

Why Zebras Don't Get Ulcers...But Dogs Do

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The purpose of this thesis is to look into chronic eustress and its effects, mentally, physically and physiologically in dogs.

Abstract

I attended a seminar where Steve Mann, IMDT who spoke about his 'rucksack walk' where he talks about his visit to Cusco, a city in Peru where he went to study the local dogs which famously populate the streets. He sat and watched these dogs for weeks and weeks and finalised that '**the dogs never ran**'. They mooched about, sniffing things, being nosy, liked interacting and being around people, investigated sounds, sights and passers by. Thousands of dogs in a small space, that rarely had disagreements, had any massive behaviour problems, navigated roads and vehicles perfectly and engaged with people politely. And **they never ran**. Steve invented the rucksack walk to try to capture this concept with dogs in Western Society, by helping carers engage with their dogs at a simple level, as a form of mindfulness to connect. The gist is to mooch around slowly to a location with a few items in a rucksack, sit down on the ground and bring them out one by one for your dog to play with, sniff, eat, bite whatever. There is no real aim except bonding with your dog, keeping their arousal levels low and exploring the items together. I used to do this with my dog Dotty, before I'd heard of the rucksack walk, we would sit on the ground, I'd pick up sticks, leaves and grass to sniff, feed her things but it was more about engaging with her to make our little game fun so she wouldn't get so focused on the external environment which sent her into hyper arousal and her eyes would gloss over, her ears back, running about not listening to me, chasing birds! I realised if I could manage her arousal levels, she would listen to me, be more content, happy and some of her behaviour issues began to fizzle away without any behaviour modifications or training plans. Now, 6 years later, I have decided to formally explore stress, particularly eustress and how having chronically elevated levels can heighten behaviour problems and illness.

What is eustress?

Stress is the non-specific response of the body to any demand put upon it (Siang Yong Tan, 2018). Non-specific, means that the body requires an adaption irrespective of the specific stressor the individual is exposed to, positive, neutral, or negative, the body will strive to return to normality, or homeostasis (Davies, 2016). Negative, or unpleasant forms of stress include frustration, lack of sleep and illness, which I will refer to from here on out as *distress*. In modern society, stress and distress are synonyms and can be used interchangeably. Positive or pleasant forms of stress (a stressor) include play, exercise and sex, which I will refer to from now on as *eustress*. These terms were originally coined by Hans Selye, MD in 1936. Although distress and eustress are opposite by nature, (Levine, 1991) the effects on the body, physiologically are very similar if chronically experienced day after day for extended durations (see figure 1). This is known as the 'sustained activation theory' (Ursin, 1980). Acute stress responses can prove to be harmless, or beneficial, but the law of diminishing returns states that once a peak is reached, these same stressors can be in fact, detrimental to ones health if prolonged (Ader, 1985, 1986). Holger Ursin in his 1994 landmark review summarises that 'We have now ample evidence that stress, acute or chronic, eustress or distress, has an impact on

the system'. We can safely assume therefore that chronic eustress, without sufficient rest and recovery will tip over at some point into distress and it is not a linear upward positive trend. Hetts and Estep in the Certified Applied Animal Behaviourists CAABChat talk about displacement behaviours and how we should take the whole context in when viewing a stress signal (Turid Rugass- Calming Signals) and dogs can appear to be in distress when in fact they may be in eustress. In Patricia McConnell's blog she says 'A displacement activity might indicate eustress, distress and/or fear'. We can see this with our own dogs, pick up the lead which indicates you are going for a walk and some dogs will get so excited they yawn or pant in anticipation while you fiddle around getting your wellies on. Yawning and panting, typical signs of distress, in this context would probably mean eustress, excitement that they are going on a walk, but the physiological response inwardly is very similar.

