

Chapter 1

How Animals Respond to Change

1.1 UNDERPINNING PRINCIPLES RELATING TO STRESS IN COMPANION ANIMALS

1.1.1 STRESS AND CHANGE

It has been said that the only constant in life is change, and it seems that some of us cope better with this than others. In this chapter we will explore why this might be. We will focus on factors that not only affect humans but are also relevant to nonhuman animals. Attempting to adapt to change is an intrinsic part of being alive. As a feature of any living system, the environment changes around us all the time, and we have a number of mechanisms for dealing with this. Two obvious ones that are commonly described in the literature are:

- *Physiological processes*: Pure changes in physiology are often thought of as being relatively simple (metabolic changes), for example a change in sweating when the body's temperature starts to rise. These changes may be mediated by either the nervous or the endocrine system, or a combination of both. Often changes in simple physiology are relatively inexpensive, energetically speaking, for an animal to implement.
- *Behavioural processes*: Behaviour responses, for example an animal panting when it is hot (Figure 1.1), involve much greater use of resources and energy, and so are perhaps better considered as the second line of response in the majority of cases. However, physiological processes are at the root of changes in behaviour too: it is just that behaviour changes are more obvious and involve a shift in the animal's posture or position.

Sometimes an animal adapts to a stressor by making a mental adjustment (cognitive change), for example accepting something novel in the environment as nonthreatening, and this too is ultimately a reflection of physiological changes in the brain, even though we might focus on the cognitive outcome.



Fig. 1.1 Panting is a response to thermal stress. Animals encounter stressors all the time, but their behavioural flexibility means they can usually cope without significant distress.

Thus, in response to stress, we can recognise three types of change in the body:

- A metabolic shift.
- A change in behaviour.
- A psychological adjustment.

These are not independent, but rather are usually closely related, though perhaps with one being more obvious than another at a given time, depending on the demands being made or anticipated given the circumstances. Overt changes in behaviour are typically more demanding and are therefore often a secondary line of defence when metabolic shifts are not possible or do not work.

1.1.2 HOMEOSTASIS AND ALLOSTASIS

The concept of homeostasis has dominated thinking about how animals adapt to change for a long time, but in its purest form it has the potential to limit our understanding in some important ways, as we will see. *Homeostasis* basically means that an animal's body works to restore an optimal state whenever this is disturbed (stressed). So if blood sugar goes up, the body will try to bring it down again, since high blood sugar can be harmful. An immediate response might be to increase production of insulin in order to increase the uptake of glucose by cells in the body. At a behavioural level, an animal may stop feeding in these circumstances, and at a cognitive level it may no longer show positive interest in cues suggesting food. The concept of homeostasis can be applied not only to stressors associated with internal changes, such as changes in blood sugar, but also to external changes such as unpleasant and dangerous environments or situations that are confusing to the animal: thus, if something scares the animal it may run away in order to restore the preferred state of relaxation in a safe and secure environment. Sometimes an animal must work very hard to restore balance, or it



Fig. 1.2 A dog trying to escape from its kennel. Successful escape would restore homeostasis, but this is not possible because of the height of the pen walls. It is better to see the walls as a barrier which gives rise to frustration to the animal's attempts at escape than to simply consider the animal bored, since this focuses attention on the types of intervention which might be most effective. If we consider the animal to be bored, we are using a vague concept and our recommendations for intervention may be equally vague – such as unspecified 'environmental enrichment'. As we will see later in the text, if we recognise that the animal is frustrated by a specific stimulus, we can ask the question: what action is being frustrated and why? The answer in this case is that there are things outside it wants to gain access to. So treatment should focus on not only removing this frustrated desire by ensuring the stimuli outside are less interesting, but also, and more importantly, making the inside more engaging for the animal. This means enrichment needs to be applied that is dynamic and interesting. A few toys will not be enough.

may be frustrated in its efforts by an inescapable situation, such as when a dog wants to get out of a kennel (Figure 1.2).

From these examples, it should be apparent that although responses may share some common features, such as an increase in arousal, stress responses vary according to the nature of the trigger. Thus the specific response is quite different when the trigger is a rise in blood sugar than when it is frustration at a barrier.

The key feature of homeostasis that we will now consider more closely is that the body tries to minimise the impact of stressors (things that disturb us from an optimal set point in some way) by *responding* to changes. The word 'responding' is emphasised as it suggests that it is the disturbance which drives the process.

A concern with this idea is that if we provide an animal with a balanced diet, fresh water, an optimal temperature and so on in a nonthreatening environment, we might be tempted to think that the animal should not be stressed. This was one of the errors which led to the belief that factory farming would be good for animals. We now recognise that because animals have evolved in environments in which change inevitably exists, their bodies have come to expect change and so they are driven to do things even when everything seems optimal. This is probably because such a state is never very long-lasting in nature, so there is no evolved mechanism to simply accept that life is good and will remain as such.

An outcome of the evolutionary expectation that life exists within an ever-changing environment is the development of an anticipation of change within the core processes governing the regulation of the body's metabolism. The body therefore changes in anticipation of change. This is what is meant by the term *allostasis*, which provides a better model than homeostasis for many physiological processes. The key difference between allostasis and homeostasis is that in allostasis responses are driven by the *anticipation of change* as well as by actual change. So if an animal is always fed at the same time each day, insulin will eventually be produced at a certain time, even if there is no food available and even if this leads to a significant lowering of blood sugar which the animal then has to counter by producing the antagonistic (opposing) hormone glucagon.

From the preceding example, it might be tempting to think of allostasis as simply a training of the homeostatic response, but it is much more than that, as it helps to explain why animals have natural rhythms to their metabolism and activity even in the absence of cues. It also helps us to understand the wider and changeable psychological needs of animals, which we discuss in the next section.

1.1.3 PSYCHOLOGICAL NEEDS

One of the things which many animals do when they have all their fundamental physiological needs met is seek information. There are several reasons why this is useful if there is an inbuilt expectation of change. For example, it allows them potentially to exploit resources more effectively in future (e.g. by knowing where the next meal could come from if the current supply were to dry up) and it might reduce the risk of future harm (e.g. by knowing how strong different potential competitors are). Therefore, when times are good we will often see animals investigate and play much more. Object play allows animals to learn about the physical properties of things, while social play can help them learn about the characteristics of other individuals, including their strengths and weaknesses. An important implication of this is that, in such circumstances, providing for some of these activities should not be considered a luxury, but rather essential for an animal's well-being. In humans, a hierarchy of needs has been described in the literature by Maslow (1943), which indicates what individuals seek as different needs are met. While some of the higher levels originally described may not be directly applicable to nonhuman animals, this hierarchy can be adapted to give a guide as to animals' priorities in different circumstances (Figure 1.3).

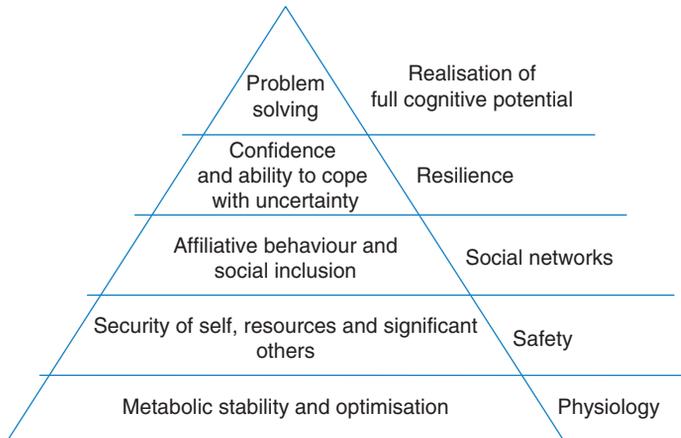


Fig. 1.3 A hierarchy of needs for animals, adapted from Maslow's hierarchy of needs for humans. The labels to the right indicate the type of need, with those at the bottom being initially most important. As the lower-level needs are increasingly met, the higher-level needs become increasingly important. Thus if an animal's physiological needs are being met, the need for safety and security is more pressing, so it can be expected that the animal will become less willing to take high risks to obtain its food and so on. All of the needs depend on the acquisition of information in order to be met efficiently, but the type of information changes with ascending levels.

Another use of this hierarchy is to help us appreciate why an animal is not performing particularly well in a given aspect of its life and what needs to be done to help resolve the issue. For example, an owner might complain that their pet lacks confidence, and this might be at least partly due to unstable social relationships at home, which mean that the animal is focusing resources on social networks as a priority. Without addressing this lower-level need, it may be difficult for the animal to grow in confidence, as its priorities are elsewhere.

This hierarchy indicates that safety or a sense of safety is a big priority for animals after their physiological needs have been met. Most pets are well fed and watered, and so the issue of safety deserves further consideration. *Safety* broadly means knowing that you can escape potential harm, and so requires that the animal has some freedom to withdraw from situations that it finds unpleasant. In the home, this means the animal has a safe haven, or some other secure attachment. We will return frequently to the importance of providing coping strategies when we discuss the use of pheromones in a clinical context to help animals cope in a variety of settings. The need for safety also helps us to understand why the inappropriate use of punishment, especially by an owner, can be so disruptive to an animal's well-being. Quite apart from being ineffective in altering the underlying motivation for the unwanted behavioural response and disrupting the bond between the owner and their pet, the inconsistent use of aversive methods leads to the animal's lacking a sense of safety. Thus common basic requirements for managing almost any behaviour problem are that all punishment should cease and that a healthy relationship between the owner and

their pet should be established. Only with these foundations in place can we expect the animal to have the confidence to change inappropriate emotional responses. Once again, pheromones can be useful in this process, as we shall see. However, there are also important constraints on what can be achieved, which are considered in the next section.

