A Systematic Assessment of Stress and Attention via short-term Canine Association: Differences between Cognitive Functioning, Performance and Subjective Experience

A dissertation submitted in partial fulfillment of the requirement for the degree

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By

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I have not failed. I have just found 10,000 things that do not work. — Thomas Edison

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Don't accept your dog's admiration as conclusive evidence that you are wonderful.— Ann Landers

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I'd rather live with a good question than a bad answer. — Aryeh Frimer

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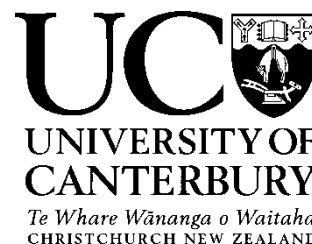
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Chapter 1

6.1 Introduction to animal therapy

Humans have coexisted with animals since the beginning, with their relationship evolving over time from one that was predatory-based (i.e. eat or be eaten), to fascination, to domestication, to integration into modern day society as pets or pests (Serpell, 1995). Many people recognize that animals deserve respect, explaining the rise in international wildlife funds, exotic animal research, humane society groups and vegetarian/vegan lifestyles of the most recent decade. Social media has been a noteworthy platform for animal content of all forms, most notably highlighting pictures and videos of animals deemed "cute", in an attempt to spread positivity through mass communication. Economically, animal activities such as zoo trips and animal sponsors show a large financial expenditure worldwide, and it has been reported that the average American pet owner spends approximately $1,500 on their pets each year for basic veterinary care, food, toys and hygiene purposes, and this is expected to reach over $60.5 billion nationwide this year (Castillo, 2015). Pet owners would likely agree that their animal serves as an extension of the family, and provides means of entertainment, objects of nurture, companionship, and in many cases happiness. This perceived relationship has made its way into clinical psychology, spawning many animal-assisted therapy programs (AAT, see Odendaal, 2000) to provide companionship and assistance to individuals that require it. It would not be strange to see a cat making its way through corridors of a nursing or rest home to receive affection from the elderly, or a visually impaired individual accompanied by his or her seeing-eye dog as they travel by airplane, as these scenarios are increasingly becoming the norm.

Analysis of interspecies interaction is woefully rare, despite the importance and relevance of humans with companion animals. Although comparative studies of animals have a large scholarly base, these methods of research are often invasive and focus on cognitive

and physiological comparisons, rather than the *value* of coexisting with these animals (Rollin, 1985). Interspecies relationships as a model of attachment have been linked to decreased doctor visits, positive affectivity, and often influence one's ability to deal with stressful relationships (Crawford, 2006). This is often referred to as the 'pet effect', suggesting that owning a pet is beneficial to physical and mental health (Smith, 2012). Although indoor-animal owners are equally likely to view their pets as part of the family (i.e. felines, birds, rodents), studies have found that canines demonstrate unusual competence in comparison to wolves and other domesticated animals, with regards to cooperation, social learning and communication (Topál et al., 2005). Between the two most common house pets —cats and dogs— cats are typically perceived as more independent, aloof and less affectionate than dogs (Zasloff & Kidd, 1994). In turn, research shows that in some cases, similar behavioral characteristics seem to be transposed onto their owners, where dog owners are often rated as more likable when they were accompanied by a dog than by a cat (Perrine & Osbourne, 1998). Not only do canines and their owners seem often to share behavioral characteristics, but there are many reports that owners and their canine companions look physically similar due to fixed facial elements or similar perceived disposition— whether this similarity is predetermined through selection or features converging over time is uncertain (Levine, 2005; Nakajima et. al, 2009; Roy & Christenfeld, 2004; Woodward & Bauer, 2006). What *is* certain, however, is the enormous role a canine plays in modern society.

The human-canine bond can be seen as a prototype of animal companionship. Not only has the longevity of the human-canine relationship (back to first domestication) believed to have spurred co-evolution between both species, but also this relationship is important in regards to a wide range of behaviors visible in canines that are similarly exhibited in human relationships; social reciprocity is an essential distinction for dogs from many other animal species (Odendaal, 2000; Zasloff, 1996). Where human-to-human emotional bonds elicit an

array of positive effects (i.e. companionship, increased self-esteem, stress reduction), likewise, human-canine bonds are often found to promote physical and mental wellbeing. Though there is much debate in defining these concepts, w*ellbeing* in this context refers to positive psychological functioning, most specifically short-term, and encompasses a broad range of psycho-physio-social benefits such as happiness, stress reduction, physical health and social functioning (Ryff, 1989). Wellbeing benefits that are derived namely from the human-dog companion bond often rely on the person's perception of the dog, a major factor that leads to an interaction that is positive or negative. It is possible that because dogs are attuned to the 'here and now' and do not harbor pre-existing motivation towards the developed pet-owner relationship, their loyalty is often automatically assumed, whereas people may be expected to prove themselves to avoid possible ill-intentions. A dog is not believed to pre-strategize concepts such as "attack" or "escape" —such acts happen spontaneously— if untaught to do so, where a person has the ability to mentally categorize such objectives. This notion could possibly yield emotional strength in ways that might not be matched in human-to-human relationships, specifically in support of the progressive use of AAT (Odendaal, 2000). The perceived trustworthiness of the dog may fully depend on the breed itself. Negative assumptions have been attached to many breeds of canine, as perpetuated by the media and selection of work and service dogs (Seagroves, 2011).

1.2   Physical and Mental Benefits from Canine Interaction

Despite the breed of canine, many studies examine the strength and benefits of the human-dog relationship, though many are dedicated to assessing the *physical* benefits. Such research suggests that dogs not only prevent owners from external damages (i.e. hazards), but also facilitate recovery from ill health and predict certain types of hidden physical issues (Wells, 2007). In tandem, these benefits contribute to short-term and long-term health.

As demonstrated with the famous Pavlov's dog study (1928), canines are highly trainable and easily conditioned, making them a prime employee for service work. Considering that the service of dogs is often cost effective and poses minimum risk to human health (although bites and transmitted disease are possibilities), they have been trained for duties such as entering minefields to self-preserve soldiers during battle, and to search terrain often inaccessible to people (Helton, 2009). This "eagerness" to serve has led to the renowned history of dogs aiding human counterparts, in the context of guarding, protecting, servicing, rescuing and guiding. Many dog breeds are defaulted to certain physical tasks, based on their physical and temperance level (i.e. a German Sheppard serves better as a guard dog, where a Labrador serves best as a guide dog) (Coren, 1996; Wilsson & Sundgren, 1996). The canine's keen sensory capacities and fast mapping in auditory and visual commands make them a valuable tool, aiding in search and rescue (Warden & Warner, 1928). The keen olfactory senses of canines have been investigated in medical research, where they have been found to detect early forms of physical ailments before they are identified by the ailed subject (Warden & Warner, 1928; Wells, 2009). Many cases have been reported of dogs alerting their owner when the individual/a family member is about to have a seizure, or when their blood sugar is running critically low ; cancer detection is currently being researched through blood and urine canine sniff training (Cornu et al., 2011; Wells, 2009; Willis et al., 2004).

Just as canines can be lifesavers through their keen senses, they also continuously encourage physical wellness in humans. Dogs have been recognized as motivators for physical activities, such as exercise and play (Odendaal & Meintjes, 2003; Siegel, 1993; Wells, 2009; Wohlfarth et al., 2013). Studies comparing health of pet owners versus non-owners show that adult pet owners are slightly more physically active than non-owners, and it is speculated that dog owners are stimulated to increase physical activity due to walking their dogs, as demonstrated in Figure 1.1. In a study by Wohlfarth and colleagues (2013), the

presence of a dog was found to have a more positive impact on the physical performance of obese children, compared to a human confederate. In relation, it is theorized that dogs arouse implicit motives that are built on associations with innate affective, non-verbal experiences called 'natural incentives' (Wohlfarth et al., 2013). Research shows these subconscious motives influence non-declarative measures (e.g. task performance, attention orienting) but not declarative ones (i.e. choices, attitudes, judgments). As different motives arrive from implicit cues of another, it is possible that the presence of a dog "watching" one exercise may suggest a non-judgmental audience, triggering the achievement motive and perpetuating sustained performance.

Figure 1.1. An owner and his canine on an evening walk

Similar types of performance enhancement via dog interaction have been noted in other literature. Dog owners performing mentally stressing challenges, such as arithmetic or reading aloud, have been found to perform the tasks with lower blood pressure and heart rate levels than performing alone or with a control group (Crawford et al., 2006; Wells, 2005; Wells, 2009). The act of petting a dog has been shown to produce many physiological

changes; not only lowering of blood pressure and heart rate, but also fostering the production

of hormones linked to positive effects, such as endorphins and oxytocin (Handlin et al., 2012;

Odendaal & Meintjes, 2003; Wells, 2009). A key experiment by Odendaal and Meintjes

(2002) was designed to investigate the neurochemical and hormonal correlations for human-

canine affiliation. The experiment involved eighteen adults claiming affection toward their

dog counterparts. All involved were first sampled for blood and established with baseline

blood pressure readings, then asked to engage in positive social interaction with their dogs for

a maximum of 30 minutes (e.g. petting, calming talking, social gestures). A control group

who quietly read books for 30 minutes was used for comparison. Results of a post blood test

and blood pressure reading showed that arterial blood pressure tended to decrease in both

species during the positive interaction, and even though this change was similar to the control

group, there were significantly higher differences for the levels of increased endorphins and

oxytocin for the human-canine interaction (Odendaal & Meintjes, 2003). Intriguingly, the

physical interaction between the dog and human also increased the production of these

hormones in canines alike, suggesting that the companion relationship mutually benefits

those participating in it. These increased hormone production levels are valuable to explore,

for increase in endorphins is linked to concentration and memory retention, where oxytocin is

linked to increases in stress relief and social functioning (Odendaal & Meintjes, 2003). The

stress reduction from dog ownership has also been noted to prevent serious health problems,

(namely coronary heart disease), linking to fewer yearly doctor visits (Wells, 2007).

  Alongside the staggering physical benefits of canine ownership, even more intriguing

is the function of dogs as catalysts for mental wellbeing. In particular, it appears as though

these benefits are mutually shared between animal and person. Dogs have been used during

therapy sessions for their ability to calm the patient without being too obtrusive, facilitating

mediation between the therapist and patient (Lefkowitz et al., 2005). This can help take away

fears the patient may have, because having a composed dog – rather than one trying to alert –

helps reassure that the environment is a secure one. Canine ownership can serve as an

extension of the self (i.e. people who wish to appear intimidating often keep "intimidating"

dogs) or as a more preferable human surrogate, which is especially true for individuals who

have been abused or are without children (Wells, 2009; Lefkowitz et al., 2005; Flynn, 2000a,

2000b). Nevertheless, the companion bond elicited from dogs make people feel loved,

protected and cared for, which from an evolutionary standpoint, are ultimate fulfillment needs

of people (Crawford et al., 2006).

It is commonly stated that dogs sense the emotional needs of their owners, as they are

readily available for comforting behavior and companionship. The reverse has been studied

alike, where people (dog owners or not), have been found to identify correct emotions from

static emotionally-induced photographs of dogs; more experienced dog handlers said they

paid specific attention to the ear position of the dog (Wan et al., 2012). Similarities in the

degree of facial expressions allow humans and dogs to communicate on a more primal level,

where requests can be made (such as an invitation to play), responses interpreted and

personality traits analyzed (Gaunet, 2010; Hare & Tomasello, 2005; Kaminski et al., 2011;

Gosling et al., 2003). This ability lends intrigue to the physical component of dogs as living

stimuli for emotion reciprocity and assessment. As increased human social functioning has

been linked to canine companionship, it is possible that exposure to dogs may also increase a

participant's ability to correctly identifying emotions; however, such has yet to be adequately

addressed in current research.

1.3   Physical Attributes of Dogs and Correlates

Though the positive benefits of canine companionship are undeniable, is it in part attributable to certain breeds or all dogs in general? Are there certain aspects of the physical properties of a dog that promote feelings of wellbeing (i.e. cute dogs make people happy), going as far as promoting mental restoration? It is speculated that the emotional bond between dog and person is not the most crucial element in promoting mental wellbeing; similar benefits may be found through simple proximity to a dog, without a pre-established relationship (Odendaal & Meintjes, 2003).