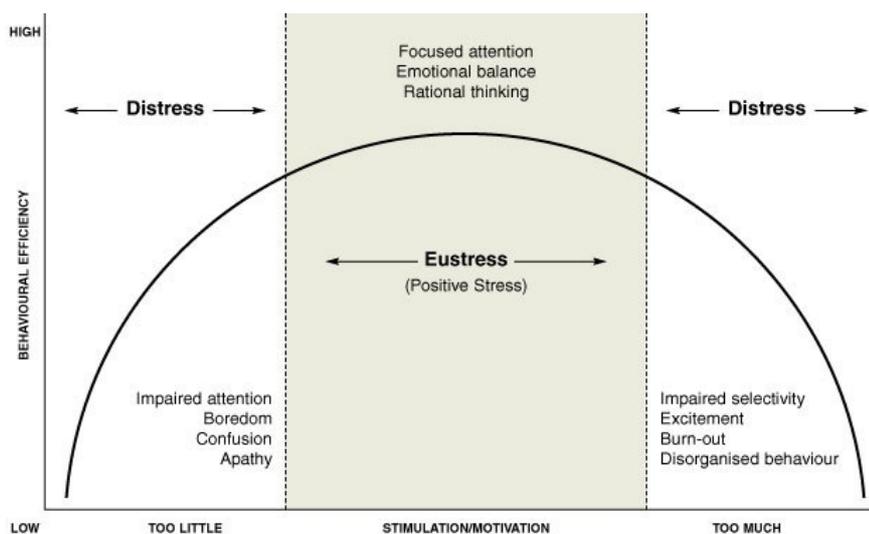


Figure 1 (<https://positivepsychologyprogram.com/what-is-eustress/>)

We see this bell curve with eustress. Too little, and we can see such effects as boredom and depression. On the other end of the spectrum, we see over excitement, burn-out and struggling to focus. I therefore theorise that the middle is the sweet spot where we should be aiming to keep our dogs, as much as practically possible. Dogs that are experiencing extremely high levels of stimulation should be given rest breaks and plenty of low impact and low arousal activities to counteract the former.

