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MOOD MATTERS

MHERA: An innovative assessment approach to animal emotionality in the treatment of behaviour problems

Dogwise Publishing

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Dedication

This book is dedicated to all the animals who have taught me so much about behaviour and emotions, especially Makoko the Western Lowland Gorilla, Fly the Border Collie and Trinx, the cat who turned a dedicated dog behaviourist into a cat fanatic.

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Acknowledgments

There are so many people who should be mentioned here, but a few names stand out. To Professor Peter Neville, who has not only been my mentor but also friend, and whose Table Mountain-based conversations changed the course of my life irrevocably. To Dr. Robert Falconer-Taylor, whose insights and passion for the science of emotion led me to the development of MHERA, and of course to Professor Karolina Westlund whose 45 degree observation made it all come together. Without each of you, MHERA would never have been born or brought to actuality.

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Foreword
by Professor Peter Neville
Co-founder of COAPE UK (1993) and Senior Tutor (1993-2018)

In 1993, myself, eminent veterinarian Dr Robin Walker, and innovative dog trainer John Fisher founded The Centre of Applied Pet Ethology (COAPE) in the United Kingdom. At the time, the field of animal behaviour was moving toward following the veterinary approach of clinical medicine in the identification of sufficient necessary signs to conclude a diagnosis, and so inevitably perhaps, dictated a rather standardized therapeutic treatment approach, increasingly coupled with pharmaceuticals. Of notable concern was the failure of this diagnostic approach to recognize personality, breed and behavioural type differences in creatures as sensitive and variable as dogs and cats, which in reality demanded individually tailored approaches to assessments and treatments.

Over the coming decade COAPE UK pioneered an alternative, yet highly controversial model (since it was based on the assessment of *emotions* in pets) for the treatment of behaviour problems. In the scientific community at the time, the existence of the emotion of fear had widely been studied and accepted, yet they were reluctant to consider the idea that their dogs could be happy to see them when they got home from work. This, perhaps, was largely because the measurement of happiness or joy and other emotions in behavioural or physiological terms was so difficult to organize.

In 1999, the first major breakthrough to resolve this dilemma arrived with the publication of *Affective Neuroscienc*e by the late Dr Jaak Panksepp, as discussed in Chapter 1 by Dr Robert Falconer-Taylor, COAPE's Veterinary Director from 2005-2018. Panksepp's research into the emotional systems of the mammalian brain proved to be an epiphany for COAPE UK and we promptly incorporated his findings into the development of the applied EMRA approach, which focused on the evaluation of **E**motional states first, then **M**ood states and **R**einforcement **A**ssessments in the treatment of behaviour problems in pets. EMRA courted criticism because COAPE behaviourists supposedly were committing the scientific sin of anthropomorphism on the assumption that emotions are the same in man and animals. Yet Panksepp was already clearly demonstrating that mammals, and likely birds and reptiles as well, shared the same neurophysiological emotional systems in what had long been known anatomically as the reptilian brain.

In 2015, the *EMRA Intelligence* book (Falconer-Taylor, R., Neville, P., Strong, V., 2015) was published in English, German and Dutch, making inroads not only in the USA at The Ohio State University where I taught for many years, but also at international pet behaviour and veterinary conferences. In 2018, the time had arrived for Dr Falconer-Taylor and me to step aside to allow COAPE to modernize. Having run COAPE South Africa very successfully since 2008, Karin Pienaar was the perfect choice for us to take COAPE UK forward into the future. We knew that she was uniquely qualified and experienced to deliver our Diploma and other educational courses on-line, making it accessible for anyone anywhere in the world — which she promptly did by launching COAPE International with her typical huge energy, insight, and commitment.

Since research into the emotional lives of animals was proceeding at a rapid pace with advancing technology (and was being embraced by academics in ethology and other related disciplines), Karin felt strongly that it was time to review the EMRA approach. MHERA was created because of her own vast practical experience, paired with years of research into the latest developments in the scientific community about animal emotionality.

Karin then took things one step further and tested MHERA's application on a variety of animals, the findings of which now have been meticulously crafted into this excellent book.

There is no longer any doubt that all mammals have rich emotional lives and that it is the very presence of emotions that helps to make us, in so many ways, the most successful class ever found on earth. It is to Karin Pienaar's enormous credit that her understanding of this subject opens the door for the applied practical methodology of the MHERA approach in cats and dogs. But MHERA affords more than this; it has already been applied by Karin and her COAPE International Team in the assessment and enrichment of the lives of a wider range of animals from captive wildlife to animals in sanctuaries, and it is clear that MHERA can (and should) form the very basis of our assessment of welfare for all animals, and perhaps even people. MHERA provides a pivotal empathetic opportunity for man to understand how to improve the lives of all animals — from our companion animals to effective wildlife conservation and management. Charles Darwin, with his book *The Expression of Emotions in Man and Animals* and Konrad Lorenz with his *Man Meets Dog*, who always accepted the presence of emotions in animals would, I believe, be as pleased as the original founders of COAPE are with the advances made by the development of the MHERA concept and the publication of Karin's book. And so would Dr. Panksepp, I'm sure.

Chapter 1
Introduction

Professor Peter Neville and Dr Robert Falconer-Taylor from the Centre of Applied Pet Ethology (COAPE) in the UK developed EMRA in 2001, a concept which laid the foundation for MHERA's creation, some 21 years later. In 2018, they asked me to take over the reins of COAPE, which then lead to the creation of COAPE International, and later, MHERA. The development of MHERA was a task I took on with great enthusiasm, as I had been applying EMRA in my own behaviour practice for over twenty years. But since EMRA's inception, a lot had changed in the world of animal emotionality, and I felt strongly that it was time to develop a new approach. One that incorporated the very latest scientific advances in the field of animal behaviour, especially when it came to research findings on mood, cognitive biases, emotionality and how an animal exists in and moves through core affect space, and so, MHERA was born. But to understand MHERA, it's important for the reader to understand the history that preceded it. To this end, I asked Dr Falconer-Taylor to provide the historical context for *MHERA: Mood Matters*, which he kindly did below.

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Some historical perspective

I believe that everyone has a special moment when they experience a life-changing revelation. Mine came on a sunny June day in 2005, and it remains so clear and vivid, it could have happened yesterday. I was reading a scientific paper called "Affective Consciousness: Core Emotional Feelings in Animals and Humans" (Panksepp, 2005). The article was written by Jaak Panksepp, someone I'd never heard of. It described in great detail the complex circuitry responsible for creating emotional experiences in the brain. As I read, two jaw-dropping facts leapt out of the pages at me and left me stunned. First, was where Panksepp located these circuits — they weren't in the cortex, the location favoured by most other scientists. The second thing was what Panksepp said about these circuits. Their location showed that all mammals experienced rich emotional lives. WOW! I had read dozens of scientific papers about emotions, but never before had I seen the terms *emotion* and animal appear so blatantly and unapologetically in the same sentence.

Dogs and their behaviour were certainly not Panksepp's subject of interest. He was a research scientist, and his primary field of interest was mental illness in people and its deep neural mechanisms in the brain. He worked predominantly with rats, and during his research he became intrigued and puzzled by what he was finding because it was at odds with the current scientific dogma. Emotions were considered to be so complex that only human brains were large enough to accommodate them, and perhaps a select group of other primates too.

The problem was that Panksepp's findings suggested otherwise. But they were just too leftfield for the mainstream scientific community at the time. As far as the wider scientific community was concerned, the idea that non-human animals felt emotions was unfathomable, even scientific heresy. And for this, Panksepp paid a heavy price. He suffered financially, academically, and emotionally, losing friends and colleagues. He was rejected, isolated, shunned and ridiculed by his peers. Yet, despite all this, he stood his ground and pressed on with his work — alone.

Eventually, other scientists in the field began to take notice and recognise his research. Panksepp's work is now regarded as largely responsible for the radical U-turn that finally took place in the scientific community. A U-turn that created a dividing moment in time. There's a 'Before-Panksepp,' the age of emotional endarkenment. And there's an 'After-Panksepp,' where we are now in the age of emotional enlightenment. The paper I was reading all those years ago was part of a special feature published in the journal called *Neurobiology of Animal Consciousness*, very definitely a publication of the After-Panksepp era!

In the 1970's a new term came to prominence in science — neuroscience — which brought the separate fields of physiology, neurology, and psychology all under one roof. This was a good move, but unfortunately not for animal welfare, since neuroscience at the time viewed animals as experiencing neither consciousness nor emotional experiences. In 1976, during my first year at university and 30 years before I discovered Panksepp, I read a book that served as my gateway from school to the real world. I grew up. The *Question of Animal Awareness, Evolutionary Continuity of Mental Experience*, written by the American zoologist Donald Griffin (Griffin, 1976), was also not received well by the scientific community. They hated it and he was attacked on all fronts by his peers. His crime? He dared to suggest that animals were much smarter than they were given credit for. They were conscious and they lived rich emotional lives. Griffin was no flake — he was a well-respected scientist with decades of first-class research under his belt. This book opened my eyes to everything bad about this new science, and how short-sighted the cognitive science community seemed to be. I had no idea. I was shocked that my dogs — according to neuroscience — were credited with neither consciousness nor emotional experiences. When I saw my dogs being happy, sad, frightened and so on, the reality was that there was not much was going between the ears. There was no one at home. My dogs were little more than automatons. Had this new science really not moved on since René Descartes wrote his *Discourse on the Method* in 1637 (Damasio, 1995), in which he considered all animals to be 'thoughtless brutes' only reacting to their environment, with no inner states or consciousness?

In the scientific literature, there are as many as 93 different definitions for emotions (Izard, 2010). Amazon lists over 60,000 books about emotions. Emotions, emotions, emotions. They're everywhere. But do we really have an objective and useful understanding of what they are? Before Griffin, my understanding of emotions was very much rooted in the 19th century world of Charles Darwin and William James, both of whom largely felt that animals were being driven by emotions and feelings. Looking back now, what both men wrote about emotionality remains as prescient and fresh today as it was then. It's also a relevant and worthy foundation to this historical perspective that I was asked to write for *MHERA: Mood Matters.*

Following on from the success of his 1859 masterpiece, *On the Origin of Species,* Darwin wrote two books explicitly addressing the problem of emotions. I say problem because history tells us that the Victorians lived in an era of emotional suppression. For men, showing one's emotions in public was seen as a sign of weakness. For women, emotional expression was used as justification for subjugation and denial into positions of importance in public life. As an aside, I have wondered if Darwin read Charles Dickens's novel *A Christmas Carol* (1843), and Emily Brontë's *Wuthering Heights* (1847)? Both books bucked the gender stereotypes of the time and are well worth reading.

Darwin wrote his first book where he explored the role of emotions in mammals in 1871. *In The Descent of Man* (Darwin, 1871), he wrote "There is no fundamental difference between man and the higher mammals in their mental faculties. The difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind." In other words, my brain and the brains of my dogs are architecturally identical. But the comparative ratio of some parts differ in complexity. And then he wrote "The lower animals, like man, manifestly feel pleasure and pain, happiness, and misery. Happiness is never better exhibited than by young animals, such as puppies, kittens, lambs etc., when playing together, like our own children."

A year later in *The Expression of the Emotions in Man and Animals* (Darwin, 1872), he took a more biological approach, suggesting that emotions are *natural kinds* (hard-wired into the brain by evolution): "…the young and the old of widely different races, both with man and animals, express the same state of mind by the same movements." And then, writing more explicitly about emotions in dogs: "When a man merely speaks to, or just notices, his dog, we see the last vestige of these movements in a slight wag of the tail, without any other movement of the body, and without even the ears being lowered. Dogs also exhibit their affection by desiring to rub against their masters, and to be rubbed or patted by them."

It's worth pointing out that Darwin wrote this over a century before Jaak Panksepp wrote his seminal 1998 masterpiece, *Affective Neuroscience*. Furthermore, Darwin's descriptions quoted above could easily be mistaken for Panksepp's. Or perhaps it's the other way round. Panksepp also recapitulates Darwin's ideas that emotions are intimately linked with *movement*, in doing something, in behaviour.

The American philosopher/psychologist William James was the first to move beyond Darwin's evolutionary account of emotions with a more mechanistic account. In his seminal 1890 textbook, *The Principles of Psychology* (James, 1890), he challenged the long-standing and intuitive folk-psychology belief that emotions were evoked directly by a stimulus, which was then followed by a physiological response. For example, you're home-alone watching the climax of a horror movie and the living room door slams shut:

1. This triggers the emotion of fear.
2. Fear then triggers an autonomic response which pumps bucket-loads of stress hormones adrenaline and cortisol into your blood stream. Your heart is pounding, your blood pressure is elevated and you're breathing faster.
3. This prepares you for action; fight-flight.

James instead argued that this chain of events was the other way round, which appears rather counter-intuitive, even today. You're home-alone watching the horror movie and the living room door slams shut:

1. The autonomic response, increased heart rate etc., comes first.
2. This then triggers the emotion of fear.
3. Fear then prepares you for action; fight-flight etc.

Given the paucity of information about the inner workings of the brain, James' version of the genesis of an emotional state was little more than a clever guess. It's worth pointing out that there was no way that neurons could be studied in any detail until Santiago Ramón y Cajal came up with his method of staining in the 1880s (de Castro, 2019). We now have plenty of empirical data substantiating the claim made by James (Damasio, 1999; LeDoux, 2015). There is a cascade of events that fall into place like a wave of falling dominos. This cascade results in an amalgamation of both the physiology (autonomic, etc.) and behaviour (fight, flight, freeze etc.), the end goal of which is to restore homeostasis. You're home-alone watching the climax of a horror movie and the living room door slams shut. The job of your emotional reaction is to restore your physiology to the state it was in prior to the slamming door event.

You'll see the same cascade of events playing out as Panksepp's EMOTION SYSTEMS unfold. In its most basic evolutionary form, the SEEKING EMOTION drives homeostatic restoration through seeking food, water, and other appetitive rewards. The PLAY SYSTEM drives the seeking out and the building of trusting friendships. The CARE SYSTEM drives seeking out affiliative relationships. And so on. William James also had the foresight to include instincts in this theory, where he described them as "Instinct is usually defined as the faculty of acting in such a way as to produce certain ends, without foresight of the ends, and without previous education in the performance."

This fits in neatly with Panksepp's EMOTIONAL systems, but Panksepp packages some instincts tightly up within them. For example, the instinctual drive for fight/flight, a perceived threat, becomes part of the FEAR system, and the instinctual drive to seek food when hungry becomes part of the SEEKING system. By the way, Panksepp was rather dismissive of James's theory, which I think was a little harsh given what I said about how much James could have possible known about neuroanatomy.

James' ideas are also the foundation of Antonio Damasio's influential interoceptive theory of emotions (Damasio, 1999). Interoception – as the word suggests – is the perception of the body's changing internal state in the brain. From here, the information then travels out in a cascade of loops that reach out across the brain, including both cortical (frontal cortex, anterior cingulate cortex, insula) and subcortical structures (hypothalamus, amygdala, midbrain, brainstem). In so doing, representations of the triggering event emerge, for example a representation of the interceptive state of the body and then a representation of the self (self-awareness). This is the point where the *conscious feeling* of fear (of the living room door slamming shut) emerges. In Damasio's theory, both feelings and interoception are necessary for the conscious experience. Because humans have a much greater volume of neocortical tissue than other animals (17 billion neurons vs. 2 billion in a dog), humans have more loops which generate additional and more elaborate representations. For example, when the door slammed, you spilled your glass of wine all over your new sofa. A representation of what your partner was going to think emerges.

So much for emotions. What about feelings? Going back to James' account of emotions, let's start with what he *actually* said. The capitalized words here are James' just as he wrote it, not mine: "My thesis....is that the bodily changes follow directly the PERCEPTION of the exciting fact and that our feeling of the same changes as they occur IS the emotion." Sounds sensible, but there is a problem with this definition. James' blunder was to conflate the term *feelings* with the term *emotions*, but they are distinctly different phenomena. So, to clarify, an emotion involves everything I've described so far; the unfolding cascade of events that leads to action — that is the behaviour. So, emotions are observable by a third party; they are *emotional behaviours*. This is beautifully articulated in how Darwin described emotions in dogs in the quote above. Over the last decade, a number of studies have evaluated the utility of facial expressions as tools for evaluating emotional states in many species, including humans, dogs, cats, horses etc. (Bremhorst et al., 2022; Holden et al., 2014; Mullard et al., 2017; Schiavenato et al., 2008).

Feelings, on the other hand, are private experiences and most often occur independent of actions. The only time feelings become observable is when they emerge as attachments to emotions, in which case they can be called emotional feelings. The most important difference between the two is that there is a much larger empirical literature on emotions than there is for feelings. Much of the literature on feelings is largely speculative and philosophical. Yet, some neuroscientists continue to use the terms interchangeably. A notable example is Joseph Ledoux, who has spent most of his career studying the amygdala (LeDoux, 1998). In the last paragraph of chapter 5 of his 2015 book *Anxious: The Modern Mind in the Age of Anxiety* (LeDoux, 2015), LeDoux wrote "Emotions, in short, are states of consciousness pieced together by complex cognitive mechanisms. To understand how these feelings come about, we have to delve into the mechanisms of consciousness."

Why does this matter? Because in neuroscience research, the term *emotional behaviour* is commonly used to describe how animals behave in an experiment. For example, the conditioned emotional response is a widely used metric to describe how a rat responds to an electric shock, and it can be measured, because it's a behaviour. The emotional feeling component of the rat's response is completely ignored and considered irrelevant. Some neuroscientists believe that most non-human animals lack the mental capacity to experience emotional feelings at all.

Now here I am in 2022, nearly 20 years after my first revelation, and I find myself having a second as I read Karin Pienaar's wonderful book. Karin has picked up the baton and brought the richness of emotion science, packaged as a practical handbook, to the people. This is not *just another dog book*. It's not *just another popular science book* either. This book ticks both those boxes and more besides. - Robert Falconer-Taylor

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MHERA defined

And that brings us to now, when animal emotionality is a much-discussed topic in the behaviour world with more and more elaborate research happening, the findings of which contribute to the ongoing rationale and applied methodology of MHERA.

MHERA is an acronym for:

Mood State Assessment, including Cognitive Bias.

Hedonic Budget Assessment.

Emotional Assessment.

Reinforcement **A**ssessment.

MHERA has proven to be a method that can easily be applied to a host of mammalian, avian and reptilian species. It has been used successfully not only in companion animals, but also by professionals who work in all aspects of animal care including veterinary practices, zoos and aquariums. It is an intuitive and flexible science-based protocol that enables the animal professional to evaluate animals as individuals, which not only allows for a more targeted treatment approach, but also a more successful one that is centred around the animal's emotional and behavioural well-being.

How the book is organized

In the first two chapters of the book, we explore some of the fascinating science involved in animal emotion, focusing on the work of Panksepp and Mendl. A brief overview of the importance of core emotions is included here, and we look at how animal emotionality impacts the ethical treatment of animals, particularly when it comes to welfare.

Chapter 3 focuses exclusively on MHERA, giving the reader an in-depth introduction to the subject. It includes discussions of how MHERA works and the essential rationale behind the inclusion of mood state assessments, cognitive bias and emotional assessment in behaviour therapy. We also look at reinforcement, how reward is defined, and compare the concepts of 'liking' vs 'wanting,' with case study examples of the MHERA tenets in practice making up Chapters 4 through to 8. In Chapter 9, the book's conclusion, the role of consent and its influence on MHERA's conception is highlighted.

Now is also the time where I want to clarify that while I use the term *'behaviour problem'* throughout the book, it is not used in the traditional sense of the term. An animal who is behaving in a manner that is causing problems for his guardians or caregivers does not have a behaviour problem that needs to be solved or stopped. He is behaving in a particular way because he is having difficulty dealing with his emotions in that moment, which means he needs compassionate help and guidance on how to manage or change his emotional responses to prevent future emotional distress. Teaching a behaviour does not necessarily change the underlying emotional state, and it's the emotional state that must be addressed, not the behaviour.

Chapter 2

What Are Emotions and Why Does It Matter if Mammals Have Them?

Exploring the key resources in the development of MHERA that discuss the relevance of emotions in behaviour

In human psychology, there is no question about the importance of emotionality when it comes to our own behaviour. We easily accept that our feelings influence how we behave, and our emotions are generally considered whenever we have outbursts of tears or rage, or when we shout with joy or excitement. However, when discussing animal emotionality, the situation is very different. Conversations can get heated and end up evoking extreme emotion in participants, and there is a clear divide in the animal world when it comes to attributing emotions to animals. The division is pronounced — you are either in the "definitely yes, to varying degrees" camp or the "absolutely not, it's anthropomorphism at its worst!" camp.

Those of us in the "definitely yes" camp ardently believe that animals are capable of experiencing emotions, albeit not perhaps with the same degree of consciousness as humans. It's difficult to determine exactly to what degree animals experience emotions, after all, we can't ask them, but there is a lot of evidence that supports the existence of at least basic emotions in mammals, as well as in birds and even some reptiles. In this chapter, we explore some of the science in the fascinating field that involves animal emotion, particularly focusing on the work of Panksepp and Mendl.

Why the resistance?

Before we begin, it's important to consider why there is resistance to the thought of animals having emotions. The simple answer is because the repercussions of this admission are vast: if we agree that animals are capable of emotions, it opens a can of worms that many industries may not be too happy about.

Consider the ethical treatment of livestock, laboratory animals or even pets and animals in captivity. Animals are used in a variety of roles all over the world, some considerably better than others. A much-loved companion dog lives a very different life to a working dog living on a farm, or a village dog living on the outskirts of human settlements, or a dog in a cosmetic animal testing facility. If we admit that animals can feel basic emotions, it means that animal testing should be viewed in the same light as testing on humans, and as such, should be deemed an illegal practice. Animal testing is already something that is vehemently opposed by many from an ethical point of view, so the scientific confirmation that animals can experience emotions will be the death knell to these practices.

Similarly, the treatment of livestock on farms or at abattoirs will be significantly affected. If a cow can feel emotions, even basic ones, it means the entire agricultural world would have to re-evaluate how they house and treat cows. Imagine the repercussions for abattoirs if the industry admitted that livestock can feel sadness or despair…

So why is the existence of emotions in animals such a hotly debated topic in the field of animal behaviour science? Well, if you consider the role of emotions in behaviour (i.e., they govern how we behave, how we respond to events, how we learn and how we remember those events), it will become clear why it is critical that its existence in animals is considered, especially when it comes to addressing behaviour problems. When behaviour problems are seen as emotional problems instead of pathological diseases, treatment approaches differ vastly.

And perhaps most importantly, the individuality of the animal must then be taken into consideration instead of relying on blanket solutions applied on a one size fits all premise.

What are emotions? Where do they come from?

Carroll E. Izard states that:

"Emotion consists of neural circuits that are at least partially dedicated response systems, and a feeling state/process that motivates and organises cognition and action. Emotion provides information to the individual experiencing it and may include antecedent cognitive appraisals and ongoing cognition including an interpretation of its feeling state, expressions or social and communicative signals, and how it may motivate approach or avoidant behavior, exercise control and regulation of responses, and be social or relational in nature. Emotions have multiple and quite significant functions in motivating and focusing individual endeavours, social interactions, and the development of adaptive and maladaptive behavior" (Izard, 2010).

Emotions are complex psychological processes comprised of many components that may not be evoked or related to each other in every situation. They can be described as impulses to act, and as states of mind produced by stimuli for very specific purposes. These include arousing the animal to take action to defend himself, seek food or other necessities and to form and maintain cooperative attachments with others in a group for obligatory social animals such as dogs. They are also necessary to communicate emotional states to others, to respond to novelty, and to memorise signals and happenings associated with social or environmental events and to learn to respond to those signals in the future, particularly in the case of ones associated with danger.

They play a crucial role in how we navigate our environments, and how we live our lives. They affect how we look at things, how our personalities develop and how we behave. Our decisions are influenced by our emotions, and even how we respond to novelty is affected by our past emotional experiences. The same can be said for the role of emotions in animal behaviour.

The impact of the behavioural science movement

Throughout the 19th century, many scientists readily accepted the concept of mind, emotions and feelings as psychological phenomena within the realms of science. However, the twentieth century marked the dawn of the 'hard' behavioural science movement spearheaded by behavioural psychologist John Watson. The behaviourists considered any kind of mental state (including consciousness and emotion) as too subjective to measure scientifically and thus they deemed them irrelevant. The term consciousness, as used here, refers to the ability to experience internal, personal, and subjective experiences. Watson and colleagues instead concentrated on the importance of conditioning and stimulus-response behaviours that could be easily measured (McMillan and Rollins, 2001; Greenspan and Baars, 2005; Lecas, 2006). Due to the undeniable success of behaviourism, talk of consciousness and emotion was ignored for much of the twentieth century (Panksepp, 2005a). Even attempts to study consciousness and emotions in humans were hindered, let alone in non-human animals.

The tide started changing as cognitive science took off in the second half of the twentieth century, bringing mind and mental processing firmly back into the realm of science, as well as demonstrating the importance and value of studies on non-human animals when it comes to mental processes. Consciousness and emotion soon followed, with much progress made in the scientific study of affect. Joseph LeDoux's early work (LeDoux, 1996) on emotional learning and the neurophysiology of fear, forced scientists to ask questions like "When animals behave fearfully, do they also feel fear? If they do, how can we prove it?" Many pet owners would probably laugh at this, thinking that it's obvious to them that their companion dog or cat feels fear, joy, anger, and many other emotions. However, the problem remains: how do you go about proving what an animal is feeling?

Even though the study of consciousness, animal cognition and emotion (also known as affect) has advanced significantly in the twenty-first century, there is still a great deal of debate and disagreement when it comes to the scientific nature of emotion in animals and humans. In fact, ask ten different neuroscientists to define emotion and you'll likely get ten different answers!

Two models of emotion

There are currently two popular models when looking at emotionality — the **Dimensional** and **Discrete** models of emotion. Both have been discussed extensively in the work of Harmon-Jones and Summerell (Harmon-Jones et al., 2017) and a summary is provided below to introduce the reader to the concepts. The Discrete model of emotion suggests that basic elements of emotions are discrete entities (Ekman, 1994) such as anger, joy, fear and so forth, and that each primary process (or **basic discrete emotion**) evokes a specific response that will address an important evolutionary need, such as finding a mate or escaping harm. This theory proposes that specific core emotions are biologically determined emotional responses, whose expression is fundamentally the same in all individuals, and that set, neural circuitry (hard-wired distinct emotional systems) serve specific and adaptive functions, which represent the fundamental building blocks of all emotional reactions. The dimensional model will be discussed in more detail later in this chapter.

Panksepp's emotional systems

Professor Jaak Panksepp argued that rather than being a recent development of the human neocortex, the roots of consciousness and emotions can be traced right back to deep ancient sub-cortical limbic regions of the brain of early mammals. This is now recognized as the dimensional model of emotions. He used the term **affective consciousness** to emphasise its internal, **feeling** nature, and identified seven basic emotional systems based on evidence from brain stimulation experiments and behavioural observations.

These seven emotional systems are: SEEKING, RAGE, FEAR, LUST, CARE, PANIC (now called GRIEF) and PLAY) (Panksepp, 2005b) (capitalisation of the names indicates that they refer to specific brain systems, not just the feeling itself).

All mammals are capable of experiencing these basic affects. (Humans take things a step further: the human neocortex in all its cognitive complexity processes the primary affects into more elaborate emotions such as love, shame, and empathy.) The evidence (Panksepp and Biven, 2012) for these core emotional systems is reviewed extensively in the COAPE International Diploma (www.coape.org), but here is a summary:

- The brain areas implicated in emotion are remarkably similar in humans and other animals and can be seen using imaging techniques such as PET (Positron Emission Tomography) scans.
- The brain areas implicated in emotion are deep subcortical areas which are evolutionarily conserved, and neuroanatomically and neurochemically similar in humans and other mammals, thus they are likely to play similar roles. For example, opiate and dopamine agonists are drugs of abuse in humans and are also attractive to other mammals. In contrast, the cortex of a human is much more highly developed than in most mammals, and not unsurprisingly plays a different and more advanced role in humans.
- The brain areas implicated in emotion are distinct and specific, and mediate multiple aspects of each emotion. When stimulated, the FEAR system coordinates appropriate behavioural and physiological responses (e.g., freezing and increased heart rate) and is also believed to generate the affective response (e.g., the feeling of fear).
- Evolutionary common sense suggests that emotion is an extension of homeostasis, and that cognition is an extension of emotion. The homeostatic mechanisms are largely unconscious, but evolved into conscious, emotional feedback systems which let the animal know how things were going.

In Panksepp's view, it is likely that affects (feelings) are crucially important when it comes to conditioning, reinforcement, and punishment; this view contrasts with the behaviourist assertion that outside events can *reinforce* behaviour with no associated *feeling*. Note that Panksepp defines reinforcement as the manner in which emotional feelings and other affects work in the brain to promote learning. Here, I agree with Panksepp, and for practical purposes, defines reinforcement as anything that serves to increase a behaviour's occurrence, whether that is internal or external. Regardless of whether emotions are truly discrete, Panksepp's approach has enormous practical value when it comes to understanding and treating behaviour problems in animals. Let's have a closer look at each system, and how it works.

1. The SEEKING System

The SEEKING system is the system that urges us to actively engage with the world around us to find the resources we need and to avoid dangers and threats. Dopamine and Glutamate create anticipatory states by helping us to associate stimuli in the environment, and the function of the SEEKING system is to search, find, or anticipate reward. The SEEKING System is therefore one of the first systems to learn about appetitive stimulation.

The SEEKING system has, in the past, been called "The Brain Reward" system, but that is misleading. Firstly, there are several systems in the brain that respond to rewards, not one system in particular, and secondly, the SEEKING system involves *expectation* rather than pleasure. In other words, the SEEKING system is involved more in **appetitive motivation** than **consummatory reward**. Karolina Westlund gives an excellent example here (Westlund, n.d.). If you stimulate the part of the brain that leads to SEEKING, the animal will look curious and will start to explore; he will look for resources and, using his senses, he'll investigate the environment he finds himself in. Similarly, if you stimulate the SEEKING system in humans, the expressed feeling is one of eager anticipation or expecting something (also called engaged curiosity). Stimulation of the SEEKING system is highly reinforcing: if you give animals the opportunity to self-stimulate SEEKING circuits by pressing a lever, they'll do so until they drop from exhaustion.

However, reinforcing isn't necessarily the same as rewarding, as we'll discuss in more depth in Chapter 4. Consider the darker side of desire: craving and addiction. The SEEKING system is hijacked in addiction, driving intense cravings and highly motivated behaviour, but few addicts are likely to describe the feeling of craving as pleasurable (Volkow et al., 2011).

Remember that the SEEKING system is *not* just about food. It is a complex system that involves behavioural invigoration or enthusiasm, and electrical stimulation will result in energized exploratory behaviour. Going back to Karolina Westlund's example of lever pressing: if an animal is hungry and offered food, he will press a lever only enough times to get the food he needs, and he will do so slowly and methodically. However, if he presses a lever to get his SEEKING system stimulated, he will engage with an almost frantic effort, for much longer, almost as if he is trying to get to something behind the lever.

Although other neuroscientists may not use the same language as Panksepp (such as SEEKING), the role of dopamine in motivated behaviour is widely acknowledged by the scientific community, including many other emotionally motivated behaviours such as reproduction (LUST) and nurturing young (CARE). Dopamine and the SEEKING system can be involved in the appetitive phases of other emotional systems. The basic systems may be neuroanatomically distinct, but they can simultaneously activate and work together. For example, an animal with LUST activation will experience sexual desire; desire is likely partly from the SEEKING system which drives motivation and enthusiasm, and the sexual nature of the desire likely comes from the LUST system.

On the other hand, if SEEKING is unsuccessful, an animal may slip into despair or RAGE. Think about it like this: if you are in your car, signalling your intention to pull into a vacant parking space in front of your office while waiting for oncoming traffic to pass so you can park, you expect that the space will still be available once the oncoming car has moved past. If the oncoming car suddenly pulls into the space you have been waiting for, your SEEKING system is thwarted, and you may then end up boiling with rage or shouting at the driver, particularly if you are in a hurry because you're late for work!

In animals, the genesis of many behaviour problems is the lack of opportunity to perform strong, innate motivated behaviours due to the limitations of their environment and so they adopt other, inappropriate behaviours instead.

Coppinger and Coppinger (2001) described in detail the evolved predatory motor patterns in various dogs from livestock guardians, headers, heelers, hounds, and pointers to retrievers. A Border Collie's SEEKING system is activated while he is performing eye-stalk behaviour, and he is likely experiencing the intense motivation that arises in this dopamine-driven system. Think of the SEEKING system in terms of motivation potential;

as soon as you feel motivated to do something, your SEEKING system is active. Some systems can function simultaneously with others, while other systems can't, and some will stop when another one activates.

However, unlike most other emotional systems, SEEKING is always a little active and never completely turned off, much like how you're constantly breathing lightly throughout the day, but if you suddenly sprint toward something your breathing becomes more laboured.

Once an animal perceives a cue that predicts reward, the SEEKING system fully activates and dopamine activity surges: this sudden burst of dopamine activity is what we refer to when we talk about SEEKING activation. Full SEEKING activation means an animal's appetitive system is active and he will seek the desired resource. Once the animal has secured the resource, his SEEKING system 'turns off' and returns to low-level background engagement. This is when the animal's consummatory system engages, allowing him to consume or enjoy his reward (Westlund, n.d.). Consider eating, drinking, or mating; once those goals are obtained, the dopamine responses (and related arousal) go back to baseline, because SEEKING is about expectancy. That is an important distinction to remember, particularly when you're using SEEKING system activation as part of a behaviour modification program: once the food is found, or the puzzle solved, the SEEKING system is no longer active because SEEKING is tuned to stimuli that predict reward, not the rewards themselves.

Animals will stop investigating familiar things because it's a waste of time and energy. But when you introduce novelty, SEEKING will become active. It helps to *create* habits, but once a behaviour becomes a habit, it no longer involves the SEEKING system to the same degree. There is still dopamine release but it's not in the SEEKING system, and it's not as rewarding.

The SEEKING system not only fits with positive experiences, but also with negative experiences. Offspring separated from their mother will engage in seeking behaviours to regain access to the lost caregiver.

Because the SEEKING system helps animals to learn about their environment, they learn what predicts resources and aversive situations. As a system, it increases attention and focus as well as affecting foraging and exploratory behaviour and it helps to trigger an orienting response, meaning that animals use it to map their territory. It's also believed that SEEKING will to some extent counteract or offset the negative feelings of hunger or FEAR. SEEKING is the system that makes an animal decide that it may be worth taking a risk to obtain a reward like food, or where to hide when being chased by a predator. Think of SEEKING as a general purpose 'find it' system; nature doesn't provide resources necessary for survival immediately at hand, so each animal has a spontaneous tendency to explore and learn about his environment. In fact, rewards in the world are meaningless unless you can (and want to) seek them out. This is why SEEKING is such an important system, without which, the animal cannot navigate in his environment.

2. The FEAR System

An animal's capacity to feel fear primarily originates from a FEAR circuit in the brain that runs between the central Amygdala and the Periaqueductal Gray of the midbrain. This FEAR system is responsible for the aversive feelings we feel when we are afraid, and it can be activated by internal events as well as various world events. Of course, the FEAR system is not the only system involved in that feeling we get when we are afraid, there may very well be multiple neural systems that contribute to making us afraid. Experientially, fear is an aversive state of the nervous system, characterized by apprehensive worry, general nervousness and tension which tells the animal that his safety is threatened.

Panksepp's FEAR system (Panksepp, 2005b; Panksepp, 2006) generates obnoxious and aversive FEELINGS of fear that help an animal to anticipate and avoid danger. Panksepp argued that it is central to understanding anxiety disorders, pointing out that this FEAR system is unconditional in that it generates these bad feelings every time it is stimulated. The FEAR system is also involved with the 5F responses (freeze, flight, fight, faint, and flirt), and anxiolytic drugs ameliorate anxiety by modulating this FEAR system. Some dogs with a long-standing fear of thunder can become withdrawn, depressed, and jumpy and it is the FEAR system that is responsible for these states.

FEAR responses progress in a predictable manner. At low intensities, animals move slowly and carefully. At medium intensity, you may see an animal who freezes or fidgets, and at higher intensity, you may see flight, fight or even faint: these make up the '5Fs' of fear responses. As a rule, the higher the intensity of the fear experienced, the faster the animal moves, and the more irrational and uncontrolled the responses (except for faint, where movement ceases entirely). When animals are scared, they do assessment shifts. They become wary, vigilant, unwilling to take risks, they avoid places where dangerous things happened, and they stay close to cover. Keep this in mind for when we discuss Hedonic Budgets, Cognitive Biases, and receptivity to behaviour modification later.

3. The RAGE System

The RAGE system does just what it says on the box. When animals are experiencing full RAGE system activation, they usually try to inflict physical damage on another living creature. In human adults it is modulated by higher cognitive centres, whereas children are less inhibited and therefore fly into tantrums easily. Other mammals also show rage, and the emotion can be elicited by direct brain stimulation. Like any other system, the degree of stimulation has an impact on the intensity of the reaction. Low levels of RAGE system stimulation will feel like frustration and at higher levels, like fury. RAGE causes an invigoration of the muscles, it increases body temperature and blood pressure, it elevates the heart rate and readies the body for action. From an emotionality perspective, RAGE is aversive, and it is a feeling that animals will work to avoid.

The neurotransmitters involved in RAGE are glutamate, noradrenaline, and substance P. Despite its reputation, testosterone isn't critically important in arousing RAGE, although testosterone can amplify the RAGE response in certain contexts. RAGE is about competing successfully for resources, arising as a function of being frustrated when access to resources is blocked or threatened. RAGE circuits may also be recruited alongside FEAR circuits when an animal's safety is under threat from another. For example, an animal that has been caught by a predator is unable to flee and has two remaining options: go limp or fight back. If the animal opts for fight (a FEAR response), RAGE circuits in the brain may also be recruited to aid in inflicting harm upon the threatening animal. Indeed, the neural circuits for FEAR and RAGE are anatomically very close, passing through the same small area of the hypothalamus and running down to closely interlinked areas of the periaqueductal grey. This suggests a close relationship between FEAR and RAGE, with the interaction of these systems currently seen as an active area of research.