1.1.4 THE GENOME LAG AND EVOLUTIONARY CONSTRAINTS

Companion animals evolved in a particular environment over centuries and today often live in a very different one. The modern environment can be very stressful for both humans and their companion animals. The fact that evolution may not have equipped them with the mechanisms to deal with the sorts of stress or that they face in the domestic home can pose a problem. Let us look at the dog as an example: it is a social animal and is adapted to live in close social groups. Hence, being left alone can be very stressful for a dog and it will use the mechanisms that it has received through evolution to cope with this situation, such as howling in order to try to reestablish contact with the members of its group. Other possible behaviours it might attempt include trying to escape from the environment in which it is isolated, which can result in considerable property damage (Figure 1.4). We might think that a dog should know it can't break through a wall, but solid, all-enclosing walls are not something it has evolved to deal with. An important thing to appreciate here is that although a behaviour may not be very effective (i.e. maladaptive), that does not mean the underlying behavioural control



Fig. 1.4 A dog may try to escape even if it cannot succeed. The lack of success can simply lead to persistent behaviour, as seen in the damage to this door.

systems are broken (i.e. malfunctional). There is sometimes a tendency to think that a behaviour must be pathological if it does not bring an obvious benefit, but this is not always the case; an animal may simply be using its evolutionary rules of thumb in an inappropriate context because of the artificiality of the environment. This has important implications as it means we should not be looking for treatments to correct a supposed malfunction, but rather we should be looking at the environmental contingencies and perceptions of the animal that are leading it to perform in this way. However, although the response may be a functional one, that is not to say it cannot be problematic or give rise to pathological processes as a result of its inappropriate deployment in given circumstances (we will return to this in Section 1.2).

Most stress responses have evolved in order to help animals cope with acute (short-term) crises, for example 'There is a predator and I need to escape', 'I am alone and I need my friends' and so on. Unfortunately, the stresses that we tend to face in modern living are often much more prolonged (possibly going on for years), and even a mild stress can end up having quite an impact, as an animal's coping mechanisms are not developed to deal with prolonged challenge. By way of example, imagine you are required to hold up a cup of water. It is not a big problem and you should be able to do it easily. But if you have to hold it up for hours it becomes a much more significant issue. In the same way, the odd stressor may be fine on its own, but when it goes on for months or years we can see wider effects on the functioning of an animal and the system it lives in. We will return to this later when we talk about factors affecting the impact of a stressor. At this point it is simply important to appreciate that animals are often not well adapted to deal with stressors that go on for a long time, even if they are small, because in nature stressors are typically resolved quite quickly one way or another. This is one reason why a thorough history of any animal presented for problem behaviour is important. For example, two cats may have never got on very well together but have tolerated each other. Over time this can lead to more substantial changes such as certain recurring health problems, an increased risk of diabetes and perhaps more overt aggressive behaviour problems.

Another important evolutionary constraint on adaptation relates to the type of response elicited. Different species have evolved in different niches and have different lifestyles. Accordingly, they may use different rules of thumb to resolve an issue. Thus cats and dogs differ in the typical behaviours that they can offer in order to help them adapt:

- Dogs are a social species that use a well-developed communication system to cooperate and to coordinate their behaviour with other group members.
- Cats are more independent but are generally capable of living in groups. Their social communication skills are not so refined, as living alone is their evolutionary inheritance given the type of prey they feed upon, which does not require pack hunting.

Thus a dog, when faced with a problem, will be much more likely to look for social support for help (which might involve trying to engage the owner in the issue) than a cat, which would be more likely to try to resolve things itself. In either case,

this can involve the animal changing the chemical environment around itself in order to cope. Alarm pheromones can help an animal avoid a dangerous area and so remain safe, but there are also pheromones that signal safety, which allow the animal to focus less energy on environmental monitoring and more on other things. We will discuss these pheromones in detail later, but first we need to consider the concept of safety in more detail.

1.1.5 SAFETY AND ITS ROLE IN LIFE

We have already mentioned that safety is an important need for animals, but it is worth considering in more detail what it means to be safe and the consequences of this.

A safe place is somewhere that is associated with the absence of harm and the absence of signs of harm. It is therefore a place in which an animal can relax and explore with confidence. This has many important implications for animal management and welfare. A *safe haven* is somewhere that an animal feels in control of events. One of the most common misunderstandings that we encounter is confusion between a 'safe haven' and a 'bolt hole'. A *bolt hole* is somewhere that an animal runs to in order to hide or to watch and hope that whatever is bothering it will pass. A *safe haven* is somewhere that an animal goes where it feels safe and in control of events. It is quite difficult to convert a bolt hole into a safe haven; to create a safe haven we need to create a place where the animal is not disturbed and where it can choose to go if it does not want to interact with us. If we really want to give the pet a place where it is truly in control, we must not impose ourselves or our interests on it in this area. It is obviously important for all who come into contact with the animal to appreciate and respect this.

Young animals frequently use an attachment figure (typically the mother) as a secure base from which to explore the world. This can be transferred to other individuals, but such individuals must be supportive of the animal, recognising and respecting its communication and responding appropriately (e.g. not forcing it into situations with which it expresses discomfort). Pheromones, like dog-appeasing pheromone (DAP), which is produced by bitches shortly after whelping, appear to be particularly important in this process. As we will see later, these chemicals seem to have an intrinsically reassuring effect through the limbic system, which helps provide the pup with a secure base from which to explore and learn about the world.

As a simple rule, it is important for social individuals to have at least two points of safety in their lives:

- A physical place (safe haven).
- A social companion (secure base).

The importance of a social companion may be lower for a more independent individual, but recent work suggests that this should not be generalised to species; that is, while cats in the wild may be quite independent, in the home they can form strong attachments and dependencies. If an animal has no need for a social companion, the physical safe haven may be especially important.

1.1.6 STRESSORS AND THE STRESS RESPONSE

The term ‘stress’ is often used in a very confusing way to refer to both an animal’s response to something and the cause of that response. In this book, we will use the term *stress response* to describe an animal’s behavioural and physiological reactions to a threat and the term *stressor* to describe the trigger of these: that is, the stimulus.

The *stress response* can be defined as the physiological, behavioural and psychological response to a challenge to an individual’s optimal state of well-being. As we have already seen, this is not a simply defined fixed point, as might be thought from a homeostatic perspective, but will vary with numerous factors. When trying to assess the stress response, it is important to distinguish the measures we can assess objectively from our interpretation of them. For example, a dog may run away in response to a loud noise, which is something we can measure objectively (e.g. the time it takes to respond (*latency*), its speed, the distance it travels, changes in its heart rate). But if we say ‘The dog is scared’, that is an interpretation, which may be much more difficult to quantify and objectify. There is room for debate when it comes to interpretations; for example, some dogs that run up to their owner when they hear a loud noise are not actually scared but are just seeking the owner’s attention or have found that the noise is a good way of getting the owner to give them more attention – this has been referred to as a *pseudofear*. In these cases it is important to examine what the owner does in response to the pet coming up to them and to determine whether they function as the previously mentioned secure base or whether they are reinforcing the dog’s attention-seeking behaviour, as these outcomes will require different types of intervention to resolve. Owners will typically report interpretations and one of our jobs as clinicians is to sensitively and objectively assess these, rather than accept them as fact.

If we consider a *stressor* as anything which moves an animal out of its normal optimal range, this means there are many different types of stressor and that not all stressors are bad. It further means that there are likely to be many forms of *stress response*, as different responses are required to cope with different types of stressor. An animal can be moved out of its normal optimal range by something unpleasant: for example, a pet running away from a loud noise or a cat hiding from a chasing dog. Both of these responses lead to increased arousal. On the other hand, increased arousal is also required for essential activities like reproduction and play that are generally considered to be more pleasurable. Hence, we should be careful not to interpret all stressors or the resulting changes elicited as indisputable evidence of poor welfare. The determination of an animal’s well-being is an inference which should be drawn from multiple pieces of evidence (a process sometimes referred to as *triangulation*).

There are many features which relate to a stressor’s impact on an individual, such as:

- *The type and number of stressors:* Some animals may find auditory stressors, such as the level of noise, more stressful than visual ones. Similarly, if certain stressors are combined, this may be much more stressful for some individuals and not for others. For example, in the case of fireworks, some animals are

able to cope with the noise or with a flash of light on its own, but when the noise and the visual stressor occur simultaneously, the animal perceives the situation as much more threatening.