A major factor in the visual attraction dogs seem to carry is thought to be in part explained by the Attentional Restoration Theory (ART; Kaplan, 1995). This theory suggests that viewing natural scenery and animals coincide with rejuvenation of mental resources, because viewing natural things invoke *indirect attention*, whereas visualization of urban and mechanical settings are often fatiguing because such viewing involves *directed attention* which is thought to deplete already limited attention resources (Berto, 2005; Herzog et al., 1997; Kaplan, 1995). Direct attention is actively controlled in comparison to indirect attention (effortless, passively controlled), and thus directed attention increases mental resource fatigue and depletion (Kaplan, 1995). From the ART perspective, it is believed that viewing natural stimuli – which in-of-itself is composed of inherently intriguing elements– helps engages the effortless attention systems needed for mental rejuvenation. This helps explain why office workers staring at a screen all day often feel refreshed when they are able to take an outdoor break, or why observing a sunset is often an inviting cessation of a mentally-tasking day. Stemming from this theory, we may see that participants exposed to dogs during a mentally stimulating task may experience similar rejuvenation.

Impacts of different dog-related stimuli (e.g. dog videos, dog colouring activities, dog toys, etc.) have been touched on in therapeutic situations, but typically only as an

afterthought or with focus on special populations (i.e. patients with dementia, see Marx et al., 2008). Throughout this dissertation, we will be examining the implications of ART as a conceptual framework in context of dog exposure on a variety of measures, including attention, mental resources and subjective reports of wellbeing. We also plan to evaluate the extent of exposure to a dog – and differential facets of stimuli engagement – needed to produce positive wellbeing benefits in university students.

1.3.1   Static Stimuli and Facial Preference

The way a canine looks can often affect how it is perceived, and how it affects (positively or negatively) a viewer. A major part of biological aesthetics is afforded from the faces of mammals, which is typically the first things to be viewed upon encounter (Seagroves, 2011). Early on, children learn to take notice of faces to gain valuable information about their surroundings, such as differentiating between caregivers and strangers (Seagroves, 2011). Facial analysis is key for giving insight into an individual's emotional state, personality and behavioral traits, signaling attention and intention; it is believed that facial analysis in canines is similarly helpful (Wan et al, 2012; Seagroves, 2011). Bloom and Friedman (2013) explored human ability to detect dog emotion from emotionally-induced static faces (i.e. organized behaviorally defined situations, such as a jack-in-the-box to elicit a 'surprise' reaction). Although more dog-experienced individuals were able to identify conditions that the dog might have been under while the photographs were taken, overall the majority of participants were able to confidently rate the photographs for their corresponding emotion: fear, happiness or anger (Bloom & Friedman, 2013).

In whole, preferences for certain facial features exist commonly throughout humanity, which may lead to developed stereotypes about believed traits and attributes; People are typically attracted to facial symmetry and averageness, where this averageness may denote

genetic heterozygosis (Fink & Neave, 2005). These preferences also target large eyes, full lips and facial symmetry, all suggesting youthfulness and health.

A study by Nittono and colleagues (2012) suggests that more focused attention is exerted when viewing youthful faces. Their study assessed *kawaii*, or the Japanese term for cuteness, and has drawn similar conclusions: people prefer cute images, and these images are namely defined by large eyes and large, round faces. Facial traits such as these are most linked to infantile creatures (e.g. babies, puppies). In humans, it has been examined that creatures maintaining these infantile features are in essence treated as infants themselves because participants are "automatically moved to a nurturing state by these physical features that [they] respond to them even when displayed by non-human animals" (Seagroves, 2011). Similarly, Nittono and colleagues (2012) found that when participants were presented cute images (puppies and kittens) before executive control tests (fine motor dexterity task and non-motor visual search task) in comparison to images that were perceived as less cute (adult dogs and cats), performance improved (Nittono et al., 2012). They go on to suggest that the viewing of cute, infantile images induces motivation and behavior of focused attention and caregiving, as one would for a baby. If viewing cute things make the viewer exert more caution and less force than normal, it would likely improve performance on focus-related tasks; in this respect, these images are also considered to produce positive affect and prime social engagement (Nittono et al., 2012).

Where cute images promote positive affect, focused attention and sociality, it is theoretically supported to assume that harsh, mature images would induce adverse effects. Research suggests that legal verdicts can be predicted from facial features, making defined faces more likely to be charged with intentional crimes, and babyish faces to be more likely found at fault when charged with negligence (Seagroves, 2011). Evolutionary psychologists often assume a linear relationship between attractiveness and fitness; anomalous faces tend to

denote physical ill-health (i.e. overweight and deformed individuals), therefore implementing withdrawal reactions to sustain genetic fitness and hygiene within others (i.e. ugliness is "contagious", see Zebrowitz & Montepare, 2008).

Wider-faced men have been linked to increased testosterone and aggression, though are seen as more cooperative and trustworthy than their thinner-faced counterparts (Loehr & O'Hara, 2013). A study by Haselhuhn et al. (2013) showed that social interactions between target men (i.e. fulfilling a specific facial width-to-height ratio [fWHR]) and observer based on stereotypes of said fWHR (i.e. aggression, cooperation) leads the targets to behave in ways that are expected by the observer (Haselhuhn et al., 2013).These findings could be applied to canines, where wide-faced dogs such as Pitbulls and Rottweilers are socially regarded for their aggression, but also for their protective dedication to their owners. Facing a dog that is perceived as dangerous may initiate a fear response in an observer, which in turn reinforces the intimidating behavior of the dog.

Intelligence has also been linked to physical attractiveness; studies show when rated by their peers, elementary school aged "attractive" children were perceived as being smarter than the unattractive children, supporting the "what is beautiful is good" stereotype (Seagroves, 2011). In general, attractive individuals are judged to be more outgoing, positive and open, and in addition, are accompanied by preferential treatment above less-attractive individuals in social and occupational settings (Seagroves, 2011; Zebrowitz & Montepare, 2008).This phenomenon is believed to transfer to the canine realm, where dogs that are commonly deemed to be cute and attractive are those that are friendlier and more intelligent. Although these findings could generalize to general facial preferences and distastes in humans, there is an obvious difference in the stature of dogs and humans, so a comparison within humans may not parallel dog perception completely (Seagroves, 2011). In a recent study however, research by Seagroves (2011) shows that humans tend to use facial features

(e.g. eyes and mouth) to characterize the friendliness in canines, as they would in humans. This provides grounds for the assumption that the appearance of a dog will likely affect perceptions and judgments of canine character (i.e. behavior and temperament).

1.3.2 Dynamic Stimuli

Though static images are valuable tools for interpreting physical preference, research shows significant benefits in viewing patterns of movement, or *dynamic stimuli*. These stimuli can be classified as meditated movement on an artificial device (e.g. computer screens) or movement that appears naturally (e.g. biological stimuli). The idea of biological restoration, or the healing ability of biological images, helps explain this relationship at the most basic connection between humans and dogs (Herzog et al., 1997; Berman et al., 2008; Taylor et al., 2001; Myers et al., 2004; Barton & Pretty, 2010; Berto, 2005; Kruger et al., 2004). Evidence shows simple exposure to natural places (e.g. forest, mountains) for even short periods (e.g. a lunch break) can lead to positive mental outcomes and restoration of productivity and attentional capacity, when normally faced with mentally-taxing urban environments such as harsh digital screens and other man-made accommodations (Barton & Pretty, 2010; Berto, 2005). Taylor and colleagues (2001) found that Attention Deficit Disorder (ADD) symptoms in children were more manageable after engaging in "green settings" (e.g. camping, fishing, soccer) versus engaging in activities that were not green (e.g. video games, television, paperwork). Unlike voluntary attentional activities that can be effortful and fatigue-inducing, natural environments prompt involuntary attention, allowing the attentional system to rest and recover by simply being immersed in nature (Berto, 2005).

This phenomenon is believed to transfer to biological beings as well, where physical interaction is not necessary to draw on benefits. The simple act of watching animals interact and exist has been shown to influence positive affect and induce emotions such as "wonder",

"respect" and "amazement" within the viewer (Myers et al., 2004; Berman et al., 2008). These positive reactions were observed to heighten when the animal took notice of the onlooker, like a 'connection' seemingly existed. In the context of viewing zoo animals, Myers and colleagues (2004) suggested that zoos are designed to elicit certain emotional responses from patrons, or alternatively, certain individuals who choose to attend a zoo are already predisposed with these emotional states.

The benefits drawn from watching the movement of animals again may have strong ties to the appearance or positive perceptions of the animal. Recent research by Iordan & Dolcos (2015) suggests that positive distracters have less of an impact on working memory than do negative distracters and may actually help broaden the scope of attention – by maintaining memory while still processing the distracters – during cognitive tasks. This suggests that watching positive videos during a break may actually help improve attentional resources during a task. This may hold relevance in modern society, where boring office work days are broken apart with distractions of cute animal videos, helping to provide justification that these videos are not distractors, but actually beneficial to workday performance through improved attention.

Dynamic stimulus is thought to be an important apparatus for inducing exposure to dogs, incorporating all of the benefits of static exposure, and more, without the possible negative consequences of live interaction (i.e. dog bites, fear, and uncontrolled temperament). Watching simple videos of a moving dog may induce positive effects similar to observing the live animal, which may include calming and mental rejuvenation. This notion raises the possibility for the beneficial design of dog-like displays and objects (i.e. robots) to gain similar positive responses that dogs might elicit.

1.3.3   Live Stimuli

Despite the plethora of wellbeing benefits suspected to yield from exposure to static and dynamic dog stimuli, it is most probable that physical canine-human interaction would elicit more cognitive benefits than simply viewing static or dynamic stimuli of dogs. Notably, the usage of live dogs in therapy-related situations is currently rising (Odendaal & Meintjes, 2003; Odendaal, 2000; Lefkowitz et al., 2005; Wells, 2007; Wells, 2009; Banks & Banks, 2002; Kruger et al., 2004; Flynn, 2000; Solomon, 2010). A dog may serve as a formal vessel of therapy (i.e. hospital and geriatric settings), or informally within the realms of dog ownership and relationship development.

One main incentive for investing in canine companionship is the increased social interaction that often comes with it. Not only are the dogs there to fulfill social needs as biological creatures, but they also serve as social lubricants for human-human interaction. McNicholas and Collis (2000) published a study where they labelled dogs as a natural "icebreaker" – that is, a person walking a dog is more likely to be approached by another pedestrian, in comparison to a person who does not have a dog. Being a catalyst for conversation, McNicholas and Collis (2000) wanted to examine if dogs could actually increase the social networks of their owners. Through a 10 day examination period, they found that though the same level of social interaction was maintained for friends and acquaintances of the dog owner, more "strangers" approached when in the presence of a dog; notably, and whereas non-verbal exchanges occasionally occurred for the no-dog control group (e.g. smiles, head nods), the presence of a dog encouraged spoken greetings and inquiries (McNicholas & Collis, 2000). The no-dog control group was assessed following post-test as the owner had been spotted with the dog days before, and because verbal exchanges were maintained with these "strangers", it was inferred that dogs foster continued social networks.

Just as people wish for interaction with others, they also have a need to interact with the environment (aspiration), and needs of 'environmental mastery', or sufficient psychological resources that help to cope when one experiences difficulties (competence) (Warr, 1990). Dogs, as biological creatures, can fulfill the need for this environmental mastery, and their reciprocating relationships can increase positive affect (i.e. how someone subjectively experiences joy) in humans (Warr, 1990). This positive affect has been observed to increase explicit motivation (i.e. declarative, such as goal setting, decision-making, and self-regulation) and implicit (i.e. task enjoyment and subconscious intrinsic stimuli) motivation (Wohlfarth et al., 2013). In sharing experience with dogs, people are able to develop these maintained motivations based not only on their physical cues (e.g. wagging tails, perked ears, proximal attachment) but also through believed emotional states these physical displays signify, as a wagging tail and perked ears often infer happiness, and initiates parallel response in humans (Wohlfarth et al., 2013). Warr (1990) suggests that affective wellbeing can be summarized on an axis (positives and negatives) of both arousal and pleasure; from this, it is believed that as long as the interaction with a dog is pleasurable, it will provide benefits towards overall wellbeing.

Perhaps one of the most dramatic findings concerning dog ownership and mental health is the chemical changes in the brain that happen during these episodes to promote mental health, through the release of endorphins and oxytocin during human-dog interaction (Odendaal & Meintjes, 2003). Release of endorphins has been linked to improved "motor skills, and performance-related [measures] such as better concentration on a task", whereas oxytocin aids in the reduction of stress-related factors and emotional-social bounds, such as improvement of mood and positive social interaction (Wohlfarth et al., 2013; Odendaal & Meintjes, 2003). Seagroves (2011) found that friendliness ratings of dogs tended to be based

on certain physical features (e.g. round faces, large eyes, floppy ears), which influenced the calming approachability of certain breeds.