RAGE is often called defensive attack or affective attack because it is so emotionally aversive. When experiencing full RAGE system activation an animal will try to inflict damage on other animals or objects nearby, irrespective of risk or injury to himself, preferring to attack other animals.

Some situations that may trigger or sensitise RAGE activation include:

1. Restraint.
2. Food deprivation.
3. Thwarted SEEKING.
4. Affect infection (exposure to another angry individual / hearing an angry voice etc.).
5. Rapid movement when scared or irritated.
6. High blood pressure.
7. FEAR sensitises RAGE.
8. Pain.
9. Punishment.
10. Genes and certain neurotransmitters (substance P, glutamate, acetylcholine etc.)

For behaviourists and trainers, it's critical to know that when SEEKING is thwarted, RAGE can be activated. When utilising SEEKING as part of a behaviour modification program, care should be taken not to induce too much frustration, as that could inadvertently cause the activation of the RAGE system as the animal perceives SEEKING to be interrupted.

4. The LUST System

Unlike the other core emotions, LUST is fuelled by the sensory and homeostatic system. We talk in terms of 'instinct' when referring to reproduction in other mammals, but the highly subjective erotic FEELINGS associated with it arise from ancient and deep subcortical structures common to all mammals and it is reasonable to assume that the purpose of these highly desirable FEELINGS is to ensure the propagation of the species (Panksepp, 2006).

When animals have their LUST centres stimulated, they show sexual behaviour, and this sexual behaviour is very different in males and females. There are several different neurotransmitters involved and, yes, they are different for males and females. In females, oxytocin, oestrogen and progesterone are the main sex chemicals, whereas in males, vasopressin and testosterone are the main role players.

Sexual and prosocial behaviour in reptiles and birds are governed by an ancient molecule called vasotocin. This molecule has evolved into two other molecules, namely oxytocin (most common in females), and vasopressin (expressed mostly in males). Oxytocin promotes confidence and social bonding, and vasopressin promotes pushiness and sex drive in males. In females, vasopressin turns them off from sex and is probably behind maternal aggression, something that is seen in many species if there are threats to the young. Interestingly, males tend to have more responsive SEEKING, RAGE, LUST systems, and females more responsive FEAR, GRIEF and CARE systems.

5. The CARE System

The CARE system is present in all mammals, birds and some reptiles and is triggered by the changing levels of oestrogen, progesterone, prolactin and oxytocin. It gives the new mother the innate ability to care for her young (Panksepp, 2006). In contrast to many of the other core emotions, it's not the individual experiencing the CARE emotion who benefits the most — it's the offspring! Receiving loving, tender care is important for survival and brain development. The behaviour of a whelping bitch to the distress calls of a separated puppy is a wonderful example of the CARE system. After the last pup is born, and for a duration of about thirteen days, the bitch is primed to respond to the distress calls of any puppy that wanders away from the nest, which in turn improves the pup's chances of survival should he get lost (Coppinger and Coppinger, 2001). Mammals and birds have either one of two strategies for raising their young, and which strategy they employ will impact on how their CARE systems function. These two strategies are:

Altricial. The mother gives birth to many immature offspring. These babies need to be kept warm, so behaviours like nest-building or retrieving stray babies are important behaviours which extend to the SEEKING system.

Precocial. The mother gives birth to a few, mature babies. In precocial species, the mother must learn to recognise her babies quickly because these babies are mobile and can move around soon after birth. For this, she uses smell to identify her baby among others of the same age.

Even though mothers tend to have more well-developed CARE systems, parental care isn't exclusive to females. In birds and around ten percent of mammals (West and Capellini, 2016), fathers have equally well-developed CARE systems which activate if babies show any GRIEF-related behaviours such as separation vocalisations.

The main neurotransmitter involved in CARE in birds and reptiles is **vasotocin** (which is believed to have evolved into oxytocin and vasopressin in mammals) and in reptiles, it's only crocodiles who provide care behaviour to hatchlings. A reptile's CARE behaviour is not as extensive when compared to birds and mammals. Primates on the other hand will form attachments, which is not the same as imprinting. Conversely, human mothers bond quickly through sight, sound and touch, but infants bond slowly. The bond between an infant and mother is not fully formed until the infant is a year old. This allows for multiple caretakers to look after the infant without causing activation of the GRIEF system, which could be detrimental to the infant's development. It really does take a village to raise a child!

There are three social systems in mammals: friendships, maternal behaviour and sexual behaviour, and they are cemented by the same chemical systems (oxytocin, vasopressin and opioids) which help to strengthen these social memories and in the case of oxytocin, generally reduce aggression. These chemicals are reinforcing, and animals will work to obtain a chemical 'fix' of each or all three of them.

When it comes to young animals, epigenetic effects can impact how they develop. Epigenetic effects are ways in which traits can be passed from parents to offspring that don't involve changes in DNA and genes (epi means upon, so epigenetics literally means in addition to genetics). For example, mothers who are stressed during pregnancy will give birth to young who tend to have a stronger stress response, even if they are never directly exposed to stressors after birth.

Additionally, a stressed mother will be less able to care for her offspring, directly affecting the level of care they receive. This results in offspring who are themselves more anxious and less prone to taking risks and when the offspring later reproduce, their offspring will also be more anxious. In other words, one stressful pregnancy can affect multiple generations of offspring. This could be advantageous: if the mother is stressed, the environment is presumably dangerous, and any offspring need to be equipped to handle it. However, an overactive stress response can also have many negative consequences down the line, such as suppressing immune responses and resulting in illness, or contributing to emotion and mood disorders such as chronic depression and anxiety.

Friendships and social bonds overlap with the CARE system, and involves the same chemistries, even if they are not identical. Opioid levels in the brain have a marked effect on social behaviour: low levels of opioids promote social interactions and during active, rough and tumble play, social grooming, maternal behaviour and sexual gratification, the opioid system is active and positive social bonds are mediated by opioid based, naturally occurring addictive processes within the brain.

6. The GRIEF System

The GRIEF system can be considered as the other side of the CARE system. GRIEF was previously known as PANIC but has been changed to GRIEF because it captures the gist of the emotions generated in this experience better. When your GRIEF system is active, you are sad, heartbroken, and sometimes even feel physically ill or in pain. It is an aversive experience, as anyone who has felt it can attest to.

Throughout the ages poets and philosophers have expressed love lost and the loss of meaningful social bonds in painful metaphors such as broken hearts or hurt feelings, and this is common across many diverse cultures including Western, Middle East and Far East cultures (MacDonald and Leary, 2005) and Eisenburger and Lieberman (2004) have shown in fMRI studies that physical pain and social pain share common cognitive and neural systems in the brain and suggest that this is an evolutionarily adaptive setup that helps to ensure that conspecifics do not become separated from each other and therefore vulnerable to danger, and in young, dependant mammals in particular, this system is essential for their survival. Panksepp and colleagues have carried out extensive research over the last 25 years on separation distress in non-human animals (Panksepp, 2003; Panksepp, 2005b; Panksepp, 2006) and have also found considerable overlap in the brain areas for physical and social pain. They found that opioid analgesics were very effective at alleviating the cries of separation distress in dogs, guinea pigs, rats, primates and even chicks, and that human sadness and guinea pig separation distress share remarkably similar brain regions (Panksepp, 2003).

In addition to opioids, neuropeptides such as prolactin and oxytocin also powerfully ameliorate separation distress and the feelings of depression, and these substances open the door to the possibility of new and exciting pharmacological treatment for emotional states in the future. The two big neurotransmitters involved in the GRIEF system are glutamate and corticotropin-releasing factor (CRF). CRF activates the stress system and indirectly results in the release of cortisol, which causes a subsequent reduction of opioids. There is significant anatomical and experimental data that indicates that the sub-cortical areas of the brain that generate and regulate both physical and social pain are evolutionarily ancient and shared by all mammals.

The bonding process between parents and offspring ranges from non-existent to imprinting to attachment. Imprinting is a fast process, usually taking place within hours or days and serves to quickly establish a bond in species where the young may be lost in a matter of minutes. In precocial birds, the chicks start following any large moving object that they have been exposed to in the early hours after hatching. Attachment, in contrast, is a process that takes time and involves several sensory systems, and it is crucial in order for primates to thrive.

Behaviour during separation goes through what is called a protest phase, in which the juvenile will be agitated and vocalize. This is done to attract the attention of everyone around, including hopefully the primary caretaker, in which case all is well. However, if the primary caretaker doesn't show up soon, it makes more sense to fall quiet otherwise you may end up attracting unwanted attention from a predator, for example. This 'falling quiet' is referred to as the despair phase when infants stop vocalizing and conserve energy by being still. Human children go through a third phase called detachment, when they stop rejoicing in reunions, something that is apparently not seen in non-human animals.

Loneliness is painful and the loss of a loved one can lead to depression. Animals and people recover more slowly from injury when alone than when in the company of friends. Patients in hospitals will recover faster if the doctor treating them is seen as compassionate and supportive. Separation related distress (SRD) is a commonly seen problem in dogs, but how often do we relate how a whimpering dog FEELS when left alone to how we feel when, for example, we lose a loved one?

Animals will learn predictors of emotional events, and they'll come to feel the same way about reliable predictors as they do about the emotional event itself. Think about the implications of that sentence in the context of separation distress! We can use this abovementioned learning mechanism to our advantage when treating separation problems by systematically introducing potentially uncomfortable stimuli as predictors of pleasant events.

People and animals learn the contexts and stimuli which include triggers that bring about a certain emotion, so they start showing that emotion simply by being exposed to the context. We call the resulting behaviours conditioned emotional responses. For instance, horses may develop a conditioned emotional response to a location where something aversive happened, so they may become agitated in that location (and less receptive to training). We call such locations **poisoned** —– an important aspect to remember when addressing separation related distress in animals.

7. The PLAY System

Panksepp calls the PLAY system the most important system of all because of its far-reaching effects on an organism's emotional and physical well-being. Play has a tremendous effect on the brain: about one-third of the identified genes of the cortex are rapidly affected by play. This epigenetic effect involves changes in gene expression where the genes are either turned on or off. Play impacts relationships, place preference and social intelligence. It improves welfare and acts as a buffer against stress. Playing may help animals recover from a bad rearing environment due to lack of CARE system activation from the caregiver, and being in a playful state may help prevent an animal from having his FEAR system activated. Play is extremely important for brain development in young animals (and children!) which is why they should play as much as possible to facilitate learning. As a matter of fact, both animals and people are better off playing, irrespective of age. Playing in a specific location leads to location preference, which means that if you choose the location, and you're present, some of that association may rub off on you even if you're not participating in the actual play session.

As Professor Karolina Westlund says: "PLAY may seem frivolous and not serious. It really isn't. *It may be the emotion that you should take the most seriously*" (Westlund, n.d.).

Many different core emotions might be recruited during a play session. During play, animals practice all types of social behaviour: collaboration, competition, sexual and even parenting behaviour. The PLAY system is not engaged when the animal is aroused. If the nature of arousal is aversive i.e., the animal feels threatened, then the FEAR system is engaged. On the other hand, if the nature of this arousal is motivational, then the SEEKING system is engaged.

In the past, play activities were often put with seeking activities, and they were treated as different facets of the same thing, but this is incorrect. The PLAY system and the SEEKING system are separate systems and work through different neural networks. When we see animals engaging in play, they'll often engage some of the predatory behaviours we associate with the SEEKING system, for example stalking each other, attacking and biting each other and so on, but this is simply because they have a limited behavioural repertoire. What you will notice is that dogs use different chains of behaviour in PLAY than they do in SEEKING, with play bows, high-pitched barking or tug of war games on a toy.

The PLAY system and the SEEKING system are often antagonistic rather than synergistic with each other and cannot be fully engaged at the same time. There are also tell—tale signs that indicate when an animal is engaged in PLAY — we call it MARS, the presence of which indicates healthy play. **MARS** stands for:

Meta-signals: the animals offer play invitations like play bows or high-pitched barks to solicit play.

Activity shifts: the behaviours are shown in a different order than during real fights.

Role reversals: they take turns winning.

Self-handicap: the bigger one handicaps himself to make the play equal.

One intriguing possibility is that laughter and joy may not be unique to humans and many mammals have a marvellous sense of fun (Panksepp, 2005c). This poses an interesting question: could animals have a rudimentary sense of humour? Other evidence supporting these claims (Panksepp, 2005b) include:

- Amphetamine stimulation of the Nucleus Accumbens (the area of the brain flooded with dopamine at times of intense pleasure and mirth in humans) induces the same vigorous 50kHz chirping in rats when they are tickled.
- Rats that have been tickled become very friendly toward the tickler and chirp at 50kHz as he/she approaches the cage and;
- These rats consistently choose to stay close to other rats that chirp a lot rather than those that do not.

Play is a common activity in all mammals, and they do it because it:

- Helps brain development because the animal is relaxed and unthreatened (and unaroused), so that the PLAY system is engaged facilitating the growth of neural circuits that strengthen social attachments and getting along with mates.
- Helps prepare for the unexpected (animals deal better with novelty).
- Helps to develop social skills. Traditionally, biologists and ethologists believe that the purpose of play is to give animals safe opportunities to practice hunting and mating skills, but hopefully now you understand that there is rather more to the PLAY system than only this.
- General beneficial effects of play include a positive emotional state (along with an improved immune system among other things).

Opioids (natural endorphins in the brain) play a major role in the PLAY system and the role of dopamine is insignificant by comparison (compare this with the SEEKING system, where dopamine is the major player). When animals play, there's a lot of body contact which causes the release of endorphins (and other neurotropic substances, which Panksepp calls brain food) in the brain that makes them *feel good* — almost euphoric.

One hypothesis suggests that play is the awake equivalent of REM sleep: both functions to organize information in the brain in a safe context. We probably all take for granted rough and tumble play in pets, but the apparatus for play, the PLAY system, is built right into the brain and is something that must be always considered as it is such a critically important system (Panksepp, 2005b).

BASIC EMOTIONAL SYSTEM	MAMMALIAN PROTOTYPE AFFECTIVE STATES	HIGHLY COGNISED HUMAN VARIANTS
SEEKING	Motivation, motor patterns, interest, frustration	Desire to win/succeed, extreme sports, addictions, cravings, obsessions
RAGE	Anger, irritability	Contempt, hatred
FEAR	Anxiety, phobias, panic, psychic trauma	Worry
GRIEF	Separation distress, sadness	Guilt, shame, shyness, embarrassment, poor self-image
PLAY	Joy, glee, happy playfulness	Laughter, sense of humour
LUST	Erotic feelings	Jealousy
CARE	Nurturance, attraction	Love, romantic attachment, the pain of broken relationships

Table 1: Prototype affective state and their human variants
In humans, the basic mammalian prototype affective states become melded with more complex self-images and images of the intentions of others towards us. For example, shame, where we feel defective in the eyes of others, is derived from the GRIEF system. (Watt, 2005; Panksepp, 2006).

The dimensional model of emotionality

This brings us to the **Dimensional model** of emotionality, which suggests that emotions have two or more fundamental dimensions: **Valence** (pleasantness to unpleasantness) and **level of activation** (arousal to relaxation) and that these range from positive to negative.

Lang and Bradley (Lang, Bradley and Cuthbert, 1998) suggest that "the dimensions of arousal and valence form an appetitive and aversive emotional orientation, and that arousal determines the *intensity* of the emotive orientation, while valence determines the emotive *direction*. This perspective builds on evidence that suggests that even simple organisms such as worms possess basic approach/avoidance responses, and then it posits that in more complex animals, discrete emotions such as anger and fear emerged from these basic emotive processes coupled with cognitive appraisals of the self and environment." In 2010 Mendl, Burman and Paul published a study called "An Integrative and Functional Framework for the Study of Animal Emotion and Mood" (Mendl, Burman, and Paul, 2010), in which the different approaches to emotion are discussed. Mendl and colleagues felt that a better understanding of animal emotion is important, and that the conscious experience of emotion cannot be assessed directly. Neural, behavioural, and physiological indicators of emotion could be measured and that these measures have been used to characterise how animals respond to situations that we assume induce discrete emotional states. This paper is an excellent summary of the two different theories, and well worth reading.

The field concerned with the psychological study of emotion has seen a lot of debate, and it is unlikely that this debate will be resolved any time soon. Fervent arguments have occurred over whether emotions should be described along dimensions of valence and arousal, or as discrete entities. As one can imagine, these two theories have often been pitted against each other. But combining the two models has formed the basis of MHERA as an assessment tool in applied animal behaviour.

Let's look at dogs to demonstrate why both **dimensional** and **discrete** models have value and work well when combined. Dogs can be described in terms of dimensions: Chihuahuas are small, and Great Danes are large. Anatolian shepherds can walk long distances, but Bullmastiffs prefer to stay close to home. All these points demonstrate how dimensional views are accurate, however, dogs can also be described in a discrete fashion, as a species different to another species such as wolves.

Describing a dog in terms of dimensions (size or the distance travelled) is clearly valid and it helps us to understand differences among dogs. But that does not mean the information provided by classifying a dog discretely as a member of a specific species is invalid. Describing emotions discretely does not disqualify the value of describing them in terms of dimensions. Harmon-Jones et al., claim that "After all, fear is different from disgust, even though both are negatively valenced and avoidance motivated" (2017). It is worth noting that discrete emotions can have dimensional aspects too — anger and rage being an example of this, and that each has its own motivational functions in behaviour.

When we say that emotional experiences are valenced, we mean that they are perceived as negative or positive, rewarding or punishing, pleasant or unpleasant. Valence is also often referred to as **motivational direction**: meaning an animal is inclined to go toward, or away from something. Arousal is measured not only by physiological arousal (i.e., arousal of the sympathetic nervous system) but also on affective arousal and can be thought of as **motivational intensity**. But like anything else in the field of emotion, definitions must not be thought of as set in stone and clear cut all the time. For example, you can be experiencing physiological arousal because of recent exercise without feeling motivated, or you can feel motivated without taking action.

As a final note, it is worth remembering that discrete emotions have different levels of arousal. Elation and contentment are both positively valenced, but elation involves a higher degree of arousal than contentment. When subjective experiences can be characterized in terms of these two dimensions (valence and arousal) they are called **Core Affect**. This will be discussed in detail in the next chapter. One final point to highlight from Harmon-Jones that must be considered when evaluating emotions is that "emotions high in motivational intensity (desire, anger, fear) narrow cognitive scope, whereas emotions low in motivational intensity (satisfaction, some forms of sadness) broaden cognitive scope. The narrowing of cognitive scope during motivationally intense emotions may serve the function of aiding in successful approach or avoidance. In other words, by focusing on the desired (or aversive) object, the organism may be more likely to obtain (or avoid) it; if the organism was not so focused and was distracted by other things, s/he might fail to obtain the desired object or avoid the harm. On the other hand, with emotions low in motivational intensity, organisms have reduced their efforts and the mind may broaden so that new opportunities can be seen" (Harmon et al., 2017).

Chapter 3
Introduction to MHERA

MHERA is an approach that has been developed by me that builds on the Mendl, Panksepp, Rolls and EMRA models, providing a practical framework that allows the behaviourist to evaluate the individual animal, considering his emotional life and the role it plays in his behaviour. It is not a rigid formula or recipe, but a fluid assessment tool that takes an individual's uniqueness into consideration. MHERA (and the treatment protocol ESTA) are powerful tools when used properly.

In this chapter, we will be taking a detailed look at:

1. **M**ood State Assessment, including Cognitive Bias.
2. **H**edonic Budget Assessments.
3. **E**motional Assessment.
4. **R**einforcement **A**ssessments.

Mood State Assessments

In human psychology, a mood is defined as an affective or feeling state. Unlike emotions or feelings, moods are not as specific or intense, and they are less likely to be provoked by a particular event. When we think about moods, we typically consider them to be either good or bad, thus we are referring to the valence being either positive or negative. Mood is an internal, subjective state that can be inferred from posture or other behaviours exhibited. (**Emotional valence** describes the extent to which an **emotion** is positive or negative, whereas arousal refers to its intensity i.e., the strength of the associated **emotional state**) (Citron, et al., 2014).

Mood differs from temperament or personality traits (see the hedonic set point discussion below) which are even longer lasting in duration, and personality traits such as optimism and pessimism influence certain types of moods. Long term mood disturbances like clinical depression and bipolar disorder are deemed mood disorders. **Mood states** are static emotional states which are **free-floating** (in other words, they are not attached to something e.g., a dog's fear of fireworks may have generalised, so he feels anxious most of the time in anticipation of fireworks) and they are generally long lasting. They linger and can influence overall behaviour, such as when an anxious dog starts showing lack of motivation to outside.

Moods represent the cumulative average of all the emotional experiences the dog will have experienced (good and bad) over a given period (Veenhoven and Rojas, 2013). An animal's mood comprises of the **collective** emotional states that are experienced. For example, if a dog has had more positive than negative emotional experiences the last few weeks, the dog's mood will more likely be positive (see right block in Figure1 below) than negative. If, on balance, the emotional experiences have been more negative than positive, then the dog's mood will more likely be negative than positive (see left block in Figure 1 below). These mood states allow an animal to make predictions about the potential outcomes of the day-to-day events he encounters, based on the probability of the animal's ability to take advantage of an opportunity, or to avoid an undesirable situation (Mendl, Burman, and Paul, 2010).

In addition, the value of positive emotional states is less than the value of negative emotional states. So, to achieve an overall positive mood, a dog needs to have more good experiences than bad experiences over that *given period*.

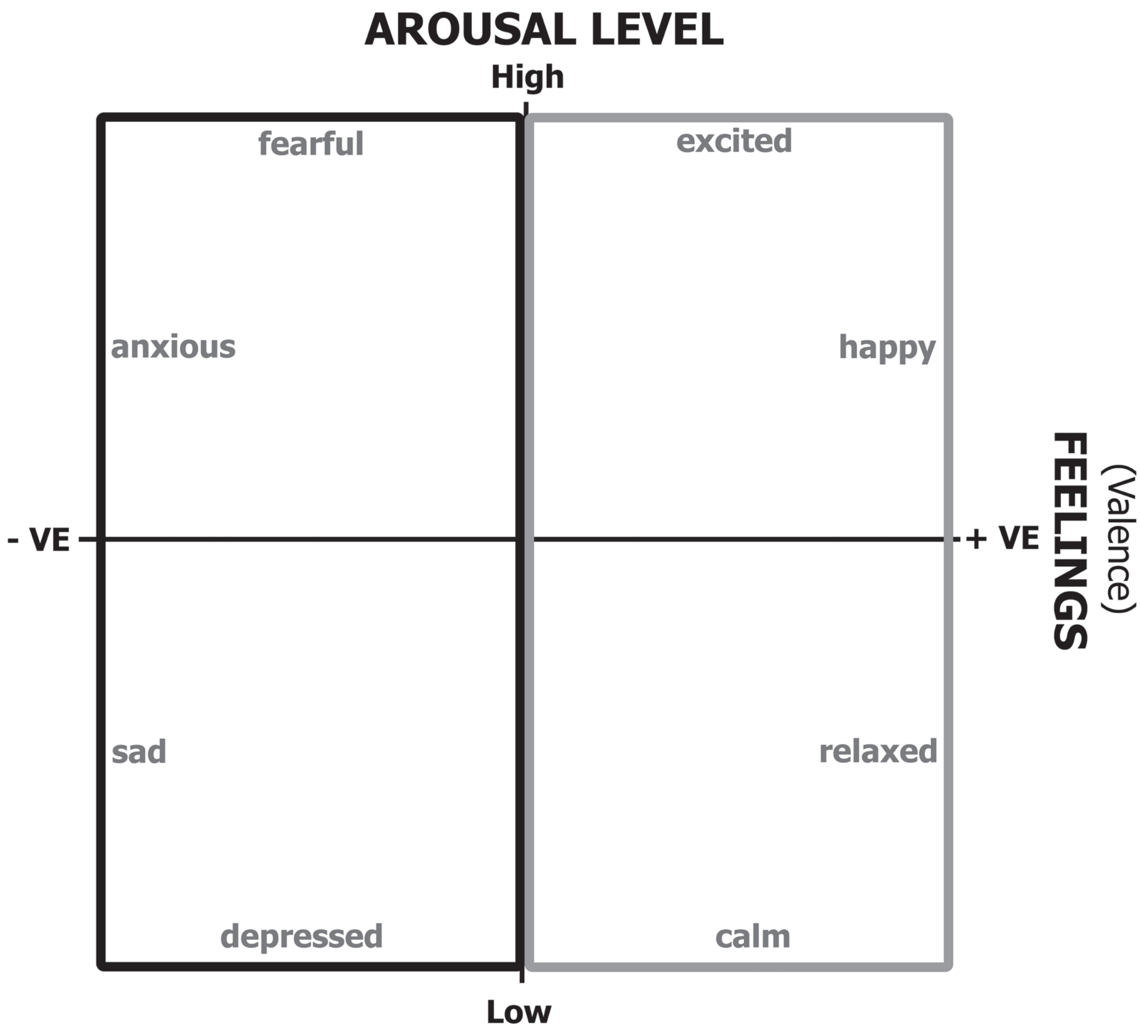

Figure 1.

This is an important concept in counterconditioning and desensitisation, where the goal is to shift a dog's mood from left to right as shown above; however, it takes time because mood states are resistant to change, and the environment plays a very big role in the ability of the animal to shift from negative to positive mood states (and usually also requires the complete removal of any negative valenced emotional experiences).

In his work on the subject, Dr. Robert Falconer-Taylor discussed the adaptation of using self-report to reliably measure animal welfare objectively. This simple test has been used for many years in human cognitive behavioural therapy (Erlandson, 2006), with subjects asked to verbally describe how they feel (happy, sad, angry, etc.). In the adapted, animal version of self-report, the animal's behaviour when offered a choice is examined. This test is considered a reliable welfare indicator in several species, including livestock, horses, rodents, companion animals and primates. The test is based on the knowledge that an animal's mood state will have an influence on his expectations about life, which in turn will influence any decisions the animal makes and, ultimately, his behaviour in general. The diagram below summarises how the test could be used in dogs.

The test works as follows: A dog is placed in a crate with a blanket over, so he cannot see what the human is doing (Figure 2 below). A food bowl with a treat in is placed at a distance in front of the dog, to the left. As soon as the door is opened, the dog can venture out and explore. When he has found and eaten the treat, he is placed back into the crate. The process is repeated until the dog has learnt that there is a treat in the bowl, and he immediately goes to the bowl for the treat without any delay as soon as the door is opened.

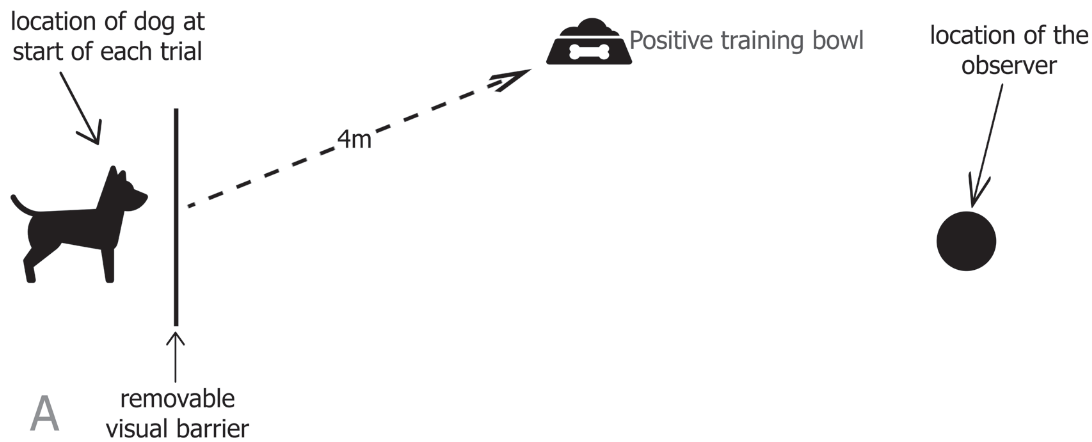

Figure 2.

The process is then repeated, with some slight adjustments. Now, the bowl is to the dog's right, and it does not have a treat as shown in Figure 3 below.

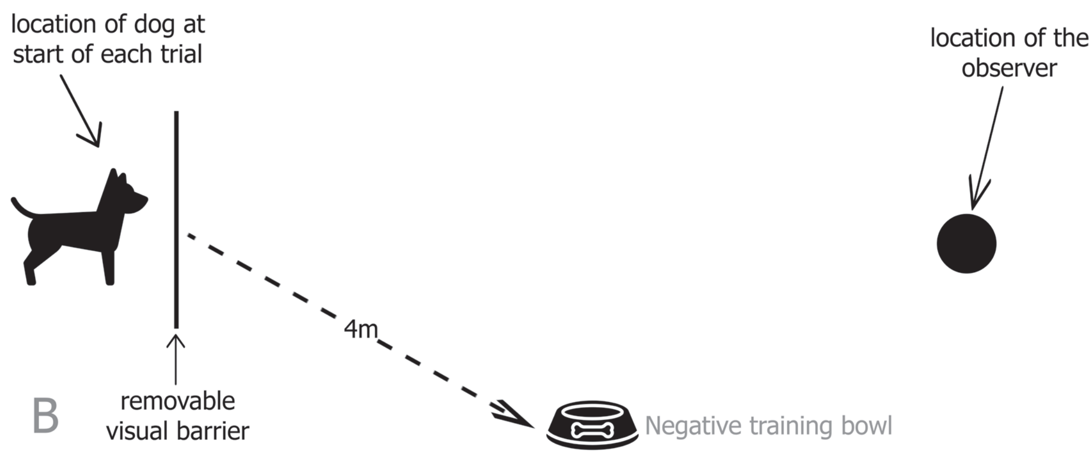

Figure 3.

After several repetitions, the dog will learn (and understand) that the left bowl has a treat, and the right bowl has no treat. The process is repeated, but now the bowls are also placed in intermediate positions, sometimes with a treat and sometimes without. The dog's response time in getting to each bowl is measured to establish if it takes longer between empty or full bowls as shown in Figure 4 below.

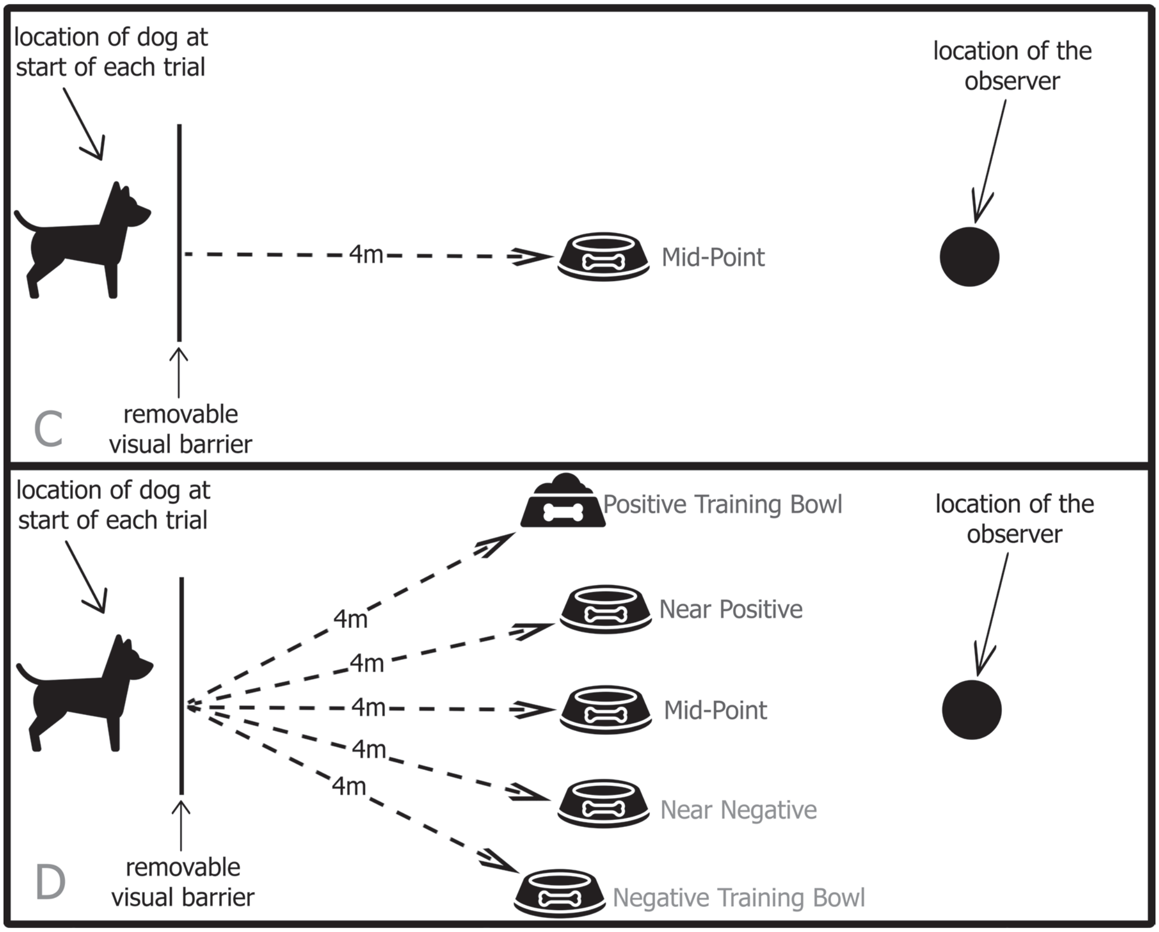

Figure 4.

Results show that the dog moves fastest to the left bowl (the 'positive' bowl, always containing a treat) and slowest to the right bowl (the 'negative' bowl, never containing a treat). The speed at which he moves to the other bowl positions varies according to their proximity to the treat or the no-treat bowl.

This test measures the dog's expectation when presented with a neutral signal. He would have learnt that the bowl on the right always contained a treat, while the bowl on the left never contained a treat. The three intermediate bowls shown are ambiguous because the dog won't know if they contain treats or not, and he must essentially guess and investigate to know for certain. If a dog has a generally positive outlook on life, he will be far more inclined to investigate the ambiguous bowls for treats, whereas a dog with a generally negative outlook may decide not to investigate at all, since he will be more inclined to believe that the bowls contain nothing. In terminology used by human psychologists, the dog who investigates the bowls has an **optimistic cognitive bias**, while the dog who does not investigate can be considered as having a **pessimistic cognitive bias**.

Cognitive biases

Cognitive biases can be defined as predictable shifts in judgement about how we perceive the world around us (see the cited works for Chapter 3 by Mendl and his associates for more research on this subject). They influence our behaviour all the time, and often, these biases cause us to make irrational decisions or have inaccurate judgements. In human behaviour, there are many types of bias, including **observation select bias, framing cognitive bias, confirmation bias** and **hindsight bias**.

When assessing an animal's likely cognitive bias, rigorous testing like above is not required. A simpler test is to present the animal with an ambiguous, unknown, previously unencountered item and measuring his response. Of course, a detailed history of how the animal has responded to novelty previously is also invaluable, and this can be obtained by interviewing the client during the consultation. It is very important to note that the cognitive bias assessment should only be done when the individual is relaxed and in a familiar environment. Ideally the owner should perform the test when alone with the pet, as your presence can influence how the animal responds to the stimulus. Brief the owner on the exact parameters of the test and give clear, detailed descriptions of the novel items. Ask the owners to record the test, so you can then determine the animal's cognitive bias yourself.

Figure 5 below shows another version of the Combined Dimensional/Discrete Model of Emotions diagram. On the right you'll see the positive quadrants (Q1 and Q2), and on the left, the negative ones (Q4 and Q3), with the effect of cognitive bias on the dog's mood state also shown.

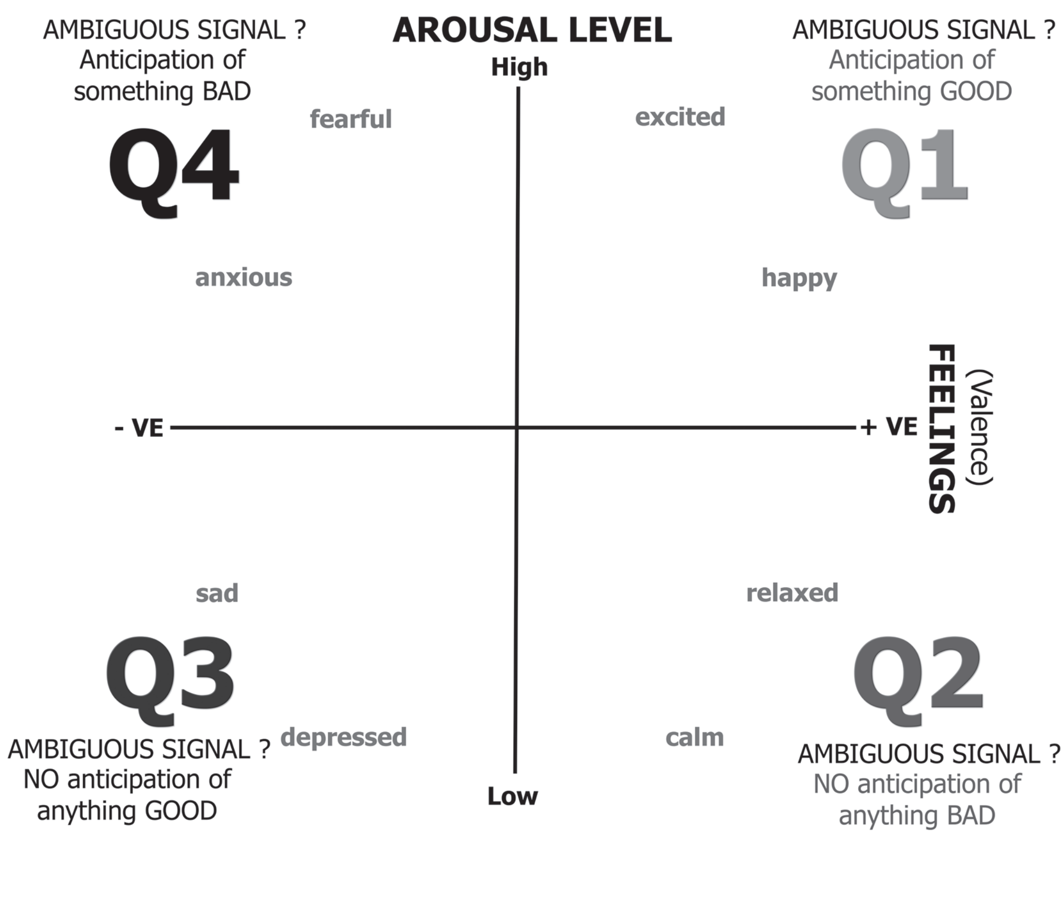

Figure 5. Optimistic (right) and Pessimistic (left) cognitive biases.

