Neuroscience of coaching: theory, research and practice

Book or Report Section

Accepted Version

Chapter 10
Neuroscience of Coaching: Theory, research and practice

Patricia Riddell

Introduction

The process of coaching involves an exploration of the way in which individuals make sense of their world and an ability to help individuals to notice ways in which this sense-making might be changed to improve their outcomes. In order to do this, coaches are required to make hypotheses about how another person might be thinking and how this might relate to subsequent behaviour. In psychology, this process is known as developing a theory of mind (Frith & Frith, 2012). We use information from other people's spoken language, body language and behaviour to make predictions about the thinking behind behaviour and test these predictions through questions that help individuals to become more aware of the relation between their thinking and their actions.

Understanding how the brain works can help to tune the theories of mind we create since this can help to elucidate the, sometimes not wholly rational, ways that humans make sense of their world. This chapter aims to provide a basic understanding of how the brain perceives, learns and acts on the world with reference to ways in which an increase in understanding is useful to coaches. We will explore the processes that allow us to change behaviour, both in terms of the way in which change occurs in the brain and with respect to the processes that are used in coaching to help elicit change. We will then consider the effect of stress on behaviour and how coaches can help individuals to be better able to cope with stress and increase resilience. We will also consider decision-making, especially in relation to leadership, in order to show how this understanding might be particularly useful in executive coaching. (Further information on the neuroscientific basis of coaching can be found in Bossons *et al*, 2016; Riddell, 2019; and Riddell, 2021.)

Theoretical foundations

Coaching provides opportunities for individuals to reflect on their goals and to make changes to these in order to improve outcomes. This often requires the ability to change behaviour. Since every thought, emotional response, and behaviour starts in the brain, making behavioural changes requires that something changes in the brain. Awareness of the capacity for the brain to change is, therefore, an important first step in understanding the human capacity for change. This can help to answer questions like whether it is true that we can't teach an old dog new tricks, or that some people have more capacity for change than others. Being able to help coachees to understand the degree of change that is possible can be important in addressing beliefs that can constrain willingness to try new ways of thinking and doing.

Change in the brain

Epigenetics

We can begin to understand the brain's potential for change by considering how the brain has evolved to learn. This starts with a consideration of how the components of the nervous system are constructed through genetics and then altered during the lifespan through a process known as epigenetics.

It is now well known that the information required to create a human being is stored in the genes (Ilies *et al*, 2006). Germ cells (sperm and eggs) contain half of the DNA of other cells in the body. When sperm and egg come together at conception, therefore, the resulting foetus will receive half of its DNA from the mother and half from the father thus providing a full genome. During development, some genes from the maternal line and some from the paternal line are 'turned on' (or transcribed) and so some aspects of our personality, intelligence and looks will be similar to our mother, and some similar to our father.

To begin to understand how genetics provides the information to create a human body, imagine the difference between a cell that becomes part of the muscle of the heart and a cell that becomes a neurone in the brain. Every cell in your body contains the full set of 23 genes and therefore, early in development, each cell has the capacity to become any other cell. Specific signals are required to activate different parts of the DNA for the cells that become heart muscle compared to cells that become neurones in the brain. Thus, genetics is the process by which we inherit the genetic information to make the human body and interpret this so that the right genes are turned on in the right places at the right time (Ilies *et al*, 2006). However, it is clear that, while genes provide a starting point for our intelligence, personality and abilities, they do not provide a complete explanation for how these develop. Research has demonstrated that there are few complex behaviours for which genetics explains more than half of the variance in ability (Plomin

& Daniels, 1987). This suggests that there are other ways in which we can adapt to our individual environment (Sherman *et al*, 1997).

More recently, it has become evident that, while the structure of DNA is relatively fixed at birth, the way that we activate DNA can be changed during the lifespan. Some parts of our genetic material are being used over and over again, while other parts lie dormant only to spring to life in response to some signal (Carey, 2012). For example, we continually replace our skin cells and so this piece of genetic code is being used again and again. In comparison, there are large changes in the structure of our bodies at puberty. This involves particular parts of the genetic code becoming active in response to some (partially unknown) signal. The point here is that the genetic code is not all or nothing – it is flexible and different parts can be activated at different times. This understanding has led to the introduction of a new field of study – epigenetics (Carey, 2012; Sweatt, 2009).

Epigenetics can be defined as the study of (heritable) changes in gene activity within an individual's lifetime that are not caused by changes in the structure of the genes. Instead, epigenetic changes refer to activation of new parts of DNA within a particular gene.

DNA is formed in long strands that take the shape of a double helix. In the nucleus of the cell, these strands are partially wound around protein blocks called histones. Between each block, a part of the DNA is left unwound. This part of the DNA is therefore available to be activated. The parts of the DNA that are bound or unbound will be different for different types of cell providing a mechanism for controlling which DNA is activated in different parts of the body. In addition to this, it is possible for the parts of DNA that are wound or unwound to be changed during the lifespan. Adding molecules (eg, acetyl, methyl or ubiquityl) to the DNA or histone blocks causes the DNA either to be wound tighter (decreasing the availability of the DNA for activation) or to become looser (increasing the availability of parts of the DNA for activation). In this way, the parts of DNA that are available for activation can be changed. For instance, if you were to start an exercise regime at the gym which worked a particular muscle, this would result in changes to the activation of the DNA in that muscle in order to build more muscle fibres.

To show how this would apply in the brain, think about a time when you learnt a new skill or some new facts. This required the creation of new connections between neurones. In order to create these new connections, a part of the genome that was previously inactive in some of the cells in your brain became active. So, every new experience that is remembered or that creates new learning involves new activation within your genome – or epigenetic change (Keverne *et al*, 2015).

Neuroplasticity

Since epigenetics has demonstrated that we can change aspects of our neural connectivity within our lifespan, it is worth asking what can be changed in the brain and how does this happen. Neuroplasticity is the term used to describe changes (*-plasticity*) in components of the nervous system (*neuro-*). We need mechanisms that allow us to learn quickly and efficiently in order to adapt to changes in our environment. Consider, for instance, starting a job in a new organisation: there will be new people to remember, new tasks to learn, a new culture to absorb. And there might be some expectation from our new boss that this will happen quite quickly. We have to be able to learn fast.

This ability to learn primarily relies on changes that occur in the synapses (or connections) between our neurones. Neurones can connect with thousands of other neurones, creating networks that can contain all the information associated with learning a new role. By creating new synapses, new information can be connected into an already existing network of relevant, stored information from our previous experience (Sultan & Day, 2011). This allows us to learn what is new in our role and connect this to our existing expertise in this area.

It might be tempting to think that once a synapse is created, and if it continues to be used, it becomes permanent ('use it or lose it'). However, this is not quite the case. Synapses are more like skin cells – they are lost and replaced. The strength of a connection between two neurones remains relatively constant over time (same number of synapses), however, the actual synapses creating this connection change regularly. Indeed, it has been estimated that, in one part of the mouse brain, 20% of synapses change in a 24-hour period (Purves *et al*, 1987; Umeda & Okabe, 2001). Humans have lower metabolic rates than mice and so the turnover of synapses in the human brain might be slower. But this might still lead to replacement of all the synapses in a given part of the brain over the space of about one week to ten days.

Creating and destroying synapses is an energy consuming process and so this has to provide a substantial benefit to survival. The importance of this process is that it gives the brain its huge capacity for change – or 'plasticity' – and, therefore, learning and memory. If the brain made synapses but did not unmake them, we would have no means to unlearn facts that were no longer useful. Consider something that you might have learned as a young child, for instance, the idea that mothers are there to provide all your needs. This information might be less useful, or no longer relevant, as an adult, and so we need a mechanism to both learn and unlearn quickly. The strength of the connection between two neurones is retained if the information represented is repeated or is marked as important. This allows us to learn and retain information that is useful. But information that is no longer

useful can be replaced by destroying synapses that are no longer in use and creating new synapses that represent new information or behaviour.

There is also research that suggests that new neurones can be created in some parts of the brain, particularly in areas associated with memory (eg, the hippocampus: Fuchs, 2000). This confers a fundamental evolutionary benefit since it provides us with an additional means of learning in new environments.

A great example of new learning is when London taxi drivers learn 'the knowledge'. Good taxi drivers are able to plot a route between any two destinations since they have such an excellent knowledge of the map of London, including which streets are one way, where traffic hold ups are likely to occur, when during the day these are most likely and so on. It has been shown that learning the knowledge results in the expansion of the part of the brain that holds the addresses of our memories – the hippocampus (Maguire *et al*, 1997). The size of the hippocampus in London taxi drivers increases in relation to the depth of their knowledge.

Since learning 'the knowledge' is a clear example of learning that has taken place in adulthood, it suggests that our ability to learn does not decline substantially with age. This was further supported by Boldrini and colleagues who used samples of post-mortem, heathy human brains to determine the number of new neurones created in individuals at different ages (Boldrini *et al*, 2018). They studied the brains of healthy adults from 14 to 79 years with no signs of cognitive impairment and found that the number of new neurons showed little decline with age. On the basis of this evidence, we can conclude that old dogs *can* learn new tricks.

Research has demonstrated that we create more new neurones and synapses when we have rich lives with many new experiences (van Praag *et al*, 2000) and when we exercise aerobically (Hillman *et al*, 2008). However, there is also evidence that there is a reduction in neuroplasticity in individuals who are stressed, depressed and/or anxious (Lucassen *et al*, 2010). This is worth bearing in mind if you are coaching someone with mental health challenges.

Neurostability

If it is not our brains that prevent us from learning, then there might be other reasons that some people find it harder to learn and change. While it is important for learning and memory that the brain continues to be neuroplastic throughout adulthood, having the same degree of neuroplasticity at all points in development would not be ideal. During infancy, there are many things to learn. Once this learning is established, it is preferable that much of it becomes relatively fixed. Imagine that each time you learned the meaning of a new word, it was forgotten again quickly. This would make it quite difficult to learn a language. It is therefore necessary for the brain to retain learning over time, and this requires a balance between

neuro*stability* (stability of networks so that information is retained) and neuro*plasticity* (ability to change networks to replace learning that is no longer required) in the adult brain.