Just as human judgments of personality and ability traits are often based on physical appearance, the same can be said for judgments of canines (Gosling et al., 2003). Physical ratings in dogs are in need of exploration, simply because mental models categorizing dog breeds seem to exist within society. Negative stigmas are attached to certain dog breeds, and because of this occurrence, it is possible the presence of these breeds might induce stress-related symptoms in a human counterpart, contrary to the intent. It is probable that a self-fulfilling prophecy occurs: dogs treated sweetly because of their appearance elicit preferred behavior, whereas those that are ignored because of their "undesirable" looks elicit cold, unfriendly behavior as they are rarely adorned by others (Zebrowitz & Montepare, 2008). Family oriented dogs tend to have a common appearance (e.g. furry, medium sized, round faces, large eyes); do people treat these 'cute' dogs with infantile care, causing the dogs to adapt to a nurturing niche, where other less attractive dogs might get less attention, and are therefore colder to the people that surround them, all the while perpetuating the stereotypes of these breeds? Maybe this distinction has led to evolutionary difference in the level of ''human-ness'' in the domestication process of dogs, or maybe the difference only resides in the collective mind of breed categorization. Still, the collective perception of breeds would foster biased interactions with certain dogs, and in turn, alter both human and dog behaviors accordingly. Noted, people have different preferences for what they perceive as attractive and previous experiences with individual dogs can determine a person's perception of the overall species (Seagroves, 2011). However, there is still an overwhelming public belief that certain dogs are not cut out for the jobs/companionship that others are, and stereotype or not, it affects the selection process of canines (CITE).

The idea of breed discrepancy supports the idea that certain dogs better serve as catalysts for positive mental effects, such as implicit motivations, security (cued by calculations and assumptions of protection) and attachment. While extensive research has been conducted to evaluate the appropriate canine breeds suitable for certain services and ability training (Wilsson, & Sundgren, 1996; Hebard, 1993), currently there is little research suggesting that wellbeing effects induced through dog exposure may not only be linked to behaviors and personality, but is actually affected by – in conjunction with, or at a higher preference – their physical appearance. The simple intrigue of dogs makes them prime living instruments in assisted therapies (Kruger et al., 2004). With that being said, is there a difference of mental benefits acquired when interacting with "cute" dogs, compared to those that have been rated with less favourability? Could the aesthetic benefits of these dogs only exist through live stimulation, or is it possible a picture or video of dogs could spark similar benefits to physical interaction? Is a positive effect from dogs breed-based, or do all dog breeds (when the interaction is positive) help to reduce stress and increase wellbeing? More comparative psychological research has been based on other intelligent exotic animals humans rarely come into contact with – such as chimpanzees and dolphins; even though dogs are very intelligent and man's closest animal companion, little research has been conducted on the impacts of their presence.

1.4   Quadrupedal Robot Developments

Though dogs are a popular commodity in the average western household, the availability and luxury of owning a live dog may be affected as the population continues to rise, and popular trends change. Just as it was once deemed "dirty" to own a dog companion in the not so distant past – and still is in some cultures (Allard, 2013) – societal opinions have the potential to shift yet again. Similarly, as technology continues to advance and societal

acceptance grows, it is expected that robotics will make their way into everyday scenarios. This is already evident from advanced technical gadgets that most modern persons are familiar with, or even possess, such as the iPhone's Siri, personal drones, self-service cash registers, and self-parking cars.

Robotics have made their way into the job sector; assembly lines are no longer a reliable means of employment (Gao et al., 2009). Currently in Pilbara, Australia, there is an iron ore mine owned by Rio Tinto mining company that is entirely run by robots, with the help of an operations control center in Perth, 1,200km away (Diss, 2015). These mining trucks are completely driverless, meaning not only are the robots fully functional to take instructions, fitted with radars, lasers and GPS systems to track and guide their every move and shut them off if something goes wrong (Chambers, 2012). This innovative mining technique can operate 24 hours a day without breaks, saving the company money, while also preventing the negative consequences of human-led mining (e.g. fatigue, injury) (Diss, 2015). Autonomous situations, such as the Rio Tinto mine, are becoming ever more prevalent as technologies advance, and as a consequence employment for manual workers is dramatically reduced while smaller numbers of skilled technical and analytical workers are required.

It is probable that robots may integrate into the therapeutic realm, be it assisting a therapist during a session or developing robot-run outpatient practices. Robotics are becoming ever more artificially intelligent, with respect to sophisticated emotional recognition and conversational reacting, appearing almost "free thinking" (Simmons et al, 2011). Virtual humans have already begun assisting elderly or disabled peoples to mitigate feelings of loneliness and create illusions of cooperation (de Rosis et al., 2005).

It isn't far-fetched to believe that a robotic dog may exist for those that wish to have the companionship of a canine, but none of the biological fallout (i.e. unpredictability, maintenance, etc.). The already existing child's toy Sony Aibo (Bartlett et al., 2004), a

robotic pet dog, has received tremendous praise from the families that own them. Similarly, the Tamagotchi craze of the 90s (i.e. having a computerized hand-held pet) highlights the societal desire of maintaining a responsible relationship with a pet (e.g. feeding, petting, attending), even if that pet is manmade. Utilizing robotic companionship, consumers may even have the ability to program the exact temperament, physical appearance and physical abilities desired.

It is important to incorporate robotics as a comparison variable within this dissertation, to assess assumptions, stereotypes and reactions from participants when presented with such stimuli. If positive effects are elicited from robots and dogs alike, this may provide insight for ergonomic specialists, when designing the robo-dog of the future.

1.5   Research Focus

The focus of this PhD will explore the effects of dogs on the psychophysiological response of humans, as well as the extent of dog involvement needed to produce such effects. In recognition of the fact that people differ in their responses to dogs, those expressing extreme aversion or phobia to dogs will not be included as participants in the experiments to be reported. In regards to natural movement, however, research has shown that the attentional restoration is not derived from affective (emotionally-related) response, but through biological response. In this respect, a dog will fulfill the natural motion stimuli needed to examine this biological restoration phenomenon. The majority of previous research has focused on the benefits of dogs in therapy related situations, specific to live interaction, rather than incorporating the involvement of aesthetics and attention restoration within these effects. Through exploration of visual modalities (e.g. static, dynamic and live), it may be found that certain modes are equally probable to produce psychological benefits as would live interaction. Further, it may be discovered that the use of dog-like stimuli can yield similar

positives to live interaction, which might be helpful for future engineering within human factors and ergonomic specialist.

The main encompassing goal of this research is to see if dogs, in comparison to other stimulus groups, may help improve wellbeing in participants. Likewise, it is important to see if participants will experience more effects of psychological wellbeing when they perceive the dog breed positively (as pre-existing stereotypes of dog breeds may influence interaction or experience). The operational measures of wellbeing for the following experiments consist of gaging stress reduction, cognitive performance and emotional functioning/compensation.

Along these lines, and among people who do not find dogs aversive, it is hypothesized that live interaction with positively rated dogs will yield the most positive mental benefits compared to other stimuli (H_1). In particular, dogs that are perceived as cute are expected to be more mentally beneficial than "unattractive dogs" (H_2). Benefits should be most evident immediately after interaction relative to during dog contact, or in similar pre-contact measures (H_3). It is also hypothesized that live dog interaction will provide more stress reduction, improve cognitive performance and facilitate social functioning (H_4, see Odendaal & Meintjes, 2003) in comparison to static pictures of canines or dynamic presentation of canines via video.

A new development of knowledge concerning the use of dogs, and the extent of their participation, is needed in developing proper regimes for canine-assisted therapies. It is in hope that knowledge gained from the proceeding studies can be applied to current therapy practices and methods, which may not only aid the realm of dog therapy, but extend into all therapies that primarily involve sight and touch.

1.5.1 Thesis Structure

The following seven chapters each report an individual published journal article, or an article that is under review or a manuscript in preparation for submission to a peer reviewed journal. All relate to the over-arching theme of the effects of dog exposure on human mental wellbeing. The following chapters are in various stages of publication: Chapters 2, 3, 4, 6 and 8 have been published, Chapter 5 has received formal feedback from reviewers, and Chapter 7 is currently being reviewed by a journal. Each chapter contains its own literature review, methodological information, analysis and conclusions. Consequently there is some unavoidable repetition of underlying theory. For the purpose of increasing readability, each chapter has been tailored to increase emphasis on the over-arching goal of the thesis, while maintaining the individual hypotheses relevant to each study.

Chapter 2 assesses the baseline perceptions people hold for dog breeds using static stimuli, and provides insight for incorporating this knowledge into the ergonomic realm of robotic dog design. Chapter 3 is designed to compare the effects of exposure to pictures of "cute" dog vs. mature dog on ability to sustain attention during a cognitively stressing task (presented predictably or not). Chapter 4 explores the effects on a sustained attention task and task induced stress with a task break that involves viewing videos of active dogs relative to other break activities

In chapters 5 - 6, the focus shifts from the effect of dogs on attention and cognition to their possible effects on emotional processing and emotional state using live dog interaction. Chapter 5 explores whether exposure to dog stimuli helps to control emotional eating during the performance of a cognitively stressing task. Chapter 6 examines whether positive interaction with a dog helps relieve the side-effects of stress, in comparison to other common therapy methods.

The last two studies compare exposure to dogs and robots (a similar but non-biological stimulus) on social functioning. Chapter 7 examines at the potential for dogs as motivators for exercise endurance, to see if exposure to a dog helps a participant sustain an isometric hold longer and relieve stress, in comparison to a robotic stimulus. Chapter 8 assesses the priming capabilities of dogs and robots (via dynamic stimuli), and their potential effect on emotional recognition in photographs.

Finally, Chapter 9 provides a brief conclusion of each experiment and a general discussion of the findings, implications and applications gathered.

These chapters will include objective measures such as task performance and physiological response, as well as subjective measures that use questionnaires and dog interaction feedback. These studies will assess the extent to which "surrogate dog stimuli" produce the beneficial effects found from encounters with real live dogs. The chapters migrate from using static exposure of dogs, to dynamic exposure, to live exposure. Only in Chapter 8 does the focus return to dynamic stimuli; this is due to the nature of the priming experiment, where it is imperative to control the exact amount of time a participant is exposed to the priming stimulus, which is nearly impossible to achieve via live stimulation.

Chapter 2

Ratings of Dog Breed Differences: Insights for Quadrupedal Robot Design

2.1 Abstract

The relationship between humans and dogs is one that is of scientific interest and dogs have attracted the attention of biomimetic roboticists, for example, Sony's Aibo. Properly designed robots may be able to elicit similar perceptions as dogs. It is important then to analyze the attitudes that people have towards dogs, in particular salient features like breed-membership. In the present paper an electronic questionnaire was developed to assess the existing mental models and categorizations of dog breeds. Participants were asked to rate representatives of 48 different dog breeds with a 7-point Likert Scale for specific behavioral traits (Energetic, Aggressive, Anxious, Affectionate, Intelligent, Obedient, Empathetic, Agile, Vocal and Protective). Based on exploratory data analysis techniques (R-factor analysis, Chain-P factor analysis and cluster analysis), four clusters of breeds were identified: Cluster 1 (Higher Drive, Useful, and Nice), Cluster 2 (Higher Drive, Useful, and not so Nice), Cluster 3 (Higher Drive, not so Useful, and not so Nice) and Cluster 4 (Lower Drive, not so Useful, and Nice). Implications for quadrupedal robot design based on pertinent existing perceptions of dog breeds and their traits are discussed.

2.2 Introduction

People have relied on dogs since early domestication, leading to the development of working, guiding and service canines (Hebard, 1993). Helton (2009) suggested the relevance of applying human factors and ergonomics knowledge and methods to the study of working dogs. This suggestion could be broadened to a general human factors investigation of the

human-dog interaction, not specific to professionally trained animals. Companion dogs (pets) are also functional members of society serving a variety of roles and uses. Companion dogs not only nurture a reciprocal attachment relationship with their owners, but also when present encourage people to exercise (Wohlfarth et al., 2013), develop social interaction (McNicholas & Collis, 2000), and provide security with regards to reducing the risk of personal crimes (e.g. break ins, personal attack) and biological pests (e.g. unwelcomed animals). Before an attempt to see how people are affected by exposure to different levels and types of dog stimuli in experimental situations, it is important to assess baseline perceptions of dog breeds from the general public, dog owners or not.