For example:

- **Q1 (optimistic)**: An exuberant, happy dog, excited because his usual walk time is approaching, spots an unfamiliar item lying on the floor. Because of his optimistic bias, he expects that any ambiguous signal means something good is about to happen, so he runs over to investigate.
- **Q2 (optimistic)**: Here, our example dog is a happy, relaxed dog. He is lying in his bed and notices an unfamiliar item lying on the floor. Because he does not expect ambiguous signals to predict anything negative, he stands up and lazily meanders over to investigate the item.
- **Q3 (pessimistic)**: This dog is a generally anxious, nervous dog. He lives in a house with very noisy neighbours who make unexpected, loud noises. This dog sees an unfamiliar item lying on the floor, and because of his pessimistic bias, automatically expects it not to mean anything good, so he decides not to investigate the item and chooses to pretend that it doesn't exist.
- **Q4 (pessimistic)**: Our Q4 pessimistic dog lives in a state of heightened fear all the time. He's hiding under the bed, and when he sees an unfamiliar item lying on the floor, he actively flees the room. He is expecting the arrival of this ambiguous signal to predict something bad.

Figure 5 represents our dogs with different mood states. Now, it should be possible to make a fairly accurate prediction of how they are likely to react when presented with an ambiguous signal, and based on their reactions, the behaviourist can determine if they have optimistic or pessimistic biases. Of course, this does not mean that the dog's emotional states can't change briefly, irrespective of whether he's a pessimist or an optimist. A depressed dog in Q3 may be briefly excited when he gets a high value food treat, and conversely, a happy dog in Q1 could feel scared when a car backfires next to him or there is a very loud thunderstorm. Therefore, it's important to only do mood state assessments when the dog is not distracted by anything around him, and why the cognitive bias test should be conducted by the owner at a time when nothing eventful is actively happening for the dog, which could result in a change in emotion at that particular moment.

An understanding of the existence and roles of cognitive biases and its impact on behaviour is invaluable and must be utilised as the fifth tenet within in the MHERA framework. Performing an overall Mood State Assessment of how the animal feels and behaves generally at all other times, away from the problem behaviour, is the first step of the MHERA assessment, which allows the behaviourist or trainer to determine the dog's cognitive bias and, subsequently, his receptivity to any changes to his environment that may need to happen through behaviour modification.

Assessing mood states

To assess an animal's mood state, we use a **Core Affect Space** matrix as shown below (Figure 6) which displays **Hedonic Set Point, Mood Before,** and **Mood After** behaviour modification.

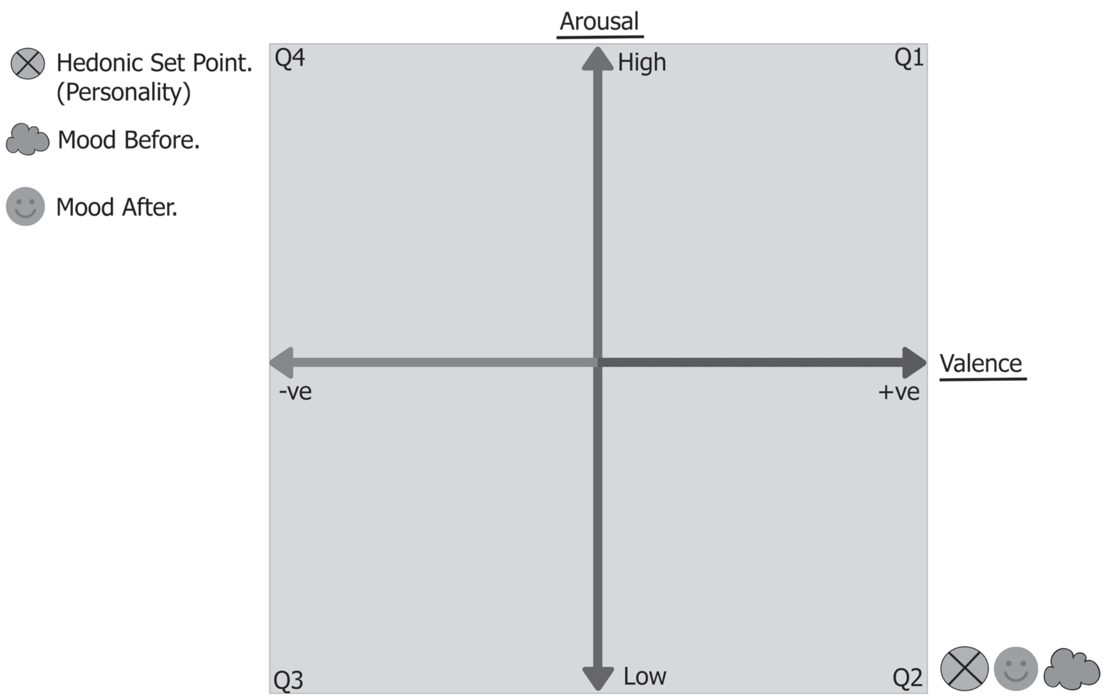

Figure 6. Mood State Core Affect Space Matrix

The first point we determine during an overall mood state assessment is the animal's hedonic set point. The definition of hedonic set point is the general baseline level of happiness an animal experiences over his lifetime, despite any temporary changes in the level from positive or negative life events (think years in terms of amount of measured time). Although events and environmental factors can affect happiness in the short term, individuals will naturally adjust back to their hedonic set point in the long term.

Another way to understand this is to think of hedonic set point as personality: your environment, cognitive bias, learning and experiences in the past have all played a role in shaping your personality and your subsequent outlook on life. The hedonic set point is determined by interviewing the owner to get as much history as possible on the animal and his responses to stimuli, and by observing the animal's response to novelty (testing the animal's cognitive bias). Cognitive bias has short- and long-term applications. You can have an optimistic personality overall, but that does not mean that you can't be pessimistic in the short term due to circumstances. When doing cognitive bias evaluations, keep in mind that there can be short term cognitive bias (that goes with mood) and long-term cognitive bias (that goes with hedonic set point) and that these two may differ from time to time.

The hedonic set point is indicated on the CAS Matrix in the following manner (Figure 7 below). (Let's assume for demonstration purposes that we are working with a dog whose hedonic set point is positively valenced, mid-low arousal, so positioned in Q2 as calm and relaxed):

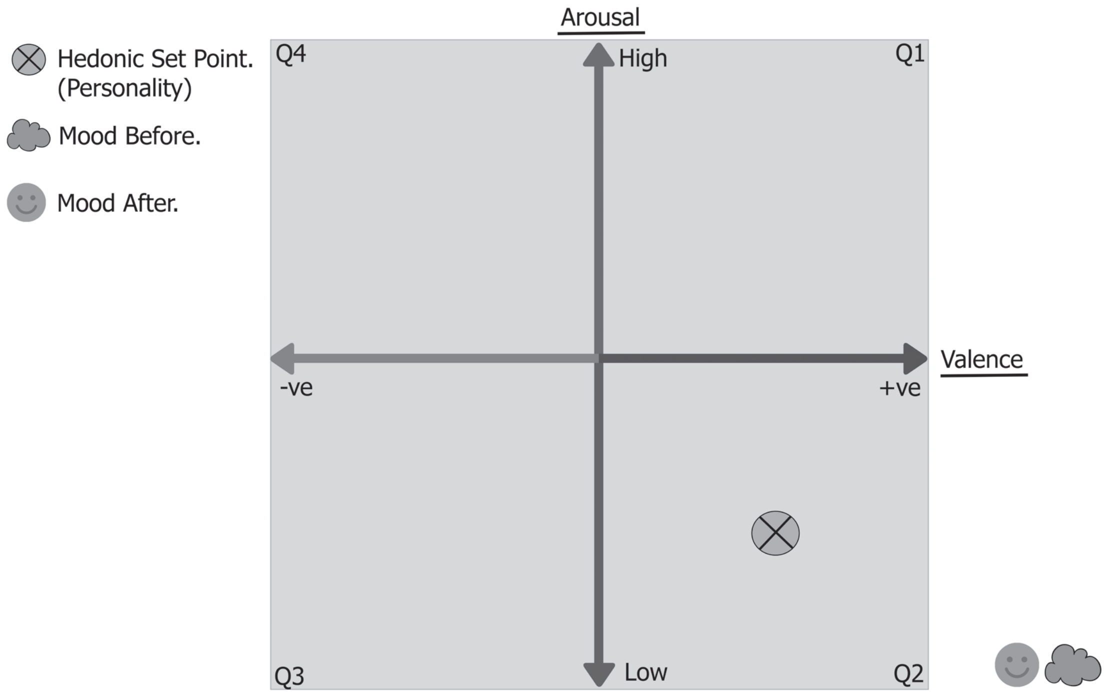

Figure 7.

Next up is the Mood Assessment: this is where we look at how the animal currently feels in terms of hours, days, weeks, or even a month. (Note that months can be thought of as leaning more toward hedonic set point measurement because moods, while less fluctuating than emotions, generally don't last for months on end without changing.)

Mood can be applied to different timeframes, with the rules defining it as not attached to a specific stimulus and lasting for longer periods of time than emotions (which are fleeting and attached to a specific experience). For example, you can be in a bad mood today because you were stuck in traffic for hours and now your whole day feels ruined. You can also be in a good mood because you've been on holiday for the last week, or you can be in a bad mood because you've had a continuously stressful month at work. Mood can provide us with information about the type of environment the animal is living in, including the presence or probability of threats and reward opportunities, as well as how well the animal is coping in that environment. This plays an important role in helping animals to make decisions when they engage new situations or stimuli. In other words, the animal's *mood* facilitates the animal's decision-making behaviour.

Mood is plotted on the matrix as shown below (Figure 8). Let's say that the dog whose hedonic set point we mapped above is having a bad month; he has torn a cruciate ligament and now he's not allowed to swim, play or walk for six weeks. He's sore, and his movement is limited to crate rest with short toileting breaks. He is bored and isn't getting as many opportunities to engage in activities that make him feel as good as he usually would. (Therefore, his current mood can be described as negative/pessimistic.) His mood is overall negatively valenced and mid to low arousal:

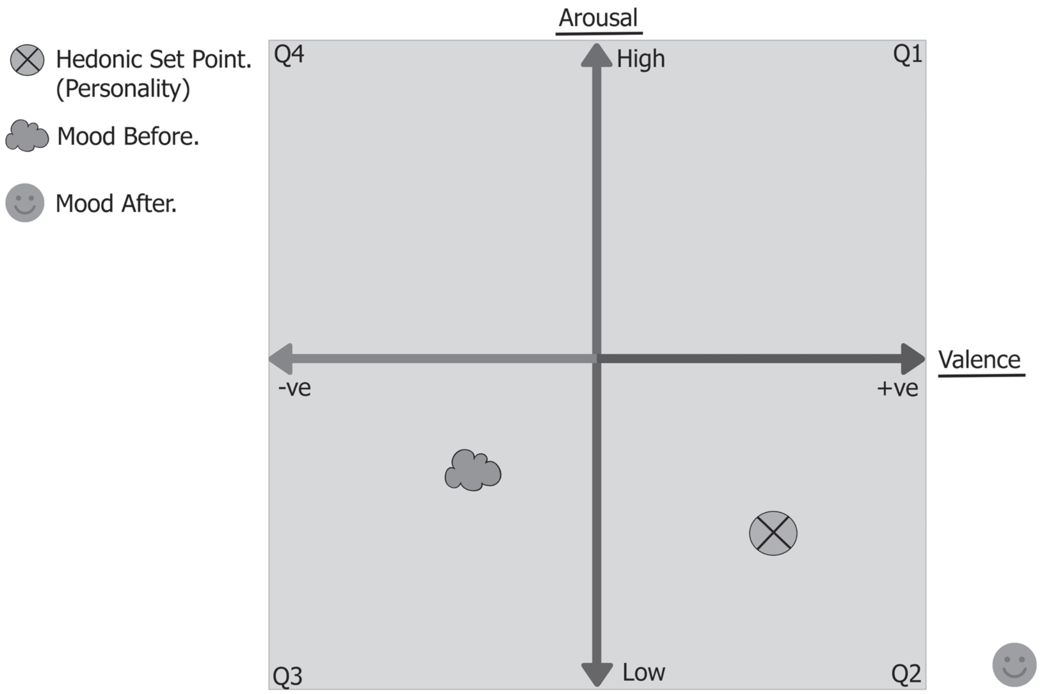

Figure 8.

The position where you plot Mood Before on your CAS Mood Matrix is the point of disinhibition that you will use on your Emotionality graph to track how the animal feels during a particular emotional experience. The Mood After can be used to show clients where you'd like the animal to be following treatment, or it can be used during behaviour modification to monitor how the animal is responding to treatment.

Establishing both mood and hedonic set point in an animal's treatment is critical. A depressed dog is much harder to motivate than a content one and will likely have a pessimistic bias. His decision-making will be influenced by how he's feeling, making it difficult in the short to medium or long term to engage his interest in any changes as part of a behaviour modification program. Of course, a dog who is maniacally happy and who loves everyone and everything is in just as difficult a mood if, say, we want to work on his ability to engage in calm social behaviour instead of leaping all over other dogs. In treatment, it's the basal mood that first needs attention, not the emotional response at the time when the dog is getting into conflict with other dogs. Mendl states that moods can be likened to a running mean of positions occupied within core affect space over a preceding period, and continually (albeit slowly in comparison to emotions) change as the result of novel events and experiences (Mendl, Burman and Paul, 2011). Addressing the emotional responses to stimuli comes after we have stabilized mood at a more communicable level.

Hedonic budget assessments

The hedonic budget assessment follows on from the Mood State assessment. It evaluates certain obligatory and required inputs that have a direct impact on the animal's mood and hedonic set point. If an animal is in an environment where fitness-enhancing rewards are present, accessible, and readily obtained, the animal is likely to experience a mood and hedonic set point that is centred on the Q1/Q2 quadrant. A low resource environment and failure to acquire rewards will lead to a predominantly Q3 mood. An environment filled with hazards and fitness threatening stimuli is likely to result in a Q4 mood. As Mendl states: "Theoretical and empirical studies suggest that positive high arousal affective states in quadrant Q1 (e.g., excitement, happiness) are associated with appetitive motivational states, and function to facilitate seeking and obtaining rewards" (Mendl, Burman and Paul, 2010; Cabanac, 1992; Carver, 2001; Custers and Aarts, 2005; Rolls, 2005; Burgdorf and Panksepp, 2006).

In contrast, negative low arousal states in Q3 (e.g., sadness, depression) are associated with experiences of loss or lack of reward and may promote low activity and conservation of energy in conditions where resources are lacking (Nesse, 2000). Thus, affective states along the Q3–Q1 axis appear to be related primarily to acquiring fitness-enhancing rewards, and the success or otherwise of this endeavour. Several researchers propose that an individual's position along this axis may be associated with the activity of underlying, perhaps primitive, biobehavioural systems ('positive activation,' 'behavioural activation,' BAS) or 'approach process' systems (Gray, 1994; Watson et al., 1998; Carver, 2001) concerned with the control of approach behaviour and resource acquisition. Negative high-arousal affective states in quadrant Q4 (e.g., fear) are thought to be principally associated with, and to coordinate appropriate responses to, the presence of threat or danger (Gray, 1994; Carver, 2001; Rolls, 2005; Burgdorf and Panksepp, 2006). In contrast, positive low-arousal affective states in Q2 (e.g., calm, relaxed) are associated with experience of low levels of threat (Carver, 2001), perhaps facilitating the expression of maintenance, consolidation, and recovery activities.

Coppinger discusses how **Type** influences an animal's day to day behaviour (Coppinger and Coppinger, 2001) especially when it comes to the seven Pankseppian systems. An animal's type influences how (and when) he responds to the activation of these systems, and how he expresses himself behaviourally. It affects what he needs, wants and likes. Type classification, therefore, plays an important role in the hedonic budget assessment step.

Once you have determined an animal's type, you can apply this information to the hedonic budget to accurately plot the animal's needs at the appropriate level for that individual. There are two sections on the hedonic budget: **Required** and **Obligatory**. Required refers to activities which promote behavioural and emotional well-being, whereas Obligatory refers to activities without which the organism could not survive. You'll see in later chapter how some of the Required categories can be left empty if they do not apply. For example, a solitary animal does not necessarily need PLAY system activation as an adult with others of the same species, in which case, it can be omitted from the hedonic budget assessment.

Note that Required can also be divided into two sections for companion animals. Required (Active), which includes the activities listed in the hedonic budget, and Required (Passive), which can be added on as needed. Required (Passive) refers to meeting the individual's need for accessing a safe space and has two options — Required Passive (alone) and Required Passive (with someone). Not all companion animals would require these to maintain a positive mood, but if they do, it should be considered as part of the hedonic budget. An example here would be cats, who may require time alone, or dogs may who require passive time resting in the company of a human.

The hedonic budget is an adaptation of Maslow's hierarchy of needs and can be thought of as a pyramid, shown below in Figure 9.

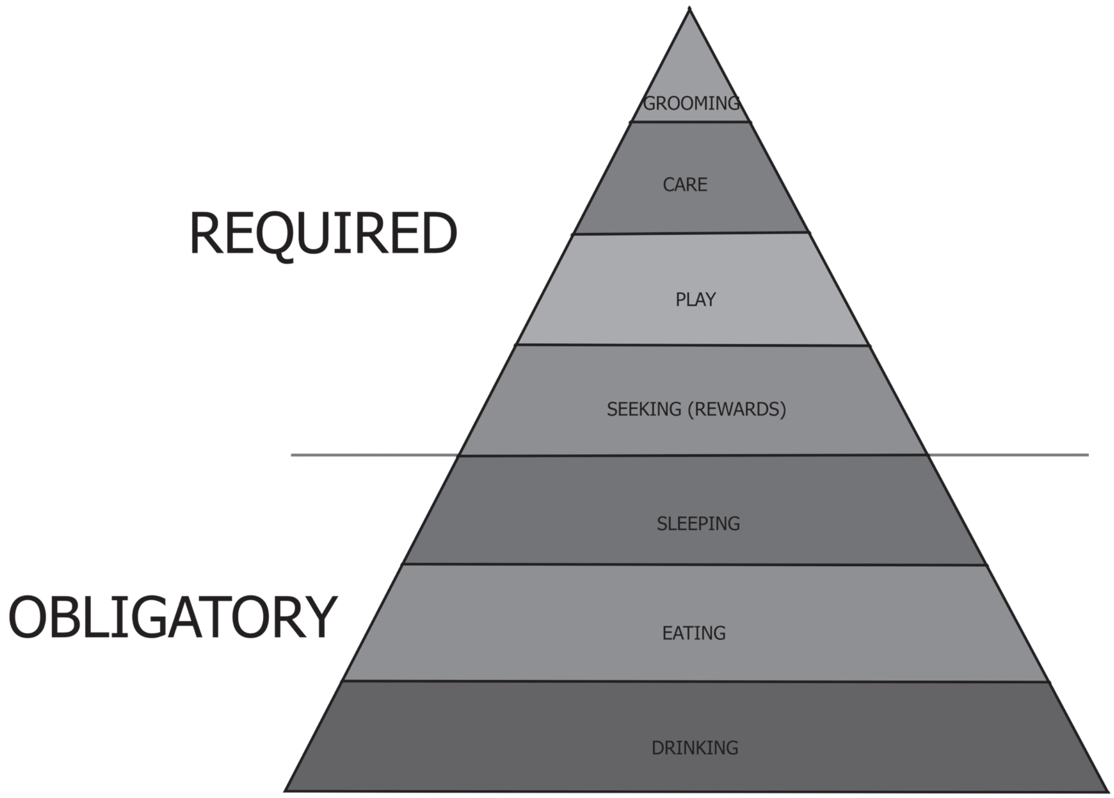

Figure 9.

Under Required we have Grooming, CARE, PLAY and SEEKING system activities, and under Obligatory, things that must happen to keep you alive, such as eating, sleeping and drinking. The hedonic budget is laid out and explained in the pages below. There are seven categories: SEEKING, PLAY, CARE, Grooming, Eating, Sleeping and Drinking. Each category is divided into the following as displayed in the chart displayed on the following page.

Type Overall: This refers to the ideal amount of time that *all animals of this type* should be spending engaged in this activity (i.e., ALL heelers/all headers/all object players or in case of other species, ALL animals of the same species). It does not take individual elements into consideration, but instead, gives a general measurement of what this activity should look like in the **original prototype** in the **original context**.

Individual Variation: This is where the individual's uniqueness is considered, for example age, physical ability or disability, likes, dislikes, personality and learning/environment.

Before: How much time the individual spent engaging in the activity before behaviour modification.

After: How much time the individual is spending engaging in the activity after behaviour modification. You can also use this as a "what we would like it to be" measurement if you're explaining a behaviour program to the client.

TYPE Overall:	
Individual variation:	
Before:	
After:	

The Hedonic Budget:

REQUIRED (Active):		
SEEKING:	Type Overall:	
Hunting/Foraging	Individual Variation:	
	Before:	
	After:	
SEEKING:	Type Overall:	
Exploring/Novelty:	Individual Variation:	
	Before:	
	After:	
PLAY:	Type Overall:	
Other animals of the same species	Individual Variation:	
	Before:	
	After:	
PLAY: People	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
PLAY: Other familiar animals – different species. (Can also be changed to object play where applicable.)	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
CARE: Other animals	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
CARE: People	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
GROOMING: Self	Type Overall:	
	Individual Variation:	
	Before:	

	After:	
GROOMING: Mutual	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
GROOMING: Other animals	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
GROOMING: Guardian	Type Overall:	
	Individual Variation:	
	Before:	
	After:	

OBLIGATORY:		
Sleeping/Resting:	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
Eating:	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
Drinking:	Type Overall:	
	Individual Variation:	
	Before:	
	After:	

You will see that SEEKING, PLAY and CARE have multiple options below them.

SEEKING: Hunting/Foraging involves **food acquisition behaviours** (including predatory motor pattern expression in context of chase/grab/bite games and chew toys, food dispensing toys, training, tracking games etc. or foraging if the animal is not a predator) and **SEEKING: Novelty/Exploring** which involves exploring the environment and encountering novelty (walks, changes in environment, new experiences etc.)

PLAY has three categories: **With other** refers to how much social play between conspecifics is needed, **People** refers to how much play with people is needed and **Other familiar animals** refers to resident/familiar friends (cats, birds, horses etc.) living with the individual and with whom play happens. Where applicable, this can be changed to become "Object Play" if needed.

CARE has two categories: **Other animals** refers to residents/siblings/friends with whom the CARE system is active and **People** referring to any humans that activate the CARE system.

GROOMING has four categories: **Self**, which refers to the amount of time the animal engages in personal grooming, **Mutual**, referring to any grooming that is reciprocated (both animals are grooming each other), **Grooming other animals** where the animal whose hedonic budget is being compiled is grooming another animal without it being reciprocated and lastly **Guardian**, which refers to either grooming needed to maintain a healthy coat, or grooming done to the guardian (such as licking).

The categories that focus on the presence of others are only applicable if relevant. Think of these as things an animal may want, instead of things he needs. A dog who loves other dogs and who appears withdrawn when none are available may benefit from a canine companion, but a dog who either dislikes other dogs or does not particularly care about their presence will not appreciate the addition of another pet in the household. As discussed in the Case Study examples in later chapters, some animals do not need to play with humans, while others thrive when that opportunity is present.

The obligatory categories are:

OBLIGATORY:		
SLEEPING/RESTING:	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
EATING:	Type Overall:	
	Individual Variation:	
	Before:	
	After:	
DRINKING:	Type Overall:	
	Individual Variation:	
	Before:	
	After:	

The obligatory categories consider both the type specific needs and the individual variation and here the physical condition of the animal may contribute to the existence of a behaviour problem, as discussed in the hedonic budget chapter further on.

The hedonic budget is a tool that measures the activation of important systems, which in turn will have a measurable impact on the individual animal's behavioural and emotional well-being and his mood. A dog with an impoverished hedonic budget will likely have a poor mood state, and a dog whose basic needs are met sufficiently will have a positive mood state.

Hedonic budget scoring example

The hedonic budget score is allocated out of 10, with 0 indicating that the animal spends no time engaged in the specified activity, and 10 indicating the highest amount of time the animal is either actively engaging or should be engaging in the activity. More detailed examples of how to fill out the hedonic budget are given in Chapters 6 and 8.

In the example below, imagine a Border Collie who chases lights and any movement to the exclusion of everything else. Such over-active system activation within the hedonic budget can lead to problems. If this was plotted on the hedonic budget graph, it would be plotted under SEEKING: Hunting/Foraging, as this is a SEEKING system activity where the dog is expressing a part of his predatory motor pattern, albeit on an inappropriate target.

SEEKING: Hunting/Foraging	**Type Overall:** Border Collies were bred to herd, an activity that includes eyeing, stalking and chasing moving animals. This is an important behavioural need that must be met in order for the dog to be behaviourally and emotionally healthy and is considered a high requirement activity for a Border Collie's Type needs.	x x x x x x x x (8/10)
	Individual Variation: This is a pet border collie, living in a suburbun household. His individual variation looks at his environment and his specific needs. This dog needs a lot of stimulation to combat boredom and lack of stimulation, but as a **pet/companion** border collie, herding does not to feature so heavily as it can (and in this case, does) lead to behaviour problems. Other more suitable options should be provided to meet his need for mental stimulation.	X x x x x x (6/10)
	Before: Our example Border Collie is engaging in eye-stalk-chase behaviour too much, he is not only 'herding' lights, but also anything else that moves in his environment, to the point where he is not doing anything else like sleep, play or exploring.	X x x x x x x x x x (10/10)
	After: The frequency of the behaviour as a goal or after behaviour modification has happened. As a goal, this should then be similar to the dog's individual variation.	X x x x x x (6/10)

Notably, the hedonic budget is more than just a measure of is an animal's life balanced. When you are working with a client, this hedonic budget helps you to monitor how the animal is responding to treatment. It gives you a solid starting point for any behaviour modification program: any deficits or excesses identified must be rectified before any other programs can be implemented. Lastly, and importantly, if balanced, it creates a positive cognitive bias that makes the animal predisposed to accepting changes to the environment and responding to them positively. A cat who is struggling to adjust to small but significant changes to improve her hedonic budget may not be receptive to a counterconditioning or desensitization program.

Remember, it can take a long time for an animal's mood to change from bad to good, but without that change, the behaviour modification program will likely be ineffective and it likely may appear that no progress is being made, which can result in a demotivated behaviourist, trainer, vet, and guardian! Therefore, you should make sure that guardians understand the importance of this crucial step, so they don't rush ahead without understanding the bigger picture. A good analogy here is to think of the hedonic budget as laying the foundation when you're building a house. If the foundation is not solid, anything you build on top of it will be unstable or temporary. By adjusting an animal's hedonic budget, you are providing a solid foundation on which to implement your behaviour modification program. You will also be putting in place tools to use later to successfully change emotional responses and to teach coping mechanisms to facilitate behavioural changes.

The Emotional Assessment

Emotional states and moods are intimately associated with each other and exist in the same framework within core affect space. As discussed, moods are the product of the cumulative emotional states an organism has experienced over a given period, and they have a very important and adaptive role in the day-to-day life of the organism. The subject of emotions in animals is of great interest to anyone concerned with animal welfare because it is now widely accepted that particularly mammals have an array of primary affective experiences similar to humans such as *feeling* happy, sad, lonely, relieved, depressed etc.

As mentioned previously, in human psychology the gold standard for measuring emotional states is self-report. From a scientific perspective, even self-report is far from ideal because it assumes that subjective emotional states are uniformly comparable across the human population. This assumption cannot be tested and therefore whether it is true is unknowable.

This difficulty in measuring emotional states in humans is one of the main reasons why emotionality in other animals is difficult to quantify, because it has not been possible to ask an animal how he feels. However, in the field of human psychology, much has been learnt about the nature of emotionality through the statistical analysis of complex questionnaire-based studies across wide and diverse populations of people. Furthermore, one can attempt to quantify what a human or animal is feeling by observing their behaviour (such as approach versus avoidance behaviour) and physiology (such as heart rate or levels of stress hormones in the blood). If the behaviour and physiology is similar across species, one may infer that the emotion (affect) is similar too. From such studies, two fundamental *dimensions* of emotions have emerged (see Figures 10 and 11 below):

Emotional states vary in arousal level: For example, feeling ecstatic and feeling terrified have high arousal levels, while feeling contented and feeling worried have low arousal levels (Figure 10):

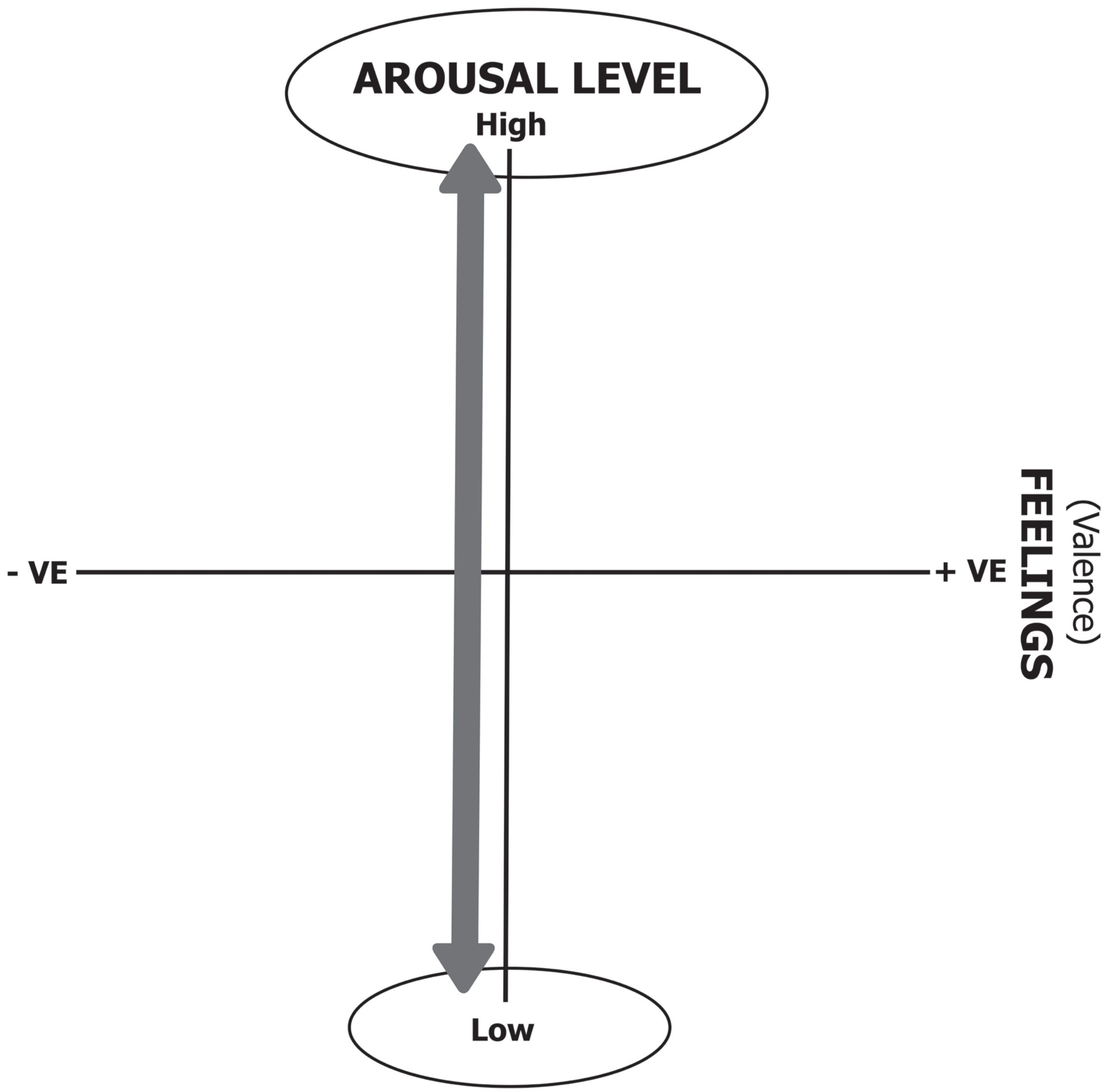

Figure 10.

Emotional states vary in quality (also called valence): For example, feeling ecstatic and feeling contented have high-valence positive/appetitive and low-valence positive/appetitive qualities respectively, while feeling terrified and feeling worried have high-valence negative/aversive qualities and low-valence negative/aversive qualities respectively (Figure 11 below).

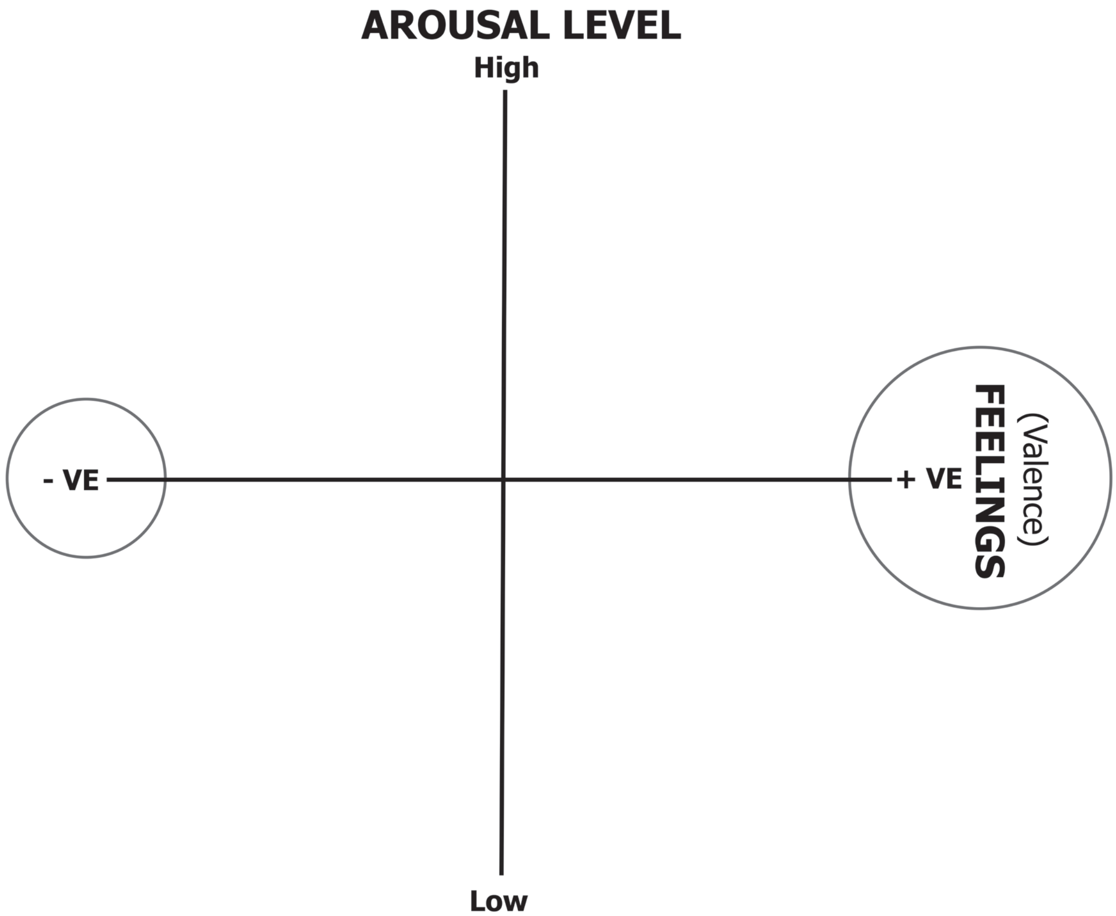

Figure 11.

The **Dimensional Emotion Model** is used widely in human psychology. Within this dimensional model, emotional states are more fluid and can be defined by where they exist in the two-dimensional space of valence and arousal. Positive feelings are located on the right side, while negative feelings are located on the left. When human subjects verbally describe how they feel using the dimensional model, they still use terms such as excited, happy, relaxed, calm, fearful, anxious, sad, depressed etc. but these emotions are defined by their valence and level of arousal and thus exist on a sliding scale, like the hues of colours in a rainbow. Let's compare the Dimensional Emotion Model to the **Discrete Emotion Model** that we previously introduced. In the Discrete Emotion Model, emotions are considered to exist as a set of distinct, separate, and hard-wired systems in the brain. These distinct emotional systems become aroused and inhibited to generate subjective feeling states and influence behaviour. In this model, an emotion such as 'fear' feels unique and distinct compared to another emotion such as 'rage.'

Consider again Panksepp's seven discrete emotional systems (SEEKING, PLAY, CARE, LUST, FEAR, GRIEF and RAGE). Each system consists of complex, inter-connected neural pathways in the brain along with their neuro-chemistries, that have evolved to fulfil very specific functions. For example, the FEAR system is essential for generating the negative emotional states that negatively reinforce escape behaviours and then facilitate the formation of long-lasting memories of the event. Since the emotional state of fear generated by the FEAR system has inherent arousal and valence properties, this emotional state can also be plotted on the dimensional model graph, for example, mild fear (nervousness: negative valence, medium arousal) and intense fear (terror: negative valence and high arousal). Thus, a small number of distinct emotions can span the entire dimensional space of arousal and valence.

Overall, it's clear that from a practical application perspective, *both models are valid* and together, they can clarify much of the complexity and dynamic variation that exists across all emotional states. Such a combined model is shown in Figure 12, where subjective feelings can be located within dimensional emotional space.