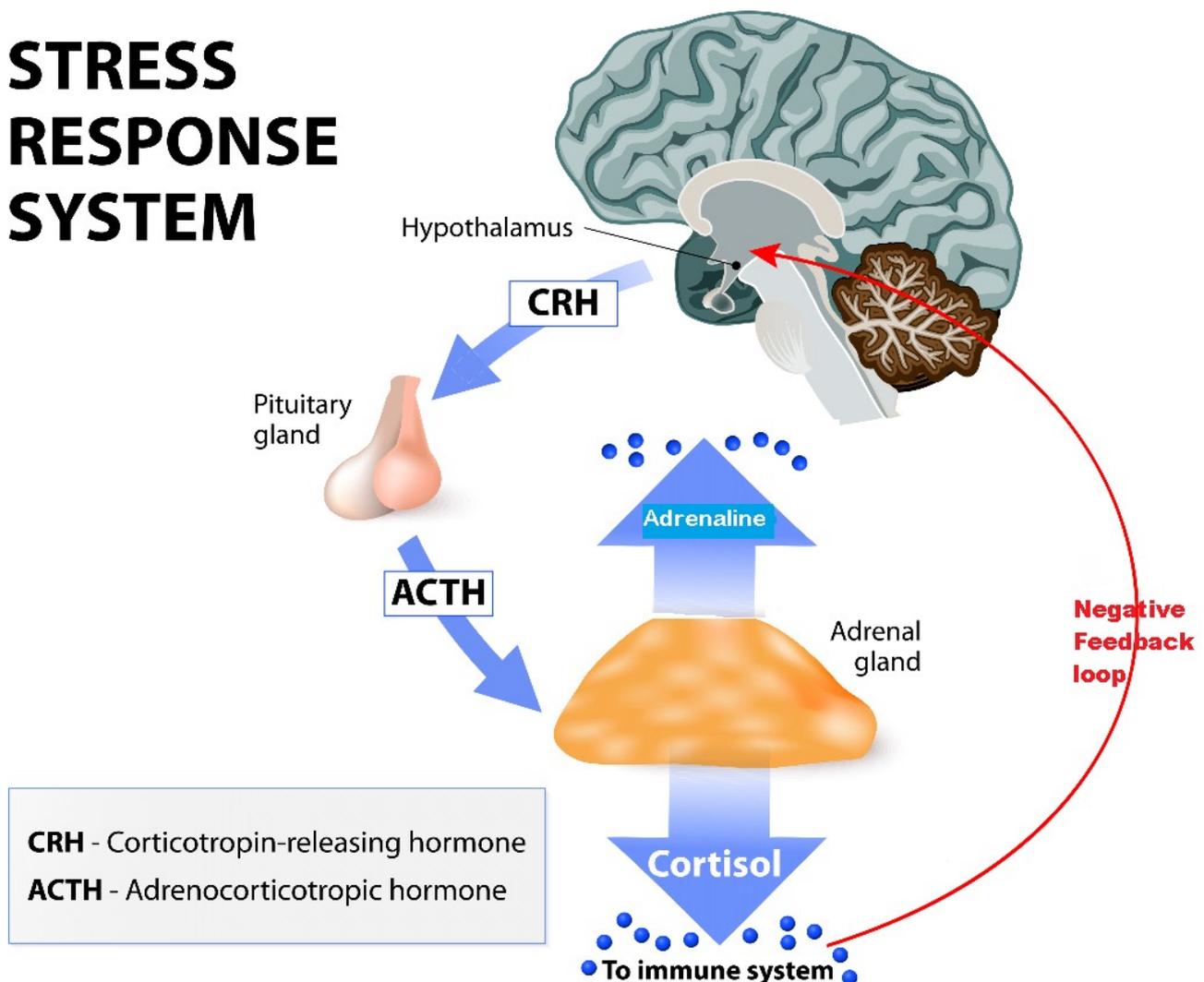
'for the healthy organism a short lasting activation has only training effects, but when the activation is long lasting and without interspersed rest periods, pathology may occur' (Ursin, 1983).

What happens to the body when we are put under stress?

As soon as a dog is put under stress, the hypothalamus in it's brain will begin tell the rest of the body to release various hormones, such as glucocorticoids (the most commonly known is cortisol). These steroid like hormones are responsible for inhibiting protein synthesis, are anti-inflammatory, mobilize glucose and tissue substrates for fuel, suppress non vital organ systems. The adrenal medulla will automatically release adrenaline and other neurotransmitters, which belong to the catecholamine family and are responsible for raising blood pressure, pulse, blood sugar, dilation of various bronchial tubes, veins and the pupils. This is known as 'the stress response' (Hannibal, 2014). All these systems have

what is called a 'negative feedback loop' which tells the body to slow down and stop producing these hormones once the stressor has stopped. Cortisol will remain elevated for a few hours before returning to baseline (Dedovic, 2009). This is a perfect response to a short term, acute stressor, imagine an animal in the wild, running or fighting for its life, hence the well known phrase 'fight or flight' (Walter Bradford Cannon). Acute stress has even been shown to boost and aid the immune system (Firdaus S, 2009). The issue comes when these hormones are chronically signalled, over and over again, without being allowed to return to baseline. Cortisol, for example, will show a fault in the negative feedback loop and it will not shut off production if an animal is under chronic stress and the previous levels returning in a few hours will now take up to three days and can elevate to super-physiological levels of four times the amount felt under purely acute stress (Figure 2). Prolonged or excessive cortisol secretion may result in a compensatory down-regulation or resistance of the glucocorticoid receptor that blocks cortisol binding (Norman, 2002) and it now has pro-inflammatory effects. Inflammation induces oxidative stress, free radical damage, cellular death, ageing, and systemic tissue degeneration (Maes M, 2011). Other signs and symptoms of stress-induced cortisol dysfunction include bone and muscle breakdown, fatigue, depression, pain, memory impairments, sodium-potassium dysregulation, orthostatic hypotension, and impaired pupil light reflex (Fries E, 2005). Adrenaline over-production causes stiffening of the arteries around the heart due to the constant increase in blood pressure, this can cause them to hypertrophy to deal with the increased load, thus narrowing the pathways reducing blood flow.