Dogs are in-of-themselves of scientific interest because they are the most morphological diverse species (Parker et al., 2010). Through artificial selection, humans have made dog breeds as distinct as the giant Great Danes and diminutive toy breeds. This leads to questions about perceived breed categorization. Findings from Duffy et al. (2008) highlight differences in dog breeds with regards to aggression towards strangers, owners and dogs. Dog owners collected from breed clubs and online samples were asked to assess an adult dog well known to them via a series of aggression questions. Results showed significant levels of reported aggression in Akitas, Siberian Huskies and Pit Bull Terriers to unfamiliar dogs, Rottweilers, Doberman Pinschers, Yorkshire Terriers and Dachshunds to stranger-directed aggression, and Chihuahuas, Jack Russell Terriers and Basset Hounds with owner-directed aggression; Golden Retrievers, Labrador Retrievers, Brittany Spaniels and Whippets were reported as the least aggressive breeds towards humans and other dogs (Duffy et al., 2008) .Similar studies have been conducted to analyze breed differences by means of perceived rated intelligence (Coren, 1995).

Even if these reported differences among breeds are only a product of social bias, and do not necessarily reflect individual dog's actual behavior, they are still of interest. When an

individual is quickly shown a Doberman pinscher, they are likely to associate aggression with the dog. Are these based on physical characteristics (see Helton, 2009) or prior associations based on social media information? Regardless, these attitudinal dispositions may influence subsequent human-dog interaction.

A better understanding of how people perceive and categorize dog breeds may be useful to human factors and ergonomics researchers for two reasons. First, dogs may be considered either as potential surrogate workers (Helton, 2009) or theoretically as kind of biological technology (organic tools). In the United States, 32% of households own at least 1 dog, resulting in an estimated 53 million dogs (Lund et al., 1999). In addition, reports estimate that US hospitals admit over 300,000 cases of dog induced injuries per year; this does not account for the overwhelming number of individuals that avoid hospital care (Duffy et al., 2008). If canines are considered as a technology, it is peculiar that such omnipresent- and somewhat risky- entities have gone unnoticed in the human factors world. People may fail to interact with dogs appropriately, just as they may fail to interact appropriately with other technologies (for example, issues like trust occur for both automation and dogs; see Billings et al., 2012).

Second, dogs are increasingly being used as models for other technologies, biomimetic robots in particular. Roboticists have begun to study the human-dog relationship, and factors that may lead to the strength and depth of this attachment bond (Billings et al., 2012). Current robots built to emulate dogs include Sony's Abio and Boston Dynamic's Big and Little Dogs (Bartlett et al., 2004). Not only are the biological movements of dogs studied to form interspecies connection, but it is also hypothesized that size and physical features may lead to human preference for certain dogs (objects) over others (Myers et al., 2004). If people harbor existing mental models or cluster-types for breeds of dogs, even if subconsciously, this may generalize to robots as well (in particular dog-like or quadrupedal

robots). Research is needed to analyze the manner in which dogs are perceived and transfer this knowledge to robotics for future development of more appropriately appearing robots. For example, the morphology of the dog (its appearance) may lead to the person's assumptions about behavior and capabilities. This may generalize to robots that appear dog-like.

In the present study, a scale to measure pertinent aspects of dogs has been developed. We employed exploratory analysis methods to address how people may be perceiving breeds of dogs. Based on previous research (Helton, 2010) we hypothesized that dogs associated with moderate size and moderate shape (medium sized/shaped dogs) were to be associated with positive attributions of intelligence or trainability.

2.3 Methods

2.3.1 Participants

Fifty-two surveys were taken from the anonymous survey link advertised through social media, via email, Facebook and University of Canterbury psychology bulletin boards; Only twenty-eight participants completed the survey in full (20 women and 8 men, 19-62 years old, M=39.1) and were included in final data analysis. No requirements needed to be met before participation, and informed consent was gathered from all, prior to gaining survey access. The study was approved by the Human Ethics Committee of University of Canterbury, HEC 2013/91/LR.

2.3.2 Materials and Procedure

The survey consisted of a 7 point Likert Scale for specific behavioral traits (Energetic, Aggressive, Anxious, Affectionate, Intelligent, Obedient, Empathetic, Agile, Vocal and Protective) corresponding with a neutral head photograph of each of the 48 dog breeds. The

images of the dogs were derived from free royalty Google Scholar images, circulated without containing copyrights of usage. Images were edited by digitally removing the background to prevent distraction, and ensured all headshots were in a front-facing position with neutral facial expressions to provide unbiased emotions or positions. Appendix A displays the photographs used for rating purposes in the survey, showing the 48 breeds used.

Basic demographic questions were present at the beginning of the survey to analyze differences in age, sex, ethnicity, education and levels of experience with dogs.

2.4 Results

2.4.1 Factor Structure

We examined the factor structure with two techniques. In the first technique we did an R-factor analysis by averaging across raters for each of the items for each dog. We then did an exploratory factor analysis using Principle Axis Factoring method using Varimax rotation on these dog level item means for the 10-items. Factors were considered based on eigenvalues greater than 1.0 and visual inspection of eigenvalue plots. In Table 1, the resulting rotated factor matrix is displayed with individual items bolded for loadings above .40. This analysis resulted in a three factor solution accounting for 90.34% of the variance.

In the second technique we performed a Chain-P factor analysis (see Nunally 1978). P-technique analysis consists of factor analysing the repeated measures from an individual; when multiple individuals are combined in the analysis this technique is called Chain-P (Baldwin 1946; Cattell et al. 1947; Molenaar 2004; Molenaar and Nesselroade 2009). The items were standardized for each participant individually for the dogs (within-subjects z-scores), and then these standardized scores were combined across participants for the analysis (chained). Factors were considered based on eigenvalues greater than 1.0 and visual

inspection of eigenvalue plots. In Table 2, the resulting rotated factor matrix is displayed with individual items bolded for loadings above .40. This factor analysis resulted in a three factor solution with 60.66% of the variance.

A qualitative comparison of the factor loadings and structures indicates relative consistency (or interpretability) across the two factor analytic techniques. One factor (Usefulness) consisting of Intelligent, Obedient, and Protective, second factor (Drive) consisting of Energetic, Anxious, Agile, and Vocal, and a third factor (Nice) consisting of Aggressive (negative loading), Affectionate, and Empathetic.

Table 1
Factor analysis using Varimax Rotation

	Factor		
Item	1	2	3
Energetic	.262	**.995**	.042
Aggressive	**.579**	.347	**-.643**
Anxious	-.305	**.827**	-.384
Affectionate	.203	-.045	**.861**
Intelligent	**.891**	.116	.356
Obedient	**.784**	-.105	**.509**
Empathetic	.269	-.156	**.926**
Agile	**.423**	**.803**	.004
Vocal	-.093	**.769**	-.164
Protective	**.922**	.075	.008

Table 2
Chain-P factor analysis

	Factor		
Item	1	2	3
Energetic	.197	**.829**	.025
Aggressive	.380	.334	**-.580**
Anxious	-.117	**.526**	-.183
Affectionate	.301	.008	**.623**
Intelligent	**.677**	.130	.301
Obedient	.321	-.039	.103
Empathetic	.264	.012	**.697**
Agile	.311	**.638**	.104
Vocal	-.001	**.494**	-.028
Protective	**.634**	.153	-.002

2.4.2 Comparison of Dogs

In order to classify the breeds into potential groupings or types we employed exploratory cluster analysis using the unit weighted 3 factors: Drive, Useful, and Nice. Because of our exploratory approach we started with hierarchical cluster analysis. We examined the resulting dendrogram to assess the plausible number of clusters amongst the breeds; based on interpretability and a suitable number of breeds in each cluster, there appeared to be four groups. We then ran a k-means cluster analysis with four clusters

(Beauchaine, & Beauchaine, 2002). As k-mean cluster analysis is considered locally optimal (meaning specific to the data analyzed; see Steinley, 2003), these resulting clusters should be considered tentative, nevertheless, they are interpretable (see Appendix A):

Cluster 1 (*Higher Drive, Useful, and Nice*): Australian Shepherd, Beagle, Border Collie, Brittany Spaniel, Cocker Spaniel, Collie, English Mastiff, Golden Retriever, Polish Scenthound, Labrador, Rhodesian Ridgeback, St. Bernard and Weimaraner.

Cluster 2 (*Higher Drive, Useful, and not so Nice*): Alaskan Malamute, Dalmatian, Doberman, German Shepherd, Husky, Karelian Bear Dog, Pit-bull, Rottweiler, Samoyed, and Shiba Inu. ,

Cluster 3 (*Higher Drive, not so Useful, and not so Nice*): American Hairless, Basenji, Boston Terrier, Boxer, Chinese Crested, Chihuahua, Dachshund, Springer Spaniel, Jack Russel Terrier, Maltese, Pomeranian, Poodle, Pug, Scottish Terrier, Shi Tzu, Welsh Corgi and Yorkshire Terrier.

Cluster 4 (*Lower Drive, not so Useful, and Nice*): Afghan Hound, Basset Hound, Chow Chow, English Bulldog, Komodor, Leonberger, Neapolitan and Shar-Pei.

2.5 Discussion

Breeds of dogs do appear to be classifiable by people on behavioral or trait dimensions, even when the ratings are of static head (face) photographs. These categories are likely influenced by pre-existing beliefs and associations of dogs; it is easily assumed that even if an individual had no prior connection to a certain breed, they would still be aware of

the stereotypes that exist for it, based on other's experiences or general morphological characteristics. Basic structures or patterns in nature (morphology) often lead to the development of templates and formulate assumptions in the human mind (mental models; see Rouse & Morris, 1986). Past experiences with structures attach to the newly developed scripts, with expectations of how they are believed to function (Rouse & Morris, 1986). These mental models include knowledge about how the script will work, and what to expect to encounter in the future. For example, if an individual was faced with a negative experience involving a Rottweiler previously, it is likely the person will recall that negative experience each time they see a new Rottweiler, even if unintended.

Sony's robot model Aibo, with canine resemblance, has been observed through children as both a robotic pet and a canine machine, most often with 'dog' used as the noun; notably, children have anthropomorphized the Aibo by proposing its 'sadness' if the owner would forget to play with it, change its batteries, and simply not giving the robot the respect it deserves (Bartlett et al., 2004). The blurring of these classification terms is of interest to human factors and ergonomics specialists, as it suggests humans can potentially view robots as biological entities, fostering connection based off of attraction and function, transforming into a trusting, sustainable relationship. Alternatively with a different model type a quadrupedal robot could be as intimidating as a Doberman or Pit-Bull Terrier.

At least based on the present results, people do appear to sort dogs into useful and less useful breeds (useful being intelligent, obedient and protective). This does suggest that one major dimension people use when classifying dogs is whether they can physically protect the person. While companion dogs (pets) are often associated with somewhat vague social benefits (improvements in social wellbeing), the reality is certain dogs (and all dogs as potential alarms) serve as potential physical guardians. Career criminals (burglars) do report that one reason they forgo certain houses as targets is the presence of dogs (Duffy et al.,

2008). Eventually if robots are allowed to occupy this functional niche, physical guardians, people will also categorize the designs on this dimension. One concern is a fairly autonomous guardian will on occasion make false alarms (note the larger number of dog bites), so roboticists will have to consider this when designing these systems. Even if not designed to be guardians, suitably sized quadruped robots may still be classified as such and this may influence people's interactions with these devices

Knowledge about the physical features of a dog would potentially make it difficult to look at a robotic dog and not transpose the qualities of the live creature onto the machine-children often automatically associate the two. With that being said, these same schemas exist differently for different dog breeds, based on physical diversity. It would not be advisable to craft a robot after a Pitbull terrier, because it could trigger the fear or respect (depending on emotive orientation) reaction that is commonly produced from seeing a live Pitbull that had no prior developed relationship with the person. The robot may then actually cause social harm by disturbing the person rather than assisting it. It is important to develop machines that are approachable, crafted in a way that users can be attracted to with regards to physical features and believed abilities/intent. Unless, of course, the intent is otherwise: e.g. to build quadrupedal robots that intimidate. Harnessing the connection people have with certain dogs would likely be a catalyst towards beneficial human-robot interaction and future development.