Recent research is beginning to determine how the brain accomplishes this balance, and how it changes during development (Bavelier *et al*, 2010). There are two ways in which the brain reduces plasticity:

1. There are two types of connections (or synapses) that link neurones together. *Excitatory synapses* release a neurotransmitter that results in an increase in activity in the next neurones in the chain. By contrast, *inhibitory synapses* release neurotransmitters that decrease the activity in connected neurones. The balance between excitatory and inhibitory connections in neural networks changes across the lifespan (Takesian & Hensch, 2013). Initially, neural networks have more excitatory than inhibitory connections and are therefore neural networks are easily changed. This is because activation is required to increase the strength of connections between neurones. During the course of development, more inhibitory connections are established, which reduces the activity in neighbouring neurones and therefore stabilises networks.
2. Additional structural brakes on plasticity are activated later in the development of the brain. These include epigenetic changes that decrease the number of new synapses that can be created in individual networks thus ensuring network stability.

The result of this is that adult brains retain information that has been learned across the lifespan but at the expense of ease of learning. There is some evidence to suggest that we can reinstate some plasticity for learning in adults by increasing motivation to learn, making learning more fun, adding humour, or creating flow states (Bavelier *et al*, 2010). Exploring where, when, and how they learn best can help a coachee to recreate the conditions they need to reinstate plasticity to create more efficient learning.

Fixed and growth mindset

While neurostability makes learning in adults less efficient than learning in children, we still have the capacity to learn throughout the lifespan. Research into neuroplasticity provides evidence to suggest that any adult with a typical brain has the potential to learn new knowledge and skills if they are prepared to put in sufficient practice. Practice is the first step in creating the necessary neural networks for expertise in any skill. Since all adults can learn with sufficient practice, there must be additional reasons that explain why we sometimes find learning difficult.

When we try something new, we use feedback to determine how good we are at this. This feedback will be derived both from assessment of our performance in relation to our own expectations and through comparisons

between our performance and how others perform. This allows us to assess our current ability.

Since assessment of performance in the moment is only a measure of ability at a fixed point in time, it provides no information about potential. It would be more useful to know what we might be capable of achieving with the right belief in ourselves, encouragement, and training. Measuring potential, however, is at least partly dependent on our current beliefs.

Imagine the behaviour of individuals who believe that intelligence, personality, or any ability is fixed and that a current measure of our ability predicts how we will always be (fixed mindset: Dweck, 2006). This group might believe that they are too old to learn, too young to learn, not clever enough to learn etc.

Compare this to people who believe that we do not yet know our own potential but that it is always possible to improve (growth mindset: Dweck, 2006). These people might be looking for the right training, seeking a suitable mentor or role model, or wondering what new strategy they can learn to get better at a particular skill.

It is easy to see how a belief can become a self-fulfilling prophecy. If you believe that ability is fixed, there is no point in seeking out new experiences from which to learn. While this belief will not stop you from becoming highly skilled in an area in which you believe in your own ability, it will stop you from trying to learn new things at which you do not believe you can succeed. Lack of confidence in our ability can negatively impact our willingness to try and therefore the possibility of learning.

If you believe that growth is possible, then there is a reason to try new things, and this very process will help you to sculpt your brain to take better advantage of your new experiences. Practising new skills creates the connections within the neural networks required to get better at this new skill.

It is important to recognise that everyone will have growth mindset in some areas of their lives and fixed mindset in others. Noticing during coaching where a fixed mindset might be stopping someone from trying to learn a new skill is therefore important. By explaining that practice, effort, and perseverance is required to create appropriate neural connections to improve in any area, we can help coachees to commit to trying something new even when they lack confidence in their abilities. Reflecting back after some practice on the change this has created can draw attention to any improvement that has occurred and can increase confidence in the ability to change.

Just like any other ability, with the right strategies and commitment to practise, it is possible to change mindset. Here are some strategies that you might try:

1. Notice when you want to prove your ability in a situation and when any criticism feels harsh. What would change if you just wanted to improve your ability and therefore listened openly to the feedback?
2. What do you do when a task becomes hard? Do you find an excuse to stop? If so, catch yourself and think what you would do if you were really in a growth mindset in which the hardest tasks represent the best opportunity to grow and learn.
3. Notice when you want to be with people who agree with you. What might you learn from people who are more willing to criticise you?
4. Reflect on any events in your past where you feel your ability was judged and found wanting (an exam mark, a parent or teacher's comment on your ability, a job review). What could you learn from this if you were to take a truly growth mindset? And what would you have to believe about yourself to remain in a fixed mindset?
5. Reflect on times when you gave up on learning because it seemed too difficult, or your progress was not as fast as you wanted. What goals were you setting yourself? What would happen if you set more realistic goals? What additional strategies might you put in place?
6. Finally, who do you know that might feel that their behaviour is being (or has been) judged harshly? This is particularly true of people for whom society has negative stereotypes (gender, race, religion, sexuality). How might you help them to achieve a growth mindset? What steps might you take to help them to challenge societal beliefs in their abilities and therefore to help them learn?

GROW model

Coaching is the process of holding a space in which a coachee can systematically explore an area in which they would like to make a change. The most popular model for this process is the GROW model that was developed by Whitmore in the 1980s (Whitmore, 2009) and is still widely used today. It is therefore worth considering what we know about the neuroscience of this model.

Goals

The GROW process starts by defining an overall goal, and a goal that is achievable within the session. Creating goals allows us to consciously process our aspirations making it more likely that we will reach these. While Whitmore (2009) focuses on the end goal (or final objective) and performance goals (the level at which you would have to perform to reach your end goal), more recent literature differentiates between performance

goals (a level you that would demonstrate your skill level) and mastery goals (a desire to increase learning or skill acquisition to continuously improve overall competence). These two goal types have been linked to fixed and growth mindset respectively (Dweck & Leggett, 1988).

Individuals who aim for performance goals tend to have a fixed mindset and therefore believe that their ability in this area is fixed. This results in setting performance goals that allow them to demonstrate their ability with the consequent aim of avoiding failure (Spielberger *et al*, 2011). Goals which avoid potential failure are driven by activation of the right dorsolateral prefrontal cortex, an area of the brain which focusses on prevention of harm (Davidson & Irwin, 1999). The potential for failure if the goal is not attained can result in increased stress (Elliot *et al*, 2011). However, it is important for coaches to understand that individuals whose brains work in this way will not necessarily benefit from attempts to persuade them to set different goals. It is sometimes necessary to work with the brain of the coachee. More effective questions for this type of coachee might be:

- What would happen if you fail to take action?
- What is the worst possible outcome for you?
- What do you most not want to happen?

Individuals who aim for mastery goals, on the other hand, have a growth mindset in this area and therefore believe that ability can be improved through persistent effort and the right strategy. They therefore set goals that approach the challenge and help them develop (Spielberger *et al*, 2011). When approach goals are set, the left prefrontal cortex is activated (Davidson & Irwin, 1999). This area of the brain focuses on potential rewards. Failure to improve fast enough or to a high enough level is therefore regarded as the result of either a lack of effort or the need for a new strategy. This demonstrates a growth mindset in which the belief might be that the goal has not been achieved *yet* (Dweck, 2006). Effective questions for this type of coachee might be:

- Who do you know that already does this well and what strategy do they use?
- What is a realistic goal for the time you have available for this challenge?
- How might you create more opportunities to practise this skill?

Reality

The next phase in the GROW model asks coachees to focus on the reality of the current situation. Again, the way in which a coachee frames their goals will influence the way in which they construct their reality. A coachee with a growth mindset who approaches situations in which there is the potential for reward tends to consider ways in which their plan will be successful. They are often optimistic, believe that their plans have a good chance of success

(hope) and are willing to take risks (Dardick & Tuckwiller, 2019). Their blind spots are more likely to be failure to notice potential threats or obstacles to their plans.

A coachee who sets goals that avoid failure is more likely to notice the obstacles and threats to their plans. They tend to be more pessimistic, less hopeful and risk averse (Dardick & Tuckwiller, 2019). Their blind spots are more likely to be the potential rewards their plan might bring if it were to succeed, ways in which they have succeeded in plans like this before and resources that they have available to increase the potential success of their plan.

Options

What happens in the brain when we start to think of options? Where do more innovative responses come from?

In order to be creative about finding solutions to challenges we need to use divergent thinking (Beaty *et al*, 2015). This is the ability to generate novel new solutions for problems that do not have a right or wrong answer. It involves fluency, flexibility, and novelty of ideas.

There are three processes involved in divergent thinking. To think divergently, we need to:

1. Make associations across different domains of knowledge and concepts which results in the generation of possibilities. This is known as 'conceptual expansion'. A concept can be thought of as the set of features or parameters that define how objects or events in the world are classified. Thus, in order for an object to be a bird, we know that typically it should have wings, a beak and be able to fly. Conceptual expansion is the ability to create larger concepts. In order for a penguin to be classified as a bird, we need to expand our category to include flightless birds in addition to birds that fly. Coaches can aid the process of conceptual expansion by asking coachees to think of unusual ways to solve a challenge or by putting constraints on how the challenge might be solved.
2. Creativity can be limited by the inability to conceive of an object in a manner different from its customary or habitual use (functional fixedness), therefore we need to be able to inhibit these habitual responses. This requires activation of the dorsolateral prefrontal cortex.
3. We are more likely to become fixed on an idea or a process if we use the same strategy in more than one context. So, if we always use wheels to make it possible to move objects, or always use salt to make our food taste better, then it is more difficult to think about other ways to do the same thing. This creates a bias towards this single strategy making it more difficult to inhibit it. By using more than one strategy for problem solving, we can decrease the likelihood of functional fixedness.

Coaches can aid divergent thinking by asking for several alternative strategies that might be used to solve a challenge. You can then explore different possibilities with your coachee to determine how well each of these provides a solution to the challenge. Testing out possible ideas involves imagining each of the new ideas. The more vivid a coachee's imagination, the easier it will be for them to select the best options from their new ideas.

This research points to an important and learnable skill in encouraging creativity: the process of inhibiting previous learned responses. It suggests that if we want to encourage creativity in others, it might be necessary to teach them ways of capturing and eliminating all the typical learned responses in order to encourage new thinking. As new ideas emerge, it will then be possible to imagine these solutions to decide which options should be pursued.

Will

When options have been created, the next stage is to create an action plan that the coachee is motivated to follow. From the options created, the coachee can choose which they will do and to encourage this, the coach can ask the coachee 'What are you going to do?'. Here there is an assumption that the coachee will do something so remember that as a coach your role is to allow the coachee choice, and this can include choosing to do nothing.