STRESS RESPONSE SYSTEM



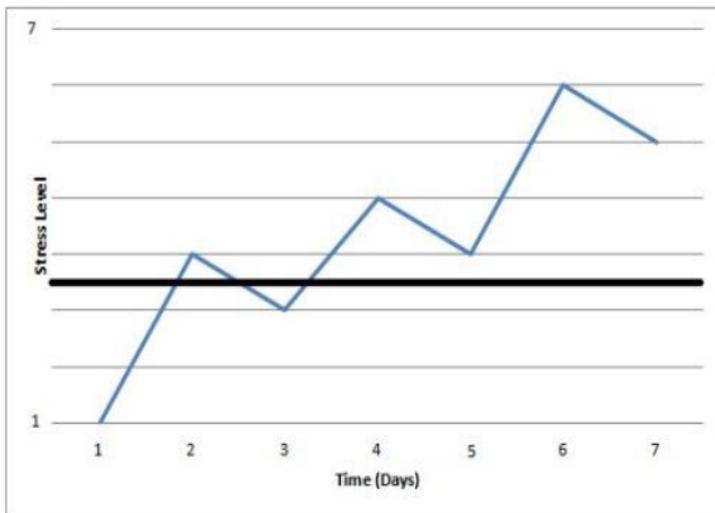


Figure 2: Hormone levels during exposure to constant stress

(Source: paws4udogs.wordpress.com)

In summary, acute stress is normal, cannot be avoided and is actually beneficial at times. The problems arise when the stress response is over active, and this is when we see huge detrimental physiological changes.

What do dogs naturally choose to do?

Back to Steve Mann's talk about his experience with the Peruvian dogs. The dogs naturally had the choice to do what they pleased, yet they rarely ran, there was no rush, they rarely barked, never chased birds or a tennis ball and showed '**no real elements of arousal**' (Steve Mann- Easy Peasy Puppy Squeazy). They simply enjoyed sunbathing, pottering about, interacting with humans, sniffing about and being nosey. Additionally, research by Luca Corrieri in 2018 looked dogs in Bali and echoed Steve's findings by concluding that 'free-ranging Bali dogs were rated as less active, less excitable, less aggressive towards animals, and less inclined to chase animals or humans than Bali dogs living as human companions'. Although there could be a genetic component present, I feel that we are severely missing a trick here. **The available evidence suggests that this is what dogs will choose to do without human intervention.** The sustained activation theory works itself out, by itself. Yet back home, at the park I see tennis balls being thrown for hours, dogs sent into hyper arousal, agility dogs barking in anticipation and detection dogs working 10 hour shifts without a break. Pastore, 2011 found that agility dogs had almost twice as much cortisol post competition and showed signs of restlessness, vocalisation, trembling and panting. The logic or reasoning for these activities is generally answered something along the lines of 'but my dog *loves* it'. This *may* or not be true but that doesn't necessarily make it beneficial. Is the dog addicted to the neurotransmitter chemicals that flood the brain when performing high arousal activities? Does a gambler or drug addict *love* their addictions or are they a slave to the chemical activity in the brain? Just because a dog performs an activity relentlessly I would argue that it doesn't necessarily love this activity and it isn't necessarily healthy, and if it really does love this activity, precautions should be made so that sufficient downtime is provided. As discussed above, this same reaction occurs if the dog is happy, excited, or fearful (Belpedio et al., 2010;Bradshaw,

2011; Carrier et al., 2013).