Chapter 3

The Effects of Warning Cues and Attention‑Capturing Stimuli
on the Sustained Attention to Response Task

3.1 Abstract

Performance on the sustained attention to response task (SART) is often characterized by a speed–accuracy trade-off, and SART performance may be influenced by strategic factors (Head & Helton, 2013). Previous research indicates a significant difference between reliable and unreliable warning cues on response times and errors (commission and omission), suggesting that SART tasks are influenced by strategic factors (Helton et al., 2011). With regards to warning stimuli, we chose to use cute images (exhibiting infantile features) during a SART, as previous literature indicates cute images cause participants to engage attention. If viewing cute things makes the viewer exert more attention than normal, then exposure to cute stimuli during the SART should improve performance if SART performance is a measure of perceptual coupling. Reliable warning cues were shown to reduce both response time and errors of commission, and increase errors of omission, relative to unreliable warning cues. Cuteness of the warning stimuli, however, had no significant effect on SART performance. These results suggest the importance of strategic factors in SART performance, not increased attention, and add to the growing literature which suggests the SART is not a good measure of sustained attention, vigilance or perceptual coupling.

3.2 Introduction

As baseline perceptions of dogs have been assessed, we should now begin to test exposure to dogs in situational settings, to see how performance and wellbeing are influenced via exposure through static, dynamic and live mechanisms. Currently, static stimuli of dog

faces will be included in a cognitively stressing vigilance task, to see if performance is influenced through exposure.

The sustained attention to response task (SART; Robertson et al., 1997) is a high Go, low No-Go task originally developed to measure lapses of sustained attention. The SART differs from more traditional tasks used to measure lapses of sustained attention, which are low Go, high No-Go tasks (Helton & Warm, 2008; Warm et al., 2008). In the SART, the primary performance metric of interest is errors of commission (failures to withhold appropriately to the No-Go stimuli), whereas the primary metric of interest in more traditionally formatted sustained attention tasks is errors of omission (failures to respond to the Go stimuli). The SART is now, however, one of the most utilized measures of sustained attention, with research examining clinical and normal populations (Bonnefond et al., 2010; Carter et al., 2013; Chan, 2001; Chan, 2002; Cheyne et al., 2009a; Dillard et al., 2014; Dockree et al., 2004; Dockree et al., 2006; Greene et al., 2009; Grier et al., 2003; Head & Helton, 2013; Head & Helton, 2014; Helton, 2010; Helton & Head, 2012; Helton et al., 2011a, b; Helton et al., 2005; Helton et al., 2010; Manly et al., 2004; O'Connell et al., 2006; Roberston & O'Connell, 2011; Shaw et al., 2013; Smallwood, 2013; Smallwood et al., 2003, 2004; Staub et al., 2014; Stevenson et al., 2011; van Schie et al., 2012; Wilson et al., 2013). Nevertheless, there remains an ongoing debate regarding whether the SART actually measures sustained attention or some other psychological processes (Helton et al., 2009). Advocates of the SART as a measure of sustained attention consider the errors of commission to be indicators of a decoupling of the conscious mind from the external task stimuli, e.g., perceptual decoupling (Smallwood, 2013). Alternatively, other researchers consider SART commission errors as more likely due to failures of response inhibition, or simply, response strategy.

The response strategy perspective of the SART is best characterized by the work of Peebles and Bothell (2004) who demonstrated that a simple adaptive control of thought—rational (ACT-R) (Anderson & Lebiere, 1998) model could characterize SART performance reasonably well. In their model of SART performance, two competing strategies are posited: The first strategy is a faster, less accurate strategy in which the participant simply makes a response once a stimulus is encoded (encode and 'click'), and the second strategy is a slower, more accurate strategy in which the participant actually checks whether the stimulus is a Go or No-Go event (encode and 'check'). As the SART requires participants to respond as quickly and accurately as they can, the participant attempts to balance these two strategies, as the first improves response time and the second improves accuracy. Because the No-Go stimuli in the SART are relatively rare, overall task performance is advantaged by the first strategy (the participant needs to respond quickly) and thus, this strategy is weighted because of the preponderance of Go stimuli. However, the participant does make errors using this strategy (inappropriate responses to the No-Go stimuli) and thus switches to the slower more careful strategy following a commission error. Indeed, the speed–accuracy trade-off (SATO) is the most defining feature of the SART (Helton et al., 2009). While advocates of the SART as a measure of sustained attention recognize the SATO occurring in the SART as well, they do not consider the SATO from a response strategy perspective, but instead see the SATO as a result of decoupled consciousness (Manly et al., 1999; Smallwood et al., 2004). This debate regarding what the SART actually measures is not merely a technical issue but has ramifications for the entire area of sustained attention given the SARTs widespread use in the literature.

One way to investigate this measurement issue is to see how inclusion of strategic warning cues impacts SART performance. In previous studies, Helton and colleagues (2011a, b) examined the impact that reliable and unreliable warning signals had on SART

performance. Response times to the Go stimuli were faster, errors of commission lower, and errors of omission higher in the reliable warning condition in comparison to the no-warning or unreliable warning control conditions. Indeed, the SATO, characterized by a sizable negative correlation between reaction times to the Go stimuli and errors of commission, was reduced by the inclusion of reliable warning cues. They interpreted this as support for a response strategy perspective of the SART, where the task is treated strategically by participants and performance is heavily influenced by strategic factors. The mere inclusion of relatively rare-occurring, perceptually salient stimuli (unreliable cues) provided no improvement to overall performance, as would be expected from the disengagement of conscious attention perspective (Robertson & O'Connell, 2011).

In the present study, we further explore how warning cues (predictive stimuli) impact SART performance. Whereas Helton and colleagues (2011a, b) used red 'x x x' stimuli, we used photographs of puppies (cute stimuli) and mature dogs (less cute stimuli) as our warning stimuli. Our choice of puppies and mature dogs as stimuli was based on previous literature suggesting there is a species wide kindchenschema or perceptual template whereby baby-like faces are likely to capture attention (Borgi et al., 2014; Golle et al., 2013). For example, in a recent study, Nittono et al., (2012) found that presentation of cute images (puppies and kittens) before executive control tests improved performance relative to images that were perceived as less cute (adult dogs and cats). Nittono and colleagues suggest that the viewing of cute (infantile) images induces focused attention. Juvenile mammals have a distinct morphology which signals their needs to adults. Indeed juvenile morphology across mammal species evokes a powerful response in people. This ability has been researched inter-species and nonhuman baby mammals (e.g., kittens and puppies) appear to evoke attention from adult humans presumably because human babies are relatively helpless and require nurturance to survive. Wynne and colleagues (2016) suggest that humans and dogs co-evolved so that dogs

are most attractive when human intervention might be most crucial to survival (at weaning age). Any mammals with these infantile features are in essence treated as human infants themselves because people are 'automatically moved to a nurturing state by these physical features that [they] respond to them even when displayed by non-human animals' (Seagroves, 2011 p.7). As prototypes of 'cuteness,' animals are seen through a hyper-cuteness lens, as they seem to require attention from people (McVeigh, 1996).

If viewing cute things makes the viewer exert more attention than normal, then exposure to cute stimuli during the SART should increase perceptual coupling during the SART. This suggests that if the SART actually measures perceptual decoupling then the mere inclusion of cuter picture stimuli should improve SART performance, relative to a SART including mature (less cute) control stimuli and definitely in comparison to non-picture versions of the SART. However, if SART performance largely reflects strategic factors, as Peebles and Bothell (2004) suggest, then performance will be improved only when the picture stimuli are reliable warning cues (predictive of No-Go stimuli); the cuteness (or attention grabbing) nature of the stimuli is irrelevant. As long as the warning stimuli are salient (identifiable) and reliable, they will be used by the participant to strategically improve task performance. Whether the inclusion of cute stimuli would enhance more traditional low-Go measures of sustained attention is not being addressed in the current work. Advocates of mindlessness or underload theories of vigilance would suggest this to be the case (Manly et al., 2004); advocates of resource or overload theories would suspect this only when the cute stimuli were themselves the target stimuli (Parasuraman et al., 2009).

3.3 Methods

3.3.1 Participants

Thirty-eight (17 male, 21 female) students, with ages ranging from 19 to 49 years (*M* = 22.9, *SD* = 4.7), were recruited from psychology courses at University of Canterbury to participate in the sustained attention to response task (SART). Students completed the experiment during a laboratory course, and were given course credit for participation. An additional three students failed to complete the task. The study was approved by the Human Ethics Committee of University of Canterbury, HEC 2013/38/LR.

3.3.2 Materials and Stimuli

There were four SARTs in total, each consisting of 162 trials each and lasting in total around 20 min. The SARTs were similar to that by Robertson et al. (1997) except that images of dogs were incorporated. Participants were required to monitor the display for number stimuli, responding to frequently occurring Go stimuli and withholding to No-Go stimuli. Go stimuli consisted of the numbers 1–9 except for 3 and had a probability of .89. No-Go stimuli consisted of the number 3 and had a probability of .11. Digits were all the same font but varied in size randomly. The font sizes were 48, 72, 94, 100 and 120, with height varying between 12 and 29 mm. In each of the SARTs, images of 18 different dogs were included. Two of the SARTs contained pictures of puppies, while the other two contained pictures of adult dogs. The predictive nature of the dog pictures also varied. In two of the SARTs, pictures were always predictive of the No-Go 3 stimulus, i.e., they warned the participant of the forthcoming presence of a No-Go stimulus. In the other two SARTs, the dog pictures occurred randomly and so had equal chance of occurring before any of the number stimuli.

Therefore, the four SARTs used were predictive puppy; non-predictive puppy; predictive adult; and non-predictive adult.

Participants were seated 50 cm in front of a computer screen (377 mm × 303 mm, 75 Hz refresh rate). Stimuli presentation and recordings of reaction times and accuracy were performed by personal computers running E-prime 2.0 software (Psychology Software Tools, Pittsburgh, PA).

Images of dogs, specifically 18 puppies (cute) and 18 adults (mature), were inserted into the SART. The facial photographs of puppies and adult dogs were centrally positioned in the frame, with no apparent emotive expressions (i.e., photographs displayed blank stares). The images were gathered from royalty-free Google images, and all backgrounds were digitally removed to ensure uniformity, as seen in Figure 3.1.

Figure 3.1. Sample of the experimental stimuli. The *top row* (a) consists of adult dogs images, while the *bottom row* (b) contains puppy images used in the Sustained Attention to Response Task trials. These photos were distributed throughout their respective trials, predictive adult, predictive puppy, unpredictive adult and unpredictive puppy.

3.3.3 Procedures

Participants were seated in a computer room at individual cubicles and instructed to turn off all cell phones, refrain from talking and remove any external distractors (e.g., watches, beverages). Participants were directed to concentrate only on the screen and to press

the 'space bar' in response to every digit besides the number 3. Participants were informed that in some trials, pictures of dogs would appear. They were not, however, told that the pictures would be predictive of the 3 stimulus, nor were they told that they would be random (unpredictive). A practice round of six trials was administered before the main trails with the screen displaying feedback as to whether they made a 'correct' response or 'incorrect' response to the target variable. The practice trials did not contain any pictures. Once everyone had successfully completed the practice trials, the researcher instructed the participants to begin the test trials.

All participants performed four SARTs, the order of which was random and counterbalanced. In the SART, number stimuli (1–9) were presented on a computer screen for 250ms, followed by an inter-stimulus interval (ISI) for 1200ms in which a mask (+) was presented. Participants were instructed to respond by pressing the 'space bar' for each number 1–9 (Go stimuli), except the number 3, (No- Go stimuli). Proportions for occurrences of Go stimuli (89 %) to No-Go stimuli (11 %) were the same for both predictive and unpredictive conditions.

In the two predictive pairing SARTs (one using puppy images, the other using mature images), all digit 3 stimuli were directly preceded by a warning photograph which was displayed for 200ms. The ISI prior to the 3 stimuli consisted of the mask (+) for 800ms, the picture for 200ms and then the mask (+) for 200ms. For all digits other than 3, the prior ISI sequence was simply the mask (+) for 1200ms. The number stimuli (1–9) were randomly presented for eighteen cycles for each SART, yielding 162 trials. Each participant had 1000ms to record a response, beginning from the onset of the number stimuli.

In the two unpredictive pairing SARTs (one using the puppy images and the other using the mature images), the pictures preceded any of the digits (including 3) with equal likelihood (i.e., the 18 photographs in that condition could appear randomly before any

number). These SART combinations again consisted of eighteen randomized cycles of the number stimuli (1–9).