- *The intensity of the stressor:* Some animals may be able to cope with softer noises, for example, but find it difficult when the volume increases beyond a certain level.
- *The duration of the stressor:* As already discussed, a stressor might be quite mild, but if it goes on for a long period of time it can be difficult for an animal to cope with it. It is therefore important to evaluate how long a particular stressful situation has been going on.
- *The predictability of the stressor:* The concept of predictability can be very important for an animal's welfare. If something is very predictable, it can make it easier for the animal to prepare its defences and to cope as a result. For example, an animal might habituate to certain stressors that have been going on for a long time (e.g. road work in front of the house) but react strongly to rarely and unpredictably occurring stressors (e.g. a thunderstorm). If the animal cannot predict the situation, it cannot divert resources in order to cope, as it does not know when the problem is going to arise. For a given individual, the optimal level of predictability of a stressor varies enormously: something that is too predictable can actually also be stressful, as we do seek some change in our environment. We often interpret it as 'boring' if something is extremely predictable. We know it is going to happen and so we do not pay much attention to it. If something that the animal knows it can't cope with is predictable, this increases arousal in advance without an expectation of being able to cope.
- *The level of control an animal has over a stressor:* If an animal has control over its environment, it is easier for it to cope and to take appropriate measures. If we return to the example of sound sensitivities, things like fireworks and thunderstorms are often very difficult for an animal, because it has very little control over when the sound will happen (in this example, predictability and control are linked, but this is not always the case). This is made worse if it has no safe haven. Noises like thunderstorms can be particularly problematic, because the sound seems to move around in an uncontrollable way and cannot be clearly located – the stressor is both unpredictable and uncontrollable. Having no way of removing itself from the situation because it is locked in the house and/or being on its own may be additional stressors that an animal has to cope with at such times. Hence, it is not surprising that problems such as noise fears and separation distress often occur together. When a case is referred for one of these conditions, it is very important to check that the other is not present as well, as they may be linked.
- *The previous consequences of the potential stressor – what the animal learns:* Has the animal been able to cope in the past? If it has then even quite severe situations may be tolerated. But if an animal has had other unpleasant experiences associated with a potential stressor, something that might seem relatively mild to us may actually become very severe for it. For example, if a dog starts to show mild signs of anxiety in response to a noise and the owner tells it off, the mild noise now becomes a predictor of punishment from the owner and so can actually

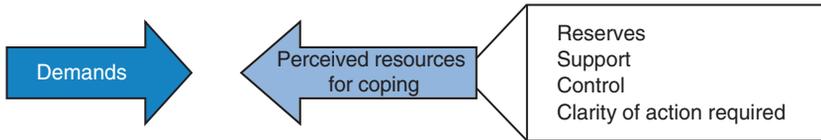


Fig. 1.5 Stressors give rise to concern over an animal's welfare when the demands they impose exceed the animal's perceived resources for coping. There are therefore many features outside the properties of the stressor which affect its potential impact. Resources for coping include not only the physical reserves of the animal but also aspects which are often influenced by the handler, such as the level of perceived support the animal has, the level of perceived control the animal has over the situation and the clarity of action required to deal with the problem. The fact that this process depends on a perception of the animal's means there are few hard and fast rules about whether a given stressor is necessarily harmful to a given individual.

become much more stressful, and the animal is likely to react even more strongly the next time it faces the stressor or predictors of the stressor.

When we think about the impact of a stressor, we often tend to focus on its physical properties, such as its intensity, duration, frequency, predictability and so on, but as the last few examples show, a central principle underpinning how much impact a stressor will have relates to the animal's interpretation of whether and how it can cope (Figure 1.5). An animal may face quite a big challenge, but if it predicts (and has learned) it can cope with change (i.e. it is resilient), the impact of the stressor may be rather small, including that on the animal's welfare. On the other hand, a phobic animal may not be able to cope with a relatively minor and – to bystanders – obviously harmless stressor, such as a fly. Coping with it seems like an insurmountable challenge and the animal's welfare is therefore seriously impacted.

1.1.7 SELYE AND THE GENERAL ADAPTATION SYNDROME

By now it should be apparent that stress responses are quite varied; nonetheless, there is still a tendency to refer to a general stress response. This idea is particularly associated with Hans Selye (1907–1982) and what he termed the *General Adaptation Syndrome (GAS)*. This basically describes the most common form of arousal, resulting from a range of stressors. It describes three phases of response to a stressor and has greatly influenced our understanding of how stress can be harmful to the body, and so deserves some attention.

Selye's three phases of the GAS consist of:

- *The alarm phase*: Selye termed the immediate response the *alarm phase* or the *alarm reaction*, with the following reactions within the body:
 - *An increase in both epinephrine (adrenaline) and norepinephrine (noradrenaline)*: These are hormones from the centre of the adrenal gland, the *adrenal medulla*,

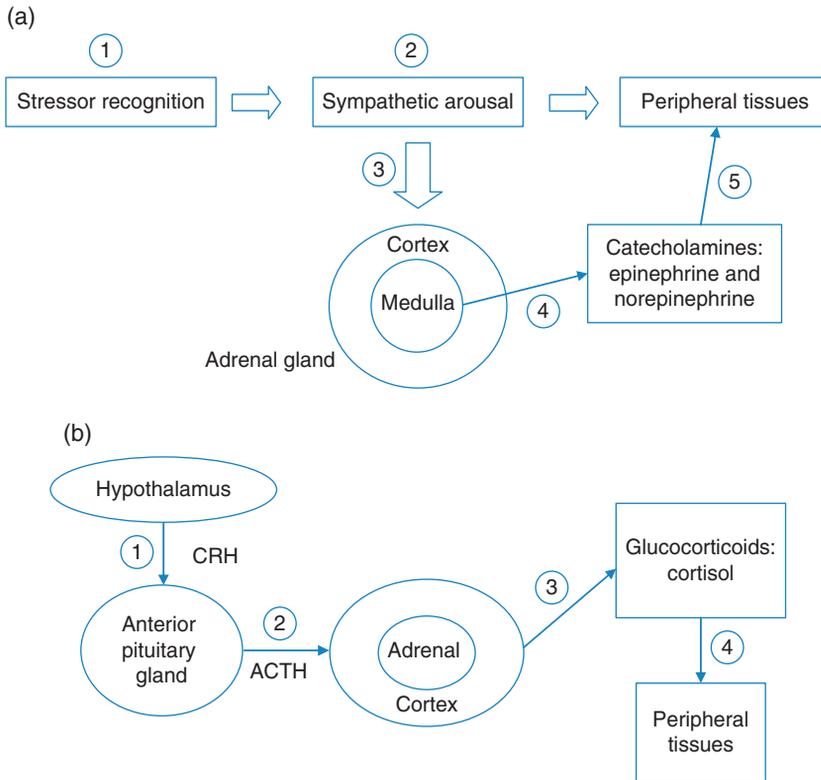


Fig. 1.6 Schematic of the sympathetic-adrenal (a) and hypothalamic-pituitary-adrenal (b) axes and general physiological and behavioural changes. (a) (1) the stressor is recognised, which leads to (2) changes in the sympathetic nervous system, which is the fight/flight system; (3) nerves associated with the sympathetic nervous system travel to the core of the adrenal: the medulla; (4) the medulla releases epinephrine and norepinephrine, otherwise known as *catecholamines*; (5) the nervous system also directly impacts on specific tissues – both the catecholamines and the direct nervous input result in a variety of changes in these peripheral tissues, which prepare them for action. (b) (1) the impact of a potential stressor is registered within the hypothalamus of the brain, which results in a release of *corticotrophin releasing hormone* (CRH); (2) CRH is transported to the anterior pituitary gland, which sits at the base of the brain and results in the release of *adrenocorticotrophic hormone* (ACTH), another releasing hormone that affects the adrenal cortex – this response requires a cascade of hormones in order to take effect and so is a slower response than that from the adrenal medulla; (3) this cascade of hormones results in the release of glucocorticoids, which include the hormone *cortisol*; (4) the glucocorticoids in turn have a variety of effects on peripheral tissues.

which are released as a result of increased activity in the sympathetic nervous system (Figure 1.6). Their production is closely associated with the fight, flight, freeze and fidget (or fiddling about/flirting) strategies, which are aimed at repelling, running away from, cautiously tolerating and redirecting attention away from the stressor, respectively.

- *An increase in corticosteroids (the hormones cortisol or corticosterone, depending on the species) from the cortex of the adrenal gland:* This is a result of activation of the hypothalamic–pituitary–adrenal (HPA) axis (Figure 1.6).
- *An increase in blood sugar:* Epinephrine, norepinephrine and corticosteroids all raise blood sugar and so help mobilise energy reserves. Another hormone change that we see in this immediate reaction is a drop in hormones such as insulin, whose role is to lower blood glucose. So, overall there is a rise in blood glucose in anticipation of having to take action, such as running away from a predator or a serious threat.
- *Diversion of reserves within the body to support immediate survival:* The body diverts its reserves towards taking immediate action in response to the potential threat and away from longer-term activities. So, in the alarm phase, the hormone changes also result in a suppression of the immune system and a reduction of the hormones that help increase productivity. Obviously, if you are faced with a predator, functions like reproduction and fighting off disease are relatively unimportant compared to staying alive in the immediate future. There is no point being very healthy but dead!
- *The period of resistance:* After the immediate alarm phase, Selye described what he termed a *period of resistance*, which has the following characteristics:
 - The levels of adrenal hormones (epinephrine, norepinephrine, corticosteroids) all remain quite high.
 - The levels of the *anabolics* (i.e. molecules that help build up reserves in the body, such as the blood glucose-lowering hormone insulin) return back to normal.
 - Raised blood glucose levels are maintained, in order to sustain and prepare for further activity as might be necessary.
- *Adaptation or exhaustion phase:* It may be that the previously mentioned response is sufficient for the animal to be able to cope, in which case the animal *adapts* successfully. However, if the response persists for a long period of time, *exhaustion* may occur, with a risk of a whole range of pathological processes as a result. It is important to appreciate that the balance between adaptation and exhaustion can be a fine one and that animals may appear to adapt for a reasonable period of time but ultimately become exhausted, which can lead to serious health and welfare problems (consider the example of holding up the cup of water). Even if an animal appears to be adapting, it may be making an enormous effort to do so and that too is a cause for concern.