Dopamine

Although the dopamine system is associated primarily with pleasure and reward, it also is thought to assist dysphoria states in several ways. Studies of drug addiction, for example, suggest that hypo activation or under stimulation of the mesolimbic system (reward pathway) is associated with a range of negative emotions (Diana, 1996) that drive drug-seeking behaviour (Diana, 1998; Goldstein, 2002). As addictive drugs are consumed, increasing neural activity in the mesolimbic system stimulates reward pathways, thereby attenuating the dysphoria associated with drug abstinence and withdrawal (Posner, 2008). The amygdala seems to respond both to appetitive and aversive stimuli, with a greater activation following the presentation of more arousing stimuli (Anderson, 2003). I hypothesise that a similar interaction is happening with dogs that are 'addicted' to chasing balls, performing agility or certain high arousal dog sports.

The Dopamine Misconception

It's often talked about that dopamine is released when performing a pleasurable activity; you hear people say that you get a big dopamine hit or rush when doing something you love, but research by Kent Berridge has shown that this is not entirely the case. In fact, dopamine peaks *before* the reward, in *anticipation* of the reward happening (figure 3). Robert Sapolsky confirms this when he states 'the stress-response can be mobilized not only in response to the physical or psychological insults, but also in expectation of them'. For example, a person holding a tennis ball or tennis ball chucker will be the cue, and dopamine will be released in the dog's brain *before* the ball is thrown. When the ball is thrown, the dopamine release is connected with a conditioned response- chasing (Ivan Pavlov) and the dogs can get 'caught in what Susan Weinschenk Ph.D calls a 'dopamine reward seeking loop'. Turns out, the dopamine system doesn't have satiation built in, therefore we can keep going and going and going, seeking for the reward, addicted to the dopamine. Think of a gambler constantly pulling the lever of the slot machine. Wolfram Schultz of the University in Fribourg describes this by saying 'if you know your appetite is going to be sated, pleasure is more about the appetite than about the sating'. So, how much dopamine release is healthy? You guessed it; **'a moderate rise that doesn't go on**

for too long'- Robert Sapolsky, Why Zebras Don't Get Ulcers. Experience severe and prolonged stress, and learning, immunity, memory, synaptic plasticity are all degraded. Cocaine is a drug that mimics the release of dopamine. The day after a user has inhaled the substance, dopamine plummets, as the receptors down-regulate and desensitise to remain in homeostasis. We now have low dopamine, and were back to dysphoria and depression as mentioned above. Studies by Hiroto and Seligman show that 'learned helplessness' is far more likely in animals with depression which can be caused by low dopamine. They are also more likely to become frustrated, tense, angry and less likely to relax. We also see an abnormally high percentage of Cushing's disease in dogs (Horm Res, 2009) caused by over expressed dopamine signalling and tumours on the pituitary gland which triggers even more amounts of cortisol. It is estimated that 10% of dogs have heart disease (Pet Health Network). Stress can accelerate tumour growth in animal studies. Dogs (Stanton, 1989) and humans are the some of the most common animals that suffer from stomach ulcers; hence the name of this essay, playing on the title of Robert Sapolsky's wonderful book. Why? Stress. Working dogs suffer from a much higher percentage of stress related disease (Stress in Dogs- Martina Scholz and Clarissa von Reinhardt).

Dopamine is part of the 'wanting' system in the brain, rather than the 'liking' system, so **do dogs actually enjoy** endless amounts of ball throwing or are they stuck in the dopamine loop?