3.4 Results

3.4.1 Picture SART Performance

Separate 2 (puppy vs. mature images) × 2 (predictive vs. non-predictive) × 2 (male vs. female) analyses of variances were performed on Go stimuli reaction times, percentage of errors of commission (incorrect responses to the digit 3) and percentage of errors of omission (failure to respond to Go stimuli). Participants were significantly slower in the unpredictive (M = 339.83 ms, SD = 14.55) than the predictive (M = 283.89 ms, SD = 17.22) condition, F (1, 38) = 55.91, $p < .001$, η_p^2 = .615, $M_{difference}$ = 55.9 ms, 95 % CI [41.4, 70.5]. Participants made significantly more errors of commission in unpredictive (M = 51.6 %, SD = 4.95) than predictive (M = 12.63 %, SD = 3.48) conditions, F (1, 38) = 133.31, $p < .000$, η_p^2 = .792, $M_{difference}$ = 39, 95 % CI [33, 45]. Likewise, there was a significant difference for errors of omission between predictive (M = 4.58 %, SD = 1.47) and unpredictive (M = 1.94 %, SD = .89) conditions, F (1, 38) = 20.02, $p < .000$, η_p^2 = .364, $M_{difference}$ = 2.64, 95 % CI [1.36, 3.92]. There was no main effect in any of the analyses for puppy versus mature image trials, $p > .05$, nor for differences in gender, $p > .05$, or any significant interactions. The descriptive statistics and correlations of the performance metrics for each task are presented in Table 1. The SATO is notable only in the unpredictive SARTs, where the correlations between errors of commission and reaction times were $r = -.629$, Bca 95 % CI [$-.82, -.34$] and $r = -.515$, Bca 95 % CI [$-.73, -.25$]. In the predictive SARTs, these correlations were insignificant, $r = .041$, Bca 95 % CI [$-.14, .37$] and $r = .087$, Bca 95 % CI [$-.21, .42$].

Table 1. *Descriptive statistics and correlation matrix for mean reaction times (RT), percentages of errors of commission (EC) and percentages of errors of omission (EO) among the predictive and unpredictive picture groups.*

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
Predictive Adult Mean RT	279.01	75.70											
Predictive Adult EC	11.7	14	.041										
Predictive Adult EO	5.3	7.8	-.535**	-.055									
Predictive Puppy Mean RT	288.77	74.45	.693**	-.061	-.249								
Predictive Puppy EC	13.6	16.1	-.008	.408*	-.075	.087							
Predictive Puppy EO	3.8	4.6	-.088	.325*	-.057	-.553**	.275						
Unpredictive Adult Mean RT	340.78	65.84	.795**	.016	-.312	.630**	-.009	-.020					
Unpredictive Adult EC	52.6	23.2	-.582**	.193	.192	-.478**	.384*	.267	-.629**				
Unpredictive Adult EO	1.7	2.2	-.395*	-.161	.359*	-.208	.232	.152	-.237	.360*			
Unpredictive Puppy Mean RT	338.87	60.95	.725**	.043	-.343*	.438**	.055	.078	.684**	-.592**	-.270		
Unpredictive Puppy EC	50.6	19.9	-.452**	.155	.132	-.210	.243	.193	-.335*	.546**	.131	-.515**	
Unpredictive Puppy EO	2.2	5	-.243	.182	.431**	-.071	-.064	.097	-.089	.187	.261	-.384*	.094

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed)

3.4.2 Comparison with the Original SART

In order to examine the impact of the predictive and unpredictive pictures on unmodified SART performance, data from a comparative sample which employed the unmodified SART were compared with data from the present study. The data from this unmodified original format SART were from Wilson et al. (2013). This sample consisted of 13 participants (7 men and 6 women), aged 18–45 years ($M = 26.15$, SD = 8.6) from the University of Canterbury, serving as a comparable population in terms of demographics. These participants engaged in a similar computer-based SART but without the pictorial stimuli. The number 3 was the No-Go target stimulus, as with the present study. The SART consisted of 225 trials, with number stimuli displayed on screen for 250ms, followed by a mask displayed on screen for 900ms; this is the original format of the SART (Wilson et al., 2013). We compared performance of the predictive and unpredictive SARTs directly with this control SART using unpaired t tests. In regard to errors of commission, the predictive trials from the current picture SART ($M = 12.63$ %, $SD = 3.48$) had significantly lower commission levels than the original non-picture control SART ($M = 55.00$ %, $SD = 18.00$), t (49) = 14.02, $p < .001$, $M_{difference} = -42.37$, 95 % CI [36.29, 48.44]. However, unpredictive trials of the picture SART ($M = 51.60$ %, $SD = 4.95$) were not significantly different from the non-picture original SART, t (49) = 1.07, $p > .05$, $M_{difference} = -3.4$, 95 % CI [−9.79, 2.99]. Predictive conditions in the picture SART ($M = 283.89$ms, $SD = 17.22$) had faster reaction times than the original SART ($M = 324.00$, $SD = 50.94$), t (49) = 4.26, $p < .001$, $M_{difference} = -40.11$, 95 % CI [21.18, 59.04]. Unpredictive picture SART ($M = 339.83$ ms, $SD = 14.55$) conditions were, however, not significantly different from the original SART reaction times, t (49) = 1.75, $p > .05$, $M_{difference} = 15.83$, 95 % CI [−2.38, 34.04]. Errors of omission for predictive picture SART trials ($M = 4.58$ %, $SD = 3.48$) were significantly different to errors of omission for the original SART ($M = .00$ %, $SD = 1.00$), t (49) = 4.65, $p < .001$, $M_{difference}$

= 4.58, 95 % CI [2.60, 6.56]. Interestingly, errors of omission for the unpredictive picture

SART trials (M = 1.94, SD = .89) were also significantly different from the original SART, t

(49) = 6.58, p < .001, M$_{difference}$ = 1.94, 95 % CI [1.34, 2.53].

3.4.3 Picture Stimuli

Cuteness ratings 1. Because of the failure to detect differences for the puppy and

adult dog picture stimuli, 60 additional participants (13 men and 47 women) aged 17–80

years (M = 34.51, SD = 14.97) rated the 'cuteness' of the same 18 mature dog images and 18

puppy images used previously on the SART, in an online survey. A 1–7 Likert scale was

utilized, with 1 being low and 7 being high in cuteness. Based on a paired samples t test,

puppies (M = 6.04, SD = .68) were rated more cute than adult dogs (M = 4.21, SD = 1.08), t

(59) = 14.92, p < .001, M$_{difference}$ = 1.83, 95 % CI [1.59, 2.07]. No significant differences

between males and females were found with regard to puppy and adult dog ratings, p > .05.

Cronbach's α (a measure of internal consistency) was .942, showing high inter-rater

reliability for cuteness ratings.

Cuteness ratings 2. To get a more representative demographic sample group from the

university, another 60 participants aged 18–41 (M = 24.27, SD = 4.00) consisting of 25 males

and 35 females rated the 'cuteness' of 18 mature dog images and 18 puppy images. This

survey was available only to University of Canterbury students. Participants rated the images

with a 1–7 Likert scale, with 1 being low and 7 being high in cuteness. Based on a paired

samples t test, puppies (M = 5.96, SD = .71) were rated more cute than adult dogs

(M = 4.10, SD = 1.04), t (60) = 16.05, p < .001, Mdifference = 1.76, 95 % CI [1.53, 1.97]. An

independent samples t-test showed that ratings of cuteness for puppies were significantly

different between males (M = 5.59, SD = .71) and females (M = 6.06, SD = .65), t (59) =

−2.64, $p = .01$, Mdifference $= −.46$, 95 % CI [−.81, −.11], but not the cuteness of adult dogs, $p > .05$. In addition, we asked participants directly what they typically rated cute, in regard to both puppies and adult dogs. In response, 74 % of participants said that they typically believe puppies are cuter than adult dogs ($M = 16$, $F = 24$) versus thinking that puppies and dogs are equally cute ($M = 7$, $F = 7$) or equally unattractive ($M = 0$, $F = 0$). Cronbach's α was .922, showing high inter-rater reliability for cuteness ratings.

3.5 Discussion

The use of reliable warning cues (predictive stimuli) had a dramatic impact on SART performance. When the pictorial stimuli (regardless of its cute nature) reliably predicted the onset of the No-Go stimuli, commission errors were much lower (12.6 % predictive vs. 51.6 % non-predictive). This performance advantage was also matched by an improvement in response time, whereby participants were able to respond much faster to the Go stimuli in the predictive tasks than in the non-predictive tasks. Interestingly, these performance gains in the predictive tasks coincided with an elimination of the typical SATO which is characteristic of the SART. The present findings match the expectations of the perspective of researchers who interpret the SART not as a measure of sustained attention per se, but a measure of response inhibition and response strategy (Gardiner, 1972). When there is a clear and reliable warning signal, participants use this to their strategic advantage on the task (Helton et al., 2011 a, b). The inclusion of non-predictive pictorial stimuli, whether cute or less cute, into the SART did not improve SART performance relative to a non-picture original SART format control condition. This is contrary to the expectations regarding SART performance from a mindlessness theory perspective (Manly et al., 2004), where commission errors in the SART are attributed to the lack of exogenous attention support and task monotony. From a mindlessness viewpoint, the inclusion of picture stimuli, in particular cute or attractive

pictorial stimuli, should have had a refocusing effect and improved commission errors. This, however, was clearly not the case. Accumulating evidence suggests the SART is primarily a measure of response control, not perceptual awareness, perceptual decoupling, or mindlessness induced by stimuli poverty and monotony (Head & Helton, 2013).

One finding of interest in this regard is the increase in errors of omission in the predictive SARTs relative to the non-predictive SARTs. There is a debate about what the errors of omission may be indicators of in SARTs, with some researchers suggesting complete mental disengagement (Cheyne et al., 2009b; Cheyne et al., 2011) and others suggesting they may instead be tactical rest-stops (Helton et al., 2011a, b). Given the sizeable improvements in the other SART metrics with predictive stimuli, we believe the present results would more likely indicate the errors of omission are tactical rest-stops, or *taking a breather*. In the predictive condition, the participants could respond quickly to the Go stimuli with little cost on errors of commission to the No-Go stimuli, but this is demanding and may require the occasional forced rest-stops. Other researchers have noted the paradoxical increase in errors of omission in SART condition in which the other metrics of performance are improved (Doneva & de Fockert, 2014; Helton et al., 2010). From the alternative perspective, the participants would have to be mindless and disengaged to make increased errors of omission, but this would occur in task conditions where otherwise the participants are performing better (fewer commission errors and faster reaction times to the Go stimuli). Regardless this issue of what errors of omission indicate in the SART requires further research.

Although images used as reliable warning cues yielded significant impacts on performance, there was no evidence of any impact of the inclusion of cuter images on SART performance. Our decision to use puppy images as the cute stimuli and adult mature dog images as less cute control stimuli was based on existing literature; however, we also did

follow-up studies in which participants rated the picture stimuli for cuteness. Indeed, the puppy stimuli were rated significantly cuter than the mature dog stimuli. One challenge with testing the impact of cute stimuli on SART performance may be the choice of appropriate control stimuli. Although the mature dogs may have been rated less cute than puppies, they may have still been too cute to use as a control (i.e., dogs in general may trigger a 'cuteness' paradigm). A problem, however, is that stimuli very low in cuteness may begin to elicit anxiety, and anxiety is known to influence SART performance (Robinson et al., 2013). Therefore, any effect may be due to anxiety, not cuteness per se. Our results do, however, contrast with those found by Nittono et al. (2012), who report that cuteness improved executive control performance via increased attention.

The differential results of the present study with Nittono et al.'s results may be due to cultural differences. Micro-cultures of Japan are designed around kawaii (cute) images, and they are more evident in mass media in Japan, where cuteness is used for advertising, government campaigns and pornography (McVeigh, 1996). Although the dog images were chosen based on neutrality of expression (i.e., no growling, no tongue protrusion or ears tucked back) and central positioning (e.g., not tilted), it is possible that the images of the dogs were not perceived as 'emotionally neutral' (e.g., sad eyes expression) which may have an effect on cuteness ratings and emotion-influenced SART performance, which would be important to investigate in future studies. Alternatively, the SART used in the present task may measure different processes than those in the executive control tasks (fine motor dexterity task and non-motor visual search task) used by Nittono et al. (2012). If cute images illicit heightened perceptual coupling (externally directed attention), and the SART is not a measure of perceptual coupling, then the current findings may not actually be in conflict with Nittono et al.'s. In the later studies, the improvement on task performance may have been due to heightened perceptual coupling (external awareness), whereas in the present study, the lack

of effect of the cute images on the SART may be because the SART itself is not an indicator of perceptual coupling per se, but of response strategy and inhibition.