The MHERA Emotional Assessment model below combines the different models discussed above, resulting in a tool that allows the practitioner to accurately plot the animal's emotional experiences. It also clearly shows where the Pankseppian systems would fall based on valence and arousal. Note that SEEKING is present in all four quadrants, since SEEKING is always a little activated, like background noise, and plays a general role in motivated behaviour.

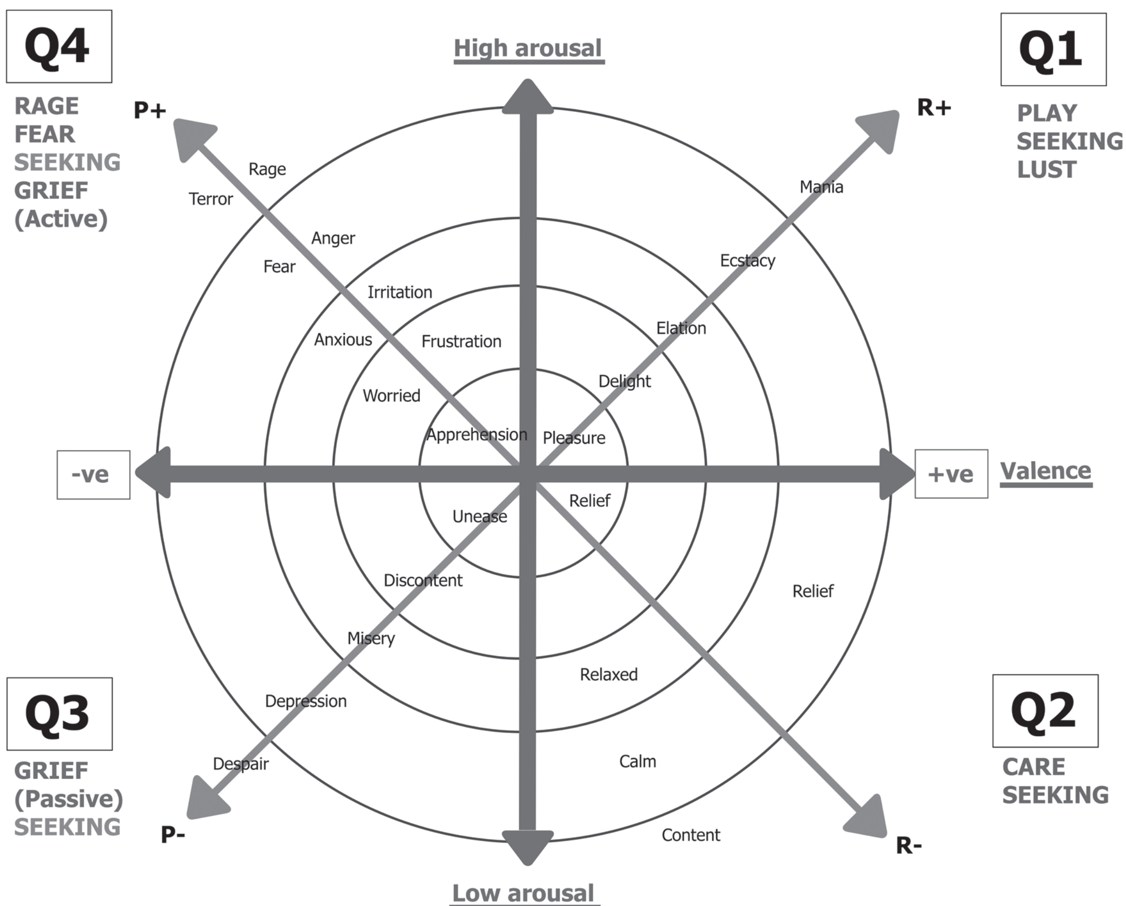

Figure 12.

It may look daunting when you first encounter it, but once you understand how this model works, it quickly becomes an invaluable tool that is easy to use. Changes in emotional states usually occur because of a specific event or stimulus, meaning they are (a) attached to something (e.g., a dog fearful of other dogs because of a previous negative experience may tend to bite if approached by another dog), and (b) generally brief in duration (e.g., once the other dog leaves the dog's level of fear subsides). The emotional lives of animals are complex because they engage in behaviours that involve a combination of:

1. Fulfilling needs, such as acquiring food and water. (These would fall under the **Obligatory** categories in the hedonic budget.)
2. Pursuing wants, such as the desire to play, to be petted and groomed and to maintain social bonds. (This would fall under the **Required** if applicable categories.)
3. Negotiating fitness-threatening hazards, such as punishers and predators.

When we do an emotional assessment of an animal, we are tracking the shifting emotional experiences that the animal is having in that moment. Always remember that emotions fluctuate, sometimes rapidly, which is why emotional states can be measured in micro to nanoseconds. When we are looking at a problem behaviour, we use the emotional assessment tool to establish what the animal is feeling shortly before, during and after the problem behaviour is seen (the 'after' forms part of the Reinforcement Assessment discussed later.)

There must always be a starting point when using the Emotional Assessment graph; this starting point is referred to as the point of disinhibition and is where you would begin plotting the individual's emotional experience. This point of disinhibition is the *Mood* that you've determined on the Mood State graph. Let's use a dog for this example. Imagine this dog's hedonic set point is in Q2 (positively valenced, low arousal-relaxed) and through the completion and evaluation of his hedonic budget, you've determined that his mood is currently one of pleasure (Figure 13 below), because his week so far has been filled with fun activities, lots of positive interaction with his humans and almost no stressful experiences.

On the CAS Mood state graph, it would look like this:

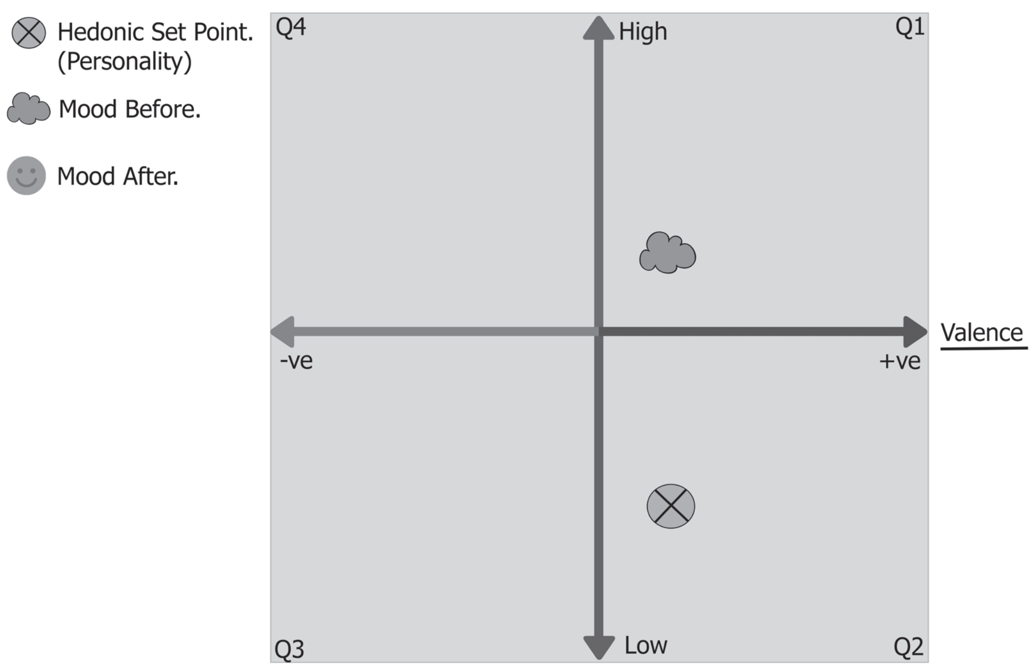

Figure 13.

On the Emotionality graph, the point of disinhibition is then going to be one of pleasure (Figure 14 below), so a mark is made to indicate the valence and arousal level of the point of disinhibition (the base mood of the animal at the time of disinhibition):

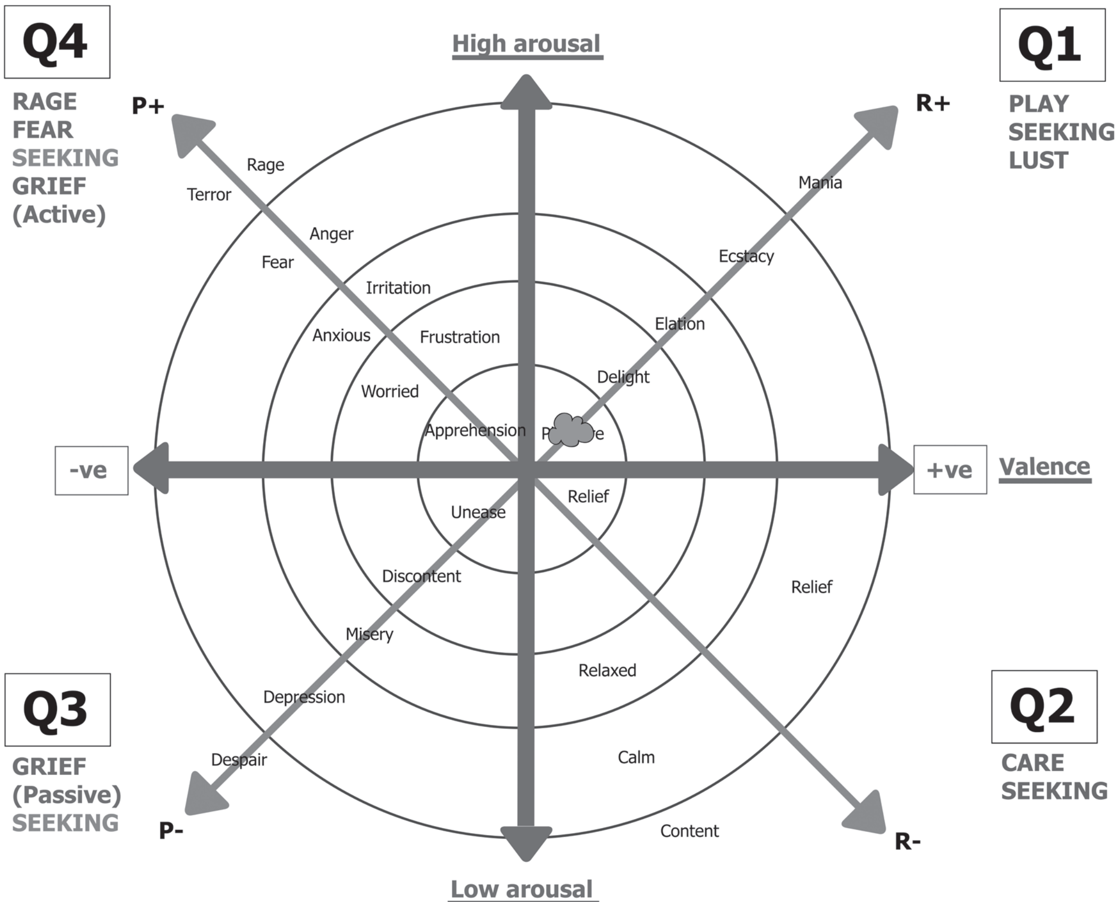

Figure 14.

Let's look at how to practically apply an emotional assessment. Imagine this dog is about to go to the vet. His owner picks up the car keys and the dog's lead. His emotional state changes to delight based on this new information about changes in his environment.

Since this dog has a positive cognitive bias / an optimistic outlook in life (because of a long-term, appropriately balanced hedonic budget, more positive mood states than negative ones and very little negative experiences and an optimistic hedonic set point,) he gets excited about the prospect of something good happening (Figure 15 below).

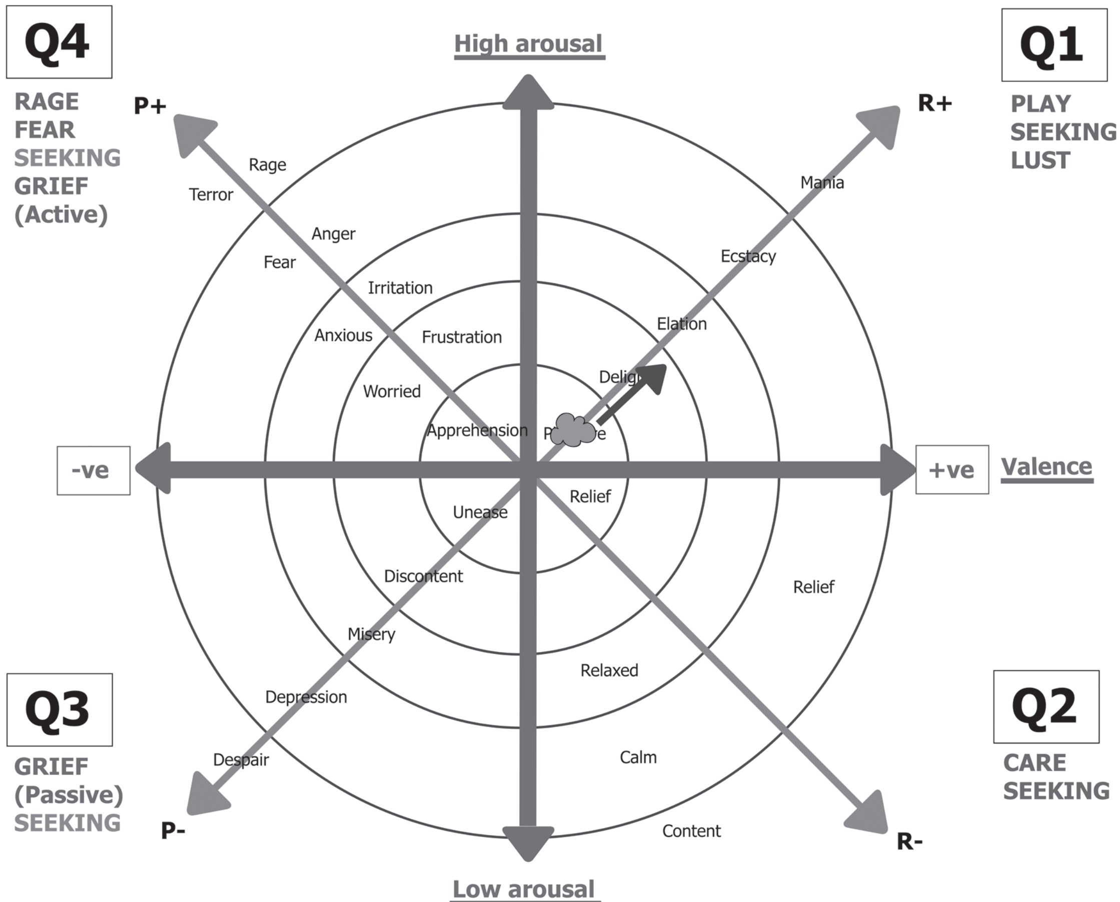

Figure 15.

His owner loads him into the car, and they start driving. The dog gets even more excited, and his emotional state escalates to elation (Figure 16 below).

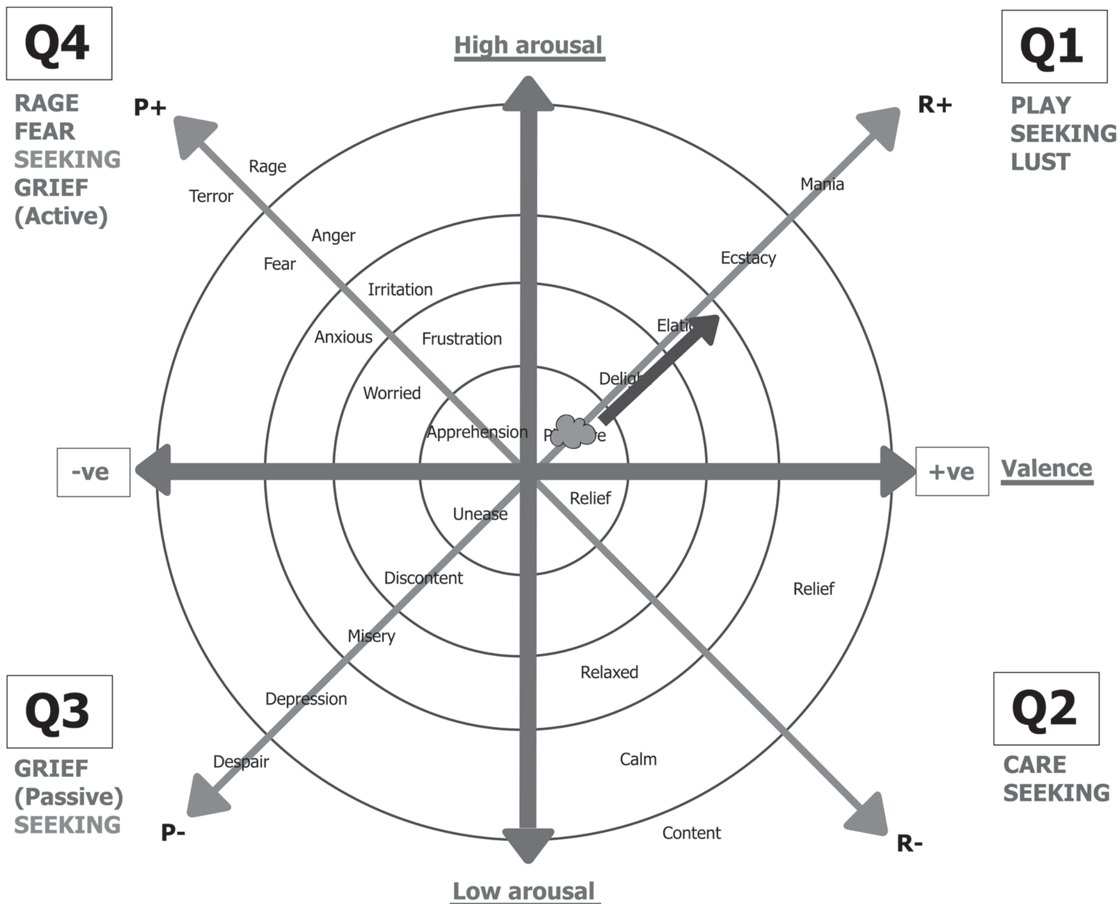

Figure 16.

The owner drives past the park, and into the vet's parking area. The dog has overall been healthy, and only goes to the vet for yearly vaccinations and check-ups. For this dog, visits to the vet have not exactly been pleasant experiences. When he visited, he would always be restrained, examined, injected, dewormed and then taken out through a waiting room full of dogs barking at him, resulting in a negative association with the vet practice. He immediately recognises the practice and his emotional state changes from elation to apprehension (Figure 17 below).

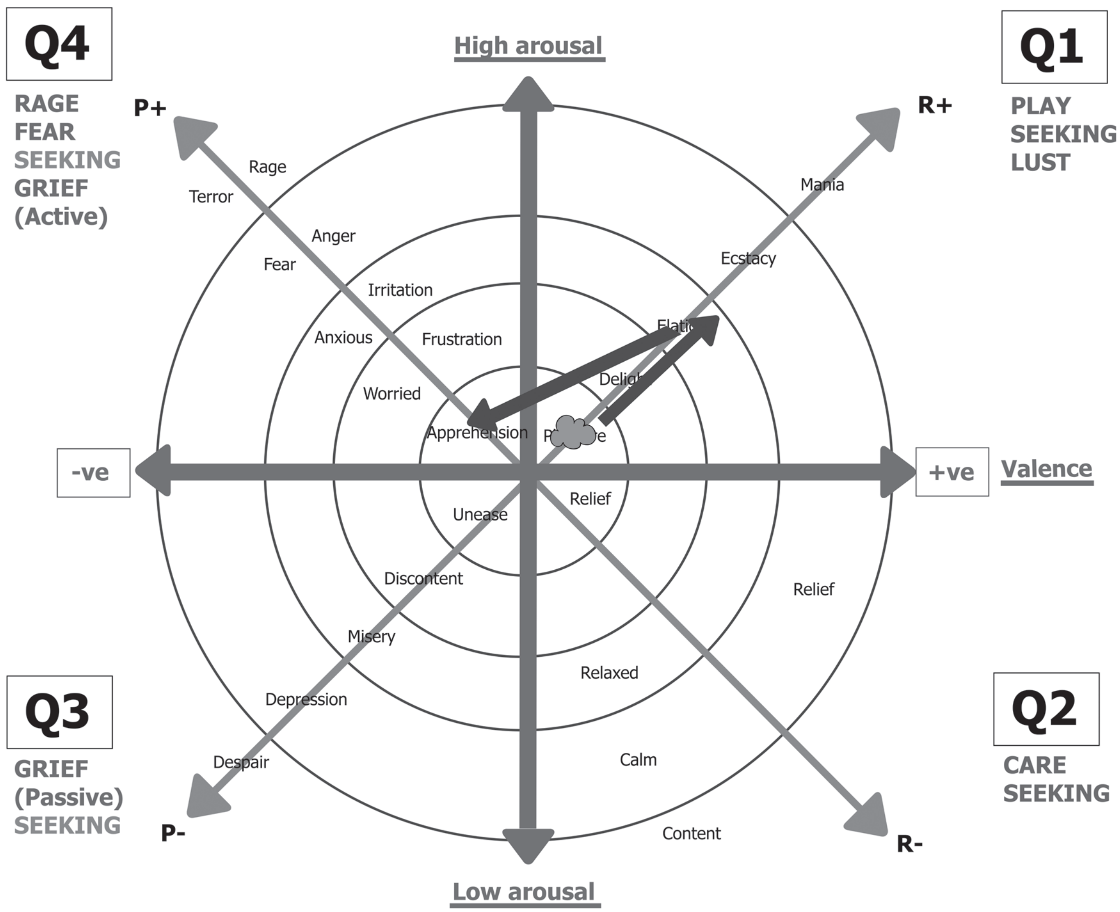

Figure 17.

His owner takes him out of the car and walks him into the veterinary practice, where the receptionist greets them. While other dogs bark at him, the owner walks the dog to the scale, and the receptionist stands next to them. The dog is placed on the scale, something he is not often expected to deal with, and his apprehension increases, now resulting in him feeling anxious (Figure 18 below).

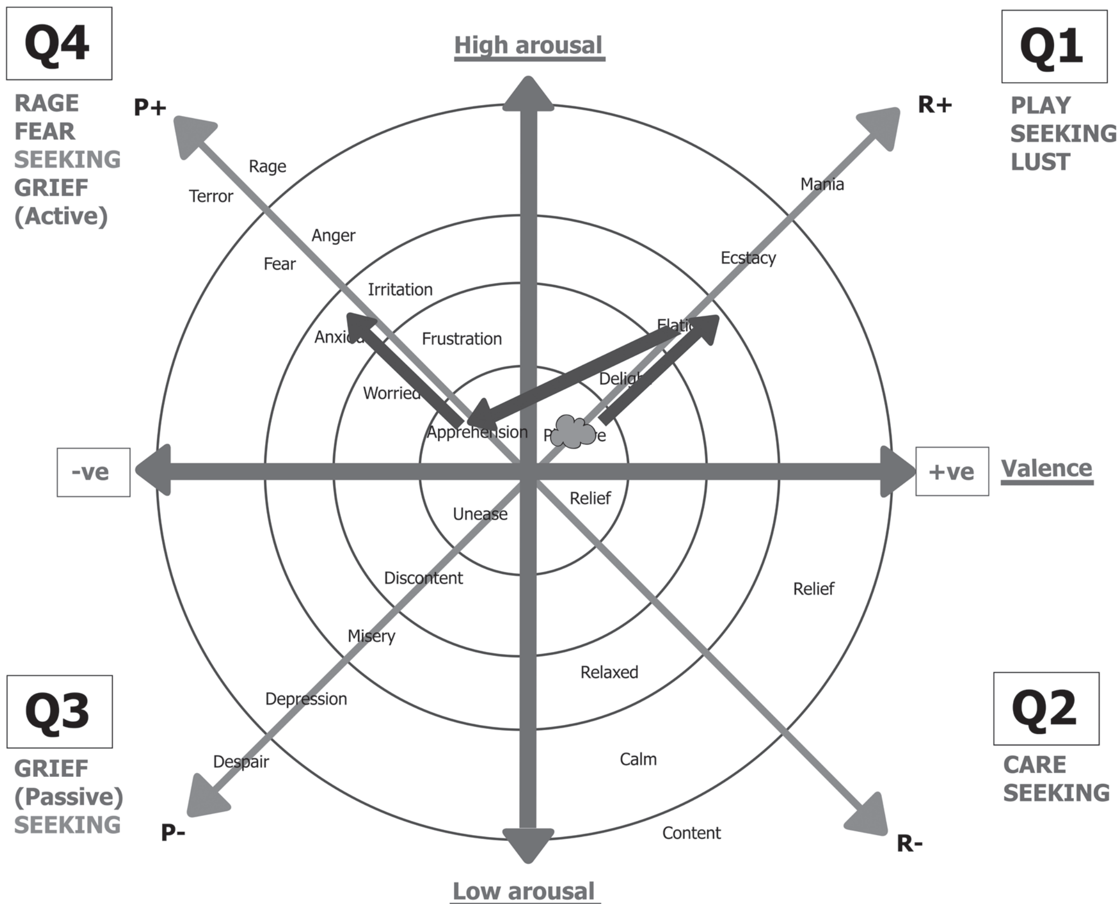

Figure 18.

The receptionist leans over the dog and reaches out to hold him still so she can see how much he weighs. The dog's emotional state escalates past feeling anxious, all the way to fear (Figure 19 below) and he growls at her to warn her to stay back.

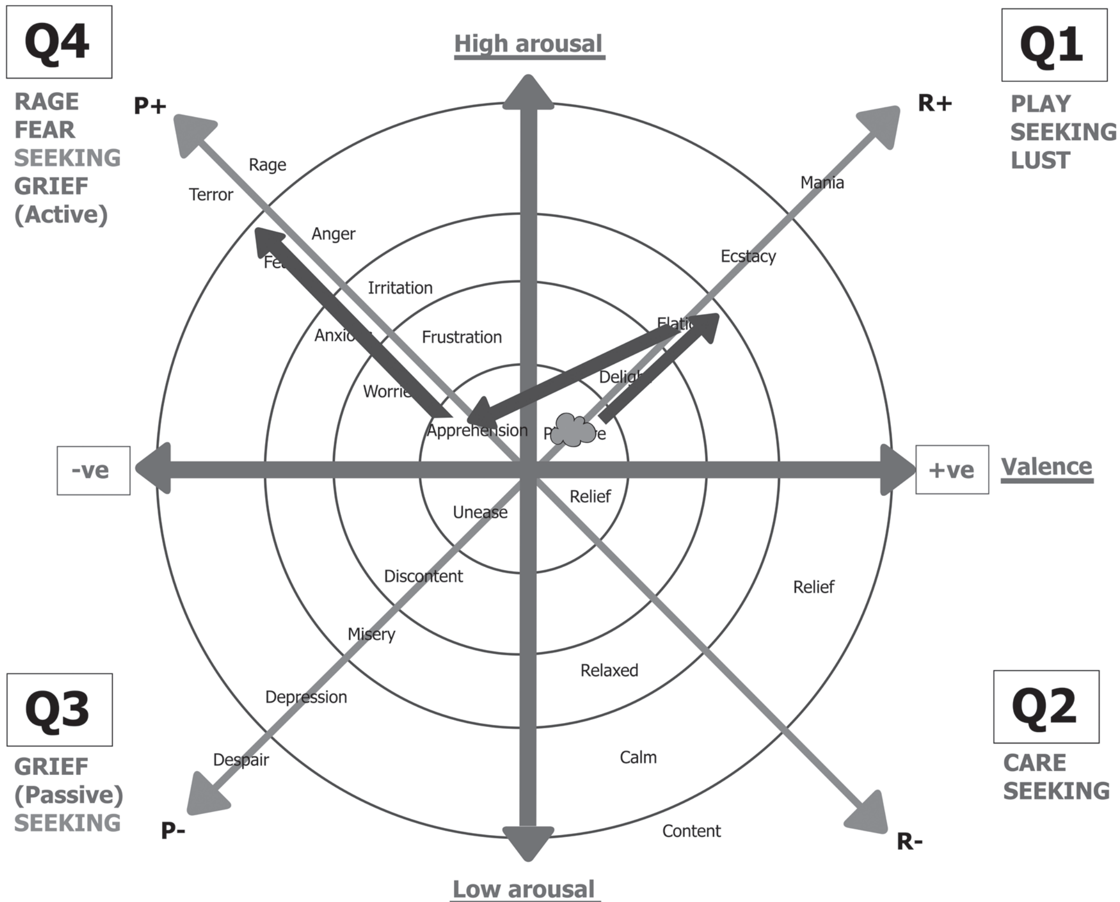

Figure 19.

As you can see, the valence of the experience has moved from positive to negative, and the dog's arousal level has changed. The receptionist moves away, the dog is taken off the scale and walked away from her towards the exit where his owner strokes him to calm him down. The increase in distance between the dog and the receptionist, and the decrease in distance to the exit, results in the dog's emotional state now changing to relief (Figure 20 below.)

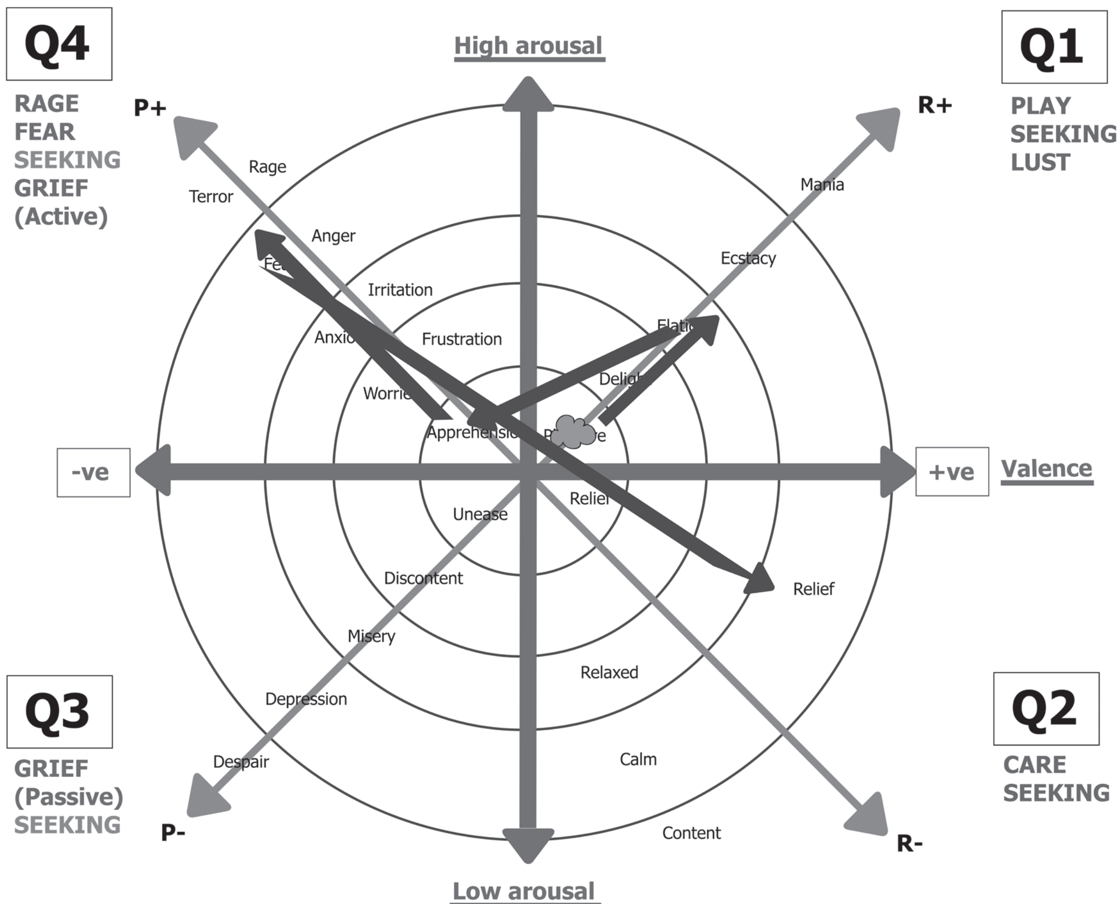

Figure 20.

His behaviour of growling is rewarded because not only does it increase distance between him and someone he views as scary, but it also increases proximity to the exit of the scary place, and it results in him feeling relieved. The dog is loaded in the car and driven back home, where he reverts to his normal mood once he calms down.

The emotions he experienced were fleeting and fluctuated rapidly — which is exactly what emotions do. Using the Emotional Assessment, you can track these emotional fluctuations to get an accurate representation of what the dog is feeling in terms of valence and arousal levels. This allows you to identify the reinforcement present in any given behaviour, which takes us to our final step, doing the Reinforcement Assessment.

The Reinforcement Assessment

The final part of the MHERA approach is the **Reinforcement Assessment**, which involves assessing what the benefit is to the dog in performing the behaviour. If there was no emotional benefit to the dog, then the behaviour would never have been established or rehearsed, nor would it have withstood any efforts to remove it.

This part is crucial, as the question of reinforcement must also be considered at the neuro-chemical level, and any treatment must first un-pair the feelings of success or relief that have become established at carrying out the behaviour. Only then can one establish opportunities in treatment for the dog to carry out alternative, but equally successful or relief-bringing behaviours, which then themselves become reinforced and established in those circumstances. In Chapter 4, the concept of reinforcement is discussed extensively.

Chapter 4

Reinforcement – What is it Really?

Written by Nancy Payne

The process of reinforcement appears simple enough. When applying positive reinforcement, the desired behaviour is rewarded, resulting in the behaviour occurring more frequently. The reward could be anything pleasant: food, physical touch or a ball to chase, depending on the mammal and what they want in that moment. Then there is negative reinforcement, when a behaviour results in something aversive being removed from the situation, such as a dog barking at a scary stranger and causing the stranger to move away, rewarding the bark. However, research into the biological nature of reward has forced scientists to refine how we think about distinct types of reward and their different effects on behaviour.

Separating rewards into 'liking' and 'wanting'

The original theory about how pleasure is mediated in the brain comes from experiments with rats. A scientist could ask a rat how rewarding a particular stimulus was by studying how frequently the rat would press a lever to obtain the stimulus. For example, a rat might press a lever 10 to 100 times an hour if rewarded each time with a pellet of plain food, and 150 times an hour if rewarded each time with a sweet sugary treat. The conclusion was that the sugary treat must be more pleasurable, or more rewarding, thus the lever-pressing behaviour was more strongly reinforced by the sugary food and therefore occurred more frequently.

Extending this work, Olds and Milner implanted electrodes into particular areas of a rat's brain and stimulated these areas with electricity whenever the rat pushed the lever (Olds and Milner, 1954). The purpose was to determine if electrical stimulation played the same role as a piece of food. They found that when electrodes were inserted into certain parts of the brain, the rats would frenetically push their levers up to nearly 2000 times an hour to stimulate the electrode — a huge increase in lever pressing! (Olds, 1956). The conclusion was that the electrical stimulation must be producing a strong feeling of reward or pleasure in the rat, reinforcing the lever-pressing behaviour. The brain areas that produced such powerful responses — the septum and the nucleus accumbens — became known as the "pleasure centres" of the brain (Berridge, 2010). Since these brain areas used the neurotransmitter dopamine for signalling, dopamine additionally become known as the brain's "pleasure chemical" (Kringelbach and Berridge, 2010).

Over time, scientists questioned whether stimulation of these so-called pleasure centres was truly pleasurable or not. For example, rather than experiencing some sort of electrode-induced bliss, the rats appeared frantic and compulsive in their lever-pressing endeavours. Additionally, similar experiments on humans failed to induce feelings of pleasure but did seem to induce a form of motivation (Green, Pereira, and Aziz, 2010).

To determine what was going on, Berridge and colleagues conducted experiments which manipulated the level of dopamine in the brains of mice to see how this affected the impact of different rewards (Berridge, Robinson, and Aldridge, 2009). They discovered that changing dopamine levels in these so-called pleasure centres didn't seem to affect how much mice actually 'liked' or 'enjoyed' a particular sweet treat. However, the amount of dopamine present in the animal's brain did affect how motivated mice were to obtain the same sweet treat (i.e., how much they 'wanted' it). Berridge also discovered much smaller brain areas that specifically seemed to modulate liking but not wanting. In other words, the research suggested that liking and wanting are psychologically and neurobiologically distinct processes in the brain (Berridge, Robinson, and Aldridge, 2009). In the words of Berridge, "getting what you want is different from liking what you got and getting what you want is not always pleasurable."

Liking

Liking refers to the hedonic impact of a reward, or how good something feels in the here and now. When we use the word pleasure, we're usually talking about liking — it feels good to eat cake, hold a loved one, or have sex. However, there's nothing intrinsically pleasurable about (say) particular tastes or physical sensations. Your tongue detects different molecules and sends signals to the brain. What dictates that sugary food tastes nice, and bitter foods taste unpleasant? Paraphrased from Nico Frijda, pleasure is an additional "pleasantness gloss" that is generated by hedonic brain circuits and painted upon the sensation of sweetness to turn the neutral experience of sweetness into a pleasurable experience (Frijda, 2001).

There is a clear evolutionary sense behind liking — if activities that promote survival or reproduction feel good, an animal is positively reinforced for performing those behaviours with a prompt feeling of pleasure, mediated by chemicals such as the brain's version of opioids (Kringelbach and Berridge, 2010).

Several hedonic hotspots have been identified in the brain that mediate feelings of liking. These hedonic hotspots tend to be localised in very small and well-defined brain areas. For example, several opioid and endocannabinoid hedonic hotspots have been found in the nucleus accumbens and the ventral pallidum, two well-connected brain areas known for their roles in motivated behaviour. Microinjections of opioids into these hotspots can increase liking. Conversely, damage to these areas can abolish liking completely — without your hedonic hotspots, cake still tastes sweet, but eating cake is no longer pleasurable (Kringelbach and Berridge, 2010).