Although Selye proposed that the GAS was the general way in which animals responded to stressful situations, it was soon recognised that it was not perhaps quite as general as he initially thought. There is a whole range of specific responses that animals may employ when faced with unpleasant situations. For example, many species respond to a rise in the environmental temperature with a drop in corticosteroid levels, rather than an increase. Similarly, when sheep are dehydrated, there may be no perceptible adrenal response at all. This makes sense from an adaptive biological perspective, because raising blood glucose when you are hyperthermic or dehydrated will actually tend to increase activity within the

body and so increase demand for water, as well as raise body temperature further as a result – not to mention that the water may be more useful in aiding cooling through panting or sweating. It makes a lot of sense not to produce a response which is likely to make matters worse.

Animals vary enormously in how they cope with a given stressor, not just between species but also between individuals of the same species. For example, an increase in temperature may be far more difficult for one animal to cope with than another (consider the short-nosed – *brachycephalic* – breeds of dog in this context, which can have difficulty panting efficiently). If we think about changes in the social environment, we will also see enormous individual differences, with some animals showing behavioural problems and others seeming to cope fine.

Another concern over the common interpretation of the GAS is the emphasis it puts on *cortisol*. It is easy to see why this happens as there seems to be an ever-growing list of known effects of cortisol on the body. Not only does it have the physiological effects discussed, it also produces behavioural changes and biases. For example, as part of its effect in helping to maintain blood sugar, it actually stimulates appetite. This is why you might feel the need to eat lots of chocolate when you are chronically stressed. This may seem strange, considering that we would expect an animal's priority to be escape, but it is important to note that we are now talking about longer-term stressors. The role of cortisol in this context is to help the animal cope with these longer-term impacts of stress; for example, after the stress is over, the raised cortisol will stimulate the animal to eat and, thereby, to replenish its reserves – this helps to explain why physiological arousal lasts longer than the stimulus causing it (a characteristic of emotional reactions). Cortisol also produces quite important cognitive changes. It biases an animal's attention towards negative events, which means that the animal may view otherwise neutral stimuli as potentially threatening. This is not just of academic interest, but also of clinical importance, because in clinical practice synthetic and much more powerful versions of the glucocorticoids are used to control a whole range of medical conditions. One must keep in mind that treating an animal with these medical drugs may actually induce concerning changes in the animal's behaviour as a result. An increase in appetite is a commonly recognised side effect of the use of glucocorticoids, but less attention has been paid to their cognitive effects, and so some behavioural advice – aimed at reducing the impact of an increased sensitivity to aversive events – may be useful when dispensing these drugs.

Prolonged or excessive cortisol can be quite toxic to parts of the brain involved in memory, like the hippocampus, with obvious and immediately apparent effects. For example, as a result of chronic exposure an animal may forget things that it has previously learned. In the human literature, *stress-induced dishabituation*, which is when a person forgets things that they have previously learned as a result of chronic stress, is well documented, and we are increasingly recognising it in companion animals too. This can result in the appearance of a number of behavioural problems, including noise fears. If a problem appears at an unusual age, it is important to check whether or not the animal appears to have been under chronic stress recently, particularly if the behaviour in question is one which the animal had learned not to show: this might be a strong indicator of stress-induced

dishabituation. In such cases, the focus of treatment must be not just to correct the behaviour problem but to look at general stress management for the animal so that the problem goes and stays away.

We may also see changes in the reactivity of the adrenal cortex, particularly in the case of long-term or repeated stimulation. These changes, however, can be difficult to predict, as the adrenal cortex may become less responsive or exhausted, or it may become sensitised. This is clearly an area in need of further research. The relatively routine *ACTH stimulation test* can be useful in some cases when we see a marked change, in the sense of either an over- or an underreaction, in the adrenal response. Changes in response can indicate that an animal has been subject to long-term stress, but the fact that individuals vary enormously in their normal response to the test often makes interpretation difficult. The test would really be most useful if we could assay an animal before it underwent a stressful experience as well as after, in order to assess the stressor's impact. If we were to perform the test before an owner moved house and again afterwards, we might see marked changes in the responsiveness. We mention this here simply because it is something that we might want to make better use of in future.

Undoubtedly cortisol is very important, but it is just one of many hormones which are involved in how animals cope with environmental changes (i.e. stressors in the environment). Cortisol is produced as a result of ACTH release from the anterior part of the pituitary gland in the brain. This structure also produces a whole range of reproductively important hormones: notably *prolactin* (Prl), most widely known for its role in milk production in females, but with other effects not associated with reproduction; and *luteinising hormone* (LH) and *follicle stimulating hormone* (FSH), which occur in both males and females and are associated with the production of the gametes. All of these hormones rise after initial stress and can stay elevated for several hours after the stress has disappeared. However, in response to chronic stress, levels will fall, and so we may see knock-on effects of stress with respect to reproduction.

Prolactin is of particular and growing interest within the field of veterinary behavioural medicine in that it is regulated by inhibition rather than stimulation. The removal of inhibition results in its release. Dopamine, a neurotransmitter generally involved in the activation of goal-directedness of a wide range of behaviours, seems to be one of the main factors that inhibits the release of prolactin. A high release of prolactin suggests that there is very little dopamine coming from the hypothalamus to control it; that is, the animal is not seeking out the good things in life. This may explain a whole range of behavioural changes that can be seen in relation to stress. Dopamine is associated with behavioural activation; that is, the approach an animal takes towards potential signs of reward or potential rewards. If an animal has low levels of dopamine, it may become more apathetic and less responsive towards rewards, which is reflected in its behaviours. It makes sense that an animal becomes less sensitive to rewards in times of stress, because it is probably focusing on escaping from an unpleasant situation.

In France there has been an effort to try to validate a system for both scoring and monitoring animals' responses to chronic stress, which has resulted in the production of the *Evaluation of a Dog's Emotional Disorder (EDED)* scale (see Appendix A).

Interestingly, recent work has suggested that the scoring used in this system might correlate quite well with prolactin levels.

The relationship between dopamine and prolactin and our ability to indirectly infer the level of dopamine activity from prolactin screening might also have implications for the choice of drugs used to treat particular disorders. In treating behaviour problems, it has been noted that not all patients respond in the same manner to the same medication. The postulated explanation for this is the involvement of different neurotransmitters in the same superficial behaviour presentation in different patients. If one can assess which neurotransmitters are involved in a patient's behaviour, a more targeted use of medication can be implemented. For example, if an animal is showing changes in behaviour that seem to be associated with a reduction in dopamine levels, it makes sense to use drugs, such as selegiline, that are likely to act on the dopamine system. In support of this, data are emerging to show that where anxiety is associated with a change in prolactin level, drugs like selegiline may be more effective than drugs like fluoxetine. Fluoxetine might also be indicated for the presenting complaint, but it works on the serotonin neurotransmitter system, indicating that often more than one neurotransmitter system is involved in behaviour and in behavioural changes.

There are a number of other hormonal changes in the pituitary gland that occur in response to stress, particularly changes in *oxytocin*, which is associated with bonding behaviour, and the endogenous *opiates* (*endorphins*, *enkephalins* and *dynorphins*), which are also associated with bonding but in addition also with *analgesia* (pain-killing). Both of these groups of chemicals also have effects on memory that should not be underestimated.

The domestic environment is very complex and individual animals will vary in how they perceive different changes in this environment according not just to genetic differences but also to their developmental history. Developmental history is referred to as *ontogeny* within the scientific literature. Individual differences are very important for a number of reasons. First of all, they remind us that it is actually the animal's perception of the stressor rather than its physical nature that is important. What is too loud for one dog or cat may be fine for another. It is important when working with cases that we appreciate that all animals are individuals. In behaviour therapy, it is particularly important to pay attention to individual differences, because when it comes to finding solutions, they have to be tailored to the individual animal, its circumstances and the resources of the system in which it lives. We should avoid the temptation of thinking one solution fits all.

Finally, contrary to its common representation, the GAS is not very specific to unpleasant situations. In fact, the changes in cortisol seem to be a reaction to any change that requires increased arousal, whether it is pleasurable or aversive. Based on this, some people have proposed using two different terms to distinguish between stressful situations that are harmful and those that are not:

- *Distress*: Responses associated with unpleasant events, such as punishment or fear.
- *Eustress*: Stressful situations which an animal may find pleasurable, such as reproduction or play. *Eu* is the Greek word for 'well'.

1.1.8 MOBERG'S MODEL OF STRESS

A lot of recent work on stress physiology has emphasised both the importance of individual differences in perception on the outcome of stress and the potentially detrimental effects of excessive activation of the stress-response system. This is well described by Gary Moberg's model of stress (Figure 1.7).

As a result of the stress response, animals change what they would normally do, which can put them at risk of a range of behavioural, psychological and medical problems.