Just as some coachees will set avoid goals while others set approach goals, some coachees will be intrinsically motivated to complete their goals while others are extrinsically motivated.

Intrinsic goals are easy to reach since they usually fulfil psychological needs directly. These include a sense of autonomy, good relationships with others, and competence and personal growth (Deci & Ryan, 2000). Completing intrinsically motivated tasks is associated with increased wellbeing (Sheldon, *et al*, 2004). Intrinsic goals increase wellbeing because:

i. They are chosen by the coachee from a desire to develop and therefore increase the feeling of autonomy and identity.
ii. When others are involved in the goal, they can increase feelings of belonging.
iii. They are often associated with a sense of fun or playfulness.
iv. When these are framed as stretch goals, they provide an opportunity for growth and personal development.

Extrinsic goals are harder to fulfil since they only fulfil psychological needs instrumentally (more money means…). A coachee can believe that they have to complete a particular goal because they need money to live, they will feel guilty if they don't, or because it will make them look good to others (McGregor & Doshi, 2015). As a result, these types of tasks are associated

with decreased wellbeing (Sheldon *et al*, 2004). Specifically, extrinsic goals decrease wellbeing because:

1. They result in increased social comparison.
2. As a result of this, they can lead to more competitive and less loving relationships (keeping up with the Joneses, being part of a particular gang).
3. They create contingencies between self-worth and goals (I am only worthy if….).
4. Time and effort are limited resources so that the greater the investment in extrinsic goals the lower the investment in intrinsic goals.

Coaches can help to increase the motivation to try a particular option by focusing on the intrinsic motivation for this. Direct the coachee's thinking to their choice in how to address their challenge (autonomy), the people they might be able to help them with this (relatedness and belonging) and how they might develop personally through completing the challenge (personal growth).

Another concept which is important in increasing the will to complete a goal is the coachee's belief in their own self-efficacy. This is the degree to which the coachee believes that they will be able to cope effectively with the challenge. Self-efficacy has been demonstrated to have three components: capability, opportunity, and motivation (Michie *et al*, 2011). Capability is a measure of our own internal resource that can be brought to the challenge. This might include ways in which we have successfully addressed similar challenges in the past, new knowledge, or skills that we did not have previously, and psychological factors including self-belief and confidence. Coaches can increase capability by focusing on previous successes and recent personal development. Opportunity refers to the physical requirements for success including any training required, resources including technology, space, and time, and also the opportunity to practise any new skills required for the challenge. Failure to put all the necessary physical resources in place can lead to a loss of self-efficacy. To help with this, coaches can explore the physical resource and the potential to practise any skills required. Motivation partly results from knowing that the capability and opportunity for the task are in place. Coaches might also choose to focus on ensuring that chosen options are intrinsically motivating.

Stress and resilience

The stress response

Another common topic in coaching conversations is stress caused by work-related factors, personal life experiences or the combination of both. Having an understanding of what stress is and how it influences function in the brain can provide coaches with tools to help address stress in their coachees.

The first thing to realise is that stress does not always have a negative impact. An influential model of stress suggests that moderate, short-term stress improves cognitive processing in the brain and is therefore a highly adaptive functional response (McEwen, 2013; 2008). According to this model, perceived stress results in increased activity in the amygdala which then causes a cascade of changes in hormonal and neural systems.

First, the increased activity in the amygdala causes increased activity in the hypothalamus, the area of the brain which co-ordinates hormonal responses. This results in the release of corticotrophin releasing factor (CRF). This chemical causes release of adrenocorticotropic hormone (ACTH) from the pituitary gland. Receptors for this hormone are found in the adrenal glands which release adrenaline causing increases in blood pressure and heart rate and diverting blood to the muscles in preparation for action. Receptors for ACTH are also found in the prefrontal cortex (decision-making) and the hippocampus (memory). Activation of these receptors result in improved function and better ability to make decisions quickly and to use experience and expertise appropriately. Low to moderate increases in ACTH have also been shown to protect the brain from anxiety.

Stress is one of many homeostatic mechanisms in the brain. Homeostasis is the process of maintaining a constant level. An example of this is hunger which is used to keep our blood sugar level relatively constant. Similarly, stress is used to improve brain function temporarily but then has to be reset to bring the system back to baseline. In order to achieve this, the effect of ACTH has to be counter-regulated to maintain levels of neurochemicals in the brain and prevent these from being over-produced. This is accomplished through the release of cortisol from the adrenal glands in response to increasing blood levels of ACTH. Cortisol decreases the response in the prefrontal cortex and hippocampus bringing this system back into balance. This balance between responses in the hippocampus and cortex is important in maintaining resilience.

How do we respond to stress?

Research suggests that our response to stress depends on the intensity and frequency of perceived stressful events (McEwen, 2016a). Thus, a short, sharp stressful event for which we have the resources to cope has a positive effect on our brains, increasing the function of our synapses in the hippocampus and readying us neurologically to be at our best.

However, when the level of stress increases in either frequency or intensity to a point where we can no longer cope, then we move into distress. At this point, we lose both synapses and neurones in the hippocampus (memory) and medial prefrontal cortex (cognitive function) but increase the number of synapses in the amygdala (emotional response: McEwen, 2016b). As a result, stress produces a reduction in memory and a decrease in the flexibility and

creativity of planning. This can be accompanied by an increase in vigilance and a loss of value in life ultimately leading to anxiety and depression. The cumulative result of this is to decrease our resilience to future stress. If the stress does not go on for too long then these effects are reversible, but if the stress is prolonged, then there can be permanent effects.

The degree to which a particular event activates the amygdala, and therefore the strength of the stress response, will depend on the individual assessment of the degree of threat involved – the allostatic load. The higher the perceived stress (high allostatic load), the harder the body has to work to return to equilibrium (McEwen & Gianaros, 2011). What this suggests is that high levels of acute stress are not functional. When ACTH levels are increased too high and/or for too long, this can result in emotional and cognitive instability through overactivity in the prefrontal cortex and hippocampus.

It is important to notice, however, that in this model, the stress is not actual but perceived. There will be examples of stressors that produce similar responses in most individuals, but many stressors are the result of experiences that we have had during childhood and are therefore individual to us. In these cases, the stress response is not being driven directly by external stimulation but by our interpretation of particular situations. It is therefore possible to decrease or eliminate a stress response by changing the interpretation of the 'stressful' stimulus. Coaches can ask coachees to reflect on the story that they have either created about past events or are creating about future events. This can help determine whether coachees are using all relevant evidence when constructing their story or whether they have focused, for instance, mostly on the negative evidence. Expanding the awareness of the evidence that is available can help a coachee to construct a more helpful narrative.

Individual response to stress

Each individual responds to stress in their own way and how we react to stress can result from negative childhood events that increase reactivity to future stress. A simplified description of the effects of differences in stress reactivity divides the response to stress into three categories (McEwen, 2016a):

Good stress (or Eustress) involves the stress associated with successfully rising to a stretch challenge or taking a risk which is therefore ultimately rewarding. This success increases self-esteem, and the ability to self-regulate (choose the difficult option over the easy one). The consequences of experience with good stress are that there is an increase in the likelihood that an individual will be willing to take on challenges in the future. For stress to be considered good stress, not all challenges need to be met successfully however, since treating failures as an opportunity to grow can maintain self-esteem.

Tolerable stress can be seen when the challenge of a particular situation is greater than we can cope with alone but is still able to be overcome with the help of support networks including family, friends, colleagues etc. This can lead to distress depending on the degree to which the individual feels in control of the situation. The lower the feeling of control, the greater the distress.

Toxic stress is the response to challenges that are felt to be beyond an individual's current resources even with social networks activated. This is found more often in individuals who might have had an adverse early life event, and therefore are more highly reactive to stress. It might also be found in people that have never overcome challenges (either because they failed or because they have never had the opportunity) or in people who have limited or no support network. These conditions are likely to limit the opportunities for developing self-esteem and self-control. As a consequence, individuals experience significant distress.

Stress awareness

While being under stress at some point in our lives is inevitable, our response to this is not. Both our own past experience with stress, and the support we receive from family, friends, colleagues and even our organisation can influence our degree of stress.

One way that coaches can help their coachees is to help them to become aware of their own response to stress. Sometimes we are so busy that we are not aware of how stressed we are. It is only when it stops that we notice. Being able to notice when stress is beginning, therefore, is vital to prevent this. For instance, if you notice that a coachee is aware that they are becoming tolerably stressed, they can activate their support networks to make best use of their personal resources. Or, if they notice that their stress is becoming toxic, they can arrange to discuss this with their line manager in order to take immediate steps to prevent this.

Each individual will have their own early warning signs. Coaches can help their coaches to use their memory of past stressful experiences to begin to notice the early warning signs that might indicate that they are becoming more stressed. Moving from good to tolerable and tolerable to toxic stress, will result in changes to emotional responses, bodily feelings, and behaviour changes. For instance, one sign of moving to tolerable stress might be a tightening of the muscles in the upper back and neck, with accompanying neck or headache. When moving into toxic stress, an individual might eat less healthily, or become less tolerant of interruptions, or people in general.

Ask a coachee to remember a time when they moved from good stress into tolerable stress. What were the early warning signals that they might have used to notice this change? You might ask them to consider changes in their emotional responses, changes in their body including muscle tightness and

other physical signs, and changes in their behaviour including how they reacted to others. Encourage your coachee to write down some early signs that they might use to notice this change in future.

When they have completed this, you can ask them to remember a time when they moved from tolerable to toxic stress. Again, reflect on the early warning signs that they could use to notice this change in their level of stress and write down some signs for future reference. You might suggest that they include the ways that their behaviour affects others which will allow them to consider whether there is someone close to them that might be better at noticing the changes in their level of stress than they are.

We have a right not to be placed under too much stress, but with this comes a responsibility to notice our own levels of stress so that we can take appropriate action at the right time. Practising an awareness of our own stress levels is the first step that we can take in meeting this responsibility.

It is apparent that part of our response to stress derives from individual interpretations of events. A person who thinks of challenges as opportunities to grow and who believes that failures are ways in which we can learn is likely to have a different response to a challenging event than a person who treats challenge as threatening and failure as a devastating indication that they are no good as a person. Thus, stress is a response to our interpretation of events rather than to the events themselves.