Before we move on to wanting, let's return to dopamine. As mentioned previously, dopamine had long been believed to play a role in pleasure, partly due to its apparent involvement in experiment such as those by Olds and Milner, combined with the fact that dopamine neurons activated in response to rewards such as food, sex, and many addictive drugs. The reasoning was logical: if eating a piece of cake releases dopamine in your brain, and eating cake is pleasurable — and injecting a drug such as cocaine releases a lot of dopamine, and injecting drugs feels incredible — then it could be the dopamine that's mediating the intensity of pleasure. One may then further deduce that it's this intense pleasure that leads to drug addiction. However, Berridge had already demonstrated that dopamine wasn't playing an important role in liking — so what is dopamine doing in the brain, if not generating pleasure?

Wanting

Current research supports the idea that dopamine causes the wanting of hedonic rewards by attributing salience to reward-related stimuli (Berridge, Robinson, and Aldridge, 2009). In other words, the action of dopamine turns a neutral object into an *object of desire that you're willing to work to obtain*. Note that this isn't just about liking. For example, I can like the cake sitting on my table without having enough want or desire to eat it at that moment. It also isn't just about learning — your dog can learn that when you take a toy out of the cupboard it means you intend to play with him (an activity he likes), but if he doesn't particularly want to play at that moment due to physical tiredness or pain, he won't necessarily be motivated to come and play with you.

We can also see a clear reason why evolution developed wanting — we'd never do anything without this motivation! On the flip side, it's important that we focus our motivation, time and energy into the most important activities. Evolution favours those who reproduce and pass on their genes, so it should come as no surprise that systems such as LUST are tightly linked with wanting circuits and motivational salience.

The mesocortical and mesolimbic dopamine systems (running from the ventral tegmental area in the brainstem to the nucleus accumbens and the prefrontal cortex) play a key role in wanting. Thus Berridge's description of wanting overlaps considerably with Panksepp's SEEKING system in terms of neuroanatomy, neurochemistry, and function, with one major difference: Berridge believes that the liking and wanting systems can activate without an accompanying subjective experience of liking or wanting, as we'll discuss in the next section.

The conscious experience of liking and wanting

Berridge separates the concepts of 'liking' and 'wanting' into two parts: 1) the measurable and quantifiable aspects such as behaviour, physiology, and neural processes in the brain that mediate liking and wanting; and 2) the conscious and subjective *feeling* of liking (hedonic pleasure) and wanting (motivation) (Kringelbach and Berridge, 2010).

Berridge suggests that the subjective feelings of liking or wanting are a secondary consequence that may require additional brain systems such as the cortex. This differs from Jaak Panksepp, who felt that the activation of an emotional system (e.g., SEEKING) is necessarily accompanied by a consciously experienced emotion, and it's this emotion which drives behaviour.

To consider this further we must acknowledge the murky world of consciousness. Pleasure and pain convey the fundamental valence of a stimulus or experience: is something good or bad for you? (Panksepp, 1998). The ability to feel some sort of rudimentary pleasure or pain likely evolved far before the ability to experience more complex emotion. Even the earliest single cell organisms had the ability to detect dangerous stimuli and move away from them, but did these simple organisms have a conscious subjective experience of pain? Plants turn towards the sun, but do they derive pleasure from doing so? Probably not! However, consciousness — and thus the ability to have a conscious experience of pain — emerged at some point in the evolutionary tree, although where and how this occurred is under debate (and depends heavily on your definition of consciousness) (Ledoux, 2020).

A further complicating factor is that there exists evidence that hedonic pleasure can be nonconscious. In other words, a response to something pleasurable can be measured in someone's brain and their behaviour affected, even if the person isn't aware of the stimulus and doesn't report any feeling of pleasure. Thus, the core reward systems in the brain may be dissociable from systems that bring such feelings into conscious experience. Many scientists believe that the core hedonic hotspots are crucial for the generation of subjectively experienced hedonic pleasure, but whether or not other brain regions such as the cortex are required to bring the pleasure into conscious awareness is still under a great deal of debate. This mirrors the familiar question raised and thoroughly discussed in Panksepp's work (Panksepp et al., 2017).

For simplicity and for the purpose of practical application, COAPE aligns itself with Panksepp's belief that emotion drives behaviour and the two should not be seen as separate entities, particularly when it comes to the practical application of MHERA and ESTA.

Reconciling liking and wanting with Panksepp's emotional systems

As mentioned above, liking can be considered as a pleasantness gloss painted upon a sensation, and that it's not a coincidence that eating, caring for offspring, and sex all feel so good: they're crucial for survival. On the other side of the coin, pain indicates when something is biologically harmful. How does this theory of pleasure and pain tie in with the undeniably pleasurable but distinct experiences of love and bonding (CARE,) rough and tumble PLAY, and sex (LUST), as well as the intense emotional pain of GRIEF? One approach is to make a subtle distinction between the *feelings* of pleasure and pain, and the basic *emotions* generated by Panksepp's core systems. Emotions are fundamentally distinct from pleasure and pain, albeit in a subtle way. If you were asked to make a list of emotions, would pain make it on the list and if so, why? Most people wouldn't include it, although the reasons behind this decision range widely from person to person and depend on how you define emotions. However, people are more likely to include 'emotional' pain such as sadness or grief. Another difference is that in Panksepp's view, his core emotions each have a distinct feeling tone: activation of the CARE system feels fundamentally different from activation of LUST or PLAY, even if each feels pleasurable in its own way (Panksepp and Biven, 2012).

Here's the proposed overlap: as the core emotional systems evolved, they inevitably built upon the pre-existing systems in the brain, including those governing pleasure and pain. To some extent this is well known, e.g., GRIEF circuits overlap with the neural circuits that govern physical pain (Eisenberger and Leiberman, 2004). Thus, it's possible for a distinct emotional experience such as the experience of CARE or GRIEF activation to have the gloss of pleasure or pain respectively. In other words, the overall conscious experience is the combined result of the emotions and feelings generated by a range of brain systems.

As mentioned above, the concepts of SEEKING and wanting overlap a great deal. Consider the fact that the SEEKING system activates in conjunction with the other systems. For example, SEEKING activation likely plays a large role when it comes to seeking a mate — we associate feelings of desire or craving with SEEKING activation, and it is LUST activation which turns desire into sexual desire. Consider a dog that catches the scent of a bitch in heat — SEEKING and LUST activate, and the dog is motivated to seek the female. So far this is all in the realm of SEEKING and wanting. However, if the dog successfully finds the female, his SEEKING system is no longer needed, and the LUST system proceeds to guide sexual behaviour and physiology, culminating in an intensely pleasurable act of liking and hedonic pleasure. Thus, both liking and wanting are intimately intertwined with the functioning of the core emotion systems.

Dopamine and learning

Before moving on, let's address the notion that there is a release of dopamine in response to a reward such as food. When a rat receives an unexpected reward, this activates certain dopamine neurons in their brain — the very same dopamine neurons that were targeted by Olds and Milner. Further study showed that any stimulus that *predicts* the food reward is also able to activate the same dopamine neurons. In other words, dopamine neurons respond similarly to real rewards (such as food) and to any stimulus that predicts a reward (such as Pavlov ringing his bell to signal a forthcoming treat).

Wolfram Schultz described this dopamine activity as a "reward prediction error" which reflects the difference between the reward that is obtained and the reward that is expected (Schultz, 2016). If an animal isn't expecting a reward at all and then receives one, there's a positive dopamine response (an increase in dopamine activity) because the animal obtained more than he expected. Similarly, if an animal perceives a stimulus that predicts reward, there's a positive dopamine increase in response to the stimulus, and now the animal is expecting a reward. When the reward itself is delivered, the animal's prediction matches what he obtains, so the dopamine neurons don't respond to the reward itself. In summary, dopamine neuron activity reflects the difference between what an animal expected and what he actually received.

The reward prediction error has clear links to learning about stimuli and their consequences, but what does it have to do with reward or wanting? According to Berridge, not much: in a similar way to how he separated liking and wanting in the brain, he was able to show that wanting and learning via reward prediction errors are also independent processes in the brain (Berridge, Robinson, and Aldridge, 2009). In other words, dopamine plays a variety of roles in motivated behaviour and learning, and it's not as simple as "more dopamine = more motivation."

Returning to reinforcement

Now we've got a handle on the different aspects of reward and their role in Panksepp's emotional systems, let's consider how things come together in the reinforcement of behaviour. Reinforcement is part of instrumental/operant conditioning whereby animals learn associations between their behaviour and the consequences. A reinforcer can be functionally defined as any consequence that has the effect of increasing the likelihood of the behaviour occurring again in the future. Reinforcers can be positive (something added to the situation) or negative (something taken away.) Typically, positive reinforcers are something pleasant, or liked, such as food. Other positive reinforcers — especially for predatory animals — include activities like chase, tug or running after flirt poles which serve to activate the animal's wanting/SEEKING systems. Negative reinforcement occurs when something aversive is removed as a consequence of a behaviour, such as the slackening of a collar when a dog stops pulling. Consider giving a dog a piece of steak after he offers you a sit. Is the tasty treat the reinforcer, or is the reinforcer the feeling/emotion that the treat causes the dog to feel? The latter is the view taken here — the importance of a reinforcer comes down to how it makes the animal feel. In other words, for a reinforcer to have any power, it must be able to change the emotional state of the animal for the better. For example, play can be a powerful positive reinforcer for some animals due to the intense delight animals experience when the PLAY system is activated. Similarly, if growling causes an approaching scary stranger to back away, the relief from the aversive feeling of fear is powerfully rewarding, and growling is deemed a successful tactic. In both cases, it's the changing emotions of the animal that dictate whether a behaviour will be reinforced or not. Think back to the steak. If the dog is full, and the trainer keeps offering the food because "it's the reinforcer," what is really happening in that situation? If the dog perceives the food as unpleasant because he feels uncomfortable or nauseous, food may become a neutral or even a mildly aversive stimulus instead.

An important question to ask here is: does wanting equate to feeling good? And if not, then what role does wanting play in the reinforcement of behaviour? The answer is subtle. The feeling of wanting promotes action by making you crave something, whether it's food, sex, or chasing a squirrel. If a stimulus can make you want something, then it has the power to change your behaviour to obtain the desired object. Has the jingle of an ice cream van ever made you suddenly crave ice cream, prompting you to seek out the van and hand over some money?

Wanting and liking work hand in hand in the reinforcement process: if successful in purchasing your ice cream, you can now settle down and truly enjoy it. Your wanting circuits calm down and allow your liking circuits to generate the happy feelings that accompany a sweet cool treat on a hot day. However, as discussed at length, the successful acquisition of something you like is not necessary for reinforcement to occur — activation of the wanting or SEEKING system is perfectly able to reinforce behaviour, as demonstrated by Olds' and Milner's rats who would compulsively press levers to stimulate their SEEKING systems. In fact, stimulation of the SEEKING system proved to motivate behaviour even more strongly than a 'liked' food reward. Relate this to problem behaviours in companion animals — if the problem behaviour results in SEEKING activation, the behaviour may be highly internally reinforcing for the animal. Think about a Border Collie, chasing reflected lights all day long. He will never catch the light, but performing the activity is highly reinforcing, which is why he keeps doing it.

Considering emotions as the fundamental reinforcers becomes crucial in the Reinforcement Assessment part of MHERA. This involves assessing what the benefit to the animal is in performing the behaviour, and whether it's positive or negative reinforcement. A desired behaviour can be positively reinforced with 'liked' rewards such as food or activation of the CARE or PLAY systems. When thinking of predatory animals such as dogs and cats, activation of the SEEKING system (or 'wanting') via activities such as chase or tug can be used to positively reinforce behaviour. Negative reinforcement will occur upon the removal of something that activates the negative emotional systems of FEAR, RAGE or GRIEF. Consider our previous dog who is scared of strangers — a stranger approaching will activate the dog's FEAR system and prompt the dog to bark. Consequently, the stranger moves away, relieving the feeling of FEAR, thus negatively reinforcing the barking.

Reinforcers are situational. A dog who is feeling hot may not find dry food or warmth desirable. The timing of reinforcers is also extremely important — a small but immediate reward can be much more powerful than a delayed but more desirable reward (Critchfield and Kollins, 2001). The predictability of a reinforcer is also important: will a particular behaviour reliably result in a reward, or is the likelihood of receiving a reward somewhat random? This is where schedules of reinforcement come into play, such as the variable ratio schedule of reinforcement in which the participant doesn't know how many times he has to offer a particular behaviour to receive a reward.

If a stimulus or its emotional consequences are sufficiently reinforcing, then these can outweigh any additional use of aversives. Consider a dog whose favourite thing in the world is to meet new people, so he pulls towards strangers on walks. The guardian might start getting annoyed by this and pull on the dog's leash every time the dog pulls. Yes, the pressure may be unpleasant and even painful for the dog, but if his actions bring him closer to strangers or even occasionally succeeds in making contact with a friendly stranger, the pulling behaviour will be maintained. In this case, the reinforcement (CARE activation and the joy of social bonding) outweighs the aversives (physical discomfort), and overall, the behaviour of pulling is reinforced.

Finally, keep in mind that it's the animal who decides whether something is reinforcing or punishing. Some animals love physical contact like being stroked (CARE system activation) whereas others may find constant physical contact unappealing or even unpleasant, especially on certain areas of the body or if the animal is experiencing aches or pains. Similarly, some dogs may find playing with a garden hose the best of fun, whereas this may be another dog's nightmare. Some animals are sensitive to noise and may find a yell highly aversive, whereas others may care very little. However, you can always work out whether a stimulus acts as a reinforcer or not, as the key is in the frequency of the behaviour. If the behaviour being reinforced is still occurring or becoming more frequent, then it is being reinforced somehow.

Learning and neuroplasticity

When animals learn new things via reinforcement, how is this information stored in their brains? The brain is incredibly malleable, meaning that it is able to change over time via the creation, strengthening, weakening and pruning of connections between neurons and brain networks. This has both positive and negative consequences, allowing for flexible behaviour as circumstances change or learning occurs, but at the same time, brain plasticity also opens the door for maladaptive or unwanted behaviours to creep in. On the cellular and molecular level, plasticity relates to how effectively a signal can travel through the brain. Such signals (or action potentials) are passed between neurons across a gap called a synapse. The likelihood of the excitation passing from one neuron to the next depends on different physical characteristics of the synapse, such as how many neurotransmitter molecules are released by the pre-synaptic neuron. By making long term changes to the properties of a synapse, the electrical activity of neuronal circuits can be altered and thus affect outcomes such as emotions and behaviour.

The role of synaptic plasticity in habituation and sensitisation has been studied in *Aplysia*, the sea slug. In habituation, a particular stimulus gradually loses the ability to provoke a particular reaction or emotion, whereas in sensitisation a particular stimulus becomes more effective in provoking the reaction or emotion. These can be directly linked to the efficacy of particular synapses in the relevant brain circuits (Purves et al., 2018). Synaptic plasticity is also required in classical conditioning, whereby a neuron carrying previously neutral information (e.g., a tone) acquires the ability to activate other neurons (e.g., networks that trigger freezing) (LeDoux, 2015). Although the precise mechanisms are still unclear, instrumental/operant conditioning and reinforcement will also cause changes in synaptic connections in the brain (Fernandez-Lamo, Delgado-Garcia, and Gruart, 2018), influencing an animal's emotional and behavioural responses and decision-making in complex ways.

It should now be clear why behaviour modification first involves uncoupling the feelings of success or relief that have become firmly associated with the unwanted behaviour: even if opportunities for an alternative behaviour are offered, the previously well-established neural pathways generally mean that the animal's first choice is the behaviour with the strongest reinforcement history. Once the unwanted behaviour and consequent feelings of success have been unpaired, the animal is much more likely to take advantage of opportunities to perform alternative behaviours that are equally reinforcing, giving the alternative behaviour a chance to be reinforced and become established as the default.

Many factors influence synaptic plasticity, both in terms of how easily and quickly changes can occur, but also the types of changes that can occur. These factors include age and early experience, drugs, hormones, diet, and stress (Kolb, Gibb, and Robinson, 2003.) As such, synaptic plasticity may partly explain — amongst other things — why it can be so important to first balance an animal's hedonic budget and address his underlying mood state before effective learning and behaviour change is able to occur.

Learning causes changes in the way animals perceive their physical and social environment and how they feel (emotionally) in their responses to signals associated with dangers or rewards. It is likely not possible for a dog to separate emotionality from the complexities of learning, such as a joyful response to signals associated with the discovery of food, which have been traditionally described as unemotional conditioned responses (i.e., Pavlov's classic conditioning experiments with dogs). The purpose of emotions in these instances is to equip the body to do something about events in the environment and the signals associated with them, and to shape, intensify, refine, and perfect the behaviours that gain rewards. This is especially so with the primary rewards of food, sex, social contact, and safety even though the associated behaviours are naturally innately reinforcing in themselves.

It would be a mistake to automatically label an animal who grooms and licks himself to the point of mutilation as suffering from a clinical 'obsessive compulsive disorder' (OCD), when it may in fact be the response of a perfectly normal dog or cat that is under considerable stress as a result of being socially isolated or denied the opportunity to fulfil normal mood sustaining behaviours. Denied of such important features for the maintenance of his normal species (or type) mood state balance, he may be engaging in the only behaviour available to him all the time, to try and maintain his mood. One such behaviour that makes a dog (or a person for that matter) feel better is grooming. For some dogs, a little chewing of toys brings relief; for others a lot of chewing (perhaps of themselves) is the only option available.

Restore the general mood of the dog through providing an opportunity to perform other innately rewarding behaviours and the dog is better equipped to cope with the emotional upheaval of isolation, for example, without relying on the one outlet of licking or chewing himself like a comfort blanket. There is no need in many cases to medicate the animal, especially if he is treated before the behaviour becomes addictive and performed for its emotional benefits at times when the dog is not isolated or otherwise stressed. Equally, it is rather pointless offering a range of behaviour treatments to improve the dog's mood state if they take no account of the highly variable specific behavioural needs of the type of dog presented. Jack Russells clearly need different things in life than GSDs, Border Collies, or Pyrenean Mountain Dogs to maintain their normal mood state and these, along with age, sex, and personality etc. must be individually addressed in each case (Coppinger and Coppinger, 2001).

Chapter 5
Mood State Assessment and Cognitive Bias
Dachshunds Clive and Leo Case Study

Beginning with this and the following chapters, Case Studies will be used to demonstrate each segment of the practical application of MHERA. As the acronym suggests, we start with mood state assessments and, in the case below, will look at how an individual's cognitive bias affects how he processes emotional states as well as how he perceives the world around him. In Chapters 2 and 3, I discussed how mood states allow an animal to make predictions about the potential outcome of encounters, and how they influence how he will respond to events. Cognitive bias can be thought of as the filter that is used when an individual decides how he will react when he encounters new things and is an important element in behavioural therapy that is often overlooked. An individual's cognitive bias influences how he responds if he responds and how long it takes for his behaviour to change. It affects the behaviour program the practitioner is implementing and, in turn, can influence the overall success of the behaviour modification program.

Consider this. If a dog is slow to respond to treatment because of his mood/cognitive bias, his guardians may give up implementing a behaviour modification program if, after weeks of input, nothing appears to be happening. It may not be a case of the wrong fit as far as programs go. It may simply be a case of the dog's bias influencing how he perceives and responds to the program. Cognitive bias influences the speed with which an animal will change his behaviour, and negative moods are typically resistant to change, which means it can take a long time for a dog to change how he feels about things. Mood-dependant cognitive biases are likely to influence how individuals view emotion-inducing stimuli, which in turn results in short term emotions. These will of course vary in animals (even if it's the same event) because of different background mood states and cognitive biases and emotional responses can in themselves be very useful as indicators of underlying mood. To demonstrate the impact of cognitive bias and mood on receptivity to behaviour modification, let's look at two different dogs from the same household.

Clive's background information

Our first dog is Clive, a neutered 8-year-old Dachshund, who had recently been rehomed. His adoptive guardians provided as much background information as they could, and his previous owners were interviewed. Clive and a sibling (Plato) had been obtained from a backyard breeder at the age of 6 weeks. They were initially kept as inside dogs, but when they were still not housetrained at a year, the owners decided to keep them outside the house permanently as they could no longer deal with the messes that resulted from the lack of housetraining. The two dogs were initially given free access to the courtyard and garden, until the male owner suffered a stroke and became dependent on using crutches to move around, after which the dogs were mostly confined to a paved courtyard area about five meters by eight meters, with only occasional access to the garden.

The female owner felt that the dogs should not be in the garden if the male owner was there, as they posed a danger to him. She felt they were underfoot and was worried that her husband would fall over them. The dogs also jumped up on him and any scratches would result in him bleeding profusely. To avoid this, the female owner would first catch the dogs and lock them in the courtyard before her husband went into the garden, but as time went by, the dogs started avoiding being caught to be put into the empty courtyard, so it became easier for her to just keep them there the whole time. The dogs were never walked, seldomly had human interaction for prolonged periods of time and were fed once a day. They had no chew toys barring the occasional bone, and for the better part of seven years, rarely encountered novelty. The previous owner reported that they used to play when they were pups, but when they were two years old, Plato started mounting Clive. He would follow Clive around with his nose under Clive's tail, and if Clive growled or tried to move away, he would attack him. The owners dealt with this by yelling at the dogs from the kitchen window, and the mounting would pause for a few minutes before Plato started again.

Plato died from cancer when the dogs turned eight, and that's when the owners decided to rehome Clive, who had begun to whine at the back door all day. They put it down as him being lonely and felt that he would do better in a household where he had company.

Clive meets Leo

Clive was delivered to his new home by the rescue organisation responsible for the rehoming. He was not neutered at the time, had terrible teeth and an ear infection. He was also overweight with a dull coat. Shortly after being rehomed, he was neutered, had his teeth cleaned and the ear infection addressed. He was put on a premium diet and soon started losing weight. The couple who adopted Clive had a young Dachshund, named Leo. When they first met, Clive ignored Leo completely. Clive was carried out of the car and placed in the garden, where he stood for around ten minutes, not moving and just looking around at everything. After some time, Clive started to tentatively sniff around, constantly looking up or startling at every movement the humans made. He did not approach the new people, nor did he attempt to engage with Leo, who was enthusiastically trying to entice him into a game of chase. The new guardians described him as reluctant to move, almost like he didn't know what to do next.

It took a great deal of coaxing to get him to come into the house and when they finally managed to get him inside (they didn't want to force him by picking him up since he didn't know them yet), he stuck to the side of the rooms all the time. There were several dog beds around the lounge, but he didn't seem to know what to do with them. Instead of lying on it, he would sleep on the floor next to the bed. All in all, it took Clive around four months to settle into his new home before he was truly comfortable.

In his first home, Clive had little to look forward to while living in such an impoverished environment. Nothing ever changed, the environment was stagnant and deprived of any form of enrichment. He lived with a sibling who bullied him for almost every waking moment for eight years. His interaction with the owners was limited to feeding times once a day, and the occasional pat, and overall, his mood state was one of misery. During his critical period, however, his experiences were very different in this household. He lived as inside dog, was played with, and had attention lavished on him. He had a companion with whom he played every day and lived in a fluid environment with lots of people coming and going and had new things happening daily. When this changed at six months of age, it was to an environment that was in stark contrast to the one he had come to know.

Assessing Clive and Leo

Looking at Clive's history, it's easy to see that after those initial six months, he did not live in an environment that was conducive to an optimistic cognitive bias at all. Experiences add up to create the animal's mood and hedonic set point, and bad experiences weigh more than good ones. Clive had mostly bad experiences, which completely overshadowed any good ones he may have had occasionally, leaving him not only with a hedonic set point and mood state that was undoubtedly set in Q3 of Mendl's Core Affect Space matrix, but also with a negative cognitive bias. His response to the new home, the new humans and another dog was one of distrust. His bias meant that he did not anticipate that anything good was going to come from these new developments. When I first met Clive, his guardians described him as a depressed dog, a sentiment I shared wholeheartedly. I assessed Clive and placed his mood in Q3 on the MHERA Mood state graph (Figure 21 below); in other words, quite negatively valenced with low arousal (indicated with a star).

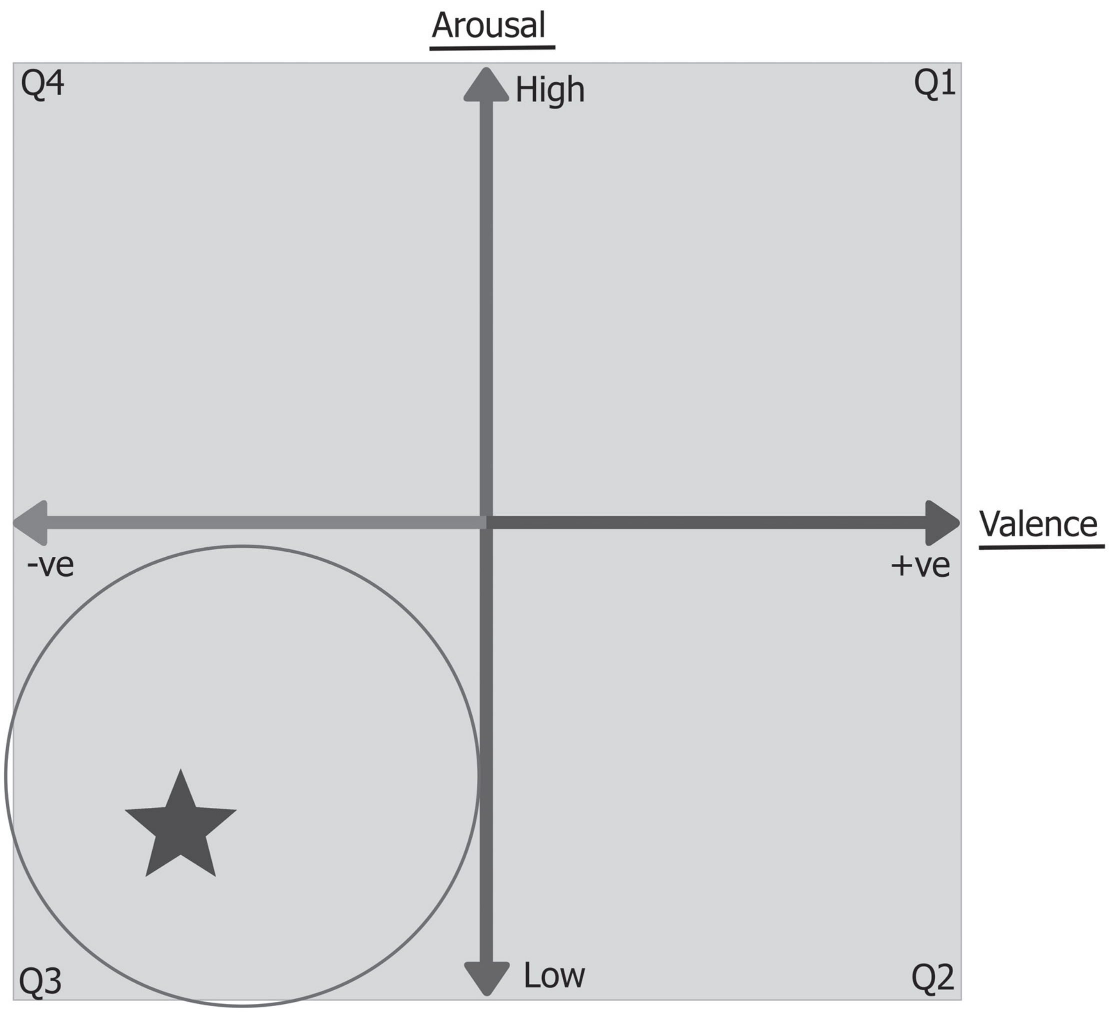

Figure 21.

Clive's cognitive bias was a negative one, and if we were to indicate this on Mendl's Core affect space graph, it could be placed in Q3 (Figure 22 below) where there is no anticipation of anything good happening.

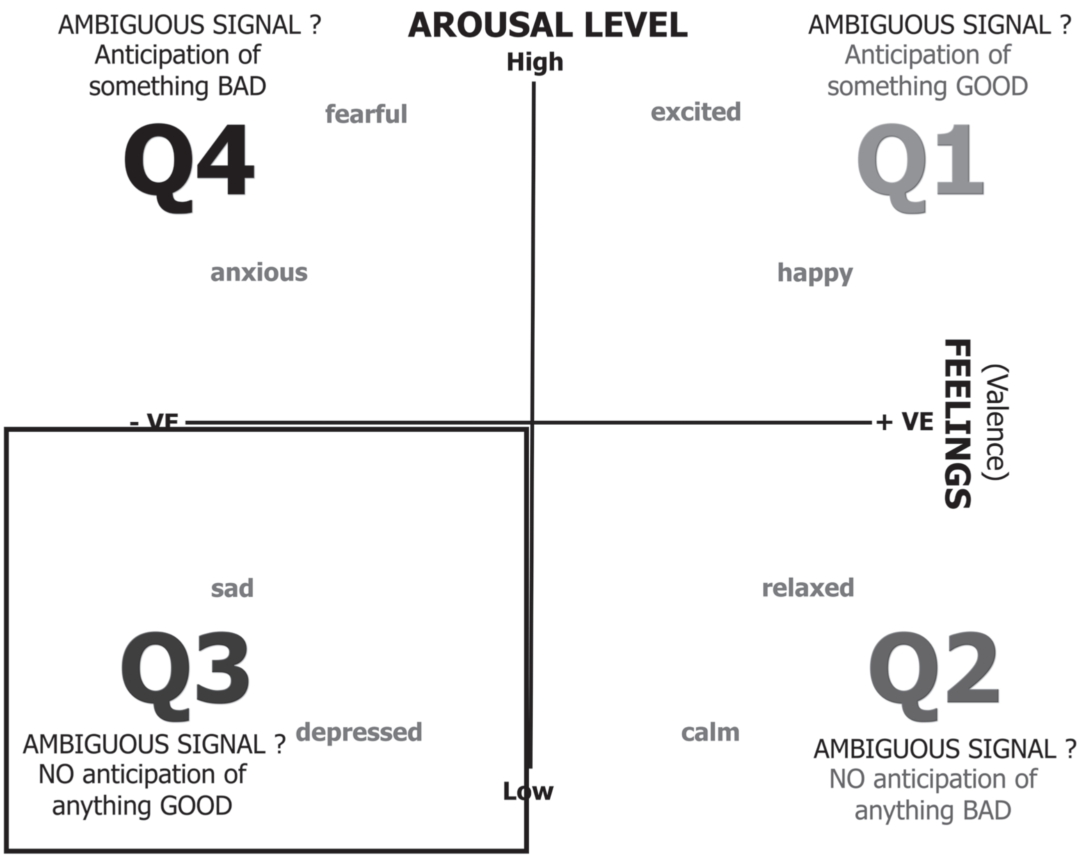

Figure 22.

In comparison, we have Leo, who is a one-year-old neutered male dachshund, in good health. Leo was bought from a breeder when he was eight weeks old, taken to puppy socialization and then later, training classes. He was sterilized when he was six months old and is described by his guardians as a cheerful, happy dog.

Both guardians work from home, so he is with them during the day, happily sleeping by their feet, or he'll be outside in the garden hunting lizards and chasing birds. He is taken to the park for a walk and a play with his friends every second afternoon, he sleeps on his own bed in the guardians' bedroom at night, is given an abundance of chew and play toys and is taken along on all family holidays. Leo loves people and dogs of all ages, and his only 'flaw' is that he is often too happy with new experiences or interactions. Leo's guardians reported that if he is allowed to be off lead, he would run up to any dog in the park and play with them. This has landed him in hot water once or twice, so now they only let him off when he's calm. He is well-trained and will respond to recall cues as well as "sit, down, leave, let's go and slowly," which is the cue the guardians use to let him know if he's being too exuberant.

When Leo was introduced to Clive, he showed no reluctance to engage with this new dog who appeared in his garden. His guardians reported that Leo approached happily, with his tail wagging and immediately offered a play bow, which Clive did not respond to (from Clive's perspective, Leo's approach was exuberant and direct and caused him to feel quite worried). They supervised the introduction and first few days very closely and if it seemed that it was too much for Clive, they would distract Leo by offering new chew toys. His obedience training also came in handy to redirect his attention away from Clive.

When compared to Clive's cognitive bias, it is easy to see that Leo's mood (indicated with a star) is a positively valenced, high arousal Q1 mood (Figure 23 below), with an optimistic cognitive bias and hedonic set point (circle).

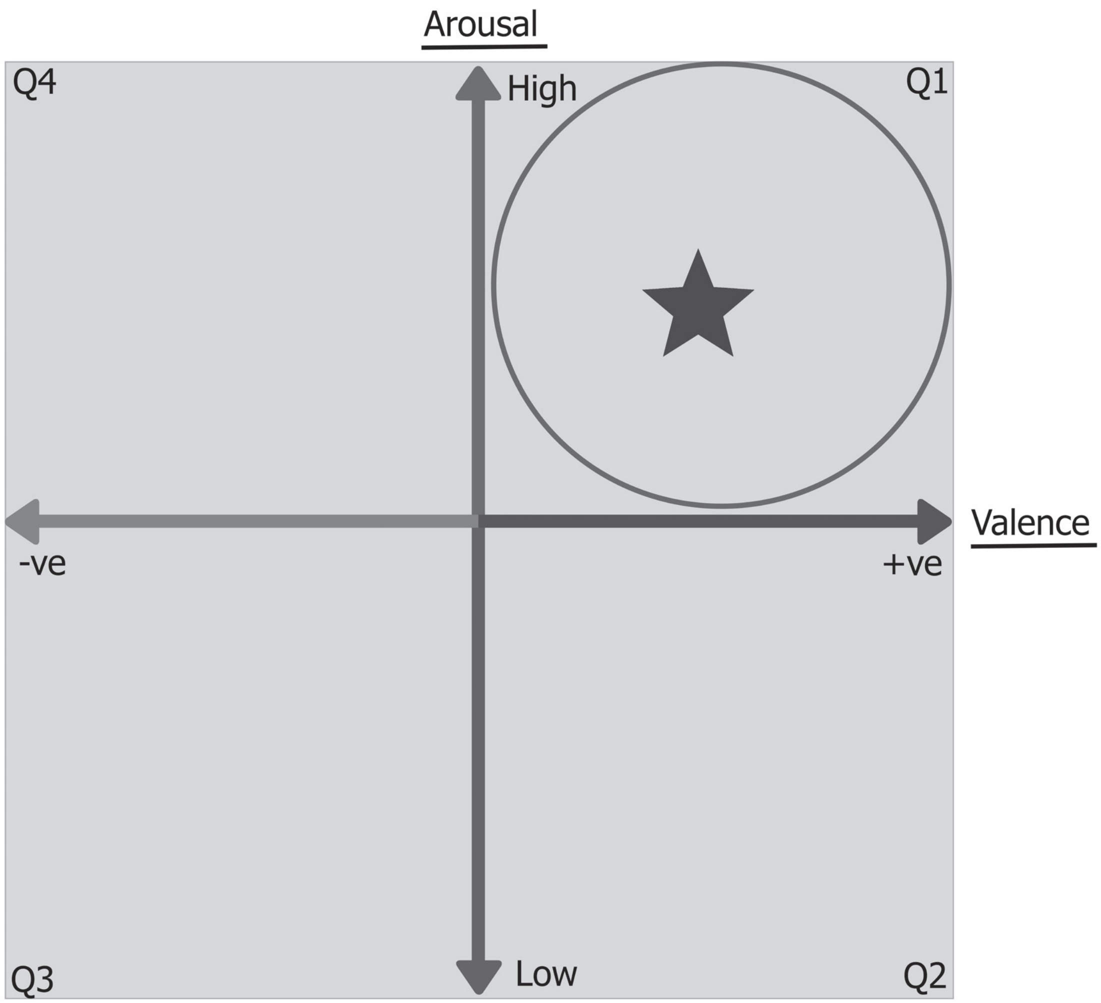

Figure 23.

In contrast to Clive, Leo views things through a filter of "new or ambiguous signals mean something good" (Figure 24 below).

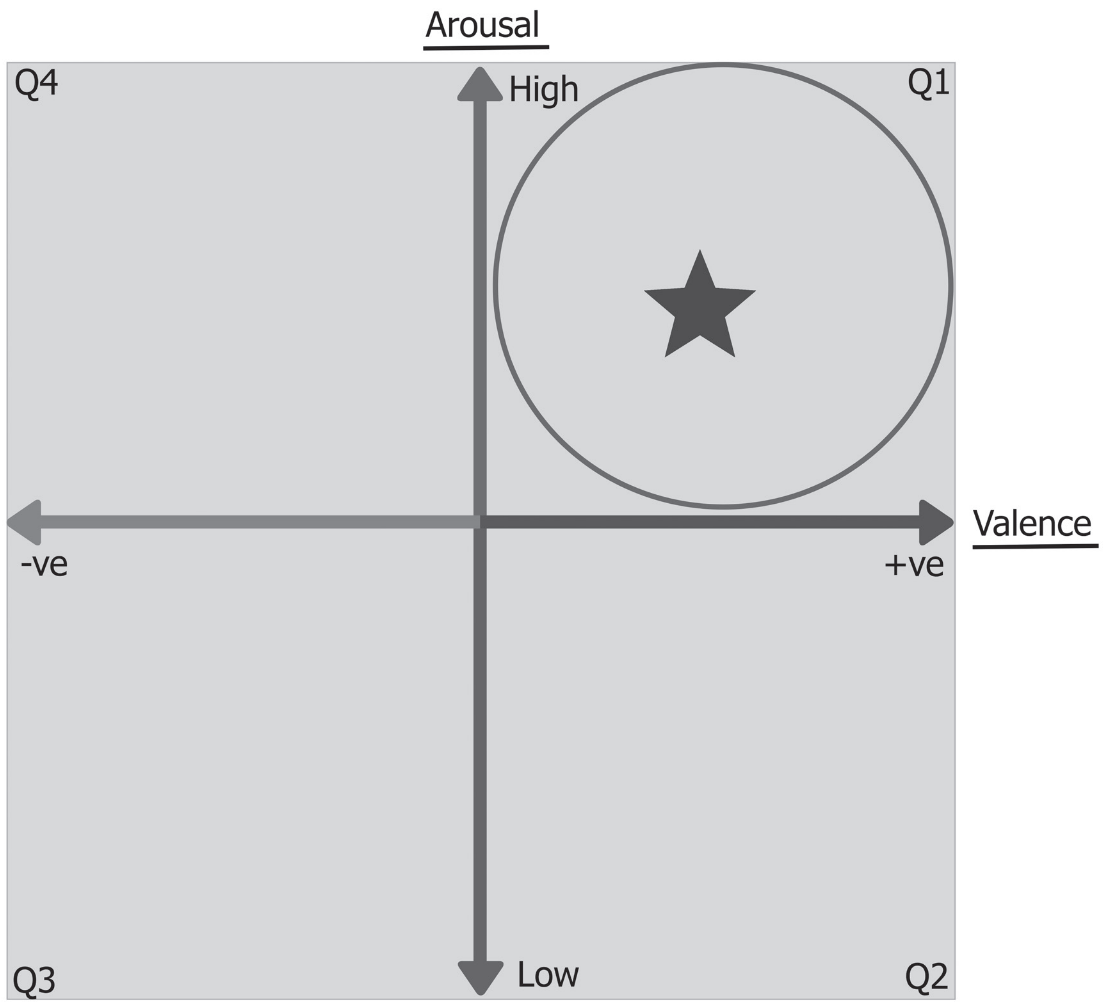

Figure 24.