The relationship between warning cues and SART performance suggests the importance of strategic factors in the SART. Indeed, the results of the present study add to the growing literature supporting the view that the SART is primarily a measure of response inhibition and response strategy, not sustained attention, vigilance or perceptual coupling, per se. The short length of the SART may not validly measure sustained attention, though it is probable longer trials would reduce attention further, given the repetitive nature of the SART. While no task is likely to be a pure measure of any psychological or cognitive process or function, the

SART is simply not a good measure of sustained attention, if by sustained attention one is referring to externally directed attention or awareness. The rare occurrence of the picture stimuli might have been a disservice to the cuteness manipulation within the study (particularly to the unpredictive trials) and warrants further exploration in future studies. The SART should not be used as a measure of perceptual coupling as performance on the SART is significantly influenced by other psychological processes, and most research indicates participants are fully aware of the stimuli (McAvinue et al., 2005). It is possible that the potential influence between cute stimuli and other vigilance measures warrants more exploration. For future studies, perhaps the cute stimuli should be embedded in traditional low-Go, high No-Go vigilance tasks, as these indisputably measure sustained attention. The inclusion of cute stimuli may also provide a means to further test theories of sustained attention. Advocates of mindlessness or under-load theories of vigilance might suggest simply including attractive stimuli in the vigilance task would improve performance by countering task monotony (Manly et al., 2004). However, advocates of resource or overload

theories would probably suggest cute or attractive stimuli would only be helpful if they were

themselves the target stimuli (see Parasuraman et al., 2009).

Chapter 4

Rest Improves Performance, Nature Improves Happiness:
Assessment of Break Periods on the Abbreviated Vigilance Task

4.1 Abstract

The abbreviated vigilance task can quickly generate vigilance decrements, which has been argued is due to depletion of cognitive resources needed to sustain performance. Researchers suggest inclusion of rest breaks within vigilance tasks improve overall performance (Helton & Russell, 2015; Ross et al., 2014), while different types of breaks demonstrate different effects. Some literature suggests exposure to natural movements/stimuli helps restore attention (Herzog et al., 1997; Kaplan, 1995). Participants were randomly assigned to one experimental condition: dog video breaks, robot video breaks, countdown breaks or continuous vigilance. We assessed task performance and subjective reports of stress/workload. The continuous group displayed worst performance, suggesting breaks help restore attention. The dog videos did not affect performance, however, decreased reports of distress. These results support the importance of rest breaks and acknowledge the benefit of natural stimuli for promoting wellbeing/stress relief, overall suggesting performance and wellbeing may be independent, which warrants future studies.

4.2 Introduction

As static exposure to dogs did not seem to affect inhibition performance on the Sustained Attention to Response Task, we now aim to include dynamic stimuli within a vigilance task to see if performance is affected through exposure. This builds on the previous study in two ways. First, the SART may not actually be a measure of vigilance per se, but response inhibition and motor strategy. Interestingly, cute images did not appear to improve response inhibition. Therefore, we currently employ a low Go stimuli task which is widely

accepted to assess sustained attention. Second, static images of dogs may not illicit as much processing as dynamic dog stimuli (videos).

A continuous drop in the level of signal detections over a period of sustained watch is a phenomenon known as the vigilance decrement, and has been widely addressed in literature (Helton & Russell, 2015; Langer & Eickhoff, 2012; Mackworth, 1948; Mueller & Weidemann, 2008). Performance on psychophysically challenging vigilance tasks such as the Abbreviated Vigilance task (see Temple et al., 2000) have been shown to produce a vigilance decrement quickly and reliably, in less than 5 minutes (Helton & Russell, 2013).

A widely held view of the vigilance decrement is the resource depletion account in which the performance decrement is attributed to the depletion of resources necessary for task performance (Ariga & Lieras, 2011; Hancock & Warm, 1989; Mackworth, 1948). The resource theory account has been criticized (Navon, 1984). For example, one criticism of the resource theory perspective is the lack of an understanding regarding the biological or physical resources necessary for maintaining vigilance (Kurzban et al., 2013). The basis of this criticism is increasingly being investigated, where many researchers have noted a relationship between vigilance performance and cerebral blood flow (CBF) in the anterior cingulate cortex and prefrontal cortex (Lim et al., 2010; Smith & Jonides, 1995). Activation in the prefrontal cortex has also been linked with working memory demands (Smith & Jonides, 1995). An overlap in working memory and sustained attention cognitive resources is plausible (Parasuraman, 1979; Helton & Russell, 2011; 2013; 2015; Wickens, 2008). Researchers have paired vigilance tasks with visio-spatial and verbal memory tasks and have suggested some domain specific sharing of resources between working memory tasks and vigilance tasks (Caggiano & Parasuraman, 2004; Helton & Russell, 2011; 2013). While a complete understanding of the actual physical basis of resource depletion is illusive, quality

work is advancing in this area and with improvements in brain imaging technologies this issue is proving tractable.

Many of the other current criticisms of resource theory may, however, be due to a lack of understanding regarding the resource theory account itself. The first issue is resource allocation. No resource theory perspective would be complete without taking into consideration the allocation as well as supply of resources. Resource theory does not preclude misallocation or reallocation of resources during a detection task. The depletion account of the decrement does assume that once a person has decided to allocate resources to the task that the decrement in performance is most likely due to the depletion of the necessary resources, not misallocation per se. But a resource theory perspective does not preclude the possibility that the misallocation or reallocation of resources during vigilance could be a cause of impaired performance (Helton & Warm, 2008; Ossowski, Malinen & Helton, 2011).

More fundamentally, another confusion regarding the resource theory account is that the resources necessary for maintaining vigilance performance are renewable resources not non-renewable resources. The resources necessary to maintain vigilance do self-recover, if the system is allowed to rest. Critiques of the resource theory account appear to occasionally make the mistake of not taking into consideration the renewable nature of cognitive resources, and thus, the actual shape of the vigilance decrement (Thomson, Besner, & Smilek, 2015; Thomson, Smilek, & Besner, 2015), which is not usually truly linear despite simplifications for analyses of the decrement function. Performance changes over time are often characterized by a decelerating linear trend to an asymptote if examined closely (Dukas & Clark, 1995; Mackworth, 1948; Parasuraman, 1979), although simpler linear trends are often used to describe the decrement in order to facilitate data analysis (Helton & Warm, 2008; Helton, Shaw, Warm, Matthews, & Hancock, 2008; Langner, Willmes, Chatterjee, Eickhoff, & Sturm, 2010; Thomson, Smilek, & Besner, 2015). The decelerating trend occurs

because the rate of resource expenditure for a vigilance task eventually matches the rate of replenishment of those resources, thus reaching what may appear to be a steady performance state. This does, however, provide another means to further explore the resource theory perspective: the inclusion of rest-breaks.

Vigilance performance recovers with rest breaks (Ross, Russell & Helton, 2014). In a recent study, for example, by Helton and Russell (2015) participants performed significantly better in a vigilance task after experiencing a rest break, in comparison to a continuous vigilance condition. They also found that a switch of task to a verbal memory, spatial memory or alphanumeric vigilance task during the break elicited results superior to a continuous vigil, but did not improve performance as well as a passive rest break. This suggests that a complete break from task related processing may provide essential time for cognitive resources required for maintaining vigilance to recover. Examining the impact different breaks have on vigilance performance may help resolve the nature of the resources required.

Different types of breaks may have different impacts on vigilance performance recovery. One body of research suggests, for example, that natural scenes and biological movement are beneficial towards attention restoration (Herzog et al., 1997; Kaplan, 1995). This theoretical perspective is commonly known as the Attentional Restoration Theory (ART; Kaplan, 1995). Within the ART, direct (actively controlled) attention and effortless (passively controlled) attention are considered distinct systems, with only the former subject to fatigue and depletion, labelled direct attention fatigue (Kaplan, 1995). From this perspective one way to facilitate the recovery of actively controlled attention resources, the kind presumably necessary for maintaining vigilance, is to engage the effortless attention system with natural scenes and natural movement (animals), even using still pictures or video (Atchly & Atchly, 2012; Berto, 2005; Herzog et al., 1997). Other researchers express some

scepticism of the attentional benefits of natural stimuli and believe instead that exposure to natural stimuli increases self-esteem and mood, improving how one subjectively feels (Barton & Pretty, 2010; Myers et al., 2004). From this perspective, though performance may not increase, people may report feeling better when exposed to natural as to non-natural stimuli (Wells, 2005). Research by Wells (2005) suggests that exposure to videos of animals, for example, significantly lowers levels of heart rate and blood pressure when compared to videos of humans and random motion, and is believed to help buffer viewers from short-term anxiety during a cognitive stressor. From this latter perspective, exposure during a break may not improve vigilance performance better than other breaks, but may make people report feeling better after the vigil. If this were the case, it may help researchers dissociate the subjective reports of distress during vigils from the psychophysically induced decrement in performance. The relationship between reports of vigilance tasks being boring and subjectively unpleasant and the changes in vigilance performance (the decrement) may not be as tight as some resource theory critics suggest (Kurzban, Duckworth, Kable, & Myers, 2013; Thomson, Besner & Smilek, 2015).

In the current experiment, we examined the performance effects of breaks on vigilance performance. Participants were assigned at random to one of four vigilance conditions. In the control condition, participants performed the vigilance task continuously without breaks or interruptions. In the experimental conditions, the vigilance task was periodically interrupted with a break consisting of completely passive breaks, videos of dogs, or videos of robots. The inclusion of dog videos during a rest period in vigilance, compared to robot videos, a passive countdown and a continuous vigil was therefore examined. Based on a resource theory perspective we hypothesized that breaks – all breaks that do not make use of the same resources for the task – to be equally beneficial for performance recovery. If in addition the ART perspective is correct, then we hypothesized that the dog stimuli will

provide additional recovery of performance when compared to the robot video or even the completely passive break. In addition, we measured participants' self-reported stress state. Aside from performance, we expected the natural stimuli (dog video) to make people feel better. Considering vigilance tasks are usually subjectively unpleasant, any intervention which can nullify these negative feelings may be beneficial, even if there are no real advantages regarding performance.

4.3 Methods

4.3.1 Participants

101 university students from the University of Canterbury, (57 women and 44 men) ranging in age between 18 and 51 years (M=24.26 years, SD= 6.74) participated in the study. Students completed the experiment as part of a laboratory elective, and were given course credit for participation. The study was approved by the Human Ethics Committee of University of Canterbury, HEC 2013/38/LR.

4.3.2 Materials and Stimuli

Videos. For the experiment, three video clips were inserted into the vigilance task in two of the experimental conditions. In one experimental condition the videos were of dogs, and in the other experimental condition the videos were of robots. For both dogs and robots conditions, each contained a video of the agent (dog or robot) rolling on the ground, a video of the agent *playing* with a ball, and a video of the agent in a social setting, as displayed in Figure 4.1. This design was created so that the environments remained similar, while the agents (dog and robots) were the only thing differing between video sets. The video clips of robots and dogs were attained from Youtube, a non-restricted public domain for videos. Each clip lasted approximately 45 seconds.
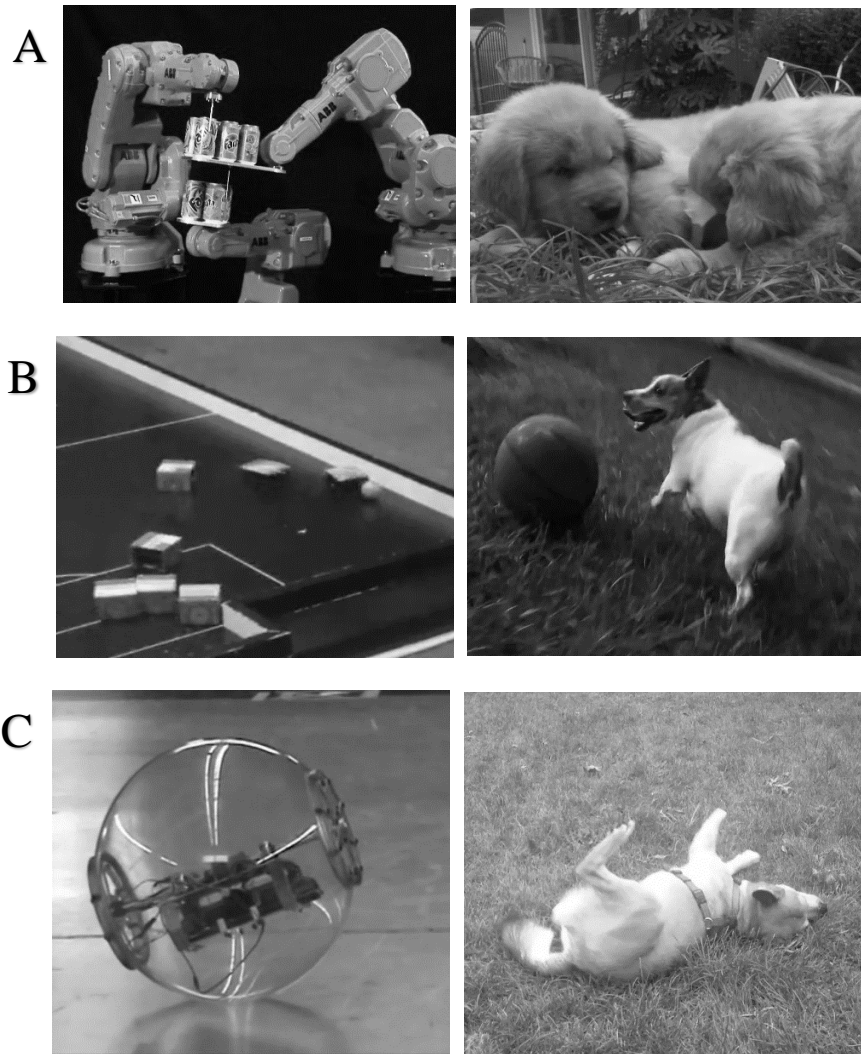
Figure 4.1. Video stills of the dogs and robots being social with like-agents (A), playing with a ball (B) and rolling (C).