It should also be clear from these definitions that an individual's response to stress is a function of their individual experience (Wood *et al*, 2010) and therefore that no judgement should attach to this. The environment in which we developed and the experiences to which we have been exposed have a substantial impact on our response to stress, and therefore those of us who do not experience events as toxic have a lot to be thankful for.

When people experience long periods of tolerable stress or short periods of toxic stress, this has a direct effect on their motivation (Maier, *et al*, 2015). As cognitive abilities decrease, self-esteem and self-control also decrease. This might lead to disrupted sleep, increased food and alcohol intake, reliance on legal or illegal drugs – all ways in which we can find relief from stress. However, these solutions do not work well with the brain's own ability to regulate stress and to improve function. Therefore, it is possible to refresh an individual by removing the sources of stress (even if only temporarily) and providing the best conditions for the brain to act in its own defence. Coaches who are dealing with coachees with high levels of stress can encourage the coachee to consider ways in which they might (even temporarily) remove the stress to give their brain time to recover fully.

Resilience

Resilience is a trait that many organisations would like to encourage in their employees. The definition of resilience in this context is:

> *'the ability of an organization to anticipate, prepare for, respond and adapt to incremental change and sudden disruptions in order to survive and prosper'*

BSI https://www.bsigroup.com/en-GB/our-services/Organizational-Resilience/

On the basis of this definition, resilience is clearly important in order for organisations to adapt to a changing landscape. However, this definition is quite different from that used by psychologists to define individual resilience:

> *'the process of adapting well in the face of adversity, trauma, tragedy, threats, or significant sources of stress – such as … serious health problems, or workplace and financial stressors.'*

American Psychological Association https://www.apa.org/topics/resilience

This definition suggests that resilience is an individual response to significant stress or trauma. Using this definition of stress, it might be concluded that organisations want to be able to put their employees under stress but provide them with the tools to bounce back effectively. As previously discussed, toxic stress causes damage to the brain, cardiovascular system and gut and so should be prevented as much as possible. It is therefore important to differentiate between naturally occurring situations that result in stress for which individual resilience is a good adaptive strategy, and imposed stress for which individual resilience should not be expected. Helping coachees to become aware of their sources of stress, and whether these are appropriate or not, can be an important role for a coach.

In order to improve resilience for situations where this is an appropriate response, it would be useful to understand what resilience is and whether it can be developed. One influential model of how resilience can be increased is based on the tripartite model of depression and anxiety (Clark & Watson, 1991). They suggest that there is an increase in negative emotional responses (or affect) in both depression and anxiety. This is thought to result from increased activity in amygdala. Individuals with depression, however, are also more likely to show a decrease in positive emotional responses that are not found in those with anxiety. An example of this might be a failure to correctly anticipate whether future events will be rewarding. This is a result of decreased activation of the dopamine reward system including the nucleus accumbens and ventral tegmental area. By contrast, individuals with anxiety are more likely to show states of hyperarousal that are not found in those with depression. An example of this might be increased attention to any social interaction that might be considered threatening. This is thought

to be related to increased activation of the default mode network which is responsible for considering our relationships with others.

Tabibnia (2020) used this to create a model for building resilience which has three components:

1. Increase positive affect by increasing activation of the dopamine reward system. Studies have shown that resilience is related to positivity (Fredrickson *et al*, 2003). People that are more positive about their experiences after the 9/11 attacks were found to be less stressed and more resilient (Fredrickson *et al*, 2003). Compassion, gratitude, optimism, humour and positive memories are also ways in which greater activation of the reward system can be achieved.
2. Decrease negative affect by decreasing the activation of the amygdala. Inoculating against stress by mild exposure to a stressful event is one way that has been shown to reduce the activity in the amygdala (Lyons *et al*, 2010). Other ways to reduce negative affect include reframing events, increasing self-efficacy by learning new skills, and naming the emotion.
3. Decrease hyperarousal by decreasing activation of the default mode network. Research by Zeidan *et al* (2014) has demonstrated that mindfulness meditation can reduce anxiety through reduction of activity in components of the default mode network (eg, anterior cingulate cortex). Increased sense of purpose, nature and a sense of awe have also been associated with reducing in hyperarousal in anxiety.

Our response to stress will depend on a number of additional factors including our genetics, development and experiences in life. For instance, women have been shown to react more emotionally to stressful events (Pilar Matud, 2004). However, men have been shown to become more cognitively impaired than women when stressed (Pilar Matud, 2004). It is important to remember that gender differences are found between populations not individuals – while, on average, women are more emotional but have better cognitive processing when stressed, there will be some women who do not respond emotionally to stress and some men who will show little cognitive impairment when stressed.

Early life events also affect our stress response. People who have suffered childhood trauma, including abuse, are more easily stressed than those who have not (Bremner, 2003). It appears that our response to stress is set in childhood partly as a result of the security of our environment. Children who are securely attached and who grow up in supportive environments are less reactive to stressful events than children who are insecurely attached and grow up in environments in which they have to guard against threat (Bender & Ingram, 2018). The level of stress that creates the same allostatic load is therefore higher for insecurely attached children than for securely attached

children. There is hope, however, because the way that people react to stress can be altered in adulthood.

Decision-making

The goal of a coaching session often revolves around a decision that has to be made. Knowing how we make decisions and the systems involved in this can help coaches to improve decision-making in their coachees.

Fast and slow thinking

Fast thinking (System 1) and slow thinking (System 2) were terms developed by Nobel Prize winner Daniel Kahneman to describe the two types of decision-making processes that are available in the brain (Kahneman, 2012). Slow thinking, or system 2, is used to describe conscious decision-making processes which are slow, subject to reasoning or cost-benefit analysis and more deliberative. In comparison, fast thinking, or System 1, decisions are subconscious, holistic and based on pattern matching the current situation to previous situations in order to activate stored reactions or habits. Neither type of processing is ultimately superior; they are both useful in particular situations.

Table 10.1 summarises many of the properties that have been associated with each type of thinking. However, we can demonstrate that decisions made with System 1 will not necessarily meet all of these criteria simultaneously. For instance, we sometimes have to wait until our other-than-conscious mind develops a new solution, perhaps the next day in the shower or when out running, in which case System 1 can be slow. Alternatively, we can sometimes know exactly the right solution for a problem, and why this is the right solution, immediately from past expertise making slow thinking fast. These criteria should therefore be taken as indicative of System 1 and 2 thinking rather than being rigid and immutable.

Table 10.1: Fast and slow thinking

Fast thinking (System 1)	Slow thinking (System 2)
Unconscious	Conscious
Implicit	Explicit
Automatic	Controlled
Low effort	High effort
Rapid	Slow
High capacity	Low capacity
Holistic, perceptual	Analytic, reflective
Associative	Rule based
Context specific	Abstract
Pragmatic	Logical
Parallel	Sequential
Stereotypical	Egalitarian
Independent of intelligence	Linked to intelligence

When deciding what to do in a new situation, System 1 is used to determine whether previously generated behaviours might be used again. To do this, the sensory input from the current situation is compared with stored sensory patterns from past situations (comparing current perception with memory for previous similar situations). If a similar situation has been encountered in the past, the sensory patterns of the current situation will (partially) match a stored pattern, which will activate the behaviour that was previously successful (Hutton & Klein, 1999).

However, in some situations, there might not be a previous experience that matches, or we might choose consciously to think about what we will do. This will require paying attention to our perception of the current situation and the actions that might be appropriate for this. This involves mental simulation of possible actions to allow us to choose which might be most effective (Hutton & Klein, 1999). This requires System 2 thinking.

Coaching decision-making

It can be useful for coaches to become familiar with the preferred decision-making style of their coachee. Some coachees will decide quickly, choosing options that are good enough. These are System 1 thinkers or gut feelers. Other coachees will want to consider all options fully and consciously before making a decision. These are System 2 thinkers or maximisers. Knowing this preference can both help coaches to work with the preferred system and to expand the frame by asking questions that direct attention to the non-preferred decision-making system.

Before describing ways that coaches might help their coachees to expand their decision-making to their less preferred system, it is worth pointing out that the processes involved in conscious (System 2) and unconscious (System 1) decision-making are very similar (Kruglanski & Gigerenzer, 2011). When making a decision, the brain assigns the expected value of a successful outcome for each option; the benefit or value of each option can thereby be calculated (O'Doherty, 2004; Tobler *et al*, 2007). By assigning a value to each option, the options can be compared to determine which provides the greatest benefit. Neurones responsible for this coding have been found in the ventral striatum and prefrontal cortex.

Many decisions, however, come with some risk. In this case, there has to be some neural calculation of the approximate expected likelihood of the outcome of each choice based on past experience (Christopolous *et al*, 2009). It might be that one option has a potentially high value but is also highly risky. In comparison, another option might provide a lower value but a higher likelihood of success. Neurones that code the uncertainty of value calculations have been found in the lateral orbitofrontal cortex. Deciding between a high value risky option and a lower value safe option will depend on the degree of risk that is acceptable for an individual.

Some individuals are risk seeking while others are more risk averse. Individuals that are risk averse show greater activity in the amygdala, anterior insula and anterior cingulate than individuals who are more risk seeking. This suggests that risk-averse people have a high negative emotional response to risk. This might imply that when a person who is risk averse assesses that an option is riskier, this stops the person from choosing this option. However, studies suggest that simply measuring the strength of the neural response to different risks does not differentiate between high and low risk situations (the amygdala is activated for both high and low risk, Christopolous *et al*, 2009). This suggests that people who are risk averse over estimate the potential risk in many situations – the amygdala is activated by any risk, and all risk over a certain value is deemed too much. This is often associated with System 2 decision-making since knowing the basis for any decision provides a sense of control and certainty.

Similarly, individuals who are risk seeking show higher activation in the ventral striatum and cingulate cortex when faced with risky choices and so potentially over estimate the potential reward from these choices. This is often associated with system 1 decision making.

Since individual differences in risk seeking and risk aversion will affect the outcome of any decision-making process, it is useful to be aware of whether individuals are more risk averse or risk seeking, so that the bias in their reaction to risk can be taken into account.

For gut feelers who are more risk seeking, here are three things that coaches might consider:

Risk

- Is your coachee underestimating the risk in the situation?
- To what are they comparing this risk?