When applying MHERA in practice, the information gained by taking a detailed history of the animal's life can be invaluable in determining hedonic set point, mood and cognitive bias, which is then, in practice, only mapped on the cleaner Core Affect Space graph. If an individual's history is not available, a conclusion can still be reached through observation and by introducing a novel stimulus to the animal under controlled circumstances. It's important to note though that this evaluation must *only be done by a familiar caregiver, in a familiar environment* where there is nothing to distract the animal, otherwise the results may be skewed or exaggerated.

Mood and cognitive bias can have a tremendous influence on an animal's willingness or ability to respond to changes recommended in a behaviour modification program. In Clive's case, behaviour modification was a slow process; he viewed changes (and anything new or different) as something that was probably not going be good or pleasant for him. He was reluctant to engage with the guardians, choosing to steer clear of them. If they approached to stroke him, he would lie down, dip his head low and close his eyes, almost as if bracing for something bad to happen. It took months before he would approach them for interaction, even though they never even spoke loudly in his presence. He avoided Leo and would freeze whenever the younger dog approached him, again appearing to brace for an unpleasant encounter. Of course, it was easy to see why. Clive's only interactions with another dog were the ones he had with Pluto, and those were anything but fun for him, often ending with him being mounted or attacked. His past experiences were influencing how he now responded to the situation he found himself in now, despite Leo never having mounted or attacked him. Leo's initial enthusiasm settled down and it was amazing to watch him with Clive. His movements were measured, slow and calm and he would often lie down near Clive, without forcing an interaction.

An important aspect of our treatment plan for Clive included educating his new guardians about his specific emotional needs. I explained the importance of working at Clive's pace to them and emphasised why we were likely to not see huge improvements immediately.

Clive simply wasn't capable of big improvements yet; but if we worked slowly and let him set the pace, we could give him the opportunity to learn that change was not always a bad thing. I have found the MHERA graphs incredibly useful when trying to explain mood, cognitive bias and emotional experiences to guardians. It helps people to have a clearer understanding of their animals' emotionality, which of course helps them to relate better to what their animals are going through (and why it can take time to get there!)

Behaviour modification plan overview

I am not going to go into depth about our treatment approach here, as it is not the focus of this chapter, but I will outline some of the program to demonstrate how cognitive bias and mood affected the rate at which we proceeded. We began by introducing one food dispensing item that was easy to manipulate, that yielded high rewards. Clive favoured the guest bedroom as his safe space, so we introduced the snuffle mat on the opposite side of the room from where he slept. Leo was kept away from this area, and Clive was given the opportunity to investigate at his own pace, without anyone there. The first time the mat was presented, he hesitantly investigated it after forty-five minutes of lying in his bed, only looking at it. However, once he learned that it was filled with food, he became more animated and the next time it was presented, he immediately approached it to look for food. The snuffle mat became his primary feeding method, with food portions gradually being reduced to increase the difficulty level. This was monitored carefully to ensure that it was never too tricky for him in the early stages of behaviour modification.

Once Clive was comfortable with the snuffle mat, a loosely stuffed Kong was offered next to the snuffle mat, which this time only had a few pieces of high value food hidden in it. Clive ignored the Kong for two hours before he investigated it. Once he started licking out the stuffing, he picked up the Kong and eventually carried it to his bed where he emptied it out. After the Kong, we introduced more feeding toys, while measuring Clive's response time and time he spent engaging with the toy.

Our next step only happened when Clive was showing active excitement when his guardians brought in food toys. He started to run up to them whenever they entered his bedroom carrying anything in their hands, tail wagging enthusiastically. That was the signal that Clive was ready for the next stage, which was to introduce minor changes in his environment. Stress can be a good or a bad thing. Too much of it can cause you to shut down completely or get sick, too little of it means you never learn how to bounce back when something unpleasant does happen. Clive had no emotional resilience, no bounce back skills. He didn't know how to resolve conflict or how to deal with stress, because his previous environment was not conducive to him learning these skills.

He was certainly used to living with chronic stress, that much was clear, but when it came to solving problems or coping with upsets, he had no idea what to do. Normally, pups would learn this when they engage with a complex and changing environment filled with challenges and complicated social interactions with others. So as part of Clive's program, we had to introduce mild stressful situations to help him learn to deal with them in a positive, productive manner and where he could develop some emotional resilience in response to stress. Clive was first taught about his safe space, where he learned he could relax and enjoy himself. Then, when change happened, he was shown how to overcome the upset by being given an alternative, pleasant activity to engage in (in this case, a stuffed Kong). He learned over time that change was not always a bad thing, and that he could adjust and recover from upsets by lying in his bed or having a jolly good chew on a Kong to relieve the tension he felt.

All in all, these few first steps took a month, which is painfully slow as far as behaviour modification goes — but it was crucial to move at Clive's pace, and not the humans'. Thankfully his new guardians were patient with him, which went a long way toward them not overwhelming or rushing him. Four months after we started behaviour modification, Clive had a breakthrough and started playing with Leo, following which he progressed in leaps and bounds. The fact that his guardians understood the important role that Clive's mood and cognitive bias played in his ability to adjust to change and afforded him the time he needed to process everything made all the difference here. If they had rushed him or flooded his environment with new things in an effort to make up for what he didn't have in his previous home, Clive likely would have shut down even further and would not have been able to experience a change in his mood or cognitive bias. A simple truth is that even if good things are within reach, if you are not able to recognise them as positive, you almost certainly won't be able to enjoy them!

Chapter 6
Bhulukhati the Nguni Bull:
Hedonic budgets and their role in behaviour modification

Figure 25. Bhulukhati the Nguni Bull.

When compiling a Hedonic Budget, the animal's environment and personal preferences play an important role in how this budget is assembled. Some of the subcategories can be marked as "not applicable" if the environment doesn't allow for it. 'Play: other familiar animals' is a good example here. If the animal has no other familiar animals in his environment, or he shows no interest in engaging with them should they be present (and either option has no negative effect on his behaviour), it can be marked as 'Not Applicable (N/A.)' Likewise, if there is no grooming partner to engage in mutual grooming with, it is marked as N/A and is then omitted from the budget.

Bhulukhati's background information

For our Hedonic Budget evaluation example, I'd like to introduce you to Bhulukhati the Nguni Bull (Figure 25 above). This magnificent creature was the focus of an unusual case study submitted by COAPE International student Marlene Sach. Bhulukhati was a four-year-old intact bull, living in rural KwaZulu Natal in South Africa. His owner Emerentia was a seventy-year-old, retired housekeeper who was doing a bit of subsistence farming, and who shared her home with her adult daughter and one grandchild. At the time, Bhulukhati lived in a small herd which consisted of his mother, Tamatisi, two other adult cows, a yearling heifer and a young bull calf. He was Tamatisi's first calf, and according to Emerentia, she was an attentive and caring mother. He was a normal, lively calf who grew into the bull he was today without any significant upsets or difficulties.

Emerentia' s herd was taken out to pasture every morning to a communal grazing area where they would spend the whole day grazing and ruminating until they were brought back in the afternoon. Emerentia kept them in a kraal (a traditional enclosure made from thorn-bush branches, mud or any available material roughly circular in form, similar to a boma) during the night to keep them safe.

She took excellent care of all her animals, including her chickens, dogs, and a cat, despite having extremely limited access to veterinary care: the closest vet was a few hours drive from her village. Medicine was obtained and vaccinations were done when there was a visit from an agricultural extension officer or state vet, during which time owners were educated on how to administer basic treatments like deworming their animals themselves. In most cases, the cattle would readily accept veterinary treatment but occasionally, young men in the village would help by holding them still if they were not cooperative.

The presenting problem with Bhulukhati was that he refused to come home from pasture in the afternoon. He would frequently run off and hide in the forest and would occasionally be aggressive toward his owner, especially when she needed to medicate him. When administering medicine, it required several young men to hold Bhulukhati, and during his last treatment, he managed to knock Emerentia over by swinging his head, despite being firmly held. Emerentia was concerned about his well-being, especially since cattle dipping would soon start (something he had never experienced due to prolonged water shortages in the area.)

Marlene spent quite a lot of time with Emerentia and Bhulukhati. She got to know them both well and was extremely thorough in both her observations and assessments.

Bhulukhati's Hedonic Budget compilation

Let's begin by looking at how the bull's hedonic budget was compiled, and how reconciling this budget affected his behaviour.

1: SEEKING system activation – foraging/food acquisition

As one of the most important systems, SEEKING system (foraging/food acquisition) is the first assessment that is done in the MHERA hedonic budget graph. After all, the importance of a proper diet is well-documented, and animals are no exception here. If you don't eat enough of the right kind of food, it can not only affect your behaviour and mood, but also your overall health and general well-being. Getting enough food, spending enough time finding the right kind of food and then being able to consume it is an important part of an individual's survival. SEEKING system activation: hunting/foraging measures how much time this animal spends each day engaged in food acquisition behaviour, ensuring that he gets enough food to sustain him.

Cattle graze slowly, spending much of their day engaged in this activity, with ruminating usually happening at night or when they are resting. SEEKING system activation for food acquisition is what motivates cattle to move around to find food, so this system is very active during the daytime. When a particular patch of grass is finished, the animal needs to find another one. Seeking system activates, the animal moves along looking for a suitable spot, and then, once food is found, SEEKING reverts to background tonal engagement, and consumptive behaviour starts.

The hedonic budget's first two segments allow the practitioner to compare the individual's needs to what is considered the species' general needs, and if there are discrepancies, to then adjust identified deficits or excesses.

Cattle usually need to cover large areas while grazing; they spend a lot of time browsing for appropriate food in the foliage accessible to them. Nguni cattle are renowned locally for being resilient animals, well adapted to the heat, disease, and environment of Africa, and quickly improving in condition as pasture improves after summer rains. Unfortunately, this means that the quality of grazing is not stable year-round and is very much determined by the amount of rainfall in the area.

If the quality of the grazing is sufficient, the average Nguni bull's 'Type Overall' indication would be seven out of ten. We use an allocation out of ten to indicate how much time is spent on an activity: so, the more crosses, the more time the animal spends engaged in the activity.

SEEKING: Hunting/Foraging	Type Overall:	x x x x x x x (7/10)
	Individual Variation:	
	Before:	
	After:	

While working with Emerentia, Marlene noticed that Bhulukhati was looking gaunt for an animal his size, despite him being out at pasture all day, and even though he did not obviously appear to be lacking in energy, his mood state was not a Q1 or Q2 one. In other words, Bhulukhati's overall mood was negatively valenced. Individual variation is influenced by several factors, including environment, quality of available grazing, individual health and amount of energy spent engaged in day-to-day activities. When Marlene started helping Emerentia, KwaZulu Natal was experiencing a water shortage, which meant that grazing was scarce. Usually, when grazing, cattle move slowly across their pasture, keeping their muzzles close to the ground and tearing off grass which is then swallowed without much chewing. When they rest, cattle will spend approximately three-quarters of the amount of time spent grazing and engaged in ruminating (animalbehaviour.net/cattle, n.d.). To get enough food to sustain him, Bhulukhati needed to spend more time out grazing, compared to a bull living on a farm where high quality feed or supplements are provided throughout the day. For this, I allocated a nine out of ten score for him in the "Individual Variation" column.

SEEKING: Hunting/Foraging	Type Overall:	x x x x x x x (7/10)
	Individual Variation:	x x x x x x x x x (9/10)
	Before:	
	After:	

Reconciling what you see in front of you, and what you have on paper from your assessment and interviews with the guardian, is important — something that is demonstrated so well with Bhulukhati's case. Marlene measured the amount of time he grazed and compared it to her research on the subject, and immediately noticed that despite being out all day at pasture — significantly more than most types of cattle — the bull's physical condition was poor. As mentioned, grazing was scarce, and it turned out that Bhulukhati's reluctance to return to the kraal at night was mostly due to him being hungry. He did not obtain enough food during the day and since the kraal had nothing to eat in, it meant that Bhulukhati saw no benefit to returning when Emerentia called him in for the night. You can see in the photo below (Figure 26) that he is not at his optimal weight; his frame is obvious, particularly over his hook bones (hip bones.)

Figure 26.

As you can see, the discrepancy between his Type and Before was clear, and that helped Marlene to identify the reason for his reluctance to return at night. Despite spending more time grazing than most other cattle, Bhulukhati was underweight, a factor that directly tied in with the presenting problem. It's worth noting that Before is only used to measure the frequency of the activity before behaviour modification, while After can be used in one of two ways: either as a visual representation of the desired end goal for clients, or as an evaluation of how this activity's frequency is progressing during behaviour modification. At the time of writing this book, Marlene was still working with Bhulukhati and Emerentia, so After was used as a goal. Here, Before is the same as his individual variation on the graph, but his After would eventually have him closer in line with other cattle (8/10).

SEEKING: Hunting/Foraging	Type Overall:	x x x x x x x (7/10)
	Individual Variation:	x x x x x x x x x (9/10)
	Before:	x x x x x x x x x (9/10)
	After:	x x x x x x x x (8/10)

2: SEEKING: Exploring

Exploring is important to animals. The only way to become familiar with your environment, and know what to expect from it, is to explore it. Exploring allows an animal to identify resources and threats within his living space, and, equally important, provides mental stimulation (if it's not a static environment). Sniffing (a type of exploratory behaviour) is motivated by an animal's need to gather information about his environment and the expression of sniffing is speculated to be intrinsically pleasant for cattle (Zhang, et al., 2021) — so not only does exploring allow the animal to map his environment but engaging in exploratory behaviour also makes him feel good. Enrichment (facilitated through SEEKING system activation) increases play, exploratory and grooming behaviours and is hypothesized to reduce fear of novelty. In other words, it can significantly improve behavioural well-being in animals. When cattle are introduced to new pastures, more time is spent exploring this new paddock (Krysl and Hess, 1993) in comparison to cattle kept in the same paddock. In Bhulukhati's case, the rest of the herd never wandered away from the same area, but because he often went into the forest to graze alone, his allocation for this activity was slightly higher. He spent significantly more time exploring than the rest of the herd, which meant he knew where to go if he wished to avoid getting caught at night. His SEEKING: Exploring/Novelty measurement was plotted as:

SEEKING: Exploring/novelty	Type Overall:	x x x x (4/10)
	Individual Variation:	x x x x x (5/10)
	Before:	x x x x x (5/10)
	After:	x x x x (4/10)

As a goal, Bhulukhati's after was placed as four out of ten. Emerentia was perfectly happy to provide additional enrichment in the paddock but was reluctant to have Bhulukhati wandering off on his own, as that put him at risk of being injured, stolen or even killed. She wanted him to stay with his herd so wanted to bring his 'after' more in line with the rest of the herd.

3: PLAY: Other

Play: Other refers to any social play that happens with **animals of the same species**. Bovine play is mainly locomotor play (galloping, bucking and kicking — which involves no physical interaction between individuals) and social play (play fighting, non-reproductive mounting etc). The occurrence of play is dependent on spatial allowance, behavioural health and physical health. For Type Overall, PLAY was plotted at three out of ten.

PLAY: Other (same species)	Type Overall:	x x x (3/10)
	Individual Variation:	
	Before:	
	After:	

As a youngster, Bhulukhati would occasionally engage in play. He was occasionally seen jumping, chasing and head-butting the rest of the herd but very little of that happened now, with Bhulukhati the adult preferring to keep to himself. He was usually seen grazing at a distance from the rest of the herd or going into the forest alone to browse. According to Marlene, Bhulukhati played less than what is considered normal for Nguni cattle, so under "Individual Variation," he was assessed as a one out of ten.

PLAY: Other (same species)	Type Overall:	x x x (3/10)
	Individual Variation:	x (1/10)
	Before:	
	After:	

If one considers that play is, as mentioned above, dependent on physical and behavioural health, it's easy to see why Bhulukhati wasn't playing at all (marked as 'none' in his Before column): sick, hungry, or unhappy animals simply don't play. Adult cattle do not play often, so this activity was not a particularly strongly motivated one already. Added to that, play wasn't of particular importance to Bhulukhati the adult, so the After here was left at his individual variation of one out of ten.

PLAY: Other	Type Overall:	x x x (3/10)
	Individual Variation:	x (1/10)
	Before:	—
	After:	x (1/10)

4: PLAY: People

No play took place between Bhulukhati and people. In companion animals, Play can be a tremendously powerful tool when it comes to cementing social bonds and improving mood state, but unfortunately the danger that play with Bhulukhati posed for the elderly Emerentia outweighed the benefits, so this was left as N/A.

PLAY: People	Type Overall:	N/A
	Individual Variation:	N/A
	Before:	N/A
	After:	N/A

5: PLAY (with familiar animals)

This category refers to any social play that may occur between the animal and other familiar animals *not of the same species* in his environment. In Bhulukhati's case, no play occurred with any of the goats, dogs or cats who shared his space, and it had no bearing on his behavioural or physical well-being, so this was marked as not applicable (N/A.)

PLAY: Other familiar animals	Type Overall:	N/A
	Individual Variation:	N/A
	Before:	N/A
	After:	N/A

6: CARE with other animals

CARE with other animals refers to any bonds that exist between the individual and other animals. Herd animals tend to have strong social bonds with each other and prefer to stick together. Not only because of the bond, of course, but also often for safety. Type Overall: for cattle was marked as six out of ten.

As for Individual variation: Bhulukhati's relationship with his mother was a pleasant one. He was Tamatisi's first calf, and she was a good mother, giving him unrestricted access to her milk for much longer than is usual in most farming communities. They often stood close together and would sleep next to each other. Despite keeping to himself during the day and being uncooperative when being brought back to the kraal, when he was with the other cattle at night, Bhulukhati would often engage in mutual grooming with the rest of the herd. This was completed as three out of ten.

CARE: Other animals	Type Overall:	x x x x x x (6/10)
	Individual Variation:	x x x (3/10)
	Before:	
	After:	
CARE: Other animals. Before was the same as individual variation, but Marlene wanted to improve the relationship between Bhulukhati and the rest of the herd, so used After as a goal here, which was set at 5/10:	Type Overall:	x x x x x x (6/10)
	Individual Variation:	x x x (3/10)
	Before:	x x x (3/10)
	After:	x x x x x (5/10)

7: CARE: People

Bhulukhati had a conflicted relationship with his owner. He was usually happy to spend time around Emerentia provided she didn't try to chase him back to the kraal at night. He even tolerated her putting a rope around his horns to lead him places. Handling was mostly not a problem, provided she didn't try to medicate or brush him or check his hooves. As a calf, Bhulukhati was a favourite with his humans, who, according to Marlene, delighted in his growth and progress. Even as an adult bull he was still adored, despite his lively nature. His owner wanted to improve their bond though, as she felt that he was a bit of a loner and she wanted him to enjoy her company as much as the other cattle did. As part of his treatment program, target training was introduced and Bhulukhati happily participated in this when Emerentia did the training. His CARE budget was completed as follows:

CARE: People	Type Overall:	x x x x (4/10)
	Individual Variation:	x x x (3/10)
	Before:	x x (2/10)
	After:	x x x x (4/10)

8: Grooming of self (southafrica.com - cattle, n.d.)

Bhulukhati spent a normal amount of time engaged in self-grooming, usually in the form of rubbing against fences or trees and the occasional licking of whatever he could reach. This was in line with other cattle, and nothing needed to be adjusted.

Grooming: Self	Type Overall:	x x (2/10)
	Individual Variation:	x x (2/10)
	Before:	x x (2/10)
	After:	x x (2/10)

9: Grooming: Mutual

Grooming: Mutual looks at how much reciprocal grooming is happening between two individuals, which in turn speaks to the nature of the relationship. If mutual grooming occurs, the relationship is generally a good one. If one individual constantly grooms another without being groomed in return, it could indicate that the relationship is problematic — with dogs and cats, this one-sided grooming is often seen when one individual bullies the other, forcing him to endure unwanted grooming. Mutual grooming means both parties choose to engage in the activity, and it is welcomed instead of forced.

Grooming: Mutual	Type Overall:	x x x x (4/10)
	Individual Variation:	x x x x (4/10)
	Before:	x x x x (4/10)
	After:	x x x x (4/10)

Cattle will usually groom each other when they are resting. For Type Overall, this was plotted as a four out of ten. Bhulukhati would often engage in grooming behaviour with the rest of his herd when they were in the paddock at night, so this was in line with his type and required no adjustment.

10: Grooming: Other Animals

No grooming took place with other animals, so this was left as N/A.

Grooming: Other Animals	Type Overall:	N/A
	Individual Variation:	N/A
	Before:	N/A
	After:	N/A

11. Grooming: Guardian (animalbehaviour.net, n.d.)

As listed in the problem description, being groomed, and having husbandry procedures done with Bhulukhati was one of Emerentia' s biggest challenges. She instinctively felt that it was not kind to restrain the bull against his will to treat him and understood that there was a big difference between standing still because it doesn't bother you and standing still because you're being held by force. Bhulukhati's mother Tamatisi would willingly walk up for treatment and would calmly stand still when being jabbed in both buttocks or given a drink of deworming medicine, and Emerentia felt that this was what she wanted to achieve with Bhulukhati. Despite the problems she was having with the bull, Emerentia cared deeply for him and wanted to do what was best for him without using physical coercion.

In comparison to companion animals, cattle require little grooming, but that does not mean it isn't necessary. Common husbandry procedures for cattle include cleaning and maintaining hooves, castration, dealing with ticks and other parasites, vaccinations and treating lameness. Emerentia was planning on having Bhulukhati castrated the following year, but that would only be possible once he accepted handling willingly. Temple Grandin, in her paper "Behavioral Agitation During Handling of Cattle is Persistent Over Time" wrote that "Cattle which become extremely behaviorally agitated during restraint and handling are dangerous to handlers and are more likely to become stressed," and that "restraint in the form of a squeeze chute (also known locally as a crush) was more aversive than other forms of restraint" (Grandin, 1993). Therefore, to avoid putting Bhulukhati through this commonly used form of containment, it was best to work on his emotional response to restraint, and to teach him that handling was something to be enjoyed, not feared. According to John Moran (1993), cutaneous sensitivity can be used to calm cattle by scratching under the neck and behind the ears, areas they find difficult to access, so this is something that Marlene and Emerentia started working on early in the treatment program.

For Type, Marlene mapped cattle in general at four out of ten. Bhulukathi's individual variation was estimated at five out of ten, slightly higher than cattle who live on farms. Realistically speaking, Bhulukhati needed more grooming than other cattle, to compensate for the lack of frequent veterinary care, meaning it was important for his owner to be able to identify injuries and pre-empt anything that could lead to serious illness. At the time, he was seen by a vet once a year, and his owner could not treat him by herself should anything happen to him. His environment and circumstances meant that he had a lower value in comparison to most cattle, and because he did not currently tolerate handling for husbandry procedures his Before on the graph was plotted at one out of ten. The goal was to improve his After to a five out of ten.

Grooming: Guardian	Type Overall:	x x x x (4/10)
	Individual Variation:	x x x x x (5/10)
	Before:	x (1/10)
	After:	x x x x x (5/10)

12: Sleeping/resting

As mentioned, Emerentia lived in rural KwaZulu Natal (KZN), and the kraal where the cattle slept was a rudimentary construction put together from whatever was available. This meant that there was no shelter from rain or cold, which contributed to Bhulukhati's reluctance to return home in the evenings. The forest was warmer and significantly drier, and he much preferred staying there. Once Emerentia put together a shelter using old roofing sheets, Bhulukhati and the rest of the herd were all more eager to come home.

When not actively grazing, Bhulukhati's herd would rest. KZN has a tropical climate, which means it gets very hot and humid during the day. Rest is vital for the health of cattle, who will commonly lie down for brief periods of deep REM sleep, which aids in the maintenance of their immune systems and overall health.

Adult cattle can sleep for up to four hours a day, and they can also spend up to 8 hours a day in a state of drowsy, semi-awake restfulness (Houpt, 1998). The Type Overall measurement for rest/sleep in cattle was set at seven out of ten. Bhulukhati's individual variation was the same as his type, but his Before was plotted at five out of ten, due to the lack of shelter and need for more grazing to meet nutritional demands.

As a goal, After was plotted to be the same as Type Overall (7/10). Sleep and rest contribute to the emotional well-being of an animal, and not getting enough of either can result in a negative mood state — something that was very applicable in Bhulukhati's case.

Sleeping/Resting:	Type Overall:	x x x x x x x (7/10)
	Individual Variation:	x x x x x x x (7/10)
	Before:	x x x x x (5/10)
	After:	x x x x x x x (7/10)

13: Eating

An adult bull weighing roughly 500 to 600 kilograms (+/- 1100 to 1300 pounds), needs to consume around 21 kilograms (45 pounds) of good quality food daily. Bhulukhati's Type was plotted at seven out of ten and his individual variation, as discussed in SEEKING Hunting/Foraging, was eight out of ten, slightly higher due to the grazing available, and the seasonal fluctuations that affected the quality of grazing. His Before, however, was mapped at ten out of ten, since he needed to spend more time grazing to obtain enough food to sustain him. His After moved to eight out of ten once Emerentia started supplementing his diet with hay and treats for training.

Figure 27.

Eating:	Type Overall:	x x x x x x x (7/10)
	Individual Variation:	x x x x x x x x (8/10)
	Before:	x x x x x x x x x x (10/10)
	After:	x x x x x x x x (8/10)

14: Drinking
Drinking was on par with other cattle and Bhulukhati had no underlying medical conditions. Marlene mapped it at six out of ten for Type, which Bhulukhati matched.

Drinking:	Type Overall:	x x x x x x (6/10)
	Individual Variation:	x x x x x x (6/10)
	Before:	x x x x x x (6/10)
	After:	x x x x x x (6/10)

Conclusions
The hedonic budget assessment as a tool proved to be extremely useful in Bhulukhati's case, allowing Marlene to identify discrepancies in this budget quickly and accurately, and addressing them in order of importance, which in turn had a huge impact on Bhulukhati's behaviour (and the problems!) While completing the hedonic budget for Bhulukhati, Marlene developed a keen understanding of the owner's capacity and skill, which allowed her to affect change by implementing straight-forward practical changes while taking the environment and restrictions into consideration.

Another benefit of applying MHERA is that, for the newly qualified behaviourist, completing the hedonic budget provides a solid starting point when it comes to developing a treatment plan. Once the problem has been assessed accurately, the next step of balancing the budget (at the animal's pace, as discussed under Mood State in Chapter 3) needs to happen before anything else can be put into action.

Chapter 7
Emotionality Assessments and Reinforcement Analysis
Cat Case Study: Figaro and Pachebel, Fighting and Overgrooming

I decided to use the case of Figaro (seven years old) and Pachebel (six months old) to demonstrate how the Emotionality Assessment tool of MHERA works, both as a tool to plot emotional experiences of animals when engaged in problem behaviours, and as a tool to evaluate the animal's emotions as reinforcers for problem behaviours. Both cats belonged to Emily, a client who lived in a spacious, three bedroomed apartment and were kept indoors all the time because the owner was worried for their safety. The apartment was on a busy road, and she did not want to risk anything happening to them. In her words, Figaro and Pachebel were the only family she had, and she was terrified they would be involved in a traffic accident if they had access outside.

Figaro meets Pachebel

Since Figaro was the older cat of the two, let's begin with his history. Emily adopted him from a rescue organisation when he was ten weeks old. He was kept in a kitten run with about eight other kittens, and Emily chose him because he was the one who climbed up against the gate, meowing loudly — in fact, so loudly that she said it reminded her of the opera "Figaro," which is of course then what his name promptly became. Figaro was a confident little kitten, who adjusted easily to life in Emily's apartment. He was litter box trained, used the scratching pole easily and slept in Emily's bed at night. The two of them were very close, and for the better part of six years, their lives were uneventful and peaceful.

Then, six months ago, Emily found a sick, wet kitten in a gutter outside her home one morning. She rushed the little creature to the vet, who immediately started treating him. The vet told Emily that the kitten was very sick, dehydrated, and malnourished, and that he wasn't feeling optimistic about his chances of surviving. However, much to the vet and Emily's surprise, the kitten was a fighter. Once the medication started working, he began to eat and drink and groom himself, and soon, was ready to go home. Except, of course, he didn't have a home to go to. Emily couldn't bear the thought of him going to a rescue organisation after his rough start in life, so after some careful deliberation, she decided to bring him home with her, as a friend for Figaro.

Before doing so, she did some reading up on how to introduce a kitten to an older cat. Since Figaro had never met any other felines, she was certain that he'd be fine and that he'd really enjoy having a playmate. Unfortunately, as many a cat owner will agree, what we think they will do, and what they actually do, are usually two different things entirely. When Emily brought Pachebel home, she first kept him in a separate room to give him time to settle in. Despite his poor start in life, the kitten was very friendly and quickly bonded with his new guardian and whenever Emily left him alone, he would sit and meow pitifully while scratching at the door. The unfamiliar noise behind the door caused a great deal of anxiety in Figaro, who would growl whenever he stalked past the door. Emily decided to leave Pachebel in the room until everyone had settled down, thinking it would be a week at most. However, it soon became clear that that was not going to be the case. A month went past without any sign of the tension abating. Figaro started to groom himself furiously whenever he heard Pachebel moving on the other side of the closed door, and before long, he had a bald spot from over-grooming. Emily took him to the vet, who ruled out any physical causes for the behaviour. She was given an ointment to apply as a first step, but it didn't act as a deterrent at all. If anything, it seemed to increase the amount of grooming Figaro did. He stopped playing and spent most of his time under Emily's bed, where he would either be sleeping or grooming. Figaro's mood state at the time was therefore in Q3, as indicated below on his emotionality graph.

Emily discussed her dilemma with her cat-owning friends, who advised her to let the cats be together. They thought that Figaro's grooming was because he didn't know what exactly was behind the door, and reasoned that if she showed him, it was another cat, he'd settle down and the two would become friends.

In preparation for the introduction, Emily arranged with a friend to come and help her when the two cats were meeting for the first time. Unfortunately, the day before the scheduled introduction, Pachebel escaped from the room by slipping through the door when Emily went in to change his litter box. He ran straight into Figaro, who was sitting and watching the door agitatedly. When the two cats came nose to nose, Figaro growled, and immediately arched his back, complete with piloerection along the spine and tail. Pachebel got a fright and reacted by also arching his back and hissing, which then caused Figaro to leap onto him, and a very loud and traumatic fight ensued. Emily saw Pachebel slipping through the door and was already on her way to grab him when the fight broke out. She reached in and grabbed him and despite getting badly scratched, she managed to separate the two. Figaro ran and hid under the bed and refused to come out for a day, while Pachebel growled and hissed every time he heard a sound coming from the other side of the door. After that, she kept the two cats separate and phoned her vet who referred her to me.

Emotionality Assessments

To demonstrate how to use the MHERA Emotionality assessment graph in practice, let's pause the story here to look at what was happening with each of the cats during this experience.

Figaro:
Given his increased stress levels, reduced activity levels and the discomfort caused by his overgrooming, Figaro's mood state was plotted as being in Q3, between discontentment and misery (Figure 28 below). This is therefore the point of disinhibition when we look at his emotional reaction to the first fight with Pachebel.

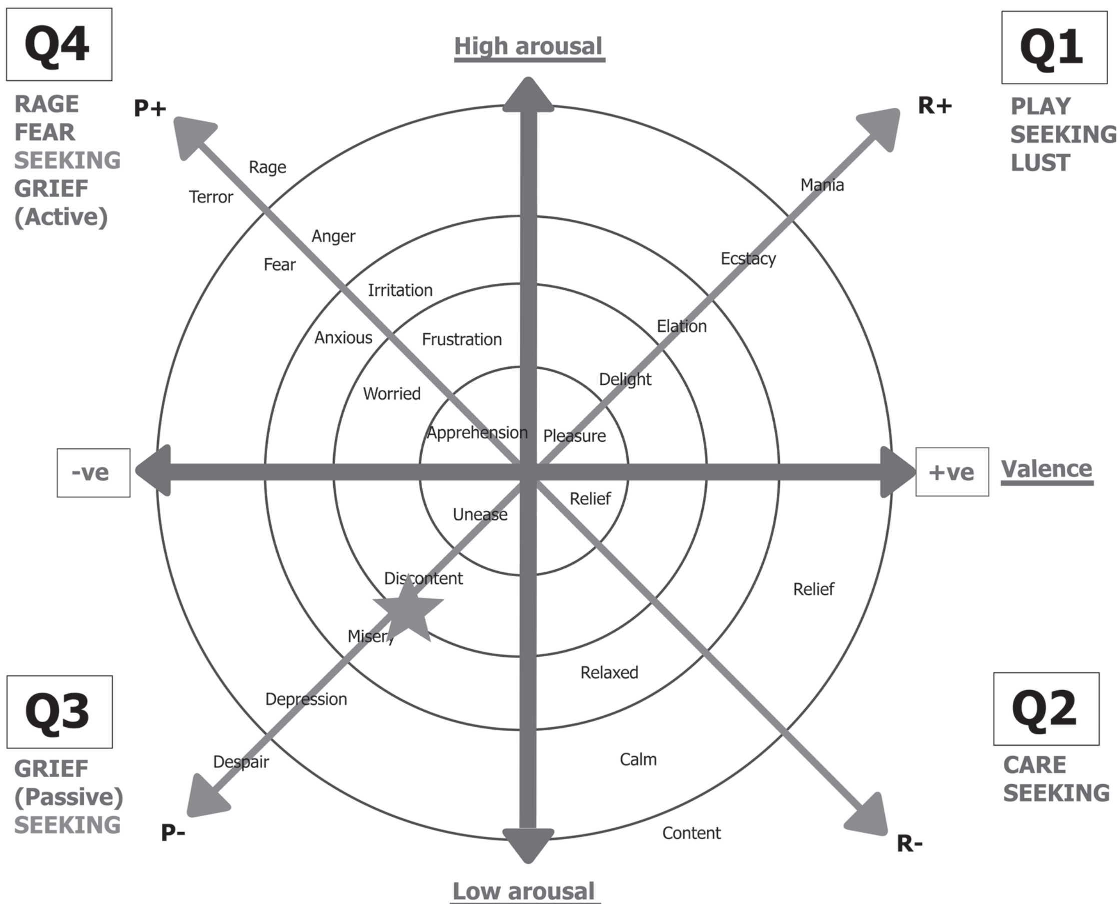

Figure 28.

When Emily went in to Pachebel's room, Figaro sat at a fair distance from the door, watching nervously. Emily described him as being agitated whenever he heard a noise coming from the room. So, when Emily opened the door Figaro's emotional state began to change. His arousal levels increased, but the valence of the experience remained the same as he sat flicking his tail, watching alertly. In other words, Figaro moved from Q3, into Q4 (Figure 29 below).

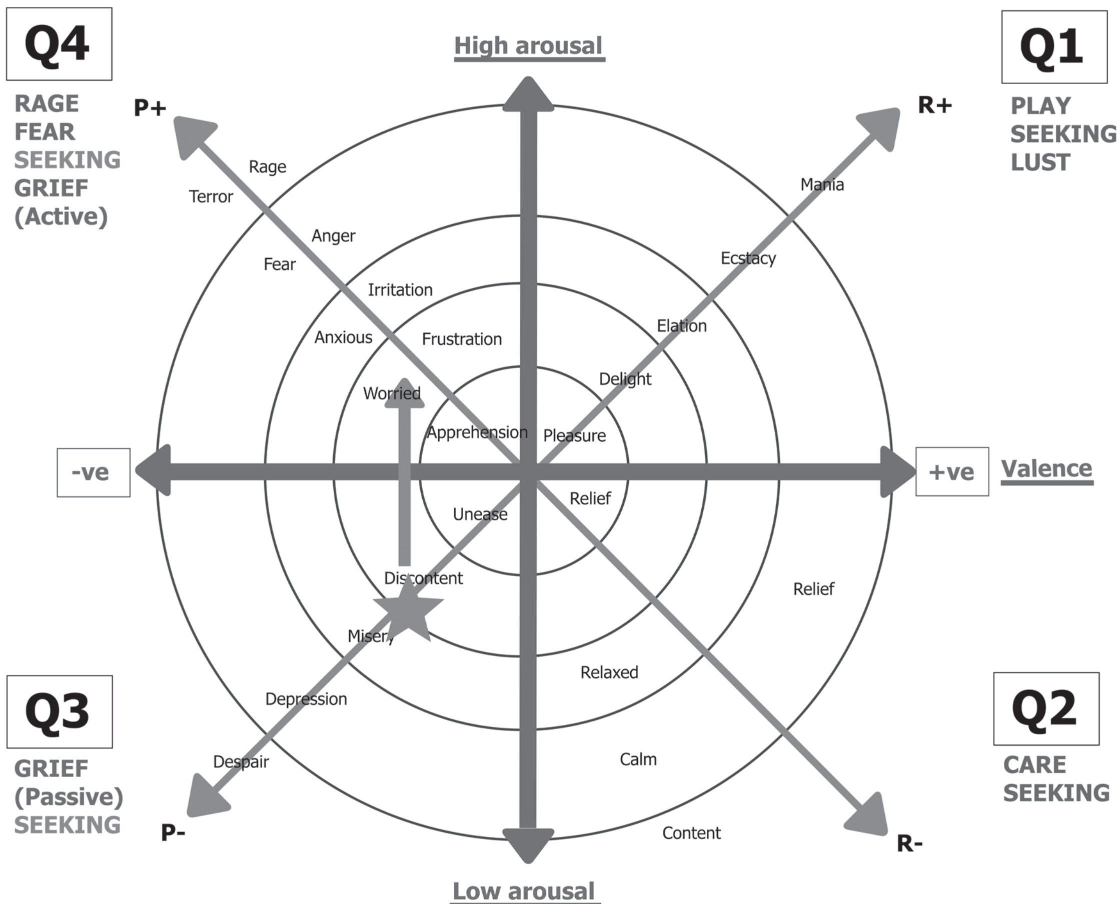

Figure 29.