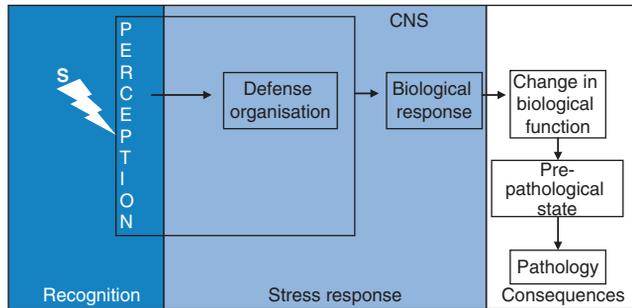


Fig. 1.7 Moberg's model of stress.

1.1.9 RESILIENCE

We mentioned the concept of *resilience* earlier in relation to an animal's ability to cope with stress. Resilience incorporates at least four important capacities:

- The ability to minimise the impact of a stressor on normal functioning.
- The ability to retain competence even when normal functioning is disturbed.
- The ability to recover very quickly when there is an impact.
- The ability to increase coping potential in future as a result of exposure to stressors.

One approach to animal welfare is to try to minimise exposure to stressors, but the reality is that some exposure is inevitable. Unfortunately, if an animal has been largely protected from stress, it may have less ability to cope and so be at greater risk of suffering even in the face of relatively minor threat. We started this chapter by saying that the only constant in life is change, and so a sensible strategy is to try to ensure that animals have the capacity to cope with changes. There are many ways of doing this, which we will discuss later in the text, but a general rule is to ensure that an animal is exposed to stressors that are within its coping capacity. This might mean gradually building up the intensity of the stressors it is likely to face in later life, which is the main goal of a lot of habituation and socialisation practices for young animals. But there is a lot more that can be done, such as ensuring that the animal has some control over its environment, including possible stressors, and a secure base from which to explore stressors, so that it learns that it can cope, as well as teaching it acceptable and transferable coping strategies. Pheromones

may be important in this regard as they can potentially help to reassure an animal that it can cope and can increase its coping capacity and thus increase resilience.

1.2 THE EFFECTS OF PERSISTENT STRESS, OR 'WHY STRESS CAN BE SO STRESSFUL'

We have already explained that the stress response has largely evolved to deal with acute problems and that when an animal is placed in a situation where there is a persistent stressor, an initially functional system might actually turn into a harmful one. In this section we consider this in more detail by first considering two types of persistent stressor – the frequently repeated stressor and the chronic stressor – before examining the impact of persistent stress more generally on the body. We finish the section by introducing the concept of stress auditing in clinical behaviour management.

1.2.1 TWO TYPES OF PERSISTENT STRESS

First we will consider the frequently recurring stressor. The *sympathetic-adrenomedullary (SAM) system* is the dominant process involved in making the adjustments necessary to respond to an unexpected event (surprise). Its function is to increase arousal and prepare the animal for possible further action. Although both epinephrine and norepinephrine are produced as a result of this process, it is thought that there is a bias depending on the type of stressor involved, with epinephrine more closely associated with psychological stressors and norepinephrine with physiological stressors. Repeat activation of these systems typically results in one of two changes: either the animal *habituates* to the stimulus (i.e. learns to ignore it as an irrelevance and stops responding to it both physiologically and behaviourally) or it becomes *sensitised* to it (in which case the physiological and behavioural response may become heightened). Behavioural and physiological responses do not necessarily occupy the same time period. This is important because an animal may appear to have adjusted behaviourally to an initial startle but still be quite highly aroused physiologically. This may be one of the factors that increase the chances of sensitisation in the longer term, if the process is repeated. Unfortunately, there is still a lot we do not know about why an animal may sensitise, and so it can be hard to predict. Even if we do not see sensitisation of the immediate response, we may see more general changes in an animal's behaviour if it is in an environment where this system is frequently activated. With frequently recurring stressors, we will typically see one or more of the following signs:

- Hypervigilance (scanning etc.).
- Hyperreactivity (jumpiness).
- Anxiety.
- Irritability.
- Recurrent anxious conflict behaviours, such as shoulder-licking or hair-pulling in cats (Figure 1.8) or hollow barking in dogs.



Fig. 1.8 A cat which started to lick between its shoulders whenever it unexpectedly encountered the new puppy that had moved into its home. An important differential in this case is a skin tumour or vaccine reaction.

By contrast, we see quite a different profile in the face of chronically enduring stressors, because these lead to an exaggerated influence from the *HPA system*. In the previous section we mentioned the importance of the glucocorticoids in raising metabolic rate and suppressing the immune system, as well as of reductions in dopamine production. If we understand these changes, the effects of chronic activation of the HPA axis become easier to comprehend. Typical changes are as follows:

- A higher metabolic rate means that the risk of damage resulting from the previously mentioned processes is increased and so we may see an acceleration of age-related problems, including cognitive dysfunction.
- Reduced dopamine activity means that there is less behavioural activation and so the animal may be behaviourally depressed.
- Stress-induced dishabituation may be observed in these circumstances as the animal learns that previous stimuli to which it has habituated may no longer be irrelevant.
- Finally we are more likely to see a whole range of stress-related illnesses, which are explained further in the subsequent sections. Since cortisol suppresses the immune system, the animal may also be vulnerable to a whole range of infections, such as chronic or mild recurrent skin conditions, gastrointestinal disturbance (vomiting or diarrhoea) and/or urinary tract problems (especially in cats) with associated behavioural changes. If animals frequently experience these problems, the significance of chronic stress in their aetiology needs to be considered.

There are, however, a whole range of other physical diseases which are more directly caused by persistent stress, although less clearly linked to one pattern or the other. We consider these next, since their occurrence in a patient should be a prompt to consider the need for a combined medical-behavioural management programme.

1.2.1.1 *CIRCULATORY DISEASE*

We mentioned earlier the role of the sympathetic nervous system in increasing heart rate and diverting blood supply. Splenic contraction may occur and result in an increase in red blood cells released into the system. There may also be a change in the secretion of antidiuretic hormone, which increases water retention. All of these responses serve to increase blood pressure and in the short term to improve circulation. However, if this short-term response is prolonged, we may see the chronic effects of increased blood pressure. This transition from the body's short- to long-term coping attempt is one of the factors which makes blood-pressure problems so common in people who suffer from stress.

1.2.1.2 *METABOLIC DISEASE*

In the initial stress-response phase, several processes are triggered in order to help the animal to be ready for action:

- Mobilisation of blood glucose, which involves a shift within the autonomic nervous system towards increased sympathetic activity and reduced parasympathetic activity.
- Reduction in insulin and increase in the glucocorticoids, such as cortisol.
- Changes in glucagon, epinephrine and norepinephrine, all of which serve to raise blood glucose.

However, the long-term effects of these changes in blood glucose can be quite problematic. In people, we recognise diabetes mellitus as a problem resulting from high levels of stress over a long period of time, and we are becoming increasingly interested in this from a veterinary point of view as well: that is, the role of the environment in diseases like diabetes mellitus in both cats and dogs.

1.2.1.3 *ENTERIC DISEASE*

If an animal is going to engage in flight, it wants to get away as efficiently as possible. Hence it makes sense to have as little food in its gastrointestinal tract as possible, as too much would slow it down. There is also not a lot of point in diverting energy reserves to digesting the food because it may not be alive to digest it if it does not manage to get away from the situation! Consequently, it is not surprising that we see a change in activity in the gastrointestinal system in stressful situations: the stomach and the small intestine slow down and there is

a reduction of blood flow to these areas. In some animals, we may actually see vomiting, because this helps to eject food and reduces the bulk carried. At the other end of the gastrointestinal system, the large bowel might actually speed up in order to eject food for the same reasons, which helps explain why we will often see diarrhoea and colitis as a result of persistent stress.

1.2.1.4 GASTRIC CHANGES

The association between gastric ulcers and chronic stress is well known. In the short term, the responses which ultimately give rise to an increased risk of ulcers make sense biologically speaking; the problem arises because the animal fails to adapt to the persistent (perceived) threat of harm. Escaping the perceived threat is of highest priority, and so the body does not prioritise digestion and as a result the blood flow to the stomach is reduced. The inside of the stomach is a very hostile environment: the acid can potentially do a lot of damage to the stomach if its lining is not properly protected and the cells are not regularly replaced. The reduction of blood flow to the stomach is not a problem in the short term, but in the longer term it might result in an increased rate of cell death, which in turn can lead to gastric ulcers. This is not, however, the only stress-related risk factor for gastric ulceration.

During stress, the pattern of the stomach's muscle contraction also changes: contractions become slower and more sustained, which means that less blood actually reaches the stomach efficiently. This results in further compromise of the blood flow and an increased risk of damage to the lining. Prostaglandin production is also reduced during stress. Prostaglandins are important factors in tissue repair. A reduction therefore leads to a decrease in the stomach's ability to repair itself. Psychological changes happening in the body more generally may also result in an increased production of hydrogen ions, and there is an increase in acid production by the stomach in order to try to eliminate these from the body. In addition, in chronic stress, the activity of the immune system is also reduced. Bacterial infection may be an important factor in the occurrence of gastric ulcers, which means that stress-induced immunosuppression can contribute to increase the risk of gastric ulcers. It is easy to see how in combination with the stomach becoming less able to protect itself and producing more acid, this further increases the risk of ulcers.