The starting point for their risk comparison acts as an anchor. If your coachee wants to take no risk, then a 10% chance they might fail will seem too high. If they are happy with a high risk, then a 50% chance of failure might seem acceptable. To determine whether an anchor is in play, ask your coachee:

- Would you make the same decision if there was nothing to lose?

Emotion

- Has your coachee been involved in decisions leading up to the current situation?
- Is there a reason that they are particularly attached to an outcome at some unconscious level?

For instance, if your coachee recruited people that might be adversely affected by their decision, this might be colouring their judgement. Ask your coachee:

- What emotions are driving this decision? Would you make the same decision if you ignored these?

Detail

- Is your coachee failing to detect a detail in this problem that might make it different from previous situations they have dealt with successfully?

Humans are exceptional at pattern recognition to the extent that we will try to make circumstances fit a pattern even when details don't match. This can have serious consequences if this detail is the one thing that changes the decision that should be made. To add to this, humans have a tendency to look for information that confirms their opinions rather than facts that contradict them. This is known as conformation bias. As a result of this, your coachee might be failing to see a detail that argues against the decision they want to make. Ask your coachee:

- What detail might someone with a different perspective to you notice that you are currently ignoring?

For rationalisers, who can be risk-averse, here are three things that coaches might consider:

Risk

- Is your coachee over-assessing the risk in the situation?

- With what are they comparing this risk?

To determine whether your coachee is being influenced by an inappropriate risk anchor, ask:

- Would you make the same decision if there was nothing to gain or lose?

Emotion

- Is your coachee underestimating the emotional impact their decision might have on themselves or others involved in the outcome of the decision?

Maximisers can hold a belief that decisions should be rational and therefore can attempt to remove any emotional content from their decision-making. This can leave them prone to treating people as cogs rather than with empathy. To help a coachee who does not want to consider the emotional implications of their actions on themselves or others you might ask:

- How might someone more emotional than you view this situation?
- What decision might this lead them to make?

Detail

- Is your coachee considering the problem in too much detail?

Maximisers can be data fiends who want to know as much as possible about every situation in an attempt to create certainty about the decision they are about to make. In leadership, there are often situations in which decisions have to be made with only partial information. This can be more difficult for a maximiser. Coaches can help coachees with this by asking:

- Are some of the details less important and could they be ignored in this instance, in order to make the decision-making process simpler?
- If you had to focus on three factors for this decision, what would they be and what decision would you therefore make?

Cognitive biases or shortcuts

While individuals might have preferences for one or other system when making decisions, it is important to understand that both systems are always working, and therefore that most decisions use System 1 to some extent. Indeed, a little reflection on the average day might indicate that most of our decisions are not conscious and therefore that System 1 thinking has a large part to play in decision-making. This is particularly the case when we are tired or under stress. For this reason, it is worth understanding both how this system works in more detail and the impact it has on decision-making.

System 1 thinking is responsible for the cognitive biases in our decision-making (Kahneman, 2012). The term cognitive bias implies that these types of decision are not fully rational and therefore should not be relied upon. However, there is a major benefit in having quick decision-making processes

(Ariely, 2011; Gigerenzer, 2008). If we were to try to make conscious decisions about every detail of our lives, our brains would very soon become overwhelmed. System 2 does not have the capacity to make every decision.

Another, more positive, way of explaining cognitive biases is that they are the result of the evolution of useful decision-making shortcuts that work most of the time and provide us with quick decisions based on much more information than our conscious system can take on board (Gigerenzer, 2008). System 1 learns quickly through experience and notices when the same outcome is rewarded on more than one occasion. While our cognitive shortcuts, therefore, can sometimes let us down, they are also the source of expertise both in our professional lives and in general daily living.

There are four main situations in which we are more likely to use cognitive biases or short cuts:

1. When memory is limited and we have too much to remember, we reduce the load on our memories by extracting the main points or gist rather than trying to remember the detail. Here are some ways that we do this:

We act on strong, immediate emotions since these are likely to be important.

An example of this is the *current moment bias*, or 'a bird in the hand is worth two in the bush'. We do not weigh reward in the future as highly as reward now! Because we are better able to feel the emotional response to immediate reward but find it more difficult to imagine how we will feel in the future, we discount our future reward in comparison to immediate reward. This can be a really useful bias to understand as a coach who is helping coachees to set goals which require change in their behaviour. The reward in the future should be perceived to be greater than the current reward in order for a coachee to be motivated to put effort in to changing their behaviour. We will discuss this in more detail when we explore temporal discounting.

We reconstruct our memory each time with different details depending on our goals.

An example of this is the false memory effect. Professor Elizabeth Loftus has spent her career demonstrating how we are prone to creating false memories (Loftus, 2003). Our memory does not operate like a video camera recording all the facts but instead remembers the typical things that happen in a particular context, and then differentiates our memories of, for instance, a particular day at work by adding relevant detail (Hassibis & Maguire, 2009).

Our memory is a combination of real and typical so is both correct and partly wrong. We are able therefore to create false memories by adding details that are likely but that didn't actually happen. For instance, we might

remember that there was a discussion at a meeting and that someone came up with a brilliant idea. We might wrongly remember the person that came up with the idea as the one who is usually the most innovative because there were too many people at the meeting for us to be sure of who the actual person was.

2. When we have too much information to process, we simplify the decision by focussing on the most salient information and ignoring information that is more difficult to notice. For instance:

We notice evidence that confirms our previous beliefs (and ignore evidence that does not).

An example of this is the *confirmation bias*. Our brains are biased to seek out information that confirms our sense of self – so we are more likely to attend to opinions that agree with ours than those with which we disagree. We find *cognitive dissonance* (when there is a conflict between our understanding and information in the world) uncomfortable, and the confirmation bias reduces the likelihood of cognitive dissonance.

The unfortunate aspect of this bias is that it prevents us from challenging our own viewpoint even when there is plentiful evidence against it since we ignore information that does not confirm our bias. So, while it can help us to feel good about ourselves, it can also lead to poor decisions and failure to take others' perspectives into account.

We notice other people's flaws but not our own.

An example of this is the *fundamental attribution error*. We are social animals since we are able to accomplish more, and are safer, in groups. We have therefore evolved mechanisms that help us to work with others. This includes an ability to theorise about what other people are thinking and therefore how they might choose to behave. This is important since we need to be able to choose to work with people who are fair and choose not to work with those that only look after their own interests.

In order to protect ourselves, it is better to be biased towards choosing carefully to trust, and therefore it is important to pay attention to behaviours that indicate that trust has been breached. If we focus only on outcomes, we might wrongly believe that someone has breached our trust even if the act was unintended. This is a fundamental error in our attribution of the event – we have failed to account for the intention of the action. To prevent this, it is important to consider what other explanations there are for the same outcome without it having been consciously planned to affect us.

3. When we have too little information to make meaning, we need to use the information that we do have to make decisions. We do this by adding information from the environment and our memory which is not always directly relevant to the situation. For instance:

We form patterns from sparse data.

The *turkey fallacy* is a belief that past events have an influence on future outcomes. Each day of the turkey's life is an individual event that is not dependent in any way on previous days – there is no memory of what has gone before. And so, each day might be the day that the turkey is needed as the main dish for a celebratory meal. This belief has consequences in organisations because you might notice trends in economic performance and assume that these are going to continue. This might prevent you from managing risk appropriately.

We use stereotypes and generalisations.

An example of this is the *in-group bias*. This bias is activated when we are asked to decide, for instance, who should be trusted, allocation of resource, or who we want to work with. Since in each case there is a decision to be made about who we are best able to trust, we will tend to choose the people with whom we are most familiar. This results in an unconscious belief that our own social group are more trustworthy, more deserving or smarter – without any good evidence. As a result, we treat people from our own group better than we treat those from other, equivalent groups.

We use our own thinking as a proxy for what others are thinking.

An example of this is the *projection bias*. This bias is another way that we can reduce the need to use slow thinking. Rather than working out what every person we meet might think, feel, prefer – we make the assumption that people are like us and therefore that their likes and dislikes, their emotions and their decisions will be much like our own. In order to reduce this bias, we have to consciously honour the uniqueness of the individual over our own opinions thus substantially reducing the projection bias.

4. When we need to act fast, we do not have time to look at all the evidence available and so we require mechanisms that will allow us to decide on incomplete information. In such situations:

We use group decisions to avoid mistakes and to preserve autonomy and status.

An example of this is the *bandwagon effect*. This refers to the idea that, as social animals, we have a tendency to agree with the crowd. It is very easy to fall in to 'groupthink' since this enables us to avoid being held accountable for mistakes. When mistakes happen, and we are thought to be responsible for these, we can lose credibility and might be more carefully monitored in future in order to prevent further mistakes. Agreeing with the crowd is therefore a means to maintain our status and autonomy since it will not be our fault if things go wrong. Having the courage to speak up when you disagree with the majority and creating cultures in which everyone has a voice and is heard fairly can help prevent the main downfalls of groupthink.

We choose to complete things that we have invested energy and time in whether they are important or not.

An example of this is the *sunk-cost fallacy*. This occurs when we continue a behaviour or invest more time or resource in an endeavour on the basis of the amount of previously invested resource (time, energy or money). We do not want to feel that we have spent resource without gaining some return from this (loss aversion) and therefore continue to commit resource even when we would be better to cut our losses. In coaching, this can be seen when a coachee wants to continue to put time and effort into completing a goal, even when it is clear that this effort is no longer effective.

There are two particular cognitive biases that are worth exploring in more detail because of the impact that these can have on decision-making process. These are temporal discounting and the Dunning-Kruger effect which are described in more detail below.

Temporal discounting

Temporal discounting is another way in which our decision-making is not rational. This describes the fact that the value of objects decreases over time. Research has clearly demonstrated that rewards in the present are valued more than those in the future – or a bird in the hand is worth two in the bush.

To take a concrete example, if you were asked if you would prefer £10 now or next week, you would be slightly mad to take £10 in the future since you would have no idea whether you would be around to accept the money.

