluating'

The creation of these two subscales was a very significant enhancement to the overall precision of *PRISM*. Although each subscale shared the core characteristics of the relevant behaviour-related chemical, they also demonstrated significant differences.

It is also important to bear in mind that chemicals have their own specific pathways throughout the brain, and this also has a bearing on the impact that the brain's architecture has on behaviour.



Over the past 20 years *PRISM* has undergone major development as more and more scientific research has become available. It has also been translated into a variety of languages. In 2007 and 2014 engaged a university to carry out independent validity studies on the instrument and to see how the instruments works across cultures and ethnic groups. A summary of those studies are available to download on the *PRISM* website.

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