When Pachebel escaped and ran straight to him, Figaro's emotional state changed rapidly. His FEAR system activated, and he went from worried to terrified in a split second (Figure 30 below).

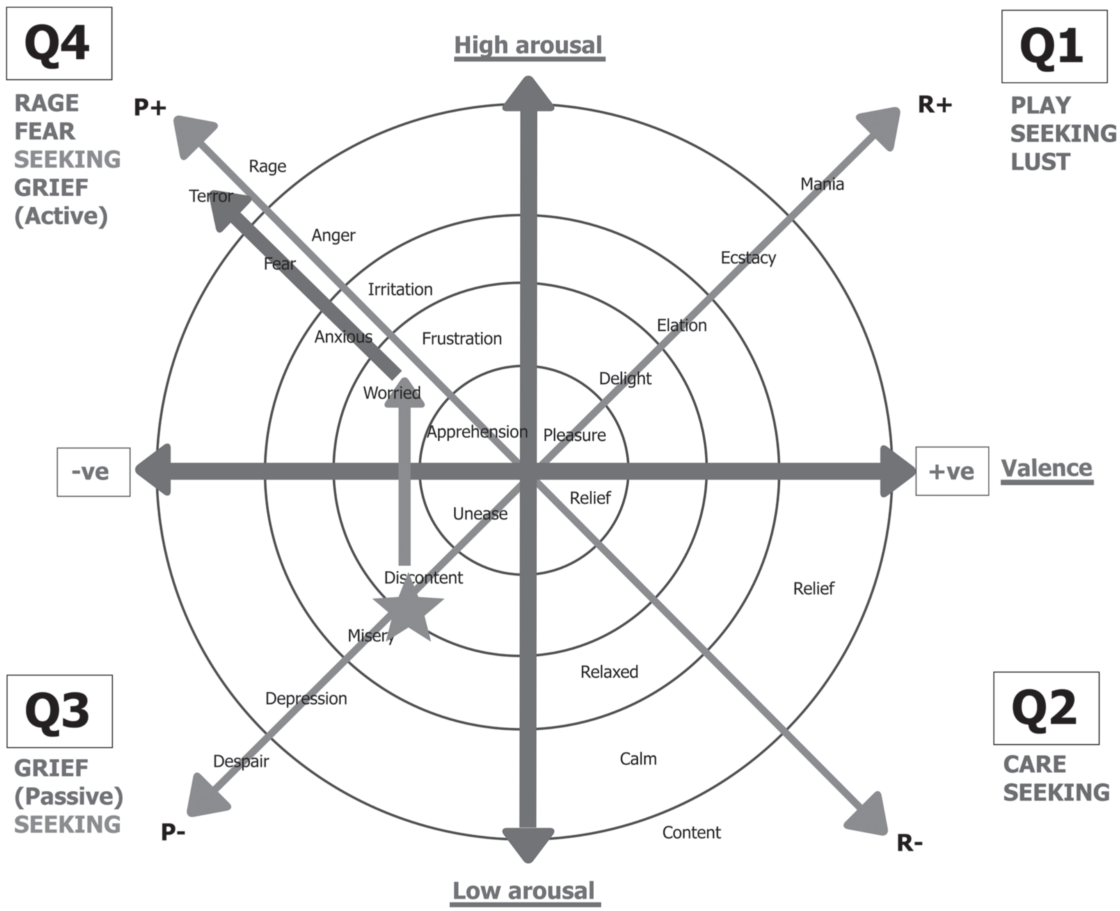

Figure 30.

Then, when Pachebel hissed at him, his RAGE system activated, and he attacked (Figure 31 below).

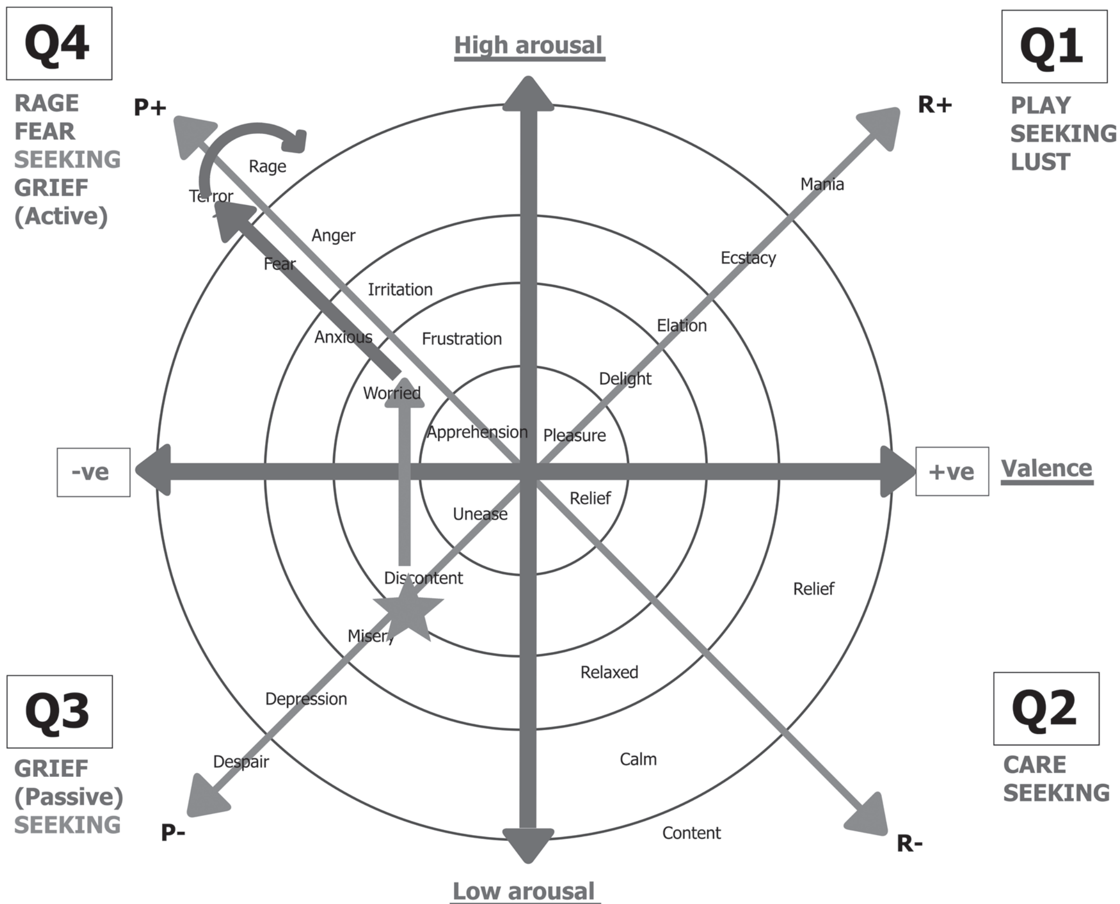

Figure 31.

When Emily removed Pachebel by picking him up, Figaro fled into Emily's room to his usual hiding spot under her bed. As soon as he reached safety, he felt a sense of relief at having escaped the threat (Figure 32 below).

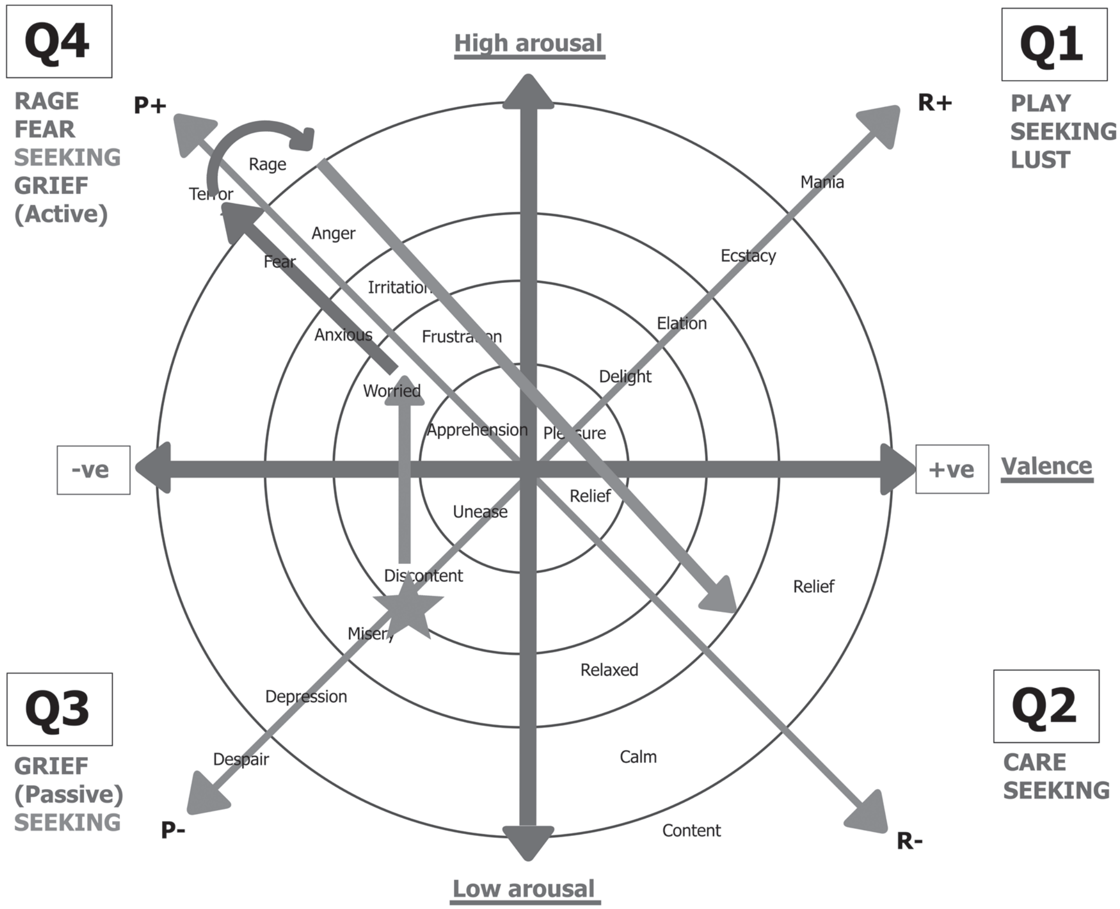

Figure 32.

After a while, the pleasurable effect of temporary relief subsided, and he once again reverted to his normal mood state (Figure 33 below).

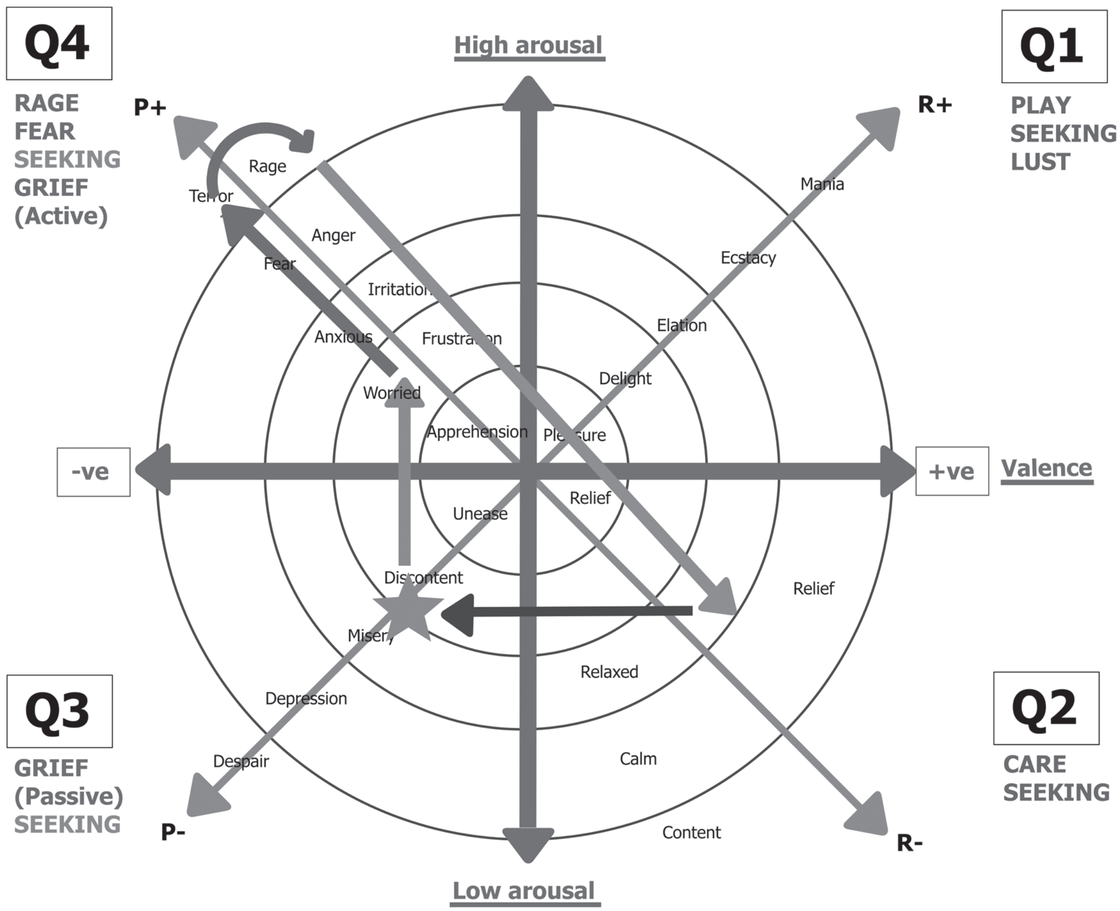

Figure 33.

Pachebel:

In contrast to Figaro's Q3 mood state, Pachebel was becoming increasingly frustrated with being confined. He was growing and quickly became a very agile, very bored five-month-old cat. His efforts to get out of the room doubled, which only added to Figaro's stress. At the time of the fight, Pachebel's mood was in Q4 (Figure 34 below), with a higher arousal level than Figaro's.

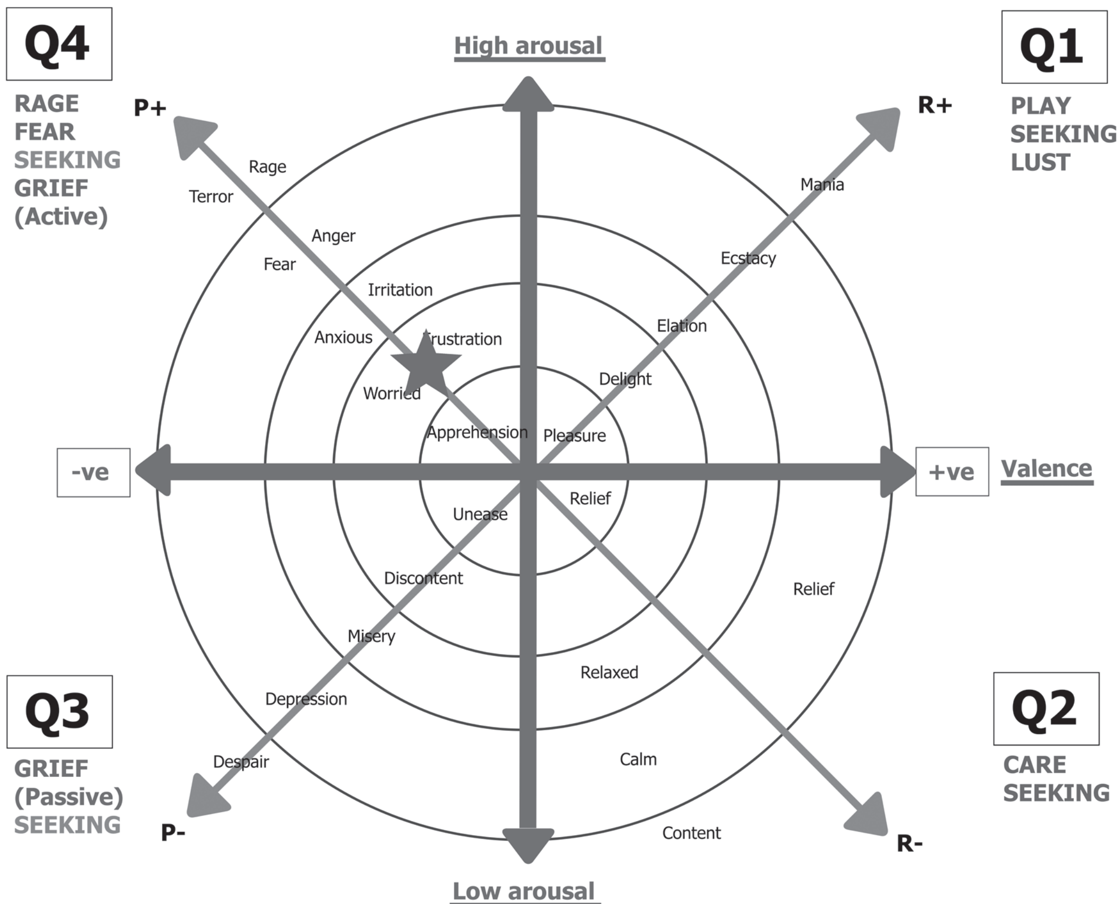

Figure 34.

When he heard Emily opening the door, Pachebel's excitement increased at the prospect of something happening that could alleviate his boredom and frustration. The valence of his emotional state changed to positive (Q1), even though his arousal level stayed the same (Figure 35 below).

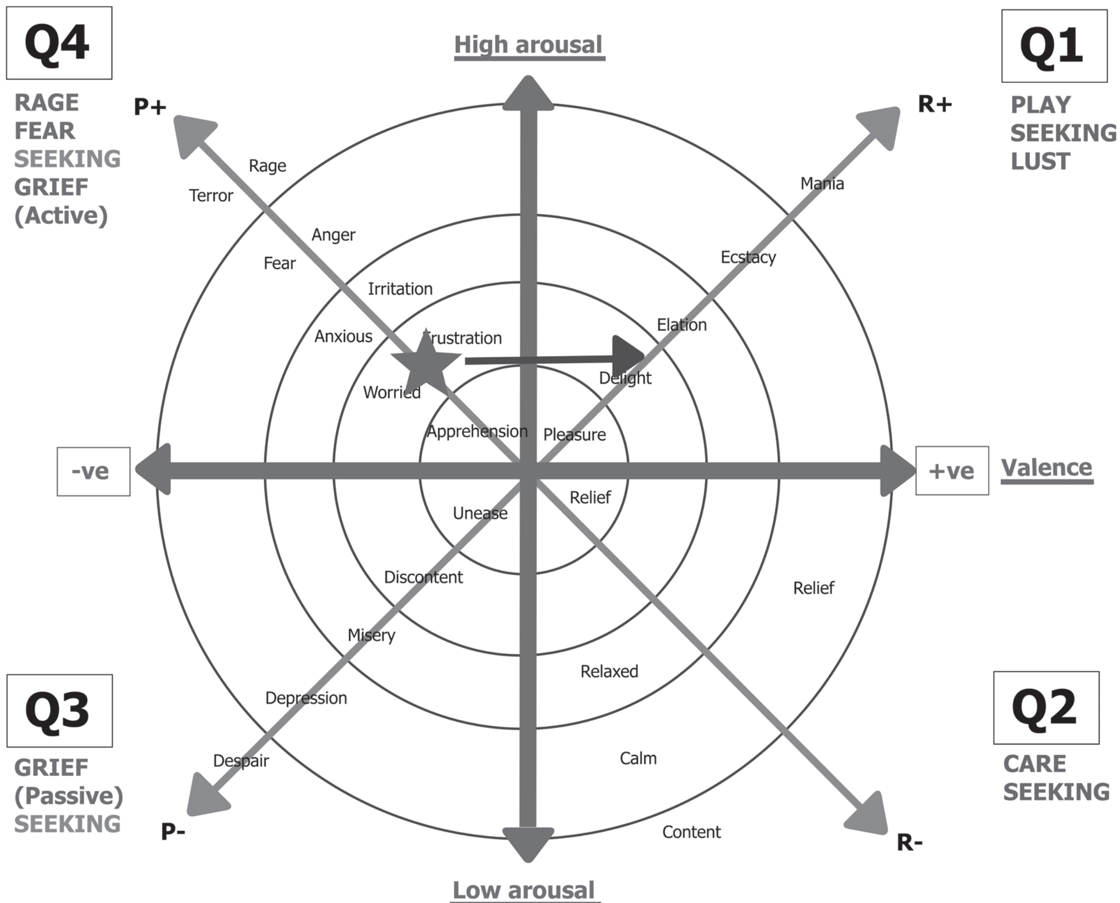

Figure 35.

When the door opened and Pachebel ran out, his arousal levels increased, as did the valence of the situation – this was the most exhilarating thing that had happened to him since he arrived and the prospect of exploring a new place filled him with excitement (Figure 36 below).

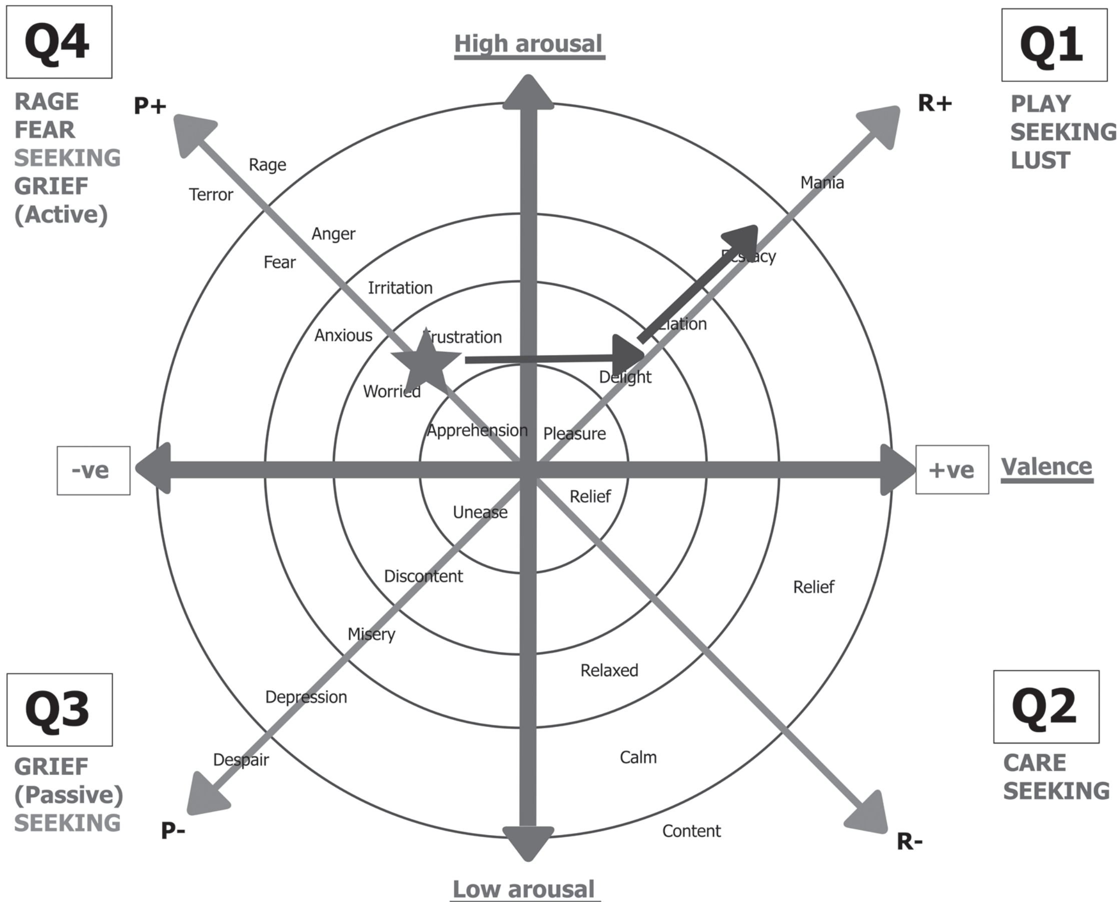

Figure 36.

Coming face to face with another cat was not something Pachebel had expected or anticipated. To Pachebel, Figaro was a stranger who not only hissed at him, but then proceeded to attack him without any delay. This interaction frightened Pachebel and immediately the valence of his emotional experience changed. His arousal level at the time was already high, and despite the change in valence, the arousal level remained the same (Figure 37 below).

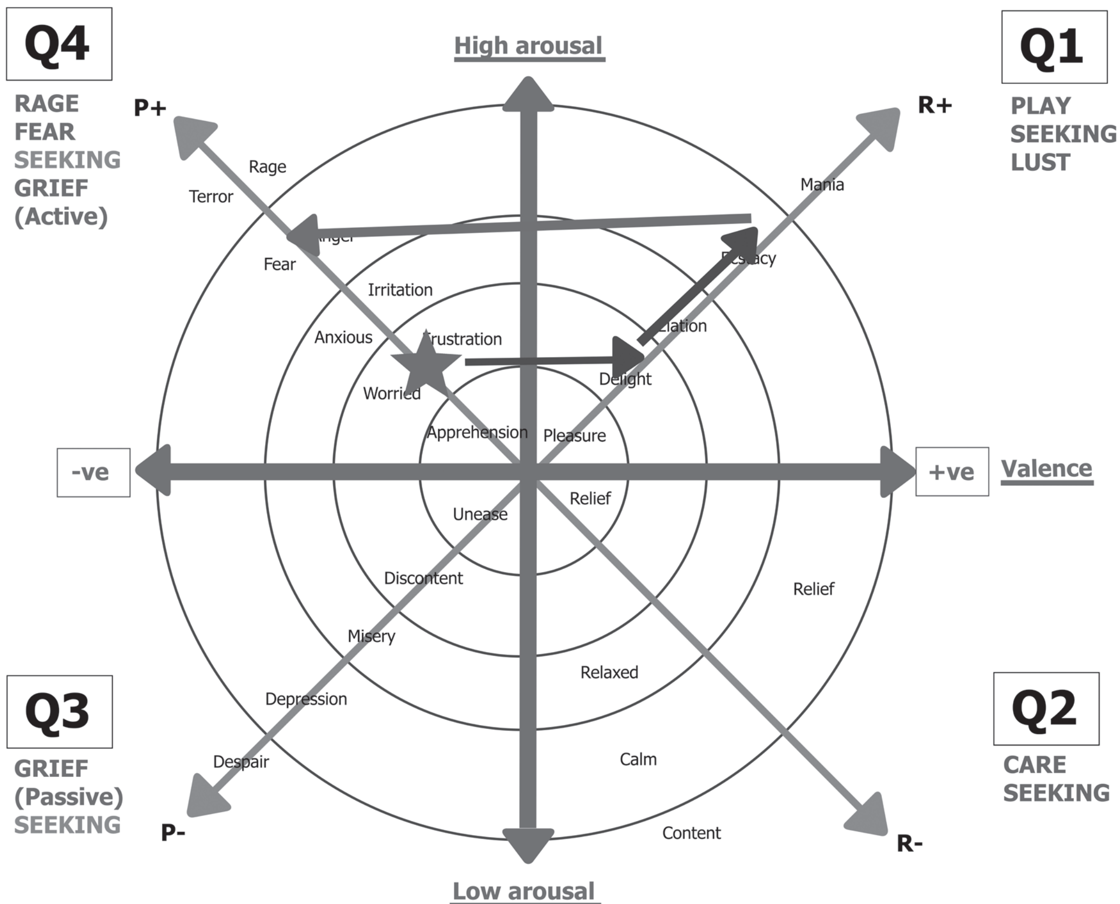

Figure 37.

Pachebel's 5F system activated and he defended himself from the attack. When Emily picked him up, he reacted instinctively by lashing out at her. As she was removing him, he continued defending himself against what he thought was an attack. When she put him on the floor, he ran to the bed, jumped on it and sat watching the door while his tail swished from side to side in agitation (Figure 38 below).

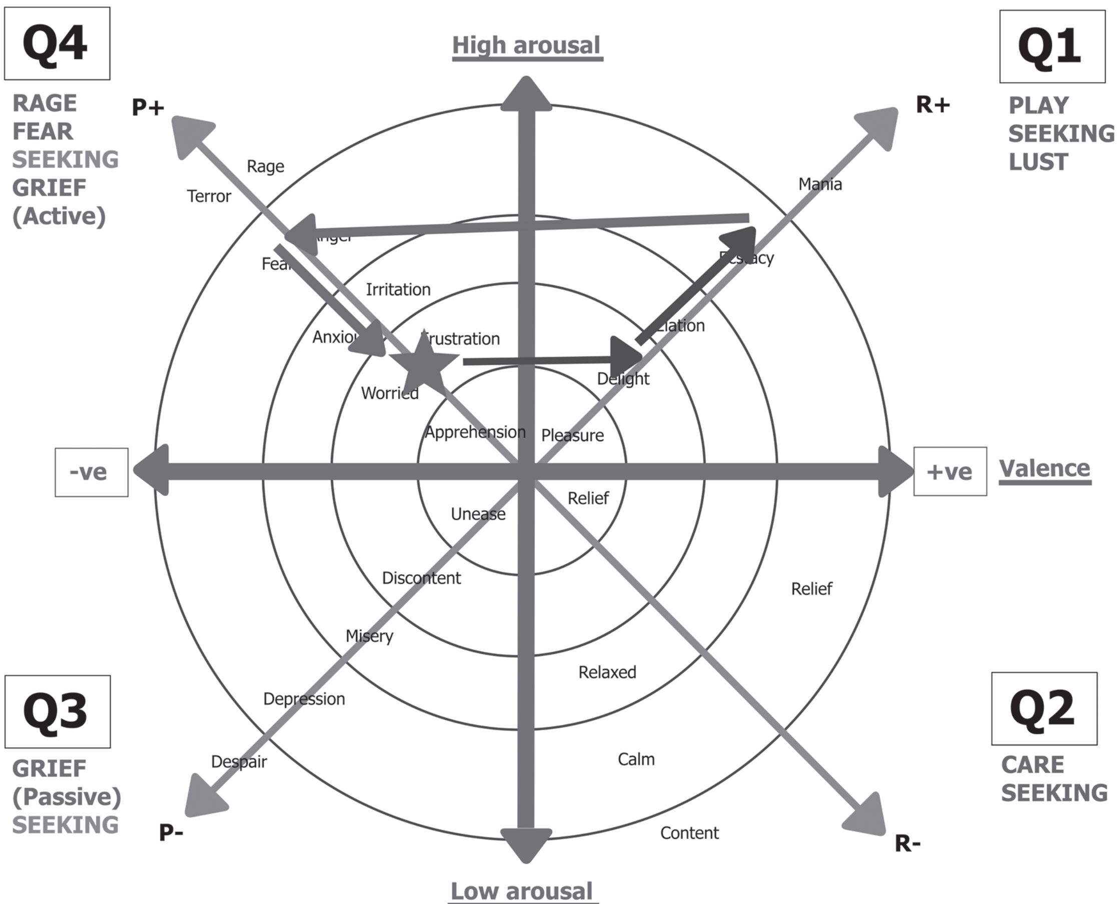

Figure 38.

Emily stayed with Pachebel and ran her hands over him to check for injuries as she was concerned that Figaro had hurt him. Pachebel slowly relaxed and after five minutes, he had calmed down and was lying on his back purring while she rubbed his belly. His CARE system was active, and he was now in Q2 (Figure 39 below).

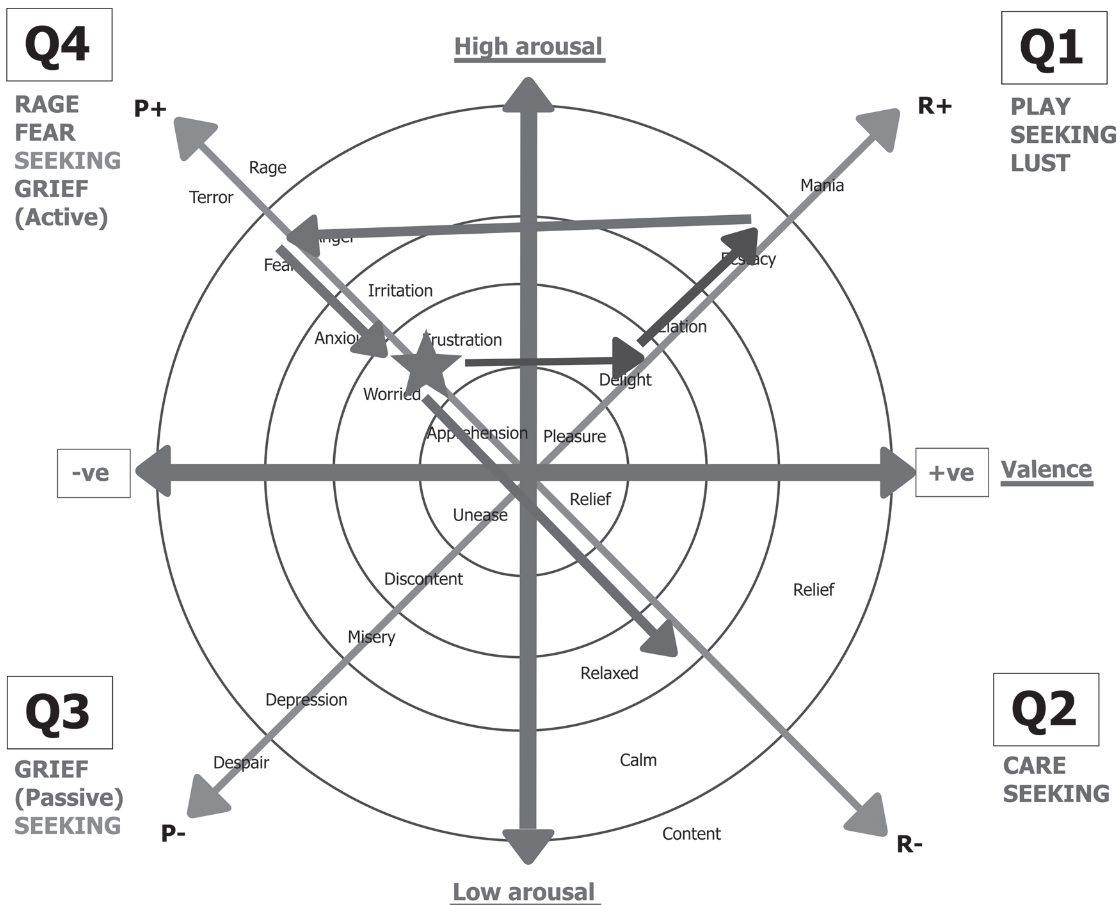

Figure 39.

When Emily left, he remained on his back and appeared to her to be almost asleep. An hour later he was meowing at the door again and had moved back to being frustrated at being confined (Figure 40 below).

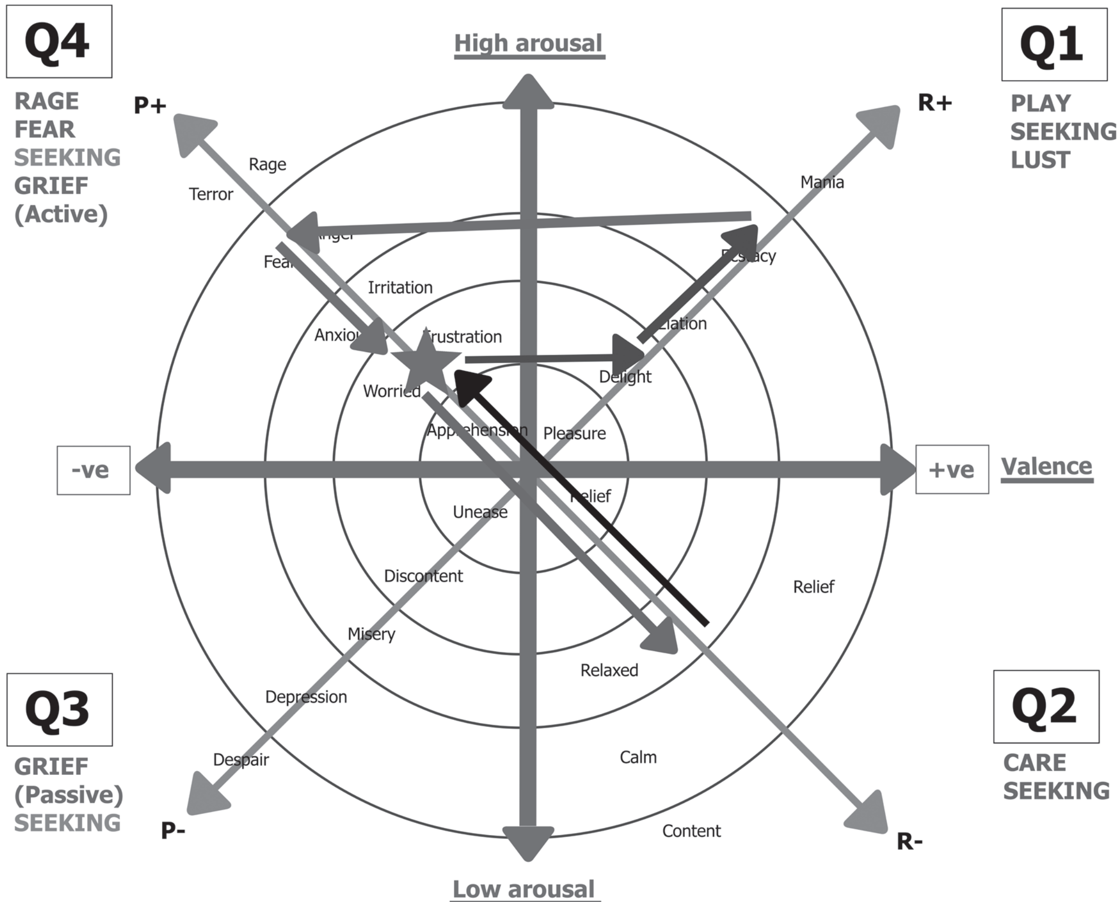

Figure 40.