Which would you choose, however, if you were offered £10 now versus £12 next week? You still might not think it worth waiting. What if you are offered £10 in four weeks' time versus £12 in 5 weeks' time or even £10 in 52 weeks' time versus £12 in 53 weeks' time. As we look further into the future, waiting one week for the larger sum of money seems less difficult. This is known as *temporal discounting* – the value of time seems to shrink in the future and therefore a slightly larger reward seems worth the wait. This has been shown to involve the reward system (ventral striatum) and the prefrontal cortex (inhibition: Christakou *et al*, 2011; 2013). People who are reward-focused find it harder to inhibit the desire for immediate reward in order to wait for a future reward.

Another example of this is when we believe in the morning that we will use our evening to go to the gym, complete a work-based project, or learn a new skill. When evening comes, we find ourselves sitting down to, for instance, watch junk on TV when we had believed that we could so easily resist this to make progress on our project. In this case, the reward of the immediate option to relax in front of the television was easy to resist when it was distant in time but is much harder to resist when it can be accessed

immediately. We discounted the reward from television when we thought about it from a distance in time.

Temporal discounting can help to explain some typical human behaviours including, for instance, procrastination. When we procrastinate, we choose the immediate reward of not doing the work for our current self and leave the more difficult task of completing the work to our future self. Similarly, it explains impulsive behaviour. Imagine that you have arranged with your line manager that you will complete a project by the end of the week. Thursday comes and the project is not complete, but you are given the opportunity to work on a really important bid for new work. The new project is exciting and novel and, if it comes off, there is a real chance you might get promoted. What do you do? Do you complete the work that you promised you would have finished, or do you work on the new project? The more impulsive you are, the more you will be attracted by the new project since there is immediate reward in this.

There are individual differences in temporal discounting (Christakou *et al*, 2011; 2013). For a person who is able to delay gratification, there is only a gradual decrease in the value of time into the future such that immediate rewards are not valued significantly more than rewards in the future. By contrast, someone who finds delaying gratification difficult, or is impulsive, values the immediate reward much more highly than the future reward and so finds it much harder to resist this in return for a reward in the future. For this person, there is a steep decrease in the value of time in the future. This makes it harder to resist a large immediate reward with a discounted future reward.

When coaching a coachee with a steep temporal discounting curve, coaches can focus on making the future reward as large as possible so that it is more likely to be preferred to the current reward. This can be achieved by having your coachee think of all the potential benefits of a proposed action and then find a means to make these easy to remember (a photograph, a strong memory, an action). The coachee can then be encouraged to use this memory aid if they find their willpower is slipping.

The Dunning-Kruger effect

This is a cognitive bias through which people with low ability overestimate their confidence in their own ability (Dunning, 2011). This effect is universal – we are all ignorant, and we are all ignorant of our own ignorance, in at least some areas of our lives. This can be described as a relationship between competence and confidence. Sometimes, the least competent people can appear the most confident.

The Dunning-Kruger effect was demonstrated by testing people in a particular skill and then asking them how confident they were about achieving good results on this test (Dunning, 2011). People who scored lowest on the test were unjustifiably more confident of their ability than

those scored in the middle range. People who scored high on the test were justifiably confident in their ability.

Why are we overconfident in areas of low competence? There are several possible reasons:

- *Unknown unknowns*: Consider a complex project to which you are contributing. There are three categories of information that can be differentiated: First, there is the information that is available and that you know you have (the known knowns); next, there is information that is not available, and you know that you do not have (then known unknowns); and finally, there are pieces of information that are not available and that you do not know that you don't have (the unknown unknowns). People who are unskilled in a particular area are likely to underestimate the unknown unknowns and therefore underestimate the size of the problem. As competence grows, the understanding of the extent of the unknown unknowns will increase causing confidence to first fall and then increase as expertise grows.
- When we do not know much about a particular area, we are likely to reflect on our competence in a similar area and over-generalise this to solve the problem – even when this competence is not relevant. For instance, people are more confident that they know how everyday items like toilets or mirrors work but when they are asked to explain this, they often fail. We believe that we have this expertise because of our familiarity with the items rather than our understanding of how they work.
- People will claim to know about areas that they do not in order to maintain status. When asked if you have read a popular book, you might falsely agree that you have in order that your intellectual abilities are not challenged. We maintain status by claiming more knowledge than we actually have.

It is interesting to reflect on the meaning of uncertainty or under-confidence in a particular area. This is not a show of weakness, but instead demonstrates a realistic understanding of our own competence in an area where we have some skill but are not yet expert. When someone is willing to admit that they don't know how to solve a problem, this suggests that they have a good understanding of their own ability. They are potentially more reliable than someone who is confident that they have the answer. When coaching someone who has high confidence in an area, it is worth checking whether this is the result of expertise, or whether this is false confidence resulting from lack of knowledge in the area. It is then possible to help a coachee to understand that their confidence is understandable but unwarranted. It is also useful for coaches to understand that lack of confidence in an area might be the result of increasing awareness of how much there is to learn and therefore indicates improving ability. This might be useful to reflect back to a coachee who is doubting their own competence.

Coaching cognitive biases

Imagine you are coaching someone who is dealing with a sudden global outbreak of a highly contagious virus. They *need to act fast* to take the decisions that will both keep their employees safe and protect the organisation against economic catastrophe. There is information coming in from a variety of sources including international and national medical institutes, scientists, economists, government, and the extended leadership of their own organisation, which makes processing and integrating this information very difficult – they have *too much information*. Not only that, but some of the information about how the virus is transmitted is very sparse so that they do no*t have enough information to make clear sense of this – thus, they have too little information*. Finally, they are trying to remember to consider the needs of employees as a whole, particular employees that might be more adversely affected, employees with particular skills that might be useful, the direction they have received from leadership, instructions from government and all of the useful experience they might have from other situations that they can bring to this – this is just *too much to remember* all at once.

As a result, your coachee will have to simplify information for some aspects of the decision while making meaning from sparse information for other aspects. All this needs to happen while working fast at the limits of their memory. The natural response of the brain in this situation will be to invoke cognitive short cuts (System 1 thinking) since their processing capacity will otherwise be overloaded. Coaching can help individuals to become more aware of the short-cuts they are taking and whether these are appropriate. Understanding some of the more common cognitive biases can help coaches to be more aware of when these might be impacting their coachee's decisions. It is then possible to bring this to the attention of the coachee so that they are able to decide whether their decision-making strategy is appropriate.

Ego depletion

Coaching requires the ability to help coachees make decisions, small and large, easy and hard, trivial and important. It is therefore useful to know under what circumstances we make our best decisions.

Imagine that you are working with a coachee who has had a busy day at the office. It is nearing the end of the financial year and they have had to make a million small decisions about how to spend remaining resources. As they leave a meeting, they are immediately faced by an employee who wants them to attend to another set of decisions about hiring and firing for the year; and then they have to decide whether to exercise or not. One of the coaching objectives for this coachee has been to increase the time they spend exercising. But it is a strong person that would not begin to feel that enough is enough and that, in these circumstances, exercise can wait for another day!

This situation describes a case of ego depletion. Research has suggested that decision-making capacity is like a battery which is successively drained a little by each decision taken that requires some self-restraint. Eventually, over the course of a day, the battery will flatten, and the ability to make difficult decisions (like whether or not to go the gym) will be depleted. This is referred to as ego depletion because it is the decision-making part of yourself (or your ego – in the Greek sense not in the Freudian sense) that is being depleted (Baumeister & Vohs, 2016).

It is important to note that different people will have different sizes of decision-making battery – ranging from something like a watch battery, through the battery for a modern laptop, to a car battery. However, the battery size can be increased through practice. It is also possible to top up the battery using a number of different tips and tricks including:

1. Sleep – even short naps work.
2. Since the decision-making battery is depleted by lack of glucose, add energy through food.
3. Feeling more energetic will increase battery life.
4. Feeling motivated and believing that there is no limit to capacity for will power increases battery life.
5. Being given great feedback (constructive or positive) will increase battery life.

While this is one important view of self-control, it is not the only view. An alternative to this is that self-control is a result of balancing the desire for external rewards that come from labour and internal rewards that come from doing the things we want to do. In other words, we struggle to motivate ourselves when tasks require us to switch from 'I want-to', to 'I have-to' goals (Inzlicht *et al*, 2014).

In this model, decreases in will power arise because we require greater motivation to sustain our attention when we have to work on tasks that we find less rewarding (have-to tasks) than when we are doing tasks that we find rewarding (want-to tasks). The sustained mental effort of staying on tasks that we do not enjoy creates an increasing desire to do something less taxing and more rewarding. The feelings of fatigue after sustained work may therefore serve the purpose of preventing fixation on current tasks and switching our behaviour to tasks that might ultimately be more rewarding. Again, there will be individual differences in the length of time that an individual is able to maintain attention on a task in which they find little reward. Coaches can help to build greater will power by encouraging their coachees to swap tasks before their will power fades. A little break to do something more rewarding can increase the total time paying attention to a less rewarding task.

Followership and leadership

There is a vast quantity of literature introducing different leadership styles and considering which are most effective in terms of organisational needs. One important aspect of leadership is the ability to lead so that others are willing to follow. It is therefore important to consider the effect of different leadership styles on the activity in the brains of followers in order to determine how best to create positive motivational states. In addition, different leadership styles are likely to activate different neural networks. Knowing which network is required for different types of task can help leaders to learn to activate the appropriate network for different leadership situations.

The follower's brain

Recent work considering different leadership styles has drawn a distinction between resonant and dissonant leaders (Boyatzis, 2012). Resonant leaders have been described as having a socially shared vision that is communicated across the organisation. They are empathetic and interested in the employee's response to a situation rather than projecting their own response onto the employee. Resonant leaders have high quality and positive interactions with employees, even when these are fleeting. This sort of interaction is thought to activate positive emotional states, leading to a reduction in employee stress responses. This is an example of emotional contagion in which the emotional response of a leader, for instance, can infect the emotional response of their team. Positive emotional contagion can increase team morale.

By contrast, dissonant leaders are described as having a more personalised vision, designed more to meet the goals of the leader than those of the team. They are more likely to disagree with their employees and to impose decisions on groups. Interactions with dissonant leaders are thought to be more likely to be discordant as a result of this, and therefore invoke negative emotional states and sympathetic nervous system activation in their employees. Activation of the sympathetic nervous system can result in unhealthy increases in the stress response. This can result in a negative emotional contagion leading to reduced motivation, and therefore decreased productivity in the workforce. It should be noted that research has demonstrated that employees remember hassles with their leader more than uplifts and so negative emotions appear to be more contagious than positive emotions (Boyatzis *et al*, 2012).