Finally, if the stress eventually stops there may also be a big outsurge of acid, known as *acid rebound*, which alone can result in the burning of holes within the lining of the stomach. There are therefore lots of factors to explain the relationship between stress and gastric ulcers. Very little attention has been paid to this in cats and dogs but it is of growing interest, particularly in race horses, and is a known problem in pigs.

1.2.1.5 APPETITE CHANGES

Animals may increase or decrease their appetite when 'stressed'. The reasons for these apparently contradictory effects can however be understood and predicted. The effect of stress on appetite relates to both the effect of the glucocorticoids on

appetite and the effect of their releasing factor, 'CRH' (corticotrophin-releasing hormone or corticotrophin-releasing factor), in the brain, which strongly suppresses appetite. CRH has a very short half-life – that is, it does not exist very long in the body – but even during its short existence it is very effective at reducing appetite, which is obviously desirable in the immediate crisis of a potential threat. However, after CRH has been through the system, the effects of the glucocorticoids become more apparent. These compounds increase appetite and encourage the animal to replenish its reserves. Glucocorticoids survive a lot longer in the circulation than CRH: they have a longer half-life. In a situation in which an animal is under chronic stress, a lot of CRH is continuously released and, as result of this, a lot of glucocorticoids are released as well. However, the effects of CRH are much stronger than the effects of the glucocorticoids. This means that we see a reduction in appetite. If the animal experiences a series of small stressors, rather than one continuous one, we will get pulses of CRH being released, followed by pulses of glucocorticoids, which survive in the circulation for longer. So, while we see an initial period of loss of appetite, this state is very rapidly replaced by a period of increased appetite and so overall the animal will be eating more. The important difference here is that in chronic stress there is no relief, whereas in a series of multiple stresses we have periods of stress, periods of relief and periods of stress again.

1.2.1.6 *REPRODUCTIVE DISTURBANCE*

It is well recognised that chronic stress suppresses reproductive activity. In males, the release of endorphins and enkephalins inhibits the production of luteinising hormone-releasing hormone (LHRH), which is important in sperm production. The change in the autonomic nervous system also means that sexual arousal becomes more difficult, which can result in impotence. Increases in prolactin levels not only increase the production of milk but also suppress reproductive cycling in females. There can also be a change in the metabolism of fat cells, which are important for removing androgens. As a result, females can become more masculinised. Both of these factors combined lead to females becoming less efficient at the reproductive level. In some cases, this can be very important when trying to manage the behaviour of breeding animals.

When evaluating a patient, we need to be aware of any history of chronic or intermittent gastrointestinal disturbance, marked changes in appetite, whether or not the animal has diabetes and any history of reproductive problems if it is entire. If any of these features are present in the history, it may indicate that persistent stress might be involved, and this needs to be addressed even if the stressors are not the specific triggers of the presenting problem. Most behaviour problems do not arise because of a single cause but occur as a result of a range of risk factors coming together in a particular individual at a particular point in time, which pushes it over an acceptable threshold of behaviour. Hence, chronic stress may result in its own specific problems but may also contribute to the production of a whole range of other, less-specific problems.

1.2.2 OTHER BEHAVIOURAL EFFECTS OF PERSISTENT STRESS

So far we have emphasised the importance of a failure to manage or accommodate some form of change as a cause of stress-related problems and focused on the impact of this on the body due to the maladaptive effect of a functional system. However, at a cognitive and behavioural level there will be other changes, as the animal tries different strategies to help it cope. As we mentioned earlier, a change in behaviour is often a relatively energetically expensive way of trying to adapt, which will feature if simpler physiological changes do not succeed. We can therefore expect major changes in behaviour in cases where the animal is faced with persistent stressors. Its initial response will typically be based on the evolutionary rules of thumb that it has inherited and on developmental experience, which will depend very much on the initial cues and signals in the environment. However, the fact that the stressor is persistent means that it is highly likely that the animal will perceive that the strategy has not worked. In this case it has a limited number of choices:

- *Continuation of the original response:* One option is to continue the original behavioural response, which may be some form of the fight, flight, freeze or fidget response. These behaviours may become more intense with repetition as the animal tries harder to succeed with the same strategy. The frustration which can arise at the lack of success also means that the animal may become more irritable in general or intensively aggressive in the given context, or may run away, take flight, freeze or fiddle about (i.e. seem hyper) more readily.
- *Alternative strategy:* The second option is to develop an alternative strategy: the animal might for example shift from running away (flight) to becoming aggressive (fight).
- *Give up:* A third possibility is for the animal to give up, which is manifested as behavioural and possibly affective (emotional) depression. If an animal learns it has no control over its environment, a condition known as *learned helplessness* may result, which has been used as a model of depression in many studies.

In any case, we need to appreciate that if an animal continues to try to solve a problem unsuccessfully, we are likely to see both behavioural and emotional changes associated with frustration. In the case of persistent stress, these responses may themselves become quite persistent or repetitive. Although frustration is a commonly described outcome, it is important to appreciate that it arises from many different contexts, and it is useful to distinguish these from both a diagnostic and a therapeutic perspective. For example:

- Frustration may occur because an animal is denied access to something that it wants and so is thwarted in its efforts to obtain that resource: e.g. a dog pulling on a lead in order to interact with another dog
- It may arise because an animal gets less than it was expecting from a given situation. This might be conceptualised as a form of disappointment: e.g. a dog



Fig. 1.9 Notice the behaviour in these still images taken of one dog trying to get another to play. The dog on the right shows elements of approach and avoidance, and while in this context it is not a problem, this sort of ambivalent behaviour is indicative of frustration.

who gets given a dog biscuit when it was expecting a piece of chicken may ignore the reward, which would have been acceptable if it had not expected something better. In some situations the dog's behaviour might become aggressive.

- It may arise because an animal is uncertain about what it should do. In this case the animal is in a state of anxious conflict: e.g. a dog who is told to 'come here' by an angry owner.

Depending on the circumstances, the animal may respond passively, for example with behavioural depression, or actively with a more vigorous response. The latter seems particularly likely if the animal is highly aroused and/or predicts it has control over the situation and can alter the outcome. However, in some circumstances the animal's response may be quite measured. Some responses may simply reflect confusion and the trialling of different potential solutions based on previous experience because the animal cannot solve the problem, or an attempt to lower its arousal in order to accept the situation and settle itself emotionally so that it can move on to other projects. Therefore the behavioural manifestations of frustration are quite complex, and several categories are recognised; unfortunately, these do not precisely map on to the forms of frustration described earlier, but some may be more likely in certain contexts than others.

- *Ambivalent behaviour*: This involves doing a little bit of one behaviour and a little bit of another. Often this consists of a mixture of approach- and avoidance-type actions, as the animal is in conflict. So an animal may step forward and then step back: this is especially common when one animal is trying to invite another to play but is uncertain about how its overtures might be accepted (Figure 1.9). In this example, the frustration is unlikely to become persistent (although it may become quite ritualised) as the conflict is not chronic and can be resolved simply by walking away, but a failure to respond clearly may increase frustration further and increase arousal: for example, the dog may bark and become even more animated.



Fig. 1.10 A dog showing displacement behaviour in a stressful situation. The Afghan hound on the left yawns in response to a direct stare from the Rhodesian ridgeback.

- *Displacement behaviour*: This consists of simple behaviours which seem completely irrelevant to solving the problem. When an animal is in a state of conflict, different behavioural programmes may compete for expression with no single one being clearly optimal, which can result in an excessive information load for the animal as it struggles to make a decision. It is thought that in these circumstances the brain may evoke simple behavioural patterns which allow it to refocus and then potentially return to this attentional dilemma, by which time the preferred choice may be more obvious. In cats, a common displacement behaviour is turning round and licking between the shoulder blades (Figure 1.8); this does not solve many problems but it does focus the animal on something else for a short period. The behaviours expressed in these circumstances are typically quite fixed motor patterns; that is, self-contained sequences of behaviour that can be easily executed (we will return to this in Chapter 2). In dogs, common displacement behaviours include circling, yawning (Figure 1.10), cocking the leg and sniffing around. Sometimes these behaviours can seem very bizarre: a dog that just snaps its jaws (fly snapping), for example. Because the behaviour does not resolve the actual problem, it can end up being repeated over and over again if the conflict persists, and it can become compulsive and stereotypic with time.
- *Redirection of the behaviour*: This means the animal attempts to perform the behaviour aimed at resolving the problem towards something other than the cause of the problem. In this case, the frustration is not focused on a conflict between competing behaviours but rather on the thwarting of a behaviour. Typically the behaviour is associated with high arousal and so may be more difficult to inhibit once this level of arousal has occurred. By expressing the behaviour in a redirected form, it is thought that the animal can move on from

the situation, although this may have created other problems for it. Redirected behaviours are often seen in relation to aggressive behaviour, which is then referred to as *redirected aggression*. Dog owners often recount that they were bitten by their dog (who is known to have problems with other dogs) when it spotted another dog passing on the other side of the road while on the lead and they tried to intervene to calm it down or refocus its attention. As it is on a lead, the dog is unable to get to its target and hence in its excitement it turns around and bites the nearest thing, which in this case is the owner's hand or leg. Redirected aggression is not uncommon in multi-cat households. A typical story might be that an owner has two indoor-only cats. Another cat enters the garden, which the indoor cats can see through the window. One of the cats in the household is very highly aroused by the presence of the stranger. If it were outside, it would probably threaten and swipe out if the other cat did not retreat. However, a pane of glass stops it, and so it becomes frustrated. Unfortunately, the second resident cat happens to walk by at this point and so the highly aroused cat turns on its fellow housemate (possibly triggered by the slightest movement or proximity). Such events can lead to longer-term problems, which may be the presenting complaint expressed by the owner; for example, a fear of the dog's apparent aggression to the owner and the associated disruption of the relationship between the owner and the dog in the first instance, and inter-cat conflict between housemates, leading to communication problems, possible avoidance of one another and more aggression, in the second. Only a thorough history will reveal the situational origin of these problems.