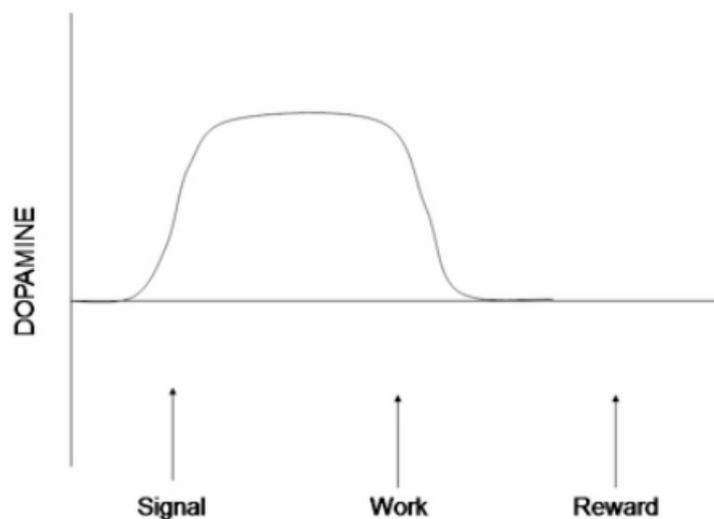


Figure 3. Sapolsky - Dopamine, Anticipation, & Relationships. The inverted U.

The 'signal' is the cue of the human with a ball. The 'work' is the chase and the reward is picking up the tennis ball. The huge rise in dopamine comes at the signal, NOT the reward.



Above, myself, holding a tennis ball up for 3 dogs. This was 1 minute into their walk and they had not yet run. It was only 9 degrees, yet they all begin to pant in anticipation.

Behaviour

Dog trainer Sara Reusche says 'A highly aroused dog will be very excited, with a fast heart rate and respiration and poor impulse control. He may have dilated pupils or chatter his teeth. He may pant, jump around or on you, or vocalize incessantly. He may become grabby or mouthy. Alternatively, he may become 'locked on' to an activity, freezing in place and staring intently at the object of his obsession, spinning in circles, or pacing.' We see dogs at the tip of the arousal valence (figure 4) which can easily tip from one side to the other. In fact, the higher the arousal, the quicker and easier one will tip over, from say, excitement, to frustration. Pre-exposure to strenuous exercise has been associated with reduced performance, frustration and decreased attention in working dogs and scent dogs provided provided with sufficient rest and enrichment made fewer errors (Camille A, 2019). Careful observations of canine body language have identified a number of indicators that show levels of excessive or unhealthy stress and suggest that hyper-energetic dogs are actually just stressed rather than exercise deficient (Rugaas,2005; Aloff, 2005). It has been suggested that certain activities, such as constant ball or Frisbee chasing for more than 30 minutes, can cause over arousal for several days if the dog is not allowed a recovery period. Over arousal causes stress; a stressed dog will eventually reach their threshold point much earlier and resort to reactivity (Fishburn, 2014; Frediani, 2000; Kimo, 2011; Rugaas 2005). Over exercise cannot only lead to heightened stress and reactivity but also to communication problems between dogs (Fishburn, 2014).