The leader's brain

Being a great leader involves a multitude of different skills and abilities. A number of leadership styles that combine these skills in different combinations have been identified. For instance, as early as the 1950s, a

distinction was drawn between task-oriented leaders and socio-emotional leaders (Bales, 1950). This division has been verified behaviourally in subsequent studies. It also is a useful model with which to consider the neural networks that are activated in the brain for different leadership tasks.

One of the important functions of the brain is to scan the environment for opportunities for reward, potential threats, and uncompleted goals. Whenever rewards, threats or uncompleted goals are detected, there is the potential to choose to act on this and this is described as task-positive (a task is present) or task-oriented behaviour. When leaders spend much of their time completing tasks, this can be described as task-oriented leadership.

The brain areas that are involved in task-oriented leadership are activated during focused attention, language, logical reasoning, mathematical reasoning, and causal reasoning. These abilities allow leaders to direct their attention to specific goals, make decisions often based on their past experience and expertise, and act on their goals. The network of brain areas that are required to be active for these abilities is known as the cognitive control network (Menon, 2011).

When no tasks are detected in the environment, a task-negative (no task is present) situation, different areas of the brain are activated. This neural network is less focussed, is more able to consider future possibilities and is more creative than the cognitive control network. It is the network that is active during socio-emotional leadership.

Specifically, socio-emotional leadership activates areas of the brain involved in emotional self-awareness, social cognition and ethical decision-making. This type of leadership is linked to consideration of self in relation to others or emotional intelligence but also creativity and insightful problem solving. This involves a network of brain areas that are collectively referred to as the default mode network (Menon, 2011).

Interestingly, activation of the network of brain areas involved in task-oriented leadership causes suppression in the socio-emotional networks, and vice versa (Jack *et al*, 2013). Thus, leaders can only access one or other mode of thinking at any point in time. Additionally, some people will have a preference for one mode of activation and will therefore suppress the other network most of the time. Since the brain operates on strengthening the connections that we use and weakening those that we don't use, this suggests that some leaders will have become more adept at one type of leadership at the expense of the other.

But that does not have to be the case. We know that our brains are able to change as adults. Evidence for neuroplasticity demonstrates that, if we are motivated to change, our brains will change in response to new experiences. We can therefore explore ways in which we can become more

adept at choosing when to use different systems in our brain by creating experiences that allow us to practise both types of leadership. Practising the type of leadership that a leader is less good at can help to build stronger connections in their less familiar network. Coaches can help with this by asking questions that will direct their coachee to the areas of leadership that are currently less often considered. For instance, to increase activation in the task-oriented domain, a coach might ask questions like:

- What is your ultimate goal?
- What resources do you need to accomplish this?
- When have you succeeded in a challenge like this before?
- What is the first step, and the second step?
- What is your Plan B if Plan A does not succeed?

In contrast, to activate the socio-emotional domain of leadership, a coach might ask questions like:

- What is the impact of your current plans on your team or employees?
- What can you do to help colleagues who might struggle with this?
- Who might be best placed to help you to implement your plans?
- How might you approach colleagues who think differently to you?

One other important implication of the networks that are activated during leadership is that, while the task-oriented network and the socio-emotional network do not work together at the same time, research suggests that, given enough time and space to think, the brain will naturally cycle between activation of each of these networks, passing information from one to the other. Therefore, any leadership task that requires both decision-making and consideration of others (for instance, strategy) is best conducted with sufficient time and space to allow full activation of both networks.

Recent research suggests that these three networks function together when we are being creative (Beaty *et al*, 2015). The default mode network is thought to generate new ideas. The salience network identifies the new ideas which are generated within the default mode network and sends these to the cognitive control network for evaluation.

One way to maximise this process is to spend some time outlining the aims and objectives of a particular strategy using the task-oriented network. Creating novel solutions is more likely to happen when leaders are not focused on the challenge and therefore the default mode network becomes active. Making time to spend away from tasks and not thinking about the challenge is required in order for a more creative solution to emerge. Task free time is therefore important for leadership, especially when developing strategy, since this allows more creative solutions to emerge.

Conclusion

In this chapter, we have explored a number of ways in which knowing more about the way the brain works can help coaches to better understand their coachees. This included:

- increasing our belief in the potential for change through a better understanding of neuroplasticity
- noticing different goal-setting styles and their impact on responses to the GROW model
- understanding the stress response and considering ways that we can take more responsibility for our own levels of stress
- tools for increasing the level of resilience in our coachees
- consideration of the different decision-making processes and individual differences in decision-making styles. Use of this to consider how coaches might help their coachees to improve their decision-making
- exploring cognitive biases, what they are and when we use them to increase the chances of spotting cognitive biases in decision-making so that coachees have more choice in whether they use the results of this unconscious processing
- understanding what might cause ego depletion and therefore how coaches can help coachees to make better decisions
- understanding the neuroscience of followership and leadership in order to help leaders to consciously choose the neural networks that are activated for different leadership tasks.

These provide a number of ways in which understanding the brain can provide coaches with more insight into the processing of their coachees. The list is far from comprehensive and further information on the neuroscientific basis of coaching can be found elsewhere (eg, Bossons *et al*, 2016; Riddell, 2019, 2021).

Five questions for further reflection

1. **Why is neuroscience relevant to coaching?**

While there is no need to understand what changes in the brain during coaching, this understanding can be helpful in refining the way that coaching techniques are designed and used so that they work best with the ways that our brains work. The working of the brain is not always intuitive and sometimes a better understanding of the processing that is occurring can help to create more effective techniques.

2. **Do I have to have a neuroscience qualification to use neuroscience in my coaching?**

No. It is sufficient to understand the basics of how the brain is operating and most often there is no need to share this knowledge with your coachee. Just being able to say that a particular behaviour is to be expected because of the way the brain works is often sufficient to increase the motivation to try a particular technique.

3. **When is neuroscience most useful in coaching?**

Coachees who have an engineering or science background are often reassured that there is neuroscientific evidence supporting the way that their brain is working for a particular coaching technique.

4. **What one piece of neuroscience knowledge is most important for coaching?**

Understanding the capacity of the human brain for change is fundamental to coaching. Without this understanding, it is possible to underestimate our amazing capacity for change and therefore to limit the potential for change in our coachees.

5. **What is the future of neuroscience in coaching?**

While we currently understand why some techniques work, we have yet to demonstrate that particular techniques result in particular changes in the brain. As techniques for measuring brain activity in the workplace emerge, it will become possible to measure real-time brain changes and to evidence the impact of particular coaching techniques.

Suggested reading

Bossons, P., Riddell, P. & Sartain, D. (2015) Chapter 3: Introduction to Neuroscience. In: *The Neuroscience of Leadership Coaching*. London: Bloomsbury Press, Pp 21-41.

Brown, P. & Brown, V. (2012) *Neuroscience for Coaching: Understanding the basics*. Oxford: Oxford University Press.

Dweck, C. (2006) *Mindset: The New Psychology of Success*. New York: Random House.

Kahneman, D. (2012) T*hinking: Fast and Slow*. London: Penguin Books

Riddell, P.M. (2021) Chapter 23: Neuroscience coaching. In: J. Passsmore (Ed) *The Coaches' Handbook: The complete practitioner guide for professional coaches*. London: Routledge.

References

Ariely, D. (2011) *The Upside of Irrationality: The unexpected benefits of defying logic at work and at home*. Harper Collins: NY

Bales, R.F. (1950) A set of categories for the analysis of small group interaction. *American Sociological Review*, **15**, 257–263.

Baumeister, R. & Vohs, D. (2016) Strength model of self-regulation as limited resource: assessment, controversies, update. *Advances in Experimental Social Psychology*, **54**, 67–127.

Bavelier, D., Levi, D., Li, R., Yang, D. & Hensch, T. (2010) Removing the brakes on adult brain plasticity. *Journal of Neuroscience*, **10**, 14964–71

Beaty, R., Benedek, M., Kaufman, S. & Silvia, P. (2015) Default and executive network coupling supports creative idea production. *Scientific Reports*, **5**, 10964.

Bender, A. & Ingram, R. (2018) Connecting attachment style to resilience: contributions of self-care and self-efficacy. *Personality and Individual Differences*, **130**, 18–20.

Boldrini, M., Fulmore, C., Tartt, A., Simeon, L., Pavlova, I., Poposka, V., Rosoklija, G.B., Stankov, A., Arango, V., Deork, A.J., Hen, R. & Mann, J.J. (2018) Human hippocampal neurogenesis persists throughout aging. *Cell Stem Cell*, **22**, 589–599.

Bossons, P., Riddell, P. & Sartain, D. (2015) Chapter 3: Introduction to Neuroscience. In: *The Neuroscience of Leadership Coaching*. London: Bloomsbury Press, Pp21-41.

Boyatzis, R. (2012) Neuroscience and the link between inspirational leadership and resonant relationships. *Ivey Business Journal*, https://iveybusinessjournal.com/publication/neuroscience-and-the-link-between-inspirational-leadership-and-resonant-relationships-2/

Boyatzis, R.E., Rochford, K. & Jack, A.I. (2014) Antagonistic neural networks underlying differentiated leadership roles. *Frontiers in Human Neuroscience*, **8**, 114.

Boyatzis, R.E., Passarelli, A., Koenig, K., Lowe, M., Mathew, B., Stoller, J. & Phillips, M. (2012) Examination of the neural substrates activated in memories of experiences with resonant and dissonant leaders. *The Leadership Quarterly*, **23** (2), 259–72.

Bremner, J.D. (2003) Long-term effects of childhood abuse on brain and neurobiology. *Child and Adolescent Psychiatric Clinics*, **12** (2) 271–292.

Carey, N. (2012) *The Epigenetics Revolution: How modern biology is rewriting our understanding of genetics, disease and inheritance*. St Ives: Icon Books.

Christakou, A., Brammer, M. & Rubia, K. (2011) Maturation of limbic corticostriatal activation and connectivity associated with developmental changes in temporal discounting. *NeuroImage*, **54**, 1344–1354.

Christakou, A., Gershman, S., Niv, Y., Simmons, A., Brammer, M. & Rubia, K. (2013) Neural and psychological maturation of decision-making in adolescence and young adulthood. *Journal of Cognitive Neuroscience*, **25** (11) 1807–1823.