It is thought that some of these conflict behaviours may acquire ritual significance in some contexts, for example when an individual is unsure about the intent of another, and in such situations they may help to reduce tension between individuals, as they indicate that the sender does not intend to be a threat. In this context, many conflict behaviours are popularly referred to as 'calming signals'.

In conclusion, some animals seem to be more active copers, who often seek to take control of a situation and so might tend to become more aggressive and to take the initiative when frustrated, whereas other animals are more passive in their coping style and so may become more withdrawn. If we see one of these behavioural changes, it indicates that the animal is having difficulty in coping with its environment and that there may be a need for therapy to help the animal deal with stress. This is one of the important roles of pheromonotherapy. If the cause of any frustration remains, the behavioural manifestation of the frustration may become quite persistent or recurrent. With time, the repeated or persistent performance of a behaviour makes it easier and more likely that the behaviour will recur in similar circumstances. This may form the basis for a form of compulsive or stereotypic type of behaviour (there are other ways that this can arise, for example from persistent reward-seeking, which is the basis of many pharmacological models of stereotypic and addictive behaviour). With time, and if there is little environmental variation, secondary neurological changes may occur, possibly as a result of mechanisms that have evolved to increase behavioural efficiency in consistent situations. These may make the

behaviour less varied and ultimately quite fixed and reduced in its form. At this point, we might refer to the behaviour as a stereotypy. Thus persistent frustration can result in repetitive behaviour, which may be a form of either compulsive behaviour or stereotypy. While superficially similar, these behaviours appear to be associated with different underlying neurological changes and so may be mechanistically different.

1.3 OTHER CONSIDERATIONS FOR ASSESSING WELFARE

1.3.1 RECOGNISING SIGNS OF POSITIVE WELL-BEING

In order to evaluate the well-being of an animal, it is important to consider another perspective on the issue of welfare. Historically, most focus has been on detecting signs of distress and the assessment of welfare has largely been based on the absence of these. But it is just as important to recognise the positive signs that indicate that an animal is coping. The following are characteristics of a 'normal' healthy animal or, perhaps, signs that an animal is enjoying life. However, as with the signs of distress, no one sign alone is sufficient. Our assessment should include the balance of signs of positive and negative well-being:

- Psychologically healthy animals can be expected to show a good variety of behaviours, as they efficiently organise their behaviour to meet competing needs at different times. These behaviours will be very variable in form, adapted to different situations and well matched to the shifting priorities presented by a changing environment. The emotional intensity with which behaviours are performed should be evaluated, with the animal seeming to be in control of its behaviour.
- The animal will typically be alert, curious and wanting to investigate things. As mentioned previously, if it feels secure, it is normal for an animal to engage in more information-gathering behaviour. The environment should be sufficiently complex, variable and changeable to ensure that there is a reason to do more than sleep the whole time, in order to maintain a healthy level of cognitive activity.
- The animal will probably be very playful and will want to interact with other members of its social group. Play takes several forms: it can be solitary, object-directed or social, but it is often informative to the animal and self-rewarding. This is why it is often considered a very useful measure of things being good for the animal.

By contrast, an animal that is struggling will typically not show these signs or will show the opposite. For example:

- A very limited range of behaviours of a very limited type, such as stereotypic behaviours (repetitive behaviours with no obvious function).
- Excessive fear, anxiety or irritability, in which the response is out of all proportion to any threat or frustration.

- Bouts of spontaneous panting, restlessness and/or shivering.
- Depression or social withdrawal.
- Hyperactivity and focal attention problems.

There may be a temptation to label these animals or signs as 'abnormal', but the term 'abnormal', like the term 'stress', is difficult to define clearly as it is commonly used in a very confusing way, with different meanings in different contexts.

1.3.2 BEHAVIOURAL ABNORMALITY

The concepts of normality and abnormality are widely used in reference to animal behaviour and its evaluation in terms of animal welfare. However, it is not always clear what they mean in practice. While behaviours vary according to context, animals also have species-specific behaviour patterns with an element of consistency, and abnormal behaviour may be considered anything which deviates from this standard. This poses the problem of recognising what 'normal behaviour' is and what standard should be used: the behavioural measure (pattern of behaviours, individual form, intensity, functionality etc.), its level of deviation and its context must be defined, and sometimes we are left with only our intuitions about some of these features. In many instances the term 'abnormal' is simply used to describe behaviour that is rare (literally away from the statistical norm), but in these circumstances it must be recognised that there is not necessarily a link between the abnormality (i.e. the frequency of the behaviour in the population studied) of a behaviour and animal suffering. The point of reference may be important in this context. For example, in horses, if the stabled population is considered the reference point, then using a statistical approach it can easily be argued that it is not abnormal for them to show repetitive behaviour, since so many do.

In other instances, the functionality or adaptiveness of the behaviour may be used as the reference for normality, but in this case, the terms 'functional' or 'adaptive' are preferable to 'normal' as they are more precise and less likely to give rise to confused associations with animal welfare. This again raises the question of the context for the definition of the key terms of reference; that is, does functional and adaptive behaviour relate to specific circumstances or the underlying mechanism even if it does not achieve its goal? One possible solution involves seeing whether the behaviour occurs in wild free-roaming animals, but a problem here is that the environment is very different and so the behaviour may be absent because it is not needed. Stereotypic behaviour, for example, might be considered abnormal because it is generally not seen in wild free-roaming animals. It is, however, frequently seen in captivity, and one hypothesis is that it reflects frustrated motivation based on natural behavioural predilections, such as the desire to acquire information when the environment appears to provide little (a barren environment) or to escape from an aversive environment. So large felids in the zoo may walk along specific pathways in their cages, gerbils tend to dig and mice climb up their cage walls and repetitively gnaw.

In psychology, the concept of *social deviance* is sometimes applied to assess the abnormality of a behaviour. This involves assessing other people's impression of

the behaviour and the impact that it might have on them. A major problem with this approach is that it depends on the subjective opinion of the person using the term. The philosopher Wittgenstein has argued that many concepts have a similar problem of definition. Things that belong within a given category have certain resemblances without necessarily sharing all of the same features, like members of a family. As with stress, all of the underlying defining features that make up the concept of abnormality need to be identified, and then the problem of simple assumptions about the link between the concept and welfare should be more apparent. Eight criteria that might be used when referring to something as 'abnormal' have been proposed, and they have different relationships with the welfare of the performer. It is worth keeping these criteria in mind (as well as the evidence in support of their use) whenever the term 'abnormal' is being used:

- *Suffering*: Behaviours related to suffering may be divided into those that cause harm to the performer (e.g. self-mutilation) or another, those that are associated with an attempt to adapt or cope with a suboptimal environment and those that are associated with an inadequate or noxious state (e.g. signs of frustration).
- *Maladaptiveness*: This refers to the failure of a behaviour to fulfil its goal at either an appetitive (goal-seeking) or a consummatory (goal-execution) level (e.g. a failure to achieve a desired state). Maladaptiveness may also refer to suboptimal behaviour, such as the ingestion of a non-nutritive foodstuff. As noted earlier, there is a distinction to be made between maladaptiveness and malfunctionality.
- *Malfunctionality*: This means that the underlying mechanism regulating the behaviour is disordered for some reason; that is, there is damage or disruption to the underlying neurological processes, resulting in significant deficits in the ability of the animal to execute behaviour. This might be because of a lesion in the brain or damage to peripheral nerves (neuralgia), as is thought to occur in orofacial pain syndrome in cats. Gathering the evidence for this can be challenging in behavioural medicine, and it is important not to confuse this with maladaptiveness, which arises from the application of evolutionary rules of thumb within unnatural settings. Malfunctional behaviours will typically be maladaptive, but the reverse is not true. The brain often has a large reserve and multiple ways of solving a problem, so if one system is damaged, it may use another to solve a problem, and so only when damage or disruption is quite extensive (e.g. extensive seizure activity) will any malfunction become apparent.
- *Unconventionality*: This refers to the statistical rareness of a behaviour in a given context (see earlier).
- *Unpredictability*: It is often implied that behaviours that cannot be predicted are abnormal because they have no recognised control. However, spontaneous behaviour is a rare occurrence and apparent spontaneity is usually a reflection of the knowledge of the reporter of the behaviour. Once the occurrence of a behaviour can be explained, it may cease to appear abnormal. For example, an owner who cannot predict their dog's aggression might describe it as abnormal, but a clear stimulus may be discerned by a therapist.