Figure 41. Figaro busy overgrooming.

Reinforcement analysis

To demonstrate the role that the MHERA Emotionality graph plays in reinforcement analysis, let's look at Figaro's over-grooming, where the emotionality graph helps to answer the question of "why is this cat performing this behaviour?"

We've already established that Figaro's mood at the time was in Q3. Grooming, a self-care behaviour, brings emotional comfort. Instead of feeling discontent, he would experience brief periods of relaxation or even relief while grooming (Figure 42 below).

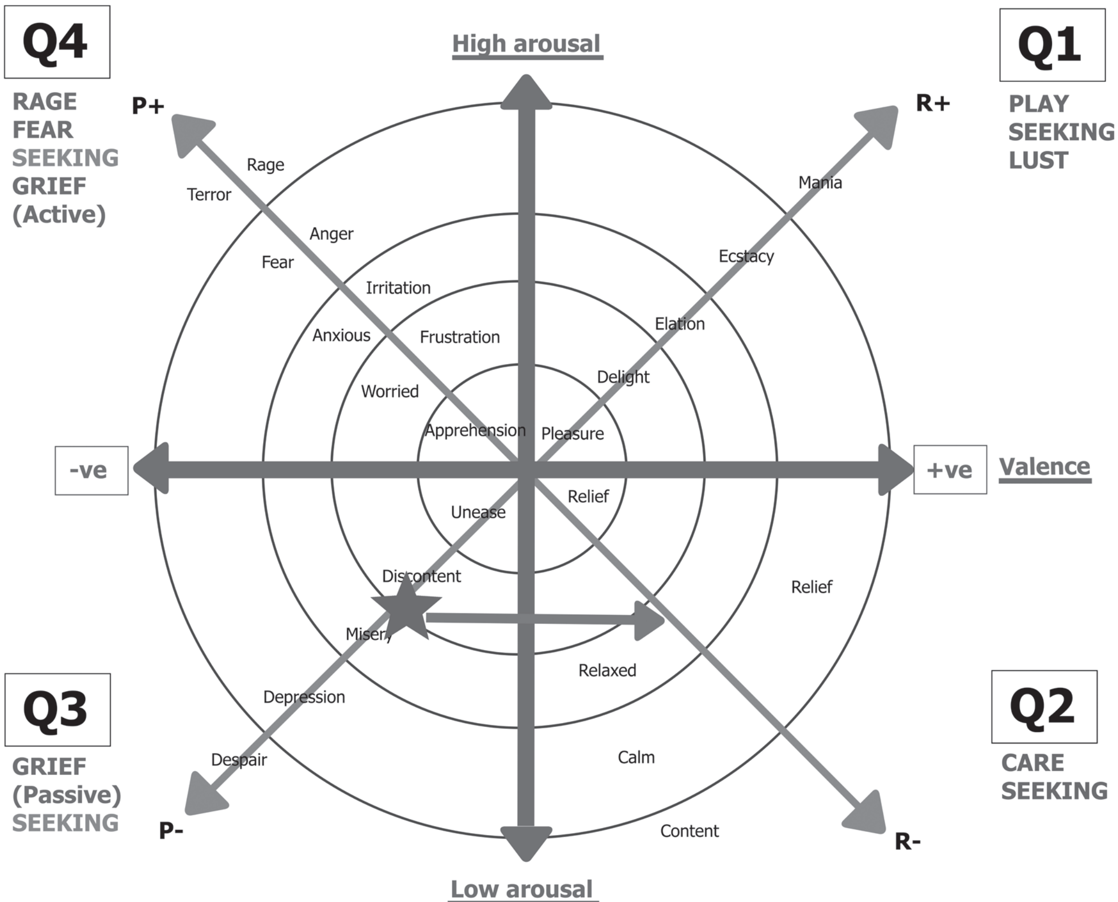

Figure 42.

Generally, whenever Figaro engaged in normal grooming it would make him feel better for a while. However, when he heard Pachebel moving behind the door his emotional state would change and he would start to feel anxious (Figure 43 below).

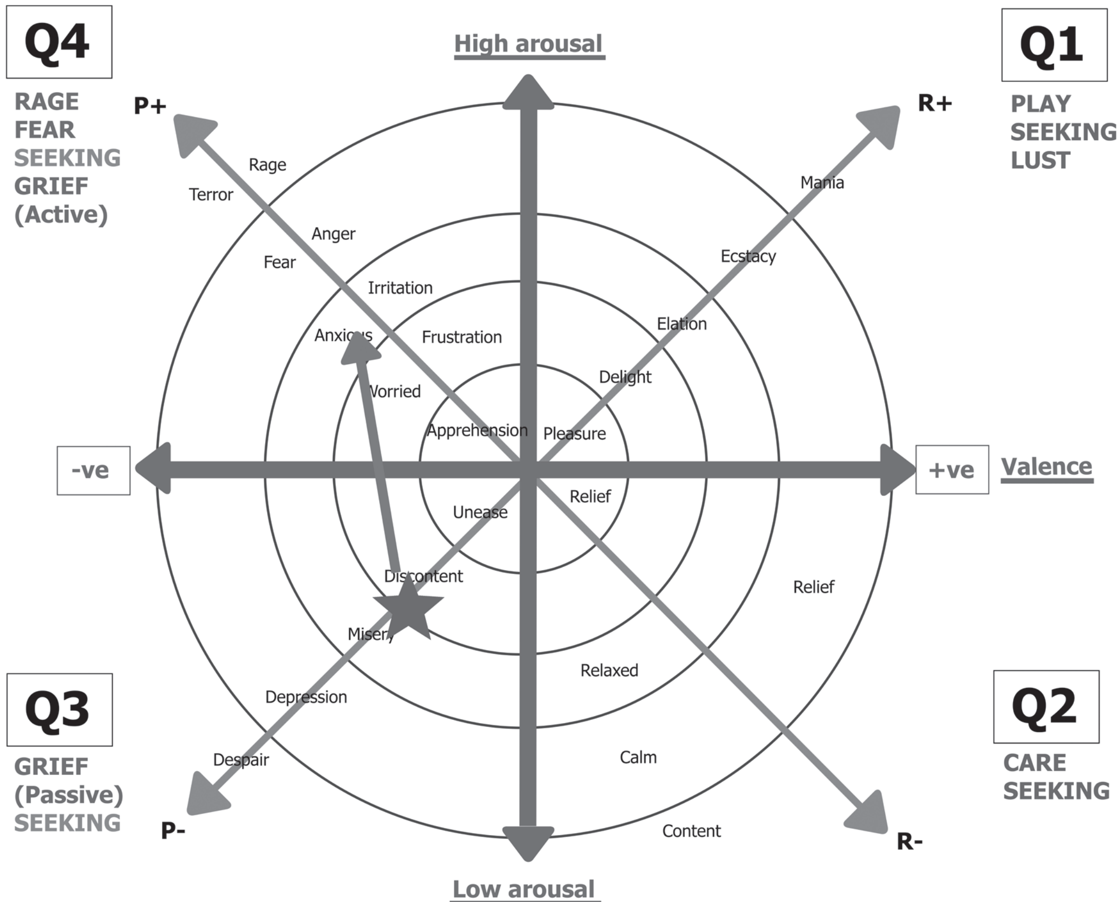

Figure 43.

To alleviate this feeling of anxiety and make himself feel better, Figaro resorted to performing an established behaviour with a strong reinforcement history. He would start (and continue) grooming, well beyond the regular amount required to maintain his coat, an action that brought him temporary respite in the form of relief (Figure 44 below).

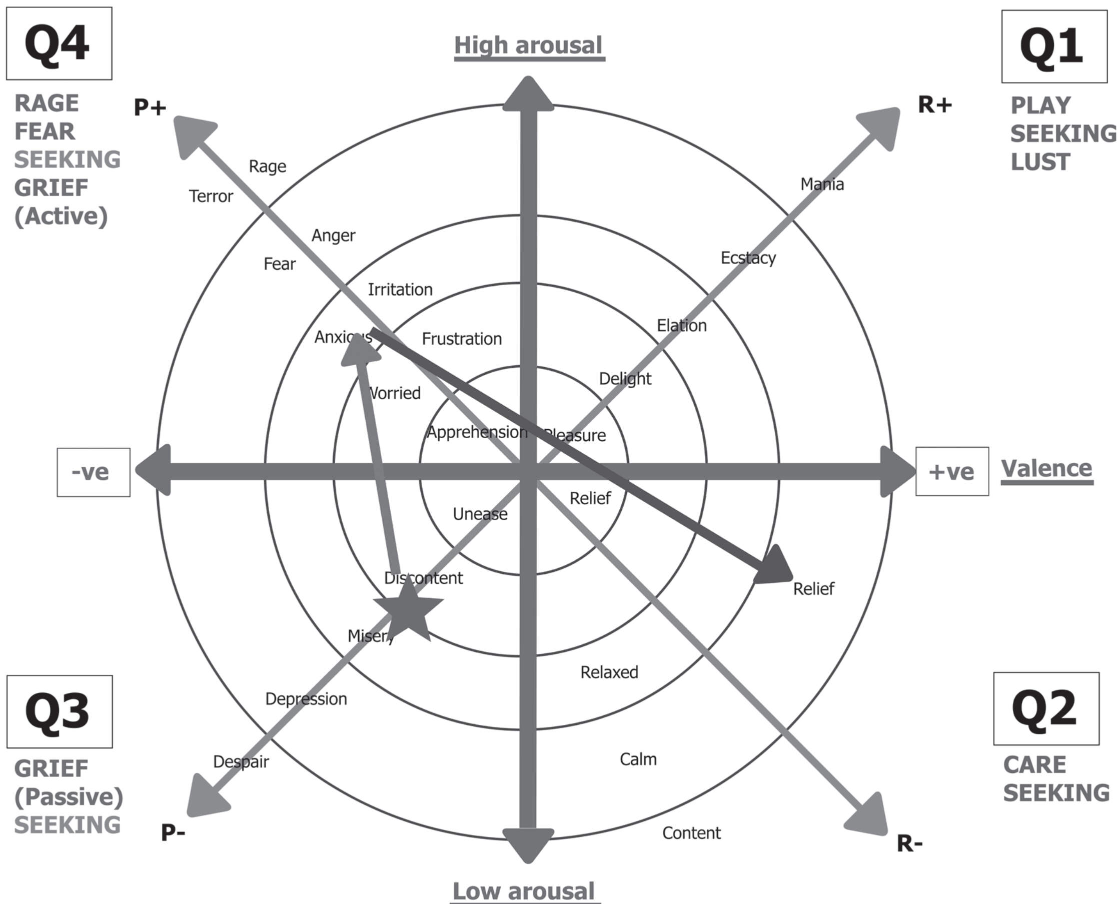

Figure 44.

Relief as a reinforcer can become addictive, and in Figaro's case, this is exactly what happened. Mapping the animal's emotional experiences gives the behaviourist an accurate, visual representation that not only shows how these emotions are contributing to the existence of the problem, but also the role that the individual's mood played in the intensity of these emotional responses. This in turn allows the behaviourist to formulate an accurate treatment plan that is tailored to the individual, instead of a blanket, one-size-fits-all approach.

In the not-too-distant past, people were often advised by professionals to use Elizabethan collars on their pets to stop the grooming as part of the treatment approach. But if Figaro's emotional experiences (and the role they played in his over-grooming) were not taken into consideration, the problem would not have been resolved, and the behaviour likely would have continued indefinitely (albeit whenever the collar was removed).

Chapter 8
MHERA Applied to a Horse Behaviour Case
Balthazar's Fears

As the final example to demonstrate MHERA's application, I chose to discuss Balthazar, a ten-year-old Draught Horse, who was scared of going through the gate to his paddock after he was caught on it one day.

Balthazar's background

Balthazar's owner bought him from a breeding yard when he was six years old. Up to that point, he lived as part of a herd, had access to large paddocks with ample grazing and was occasionally used as a stud. The care he received at the yard was exemplary, and his owner, Jill described him as a happy, content horse. Before moving to Jill's farm, Balthazar was gelded and given a clean bill of health by her veterinarian. He adjusted seamlessly to life on her farm, and quickly became part of her existing herd of horses. The paddocks were similar in size and grazing to what he was used to, and for the better part of three and a half years, everything was perfect, until one wintery afternoon when an oversight from the groom ended with the double-buckle front closure strap of Balthazar's blanket getting stuck on the gate latch. The horse tried unsuccessfully to pull back to free himself, while the groom continued to try and pull him forward by his halter. By the time Jill reached them to stop the groom, Balthazar was panicking and rearing. His blanket had torn from the pressure and was caught around his front legs, adding to his panic. Thankfully Jill managed to calm him down and free him without any resulting injuries, but after that, Balthazar refused to walk out of the paddock. He was comfortable going in as long as other horses went ahead but getting him to leave was a daily struggle that would often take up to two hours. Jill did not believe in using punishment with her horses, and was extremely patient, but after a month of no improvement, decided to ask for behavioural help.

Mood State Assessment

Mood state assessment is always the first step in every MHERA evaluation, irrespective of the species it is being applied to. After speaking to Balthazar's breeders and current owner to obtain a detailed history, it was determined that his hedonic set point (personality) was in Q2 on the Core Affect Space matrix, at a positively valenced, low arousal (relaxed) point (Figure 45 below). In general, Balthazar's outlook on life was positive. His cognitive bias evaluation confirmed that he readily investigated novelty. He eagerly participated in exercises while being ridden and enjoyed outrides and shows and was generally considered a content and easy-going horse.

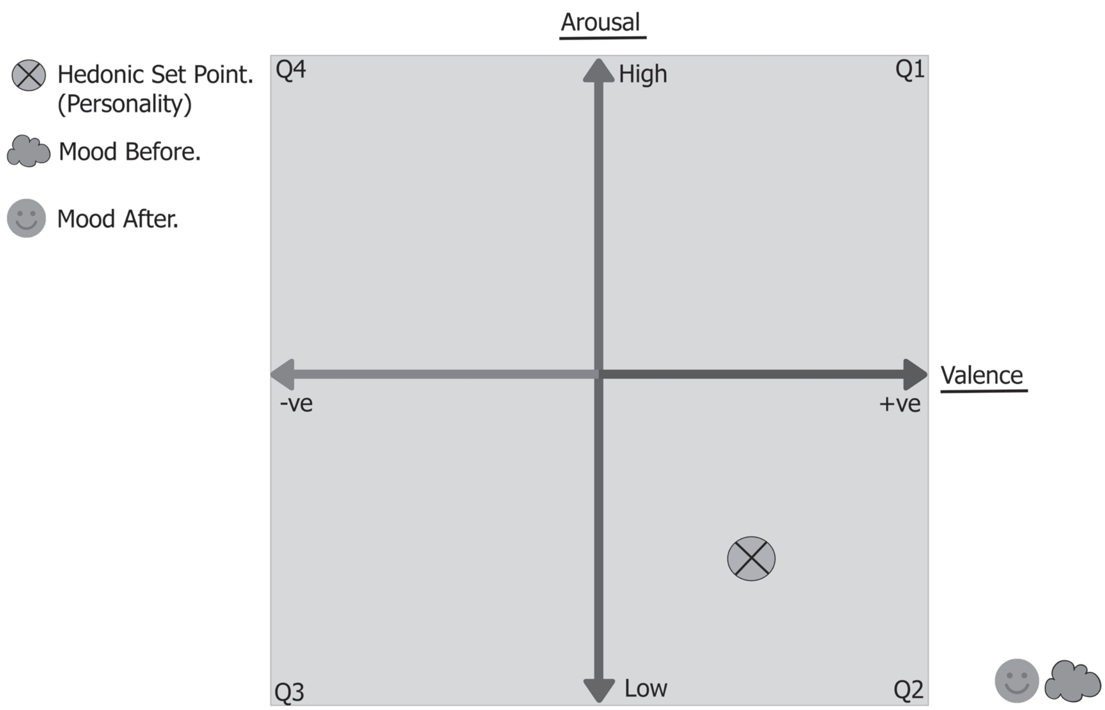

Figure 45.

The frequent exposure to the fear-inducing stimulus/context, however, meant that he was becoming more and more anxious with every passing day, and his mood reflected exactly how this was affecting him. Jill described how Balthazar would usually approach her and be first in line to leave the paddock in the evenings to go to his stable. Now he avoided being caught and despite efforts to reassure him, he approached the gate nervously with wide eyes and flaring nostrils. His interactions with the herd had changed too — Balthazar was no longer participating in activities such as grooming or playing when in the paddock and overall appeared to be more 'jittery.' Despite his optimistic personality, Balthazar's current mood was in Q4: negatively valenced, with some arousal, leaving him feeling constantly apprehensive (Figure 46 below).

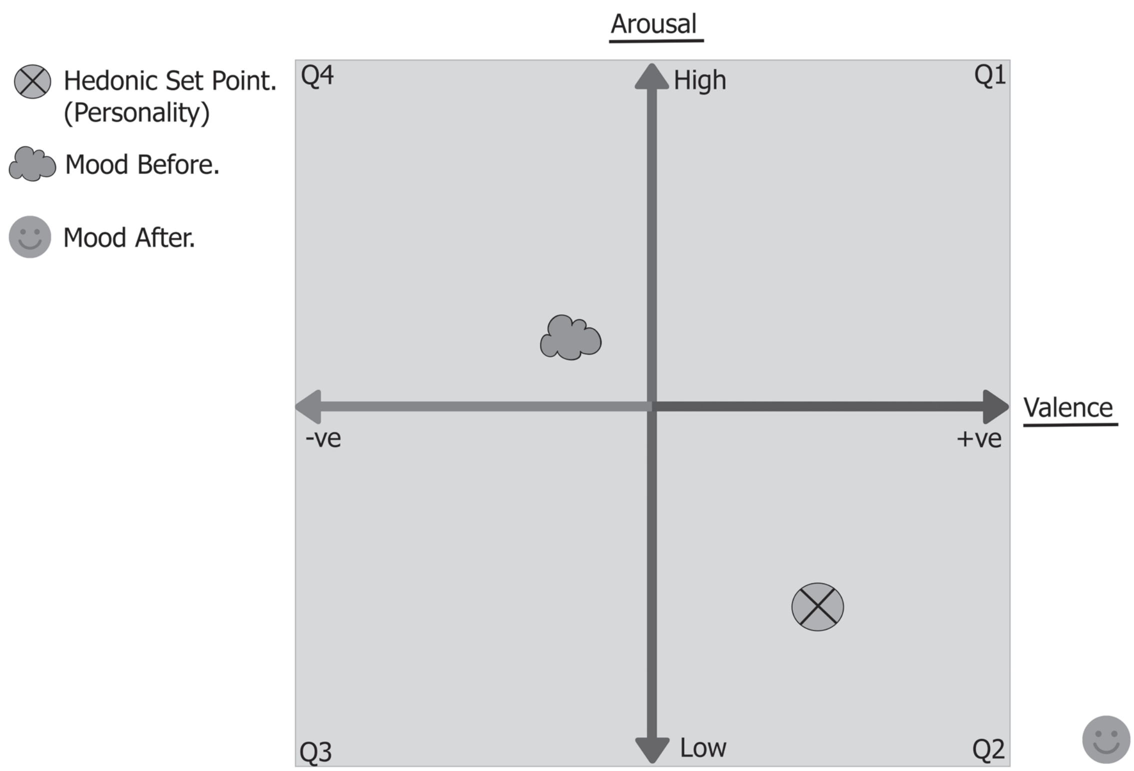

Figure 46.

In this case, Mood After was used as a goal to show Jill where we wanted Balthazar to be once behaviour modification was complete (Figure 47 below).

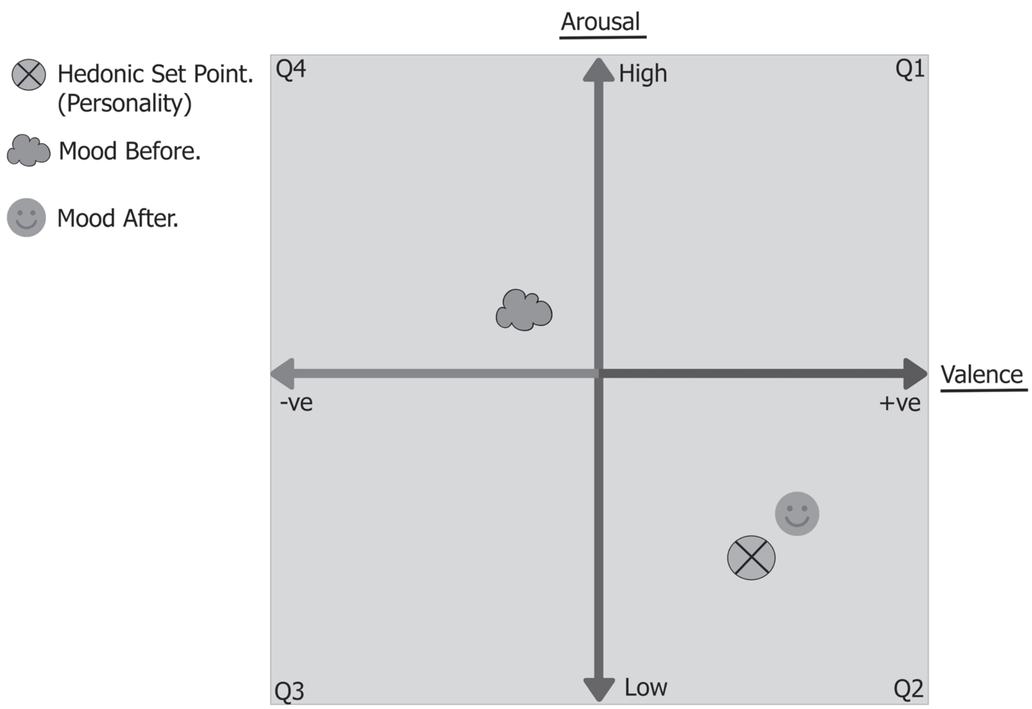

Figure 47.

Hedonic Budget Assessment

The hedonic budget assessment helped to identify areas where deficits or excesses existed in Balthazar's day to day budget. Adjusting these discrepancies would contribute to his overall emotional and behavioural well-being and would give us a starting point in his treatment program, as well as setting the pace with which we could make changes to his environment.

As always, the score used to plot the hedonic budget allocation is out of ten, with 0 being the least amount of time spent engaged in the activity, and 10 being the most.

REQUIRED:		
SEEKING: Foraging (Food aqcuisition)	Type Overall:	x x x x x x x x
	Individual Variation:	x x x x x x x x
	Before:	x x x x x x
	After:	
SEEKING: Exploring/Novelty:	Type Overall:	x x x x x x
	Individual Variation:	x x x x x x x x
	Before:	x x x x x
	After:	

PLAY: Other horses	Type Overall:	x x x
	Individual Variation:	x x x
	Before:	x
	After:	
PLAY: Object Play*	Type Overall:	x x x
	Individual Variation:	x x x
	Before:	x
	After:	
PLAY: Locomotor play**	Type Overall:	x x x
	Individual Variation:	x x x
	Before:	x x
	After:	
CARE: Other animals	Type Overall:	x x x x x x
	Individual Variation:	x x x x x x
	Before:	x x x x
	After:	
CARE: People	Type Overall:	x x x x x x
	Individual Variation:	x x x x x x x x
	Before:	x x x x
	After:	
GROOMING: Self	Type Overall:	x x x x
	Individual Variation:	x x x x
	Before:	x x x x
	After:	
GROOMING: Mutual	Type Overall:	x x x x x x
	Individual Variation:	x x x x x x
	Before:	x x x
	After:	
GROOMING: Other animals	Type Overall:	N/a
	Individual Variation:	
	Before:	
	After:	
GROOMING: Guardian	Type Overall:	x x x x
	Individual Variation:	x x x x
	Before:	x x x x
	After:	

OBLIGATORY:		
Sleeping/Resting	Type Overall:	x x x x x x
	Individual Variation:	x x x x x x
	Before:	x x x x x
	After:	
Eating	Type Overall:	x x x x x x
	Individual Variation:	x x x x x x
	Before:	x x x x x
	After:	
Drinking	Type Overall:	x x x x x
	Individual Variation:	x x x x x
	Before:	x x x x x
	After:	

Horses in paddocks with grazing generally devote most of their day to feeding (rearchgate.net, n.d.). On the hedonic budget graph, this was marked as an eight out of ten allocation. Balthazar was no exception here, so his individual variation matched that of his type. His Before was slightly lower. Because he was feeling apprehensive, he spent more time reacting to the presence of people at the gate or movement around him, and less time grazing. When Jill noticed this, she started supplementing his feed in his stable at night so despite grazing less, his body condition was not deteriorating.

Balthazar had a higher individual variation score under SEEKING Exploring/novelty, because he was a particularly inquisitive horse. Jill, an experienced horse owner, described him as the calmest, yet most curious horse she'd ever known. Balthazar enjoyed going to new places, and when they were at shows, he was in his element. He was even found inside Jill's house on occasion, investigating the kitchen! The Before allocation was lower because Balthazar was spending more time watching the gate and avoiding coming near it, and less time investigating the goings-on around his paddock. He was also playing less with the other horses, which showed in the lower Before score on the hedonic budget.

Play categories were adapted to be applicable to horse specific play patterns. Jill encouraged object play instead of play with people (for safety reasons), and all her horses were given ample opportunity to play with enrichment items such as Equi-spirit balls, barrels and traffic cones. Locomotor play was also relatively common in Jill's herd, and Balthazar usually participated. Since the gate trauma, there was a marked decrease in this activity for him.

His care and grooming behaviours toward other horses also decreased when he was in the paddock. Since most of the horses would spend a good portion of their 'standing' time congregated around the gate, it meant that Balthazar, who avoided going near that area, missed out on social/mutual grooming and care behaviours with the other horses. Finally, because he was more vigilant in the paddock, he spent less time resting than normal.

Emotional Assessment

In his mood state assessment, we placed Balthazar's current mood at 'apprehensive' (Figure 48 below). This was the base state that he disinhibited from whenever he was reacting to anything. As soon as he saw the grooms carrying hay nets to the stables, his emotional state changed to worried (A) as he recognised that as an antecedent cue which led to grooms coming to take the horses out of the paddock and therefore, past the gate. When they entered the paddock, Balthazar delayed being caught by standing as far away from the gate as possible and by moving away whenever a groom came close to him. Every time he trotted out of reach, he experienced a brief feeling of relief at having avoided being captured (B), but as soon as the groom approached again, his emotional state would move back to feeling worried (C). When the groom finally cornered him and clipped the lead reign on to his halter, his worry changed to feeling anxious (D) and the closer he was forced to the gate, the more his arousal increased, and valence decreased (E). When he eventually rushed through the gate, he experienced a brief feeling of elation (high arousal, positive valence) at having survived the scary gate (F), followed by relief that the event had passed (G).

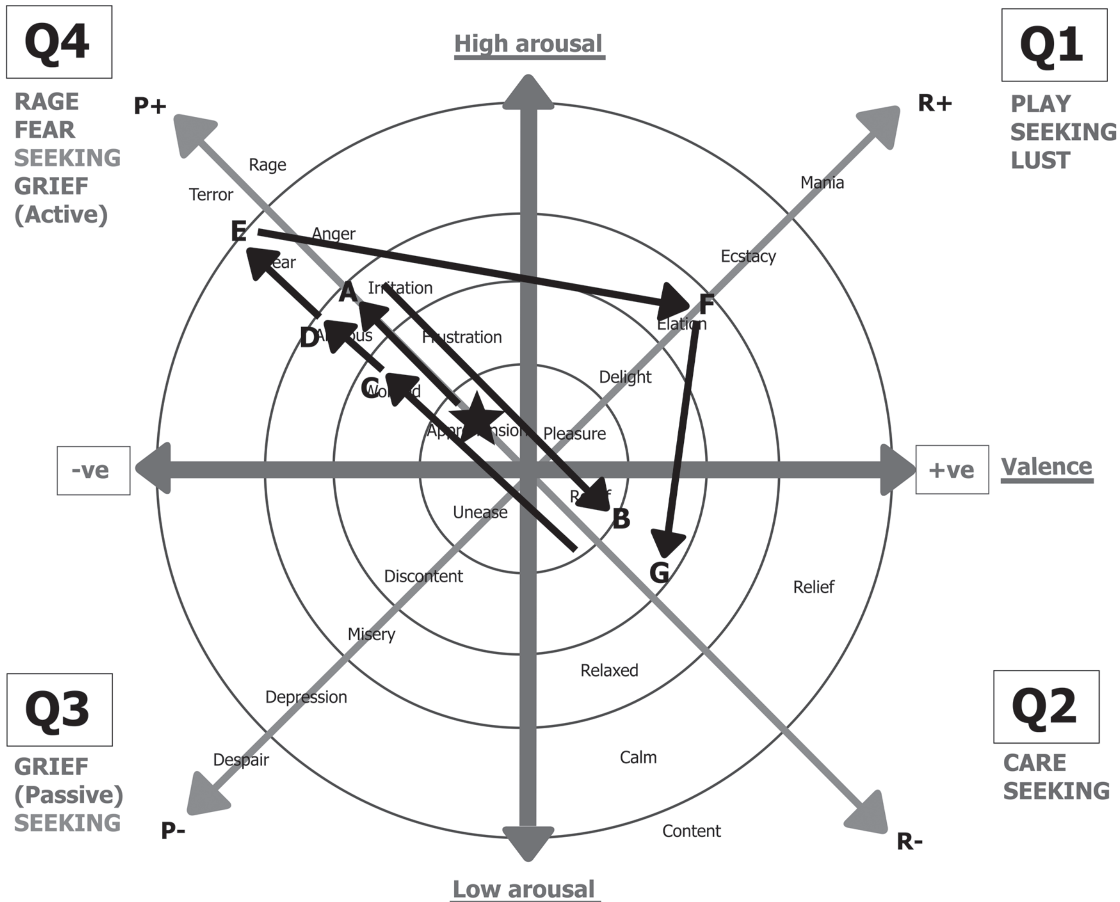

Figure 48.

Balthazar's emotional experience around the paddock gate was mapped on the MHERA Emotionality graph to show Jill exactly what the horse was feeling every time he had to go up to and through the gate. Despite being an exceptionally understanding horse owner, Jill admitted that she was frustrated with Balthazar's continued reluctance to go through the gate because she thought he was being unnecessarily stubborn. She knew that horses were flight animals but felt that after a month of being coaxed and comforted, he should have made some progress or gotten over his fear, especially since nothing bad had happened since. Showing her how Balthazar's emotions fluctuated and how they played a role in the reinforcement of his strategy of delay being caught for as long as possible and then charge through the gate at full gallop helped Jill to understand why he was not getting any better, and why his behaviour in general was being affected.

Chapter 9
Conclusions

A point that hasn't been touched on the chapters above is how consent and choice tie in with MHERA's application. If one considers that animals have rich, emotional lives that influence their decisions and behaviour, then it stands to reason that when treating any animal, the behaviourist or trainer should take the animal's choice to participate (or not!) into consideration. I have had the privilege of working with a variety of animals in my career, ranging from domesticated pets to primates of all sizes as well as carnivores, pachyderms and even fish and the one observation that stands out to me above all else is that humans take advantage of dogs when it comes to consent and voluntary cooperation, purely because they can. It doesn't necessarily have to be in an unpleasant way or by using aversive training or behaviour modification techniques, but in simple ways like asking the dog to continue focussing on the trainer or owner when the dog is tired, worried, not interested or not in the mood for training. It's easy to create a situation where the dog has no choice but to comply; think about dogs on lead being asked to participate in a training class when they'd rather be at home or further away from other dogs. Even in classes where positive reinforcement is used exclusively, dogs are often expected to participate despite not feeling like training on that day.

Let me tell you about my experience working with a Western Lowland Gorilla named Makoko. This magnificent creature was always in complete control when we did any work, purely for the simple reason that you cannot make a fully grown silverback do anything he doesn't want to. If I arrived for a training session and he rather preferred lying in the sun, I could not coax him to participate, irrespective of treats or games or toys offered. When he chose to participate, he would do so only until he decided to stop, even if the training session was only two minutes in duration. Initially I found that quite challenging — after all, when training, one usually plans to reach certain loosely defined goals on time. Normally that would mean doing a little bit of training each day to maintain momentum and make progress. But when an animal that size decides not to participate, there is simply nothing to be done but step back and hope for the best tomorrow. Some days were absolute training gems where we made huge strides forward, other days I ended up sitting on the floor trying to figure out how to get him to better cooperate or trying to coax him to engage. It was in one of those moments when he taught me about the true importance of consent, freedom of choice and the impact that had on relationships.

I clearly remember that day and I suspect it will, for the rest of my life, be a day that will stay in my mind as if it had happened yesterday. I was sitting on the floor at the door of the training area, with my clicker in hand and his favourite training treat (dates) at the ready. My plan for the day was to work on his targeting skills, which we would later use as part of a sequence to teach him to voluntarily participate in having his blood pressure taken. Makoko was sitting a few paces away, idly picking at his leg. I called to him and gave the signal to start training, but instead of coming to me, he looked me straight in the eye — and then turned his back to me.

Figure 49. Makoko ignoring my attempts to engage in training.

I tried again, waving the dates in the air to try and entice him, but he barely glanced at me over his shoulder, instead choosing to continue lazily grooming his leg. At this point I realised that it probably was not going to be a training day, and for a while I sat there pondering ways to work around this lack of cooperation. Eventually the peace and quiet of the situation caught up with me, and I decided to sit back and just enjoy being this close to this incredible creature. After all, this was a privilege afforded to only a few people in their lifetimes. A few minutes after I put the clicker and dates away, Makoko turned to face me. I had brought Panksepp's book *Archaeology of the Mind* with me and out of curiosity decided to start reading to him to see what he did next. Granted, Panksepp was an odd choice of reading material for a Gorilla, but I hoped that it would be my passion for the subject, rather than the actual content, he would (with any luck) enjoy. Halfway through the chapter, I looked up and saw that he had moved closer. Another chapter later he was lying on his back in front of me with his arms behind his head. His eyes were half closed, and he was making little contented gorilla noises. When I stopped reading, he grumbled as if to say "carry on!" and it was in that moment that I realised that this incredible animal had chosen to lie next to me not because he had to, but because he enjoyed my company. To the outside observer, we didn't appear to be doing anything productive, but from a relationship perspective, mountains had just moved in my head. I started thinking about Panksepp's CARE system, and soon my thoughts turned to MHERA. I automatically did a quick emotionality assessment on us both and realised with a start that out of the two of us, I had been the one with the problem, not him! To me, Makoko's initial reticence about training was an obstacle, something I had to solve so we could start being productive and do some training. I felt exasperated at the hold-up because I had deadlines to meet for the project. When he made it clear that he was not going to participate and I chose to sit and read to him instead, my frustration decreased, and I started feeling calmer. By the time we were two chapters along, I was feeling a deep sense of contentment which Makoko clearly shared. When I eventually stopped reading, he was fast asleep and snoring softly, something he had not done in my presence before, even though I had been working with him for almost a year.

The next time I arrived for our training session, Makoko greeted me for the first time with what his care team called his 'MY HUMAN' vocalization. It was a deep grumble that started in his chest and that would vibrate up his neck, and he only made that sound when he greeted people that he had a close bond with. Our relationship had changed completely, and from that day on Makoko would actively seek me out for interactions. If I walked to the front of his enclosure, he'd follow me, and if I was standing there talking to him, he would often move to the training gate, which was his cue for "come here, let's do some training."

Of course, he still had his moments when he did not want to train. The difference was that we now asked if he wanted to train and respected his decision when he indicated that he didn't and before long it became noticeable how much his compliance improved. When he didn't want to train, we did other things that he enjoyed, which included listening to Vivaldi's Four Seasons or playing scent games.

I tested this approach with a variety of other animals including elephants, spider monkeys, cats, dogs and horses and the difference was remarkable. As soon as animals are given a choice about participation and their wishes are respected, their attitudes change. Much like humans! After all, we prefer working with people whose company we enjoy (and who treat us with respect and value our input,) even if the project isn't necessarily always fun. If the relationship is great and filled with more positively valenced experiences than negative ones, we're far more likely to continue working with these individuals or look forward to spending time with them. The same really should be applied to animal behaviour and training, and not just with the animals. Every person who asks for help with an animal behaviour problem is likely already feeling disheartened, upset, sad or anxious due to something that has happened, and just like dogs or cats, our emotions and biases cloud our judgement and influence our decisions. By applying MHERA to the client, it can help you to determine how much work to give, what speed to make changes to the environment and what the client is capable of at that specific time, which could be the difference between a successfully implemented program or a dismal failure.

When using MHERA in practice with clients, it's entirely possible to simplify the concept to convey the desired information without going in to too much technical detail. Of course, it is important for the *practitioner* to understand the scientific foundation, because without this theoretical background it would be difficult to accurately evaluate what the animal is experiencing and MHERA Licenced Practitioner status can only be obtained through the completion of the COAPE International MHERA Certification course (www.coape.org).

Taking the individual's emotions into consideration should always be the starting point for any treatment program, whether it's for humans or animals, and MHERA truly can be applied to any species to facilitate improved emotional and behavioural well-being. As a final thought, if MHERA is used by the trainer, behaviourist, veterinarian or guardian to monitor how an animal is feeling, it can facilitate consent-based participation, which in turn would improve the relationship between animals and people significantly.

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Chapter 8

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About the Author

Karin Pienaar lives in Johannesburg, South Africa with her husband Andre, daughter Kaley and their menagerie of cats and dogs to keep them on their toes. She divides her time between traveling, working from the office at home where she is currently busy writing another book about animal emotionality, giving lectures, running COAPE International (www.coape.org) or working with a variety of animals (from pets to elephants to gorillas and everything in between). In her free time, she can be found having adventures with her daughter or busy with astronomy and astrophotography with her husband. She also paints and is an avid orchid and rose growing enthusiast (read: addict!).

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