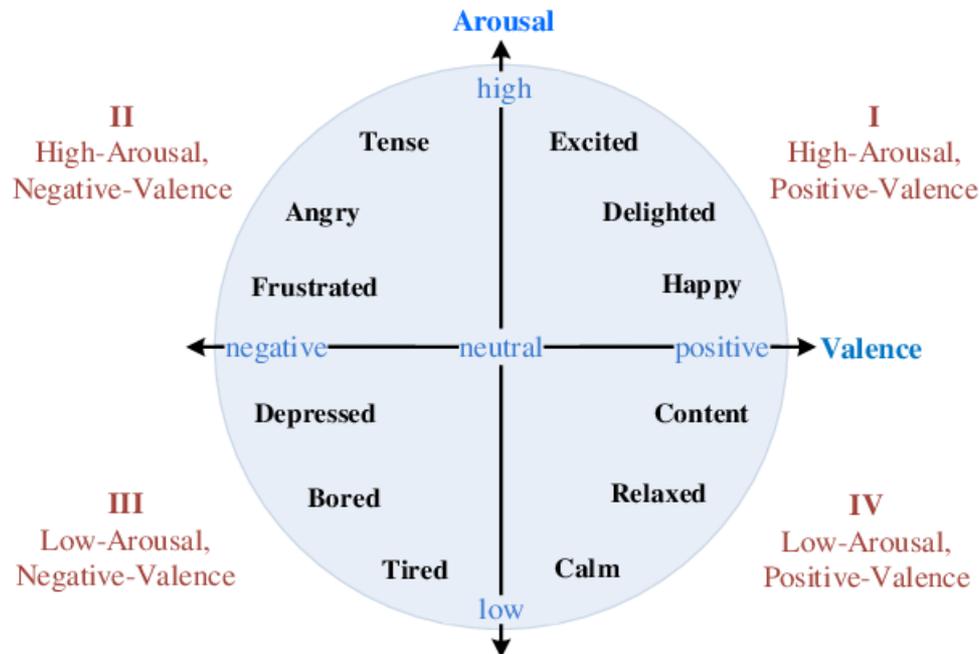


Figure 4, the arousal valance (https://www.researchgate.net/figure/Two-dimensional-valence-arousal-space_fig1_304124018). One should aim to keep their dog in the right hand side, with equal balance between high and low arousal levels, never staying in one area for long periods. Posner, 2008 states that 'We propose that clinicians and researchers move away from a strictly basic emotion model of affective states, where each emotion is thought to emerge from independent neural systems, to more dimensional models of emotions, in which all affective states are understood to arise from common, overlapping neurophysiological systems.'

The Solution

Other games, like tug can still be enjoyed without the need for dopamine signalling which can give the receptors time to re-sensitise while still using play as a reward. In fact, a study was done where dopamine signalling was suppressed in a rats brain but it did not impact the pleasure response (Berridge, 1998). These dopamine receptors can be given a nice rest while you take advantage of some of the other pleasure pathways in your dog's brain, which are far less likely to cause over arousal. Sniffing has actually been shown to reduce heart rate by 37% where playing fetch increased it by 45% (along with huge amounts of adrenaline and cortisol) (www.dogpulse.org) and sniffing games can increase optimism in a positive judgement bias in dogs (Horowitz. 2018). Chewing has been shown to be a stress coping behaviour (Kin-ya Kubo, 2015) and can reduce cortisol output in the hippocampus region of the brain, and in rodents, chewing or biting on wooden sticks during exposure to various stressors reduces stress-induced gastric ulcer formation. Once

again, back to Steve Mann's Rucksack walk (<https://www.imdt.uk.com/correspondence-courses/the-rucksack-walk/>) he seems to have settled on a similar conclusion of sniffing, chewing, eating and bonding. Agility, fetch and other high arousal dog sports can be brilliant ways to exercise dogs and utilization mental energy, and I am not suggesting that they should be avoided, but one should be aware that high arousal dogs should have sufficient downtime to rest and recover from these stressful experiences and should not be performed chronically. We know that low intensity exercise does not result in significant increases in cortisol levels, in fact actually resulted in a reduction in circulating cortisol levels (Hill EE, 2008). Another common argument in favour of throwing a tennis ball is to tire out a dog. I performed a little test myself with my dogs coming to daycare. Carers were asked to complete a short survey after their dog's returned home. For the first week I threw tennis balls, played tug and chase with them for long durations. The second week, we sat down in the park, slowly wandered about, led in the grass, sunbathed and investigated sights, sounds and smells. The average score for each dog on how 'content' they were actually increased by week 2, they slept more, ran less and yet we were walking on average 4000 steps less a day! Furthermore, one dog who has a mild fear of travelling, began falling asleep in the van and another took on average 4-5 minutes until she began panting, increased to 15 minutes, or even not panting at all. A small study by Linda Cooper (Can modifying the daily exercise regime improve behaviour?) asked owners to implement the relaxation protocol with their dogs and reduce the amount of exercise their dog received. All forms of chase and highly stimulating physical activities were to be eliminated completely for the duration of the programme and replaced with activities to provide mental enrichment. following completion of the relaxation programme. An 80% reduction in barking and piloerection and an 88% reduction in lunging were recorded (Figure 5). In fact, all stress markers were reduced and all dogs were reported to be calmer despite their overall exercise dramatically reducing.