- *Incomprehensibility*: Similarly, if the nature (as opposed to the occurrence) of a behaviour cannot be understood, it may be described as abnormal until it is explained.
- *Observer discomfort*: If a behaviour causes concern to its observer for any reason then it may be described as abnormal. For example, some people may consider mounting behaviour directed towards a toy or blanket offensive and so describe the behaviour as abnormal.
- *Violation of standards*: Anthropocentric standards may be set which, if they are not met, result in the classification of a behaviour as abnormal. For example, there may be an expectation that a given behaviour will not occur, such as aggression towards people, so its occurrence is seen as abnormal by definition, even if it can be understood.

Many of these criteria are subjective, but still they encapsulate the essence of how the term 'abnormality' can be used. Any behaviour described as abnormal may meet one or more of these criteria in a given context. It is important that any link to welfare is demonstrated logically and not inferred by virtue of the use of the term 'abnormality' for the behaviour alone. Just because a behaviour fulfils one of these criteria does not imply that it fulfils any other; that is, abnormality is not necessarily a welfare problem.

1.4 STRESS AUDITING

So far we have focused on how individuals change, why they might change in a given way and the consequences of this. Later chapters deal with how specific types of stressor might give rise to different behaviour problems. However, in many cases there is also a certain level of background stress, which can increase the risk of a problem being expressed, exacerbate any problem that is being expressed or affect the ability to implement effective change. As with specific stress responses, this background stress has a qualitative feature, which may serve to alter the likelihood of specific emotional reactions, making them more likely when the background environment is congruent with the specific types of stressor encountered (e.g. a lot of background frustration will potentially increase the likelihood of frustration responses) but less likely when they are incongruent (e.g. if the home is relaxed, the animal may be less likely to show specific fear responses, or these responses may be more attenuated). It is therefore important to both recognise and manage this background context to the problem. Temperament and prevailing mood play an important role in the risk of specific reactions in a given context. As we will see, pheromonotherapy may be useful in helping the patient to adapt to this. Before we consider the management aspects though, we present a framework for the systematic evaluation of circumstances potentially requiring intervention. This is what we call *stress auditing* (Table 1.1).

A *stress audit* is a systematic evaluation of the daily management routines and environment of an animal with regards to the demands being placed upon it. There are two elements to the environment – the physical environment and the

Table 1.1 Summary of the stress-auditing process.

Examine demands made upon the animal regarding:	<ul style="list-style-type: none"> ● Daily management ● Daily routines ● General environment
Consider demands in terms of:	<ul style="list-style-type: none"> ● Expectancy placed upon the individual <ul style="list-style-type: none"> ○ Animal's 'role' ○ Clarity and consistency of expectancy ● Physical characteristics of the stressor in relation to preparation and available resources to help the animal cope <ul style="list-style-type: none"> ○ Affective quality (threatening, frustrating, socially depriving etc.) ○ Magnitude ○ Duration ○ Predictability ● Situation faced by the animal ● Opportunity for control <ul style="list-style-type: none"> ○ Social contingencies: supportive vs conflictive
Consider quality of support	<ul style="list-style-type: none"> ● Communication ● Feedback ● Consistency
Consider where there is change	<ul style="list-style-type: none"> ● Amount of change ● Preparation and communication of capacity to cope

social environment – and it is important to recognise the difference between these, as animals have evolved processes for dealing with the specific challenges associated with social interactions.

1.4.1 DEMANDS PLACED UPON THE ANIMAL

A *demand* is any requirement for change or adaptation that restricts an animal's autonomy or deprives it of a safe, resource-rich environment which meets its needs; that is, anything with the potential to induce anxiety/fear, frustration or significant social deprivation. Within the context of a stress audit, the first aspect to consider arises from the *expectations* placed on the animal; that is, what role the animal is expected to fulfil by its carers, how these expectations are communicated to the animal and the consistency of these expectations among all those who interact with the animal. For example, an owner may want their dog to alert when there are strangers but not when there are familiar visitors. This variable role can be a difficult task to communicate efficiently. If the owner has never taught the dog to 'shh' and 'settle' on command, they may complain about its 'hysterical behaviour' when visitors arrive. Here the expectation has not been clearly communicated to the animal and may have resulted in a conflict that is in danger of spiralling out of control as the owner tries to suppress the unwanted behaviour with punishment.

Next we consider the *physical characteristics* of any demands or potential stressors and the preparation given and resources available to the animal to help it cope. In this regard, we might want to consider not just the magnitude of the stressor but also its duration and predictability. For example, many owners want to interact with their cats for prolonged periods. This is a normal pattern of behaviour for people who are typically intensive and prolonged interactors. Unfortunately this is not the norm for cats, who are less-frequent and shorter-duration social interactors. Therefore, unless a cat has been trained to accept prolonged petting, this may be stressful (frustrating) and can even result in overt aggression if the owner does not read and respond to the cat's behaviour effectively or prevents it from leaving. If the owner holds on to the cat when it would rather leave, they are, in effect, reducing the cat's control over the situation, and this is another important aspect of the stress audit: how much *control* does the animal have over the stressors/demands it encounters? Control increases the perceived ability to cope and so reduces negative affective tendencies.

1.4.2 SUPPORT PROVIDED TO THE ANIMAL

When an animal faces a demand, it will cope best if those around it are supportive rather than indifferent or, as often happens, conflictive. Very often, owners feel the urge to punish their pets when they do not behave as they would like them to when facing some stressor. Not only does this potentially reinforce the animal's anxiety or frustration, it also reduces its perception of its wider coping capacity. It is important to appreciate that in this context, we are not simply referring to any conflict associated with the presenting problem, but conflicts that occur more generally in the animal's day-to-day existence.

There are several other aspects to the quality of support given to a pet which are worth considering. These may relate to the social or physical resources available to help the animal cope: for example, the provision of a safe haven or the expectation that an owner will recognise and intervene to abort a situation in which the animal is expressing discomfort. When support is considered, we need to bear in mind its consistency, how well its availability is communicated and any feedback provided from its provision. Where support is consistently available and the pet is aware of this through communication by the owner, it should be easier for the animal to cope with demands made upon it.

1.4.3 ELEMENTS OF CHANGE

In summary, when change is required of an animal we need to consider carefully at least the following elements if we want to assess whether it is reasonable to expect the animal to adapt successfully:

- The amount and type of change required, especially in relation to the emotional processes it is likely to elicit.

- The clarity of communication to the animal that change is happening and that the animal will be able to cope with this (again focussing on each emotional process separately).

For example, if we want a dog to cope with being left alone (social deprivation and potential barrier frustration) while we are at work, we should not expect it simply to be able to accept that we are going to leave it for a prolonged period (amount and type of change required). We should consider getting the dog used to shorter periods apart first (communicate the change in small steps) and perhaps providing it with some signs of reassurance (such as safety signals like the dog-appeasing pheromone) to communicate confidence in its ability to adapt. Indeed, it has been found that working dogs adapt better to being kennelled if they are introduced to the kennels for short periods initially and allowed to habituate to the environment.

1.5 CONCLUSION

In conclusion, it is important to recognise that stressors vary both qualitatively (i.e. in the type of psychological impact they have – such as anxiety versus frustration) and quantitatively (i.e. in their intensity, frequency and duration). The response that arises will depend on the coping ability of the animal, which will be affected by whether the animal perceives the event as potentially significant and, if it is significant, by its prediction about its ability to adapt to the change demanded by the event. There is much we can do to help animals, by both downgrading the significance of events that we want them to accept and by increasing their expectation that they can cope. By increasing an animal's resilience, not only is the animal's welfare generally improved, but the risk of specific problems is reduced, and when problems do occur the prognosis for successful treatment is improved. It is therefore essential to take a broad overview of the general demands being placed on any animal presented for clinical behavioural assessment and identify where there are conflicts of interest between the owner and their pet, rather than simply focus on the presenting complaint. Such conflicts then need to be addressed accordingly. This can be done by encouraging the owner to develop a way of being with their animal that meets its needs according to its circumstances, rather than through the prescription of specific behaviour-modifying exercises. This approach also recognises that problems arise not so much because of a specific cause but rather as a result of the accumulation of a number of risk factors, many of which may be relatively minor but nevertheless enduring in the animal's general management. Specific events may result in the animal expressing its difficulty in coping in a specific way (i.e. trigger a specific undesirable response), although the problem may be much more general. It is therefore not surprising that by focusing on the general management alone in the first instance, in some cases the primary presenting complaint may disappear, as the animal is generally better able to cope with the specific event triggering this complaint. This focus on general husbandry and communication is not only conducive to a better quality of life for both owner

and pet, but also in many cases much easier to implement than more formal behaviour-modification exercises.

REVIEW ACTIVITIES

- Compare and contrast the stressors to which different companion animals are exposed in modern life and how their ability to cope may vary according to their species-specific evolutionary tendencies.
- Design practical safe havens for different companion-animal species and create instruction sheets to explain to owners how to install and maintain them.
- Explain the relationships between the various hormones and neurotransmitters which are affected when an animal perceives a stressor in the environment and how these can be used to assist evaluation of the type of stressor being perceived by the animal.
- Draw up a check list of the general physical health and behaviour signs a patient might show which would indicate the need for a more comprehensive stress audit.
- Discuss the relevance of frustration as a component of behaviour problems in animals, as well as how frustration can be minimised or avoided to improve welfare.
- Consider a range of questions that you could ask an owner to assess the positive welfare of a pet.
- Design a practical advice sheet for the owner of a new puppy and one for the owner of a new kitten, describing the philosophy behind helping their pet to become resilient as it matures.

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