Christopoulos, G.I., Tobler, P.N., Bossaerts, P., Dolan, R.J. & Schultz, W. (2009) Neural correlates of value, risk, and risk aversion contributing to decision-making under risk. *Journal of Neuroscience*, **7**, 12574–12583.

Clark, L.A. & Watson, D. (1991) Tripartite model of anxiety and depression: psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology*, **100**, 316–336.

Dardick, W. & Tuckwiller, E. (2019) Optimism shapes mindset: understanding the association of optimism and pessimism. *Journal of Interdisciplinary Studies in Education*, **8** (2) 21–56.

Davidson, R.J. & Irwin, W. (1999) The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Science*, **3**, 11–21.

Deci, E.L. & Ryan, R.M. (2000) The 'what' and 'why' of goal pursuits: Human needs and the self-determination of behaviour. *Psychological Inquiry*, **11**, 227–268.

Dunning, D. (2011) The Dunning-Kruger effect: on being ignorant of one's own ignorance. In *Advances in Experimental Social Psychology*, **44**, 247–296.

Dweck, C. (2006) *Mindset: The New Psychology of Success*. New York: Random House.

Dweck, C. & Leggett, E.L. (1988) A social-cognitive approach to motivation and personality. *Psychological Review*, **95**, 256–273.

Elliot, A., Thrash, T. & Murayama, K. (2011) A longitudinal analysis of self-regulation and wellbeing: avoidance personal goals, avoidance coping, stress generation, and subjective wellbeing. *Journal of Personality*, **79** (3) 643–674.

Fredrickson, B., Tugade, M., Waugh, C. & Larkin, G. (2003) What good are positive emotions in crises? A prospective study of resilience and emotions following terrorist attacks on the United States on September 11th, 2001. *Personality Processes and Individual Differences*, **84** (2) 365–376.

Frith, C.D. & Frith, U. (2012) Mechanisms of social cognition. *Annual Reviews of Psychology*, **63**, 287–313.

Fuchs, E. (2000) In vivo neurogenesis in the adult brain: regulation and functional implications. *European Journal of Neuroscience*, **12**, 2211–2214.

Gigerenzer, G. (2007) *Gut Feelings: Short cuts to better decision-making*. London: Penguin Books.

Hassabis, D. & Macguire, E.A. (2009) The construction system of the brain. *Philosophical Transactions of the Royal Society of London B Biological Sciences*, **364**, 1263–1271.

Hillman, C.H., Erickson, K.I. & Kramer, A.F. (2008) Be smart, exercise your heart: exercise effects on brain and cognition. *Nature Review: Neuroscience*, **9**, 58–65.

Hutton, R. J. B. & Klein, G. (1999) Expert decision making. *Systems Engineering*, **2** (1) 32–45.

Ilies, R., Arvey, R. & Bouchard, T. (2006) Darwinism, behavioral genetics, and organizational behavior: a review and agenda for future research. *Journal of Organizational Behavior*, **27**, 121–141.

Inzlicht, M., Schmeichel, B. & Macrae, C.N. (2014) Why self-control seems (but may not be) limited. *Trends in Cognitive Sciences*, **18** (3) 127–133.

Jack, A.I., Dawson, A., Begany, K., Leckie, R.L., Barry, K., Ciccia, A. & Snyder, A.Z. (2013) fMRI reveals reciprocal inhibition between social and physical cognitive domains. *NeuroImage*, **66** (Supp. C), 385–40.

Kahneman, D. (2012) *Thinking: Fast and Slow*. London: Penguin Books

Kempermann, G. & Gage, F. (1999) Experience-dependent regulation of adult hippocampal neurogenesis: Effects of long-term stimulation and stimulus withdrawal. *Hippocampus*, **9**, 321–332.

Keverne, E., Pfaff, D. & Tabansky, I. (2015) Epigenetic changes in the developing brain: effects on behaviour. *Proceedings of the National Academy of Sciences*, **112**, 6789–6795.

Kruglanski, A. & Gigerenzer, G. (2011) Intuitive and deliberate judgements are based on common principles. *Psychological Review*, **118**, 97–109.

Loftus, E. (2003). Make-believe memories. *American Psychologist*, **58** (11) 867–73.

Lucassen, P.J., Meerlo, P., Naylor, A. S., van Dam, A.M., Dayer, A. G., Fuchs, E., Oomen, C.A., & Czeh, B. (2009) Regulation of adult neurogenesis by stress, sleep disruption, exercise and inflammation: Implications for depression and antidepressant action. *European Journal of Neuropsychopharmacology*, **20**, 1–17.

Lyons, D.M., Parker, K.J. & Schatzberg, A.F. (2010) Animal models of early life stress: implications for understanding resilience. *Developmental Psychobiology*, **52**, 616–624.

Maguire, E., Frackkowiak, R. & Frith, C. (1997) Recalling routes around London: activation of the right hippocampus in taxi drivers. *Journal of Neuroscience*, **17**, 103–110.

Maier, S., Makwana, A. & Hare, T. (2015) Acute stress impairs self-control in goal directed choice by altering multiple functional connections within the brain's decision-making circuits. *Neuron*, **87**, 621–631.

McEwen, B. (2016a) Stress effects on neuronal structure: hippocampus, amygdala, and prefrontal cortex. *Neuropsychopharmacology Reviews*, **41**, 2–23.

McEwen, B. (2016b) In pursuit of resilience: stress, epigenetics, and brain plasticity. *Annals of the New York Academy of Sciences*, **1373**, 56–64.

McEwen, B.S. (2008) Central effects of stress hormones in health and disease: understanding the protective and damaging effects of stress and stress mediators. *European Journal of Pharmacology*, **583**, 174–185.

McEwen, B.S. (2013) Brain on stress: How the social environment gets under the skin. *Proceedings of the National Academies of Science*, **109**, 17180–17185.

McEwen, B.S. & Gianaros, P.J. (2011) Stress- and allostasis-induced brain plasticity. *Annual Reviews of Medicine*, **62**, 4431–445.

McGregor, L. & Doshi, N. (2015) How company culture shapes employee motivation. *Harvard Business Review, November 25th, 2015*. Available online at: https://hbr.org/2015/11/how-company-culture-shapes-employee-motivation. Accessed 17 July 2021.

Menon, V. (2011) Large-scale brain networks and psychopathology: a unifying triple network model. *Trends in Cognitive Sciences*, **15**, 483–506.

Michie, S., van Stralen, M. & West, R. (2011) The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation Science*, **6**, 42.

O'Doherty, J.P. (2004) Reward representations and reward-related learning in the human brain: insights from neuroimaging. *Current Opinions in Neurobiology*, **14** (6) 769–776.

Pilar Matud, M. (2004) Gender differences in stress and coping styles. *Personality and Individual Differences*, **37** (7) 1401–1415.

Plomin, R., Fulker, D.W., Corley, R. & DeFries, J.C. (1997) Nature, nurture and cognitive development from 1 to 16 years: a parent-offspring adoption study. *Psychological Science*, **8**, 442–447.

Purves, D., Voyvodic, J., Magrassi, L. & Yawo, H. (1987) Nerve terminal remodelling visualized in living mice by repeated examination of the same neuron. *Science*, **20**, 1122–1126.

Riddell, P.M. (2021) Chapter 23: Neuroscience coaching. In: J. Passsmore (Ed) *The Coaches' Handbook: The complete practitioner guide for professional coaches*. London: Routledge.

Riddell, P.M. (2019) Chapter 2: Coaching and Neuroscience. In: S. Palmer & A. Whybrow (Eds) *Handbook of Coaching Psychology: A guide for practitioners*, 2nd Edition. London: Routledge.

Sheldon, K.M., Ryan, R.M., Deci, E.L. & Kasser, T. (2004) The independence effects of goal contents and motives on wellbeing: it's both what you pursue and why you pursue it. *Personality and Social Psychology Bulletin*, **30**, 475–486.

Sherman, S.L., DeFries, J.C., Gottesman, I.I., Loehlin, J.C., Meyer, J.M., Pelias, M.Z., Rice, J. & Waldman, I. (1997). Recent developments in human behavioral genetics: past accomplishments and future directions. *American Journal of Human Genetics*, **60**, 1265–1275.

Spielberger, J., Miller, G., Engels, A., Herrington, J., Sutton, B., Banich, M. & Heller, W. (2011) Trait approach and avoid motivation: lateralized neural activity associated with executive function. *NeuroImage*, **54**, 661–670.

Sultan, F.A. & Day, J.J. (2011) Epigenetic mechanisms in memory and synaptic function. *Epigenomics*, **3**, 157–181.

Sweatt, J.D. (2009) Experience-dependent epigenetic modifications in the central nervous system. *Biological Psychiatry*, **65** (3) 191–7.

Tabibnia, G. (2020) An affective neuroscience model of boosting resilience in adults. *Neuroscience and Biobehavioral Reviews*, **115**, 321–350.

Takesian, A.E. & Hensch, T.K. (2013) Balancing plasticity/stability across brain development. *Progress in Brain Research*, **207**, 3–34.

Tobler, P.N., O'Doherty, J.P., Dolan, R.J. & Schultz, W. (2007) Reward value coding distinct from risk attitude-related uncertainty coding in human reward systems. *Journal of Neurophysiology*, **97**, 1621–1632.

Umeda, T. & Okabe, S. (2001) Visualizing synapse formation and remodelling: recent advances in real-time imaging of CNS synapses. *Neuroscience Research*, **40**, 291–300.

Van Praag, H., Kempermann, G. & Gage, F. (2000) Neural consequences of environmental enrichment. *Nature Reviews: Neuroscience*, **1** (3) 191–8.

Whitmore, J. (2009) *Coaching for Performance: GROWing Human Potential and Purpose*. 4th Edition. London: Nicholas Brealey Publishing.

Wood, S., Walker, H., Valentino, R. & Bhatnagar, S. (2010) Individual differences in reactivity to social stress predict susceptibility and resilience to a depressive phenotype: role of corticotropin-releasing factor. *Endocrinology*, **151** (4) 1795–1805.

Zeidan, F., Martucci, K.T., Kraft, R.A., McHaffie, J.G. & Coghill, R.C. (2014) Neural correlates of mindfulness meditation-related anxiety relief. *Social, Cognitive and Affective Neuroscience*, **9** (6), 751-759.