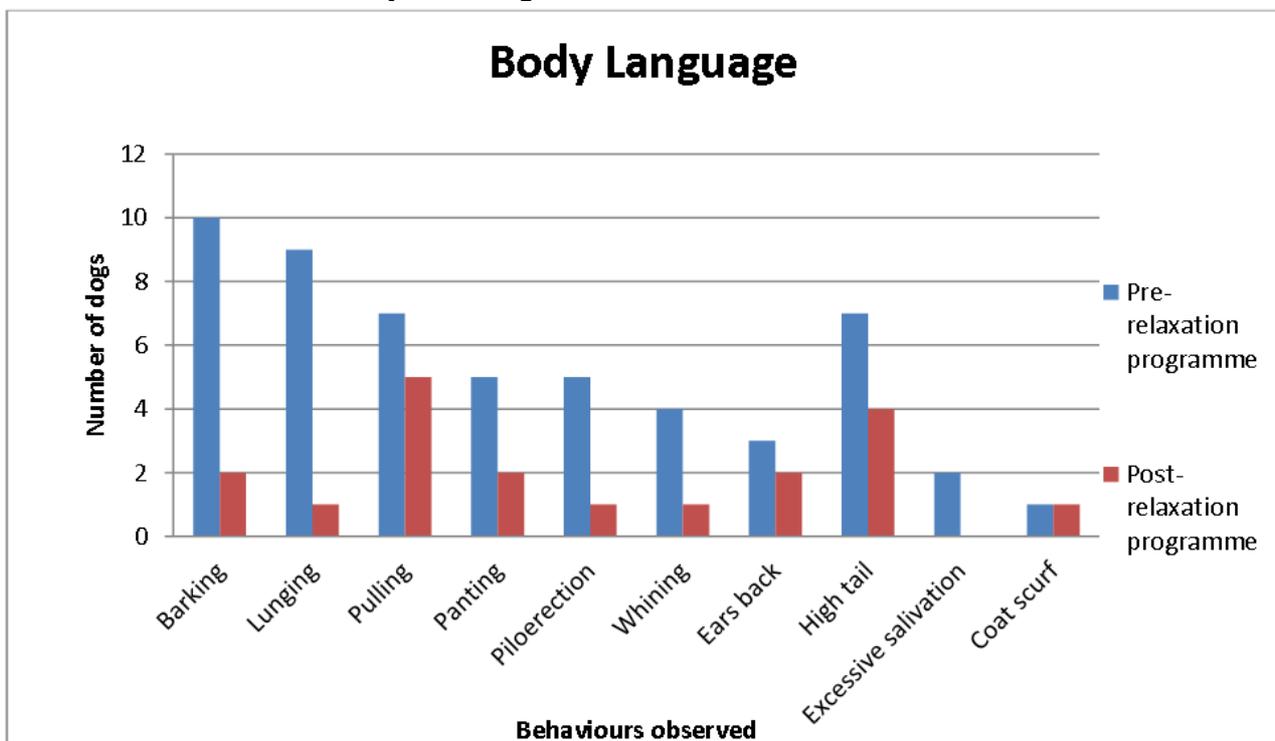


Figure 5- Linda Cooper's behaviour results pre and post- relaxation program

Therefore, in summary. I conclude that chronic eustress has significant negative consequences and dogs should be given the chance to wind down and practice their natural instinctual behaviours to have a break from stressful activities and the stress response that is induced from such activities. Sufficient downtime will improve behaviour,

quality of life and health.

'I'm all for fun and games...But not *always*. A good friend should be someone you're happy just to be 'with'. That being said, I want you to be able to give puppy a ton of what they need: recall, loose lead walking, focus, adventure, exploration, olfactory satisfaction, food, novelty, and a nice fat dose of serotonin and oxytocin *without* the presence of an adrenaline rush.'- Steve Mann.

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