Short Task Relevant Evaluation of Stress State. The 17-item short task relevant

evaluation of stress state (STRESS) questionnaire is a simplified questionnaire based on the

Dundee Stress State Questionnaire (DSSQ; Matthews et al., 2002). It provides a

multidimensional assessment of stress, fatigue and arousal states. A 9-point Likert scale was employed, where 1=never/not at all, and 9=always/ extremely. In addition, we included a modified version of the NASA-TLX (Hart & Staveland, 1988) a widely used measure of task workload. The inclusion criteria of the questionnaires will later be described in detail in the results section.

4.3.3 Procedures

The experiment was conducted in a computer laboratory with individual divided workstations. Participants were seated at eye-level to the computer screens, approximately 50cm in front of a 24 x 32cm screen (75 Hz refresh rate). When participants arrived, they were briefed on the experiment, informed regarding the nature of the vigilance task and asked to sign a consent form if they agreed to the terms of the study. Following consent, participants were asked to remove watches and turn off all electronic devices.

The abbreviated vigilance task requires attentive watch of an 8 x 6 mm light-grey capital letter ('O', 'D' or backwards 'D'), displayed in Avant Garde font, and were exposed for 50ms on a visual mask made up of unfilled black circles on a white background(Temple et al., 2000). The dot mask was then displayed for 1100ms between each letter presentation. Participants were instructed to respond (e.g. press the space bar) each time the letter 'O' appeared onscreen. The target stimuli ('O') occurred with a probability of $p=.20$ for each period of watch, while the non-target stimuli ('D', backwards 'D') occurred $p=.40$, each. The vigilance task was divided into 4 periods of watch, each lasting approximately 2 min.

Participants were randomly assigned to one of four conditions. A X^2 test was used to test for possible differences in gender representation across the conditions, yielding no significant difference, $p > .05$. Participants engaged in 6 practice trials and were given feedback as to whether they responded to the target stimuli ('O') and withheld for the other

letters correctly or incorrectly. The practice trials were employed to familiarize the participants with the task, not to screen for performance. After the practice trials, a reminder to respond only to the 'O' was displayed onscreen, and the test trials were displayed.

Conditions 1 and 2 were presented with either three dog or three robot videos every 2 minutes within the vigilance trials, with videos lasting 45 seconds; Group 1 was exposed to the dog video clips during the trials, while Group 2 was exposed to the robot clips.

Condition 3 paralleled the design of Group 1 and 2, but differed through presentation of a visual countdown in place of the video stimuli. The countdown lasted for 45 seconds as well, displaying numbers 45-1 (counting down) for a second in black Avant Garde font on a white background.

Condition 4 was a continuous vigilance without-breaks control group.

In total, the vigilance tasks lasted 8mins, while included video and countdown stimuli brought the total experiment to 10mins 15s, followed by the STRESS questionnaire.

4.4 Results

4.4.1 Correct Detections (hits)

The percentage of correct detections (hits) and false alarm rates for each participant were recorded pre-interruption and post-interruption. These proportions were not Arcsin transformed for the analyses as the transformation did not alter the Kolmogrov-Smirnov or Shapiro Wilk tests for departures from a normal distribution (which were significant post-transformation, $p < .05$) and the Arcsin transformation is likely to cause distortions in interpretations of the results, especially for trend analyzes (Studebaker, 1985; Warton & Hui, 2011).Moreover, the analysis of variance is considered robust to departures from normality (Keselman, Lix, & Keselman, 1996).

Therefore, we performed a four (experimental condition) x four (periods of watch) split-plot analysis of variance on the untransformed proportions of hits with pre-planned linear and quadratic orthogonal polynomial contrasts for all periods of watch effects and interactions. For all repeated measures tests for the omnibus analyzes departures from the sphericity assumption were tested with the Mauchly's test and corrected with the Huynh-Feldt correction, but are only reported corrected if both the Mauchly's test was significant and the correction made a substantive difference. The primary focus for the repeated-measures analysis was the preplanned orthogonal polynomial contrasts and as these are single degree of freedom contrasts the sphericity assumption is not an issue. For the omnibus ANOVA, there was a significant main effect for periods of watch, $F(3,297) = 3.85$, $p = .010$, $\eta_p^2 = .037$, and a significant period of watch by experimental condition interaction, $F(3, 297) = 2.12$, $p = .028$, $\eta_p^2 = .060$, however, there was no significant main effect for experimental condition, $F(3, 99) = 1.27$, $p = .289$, $\eta_p^2 = .037$. There was a significant linear contrast for periods of watch, $F(1, 99) = 5.89$, $p = .017$, $\eta_p^2 = .056$, and a significant quadratic contrast for the period of watch by experimental group interaction, $F(3, 99) = 4.10$, $p = .009$, $\eta_p^2 = .111$. The experimental condition by periods of watch interaction is displayed in Figure 4.2. These results were followed up with separate trend analyzes for periods of watch for each experimental condition. Only the continuous experimental condition had a significant periods effect, $F(3, 22) = 6.05$, $p = .001$, $\eta_p^2 = .216$, with both significant linear, $F(1, 22) = 7.66$, $p = .011$, $\eta_p^2 = .257$ and quadratic trends, $F(1, 22) = 8.66$, $p = .008$, $\eta_p^2 = .283$. For all other conditions there were no significant period effects or linear or quadratic contrasts for periods of watch, $p > .05$.
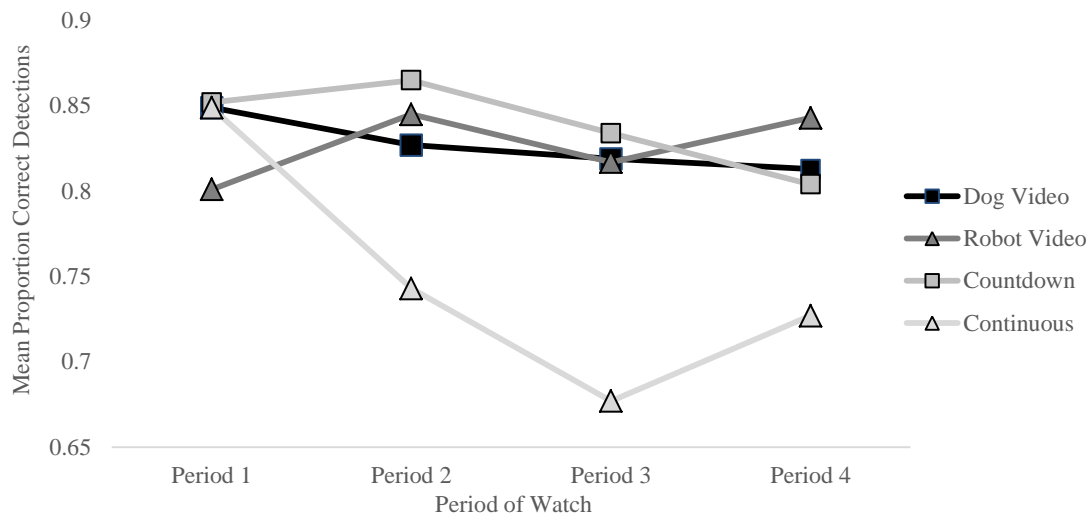
Figure 4.2. Correct detection interaction between experimental conditions and periods of watch

4.4.2 False Alarms

Mean proportion of false alarms were calculated for each period for each participant. Although false alarms are typically low with the Abbreviated Vigilance Task, we performed a similar analysis on the proportion of false alarms as we did on the proportions of correct detections. There was a significant main effect for periods of watch, $F(3, 103) = 11.45$, $p < .001$, $\eta_p^2 = .104$, but there was neither a significant interaction $F(9, 103) = .585$, $p = .809$, $\eta_p^2 = .017$, nor a significant main effect for experimental conditions, $F(3, 103) = .960$, $p = .415$, $\eta_p^2 =. 028$. There was a significant linear contrast for the periods of watch, $F(1, 103) = 16.96$, $p < .001$, $\eta_p^2 = .146$. This is displayed in Figure 4.3.
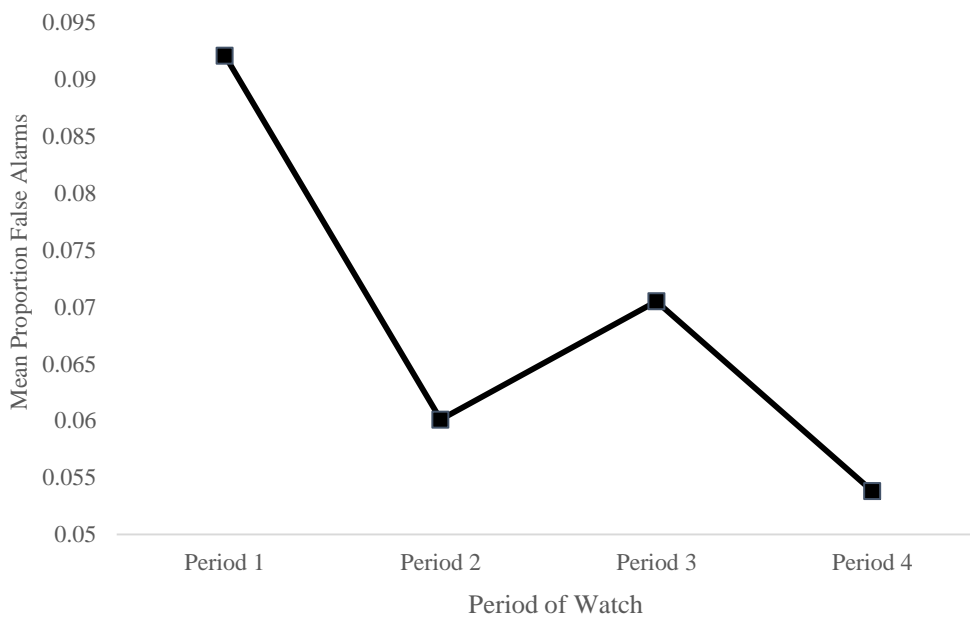
Figure 4.3. False alarm interaction for linear trend in collapsed experimental conditions and periods of watch

4.4.3 Sensitivity

Given the elevated levels of false alarms noted in this study and the unpredicted change in false alarms over periods of watch (which are atypical for the Abbreviated Vigilance Task), we calculated the signal detection theory metric A (a corrected version of A', see Zhang & Mueller, 2005) for each participant for each period of watch. A, like A', is a signal detection metric of sensitivity (ability to discriminate the target from neutral stimuli) (Macmillan & Creelman, 2005) and has been used in previous vigilance research (Donald, Donald & Thatcher, 2015). We then conducted the same analysis as we did for the hit and false alarm data on A. For the omnibus ANOVA, there was a significant period of watch by experimental condition interaction, $F (9, 99) = 1.96$, $p = .044$, $\eta_p^2 = .056$, which is displayed in Figure 4.4. Again, only the continuous group showed a significant period effect, $F (3, 20) = 4.05$, $p = .021$, $\eta_p^2 = .378$, also showing a significant quadratic trend, $F (1, 22) = 5.26$, $p = .032$, $\eta_p^2 = .193$, while all other conditional period effects remained insignificant, $p > .05$.
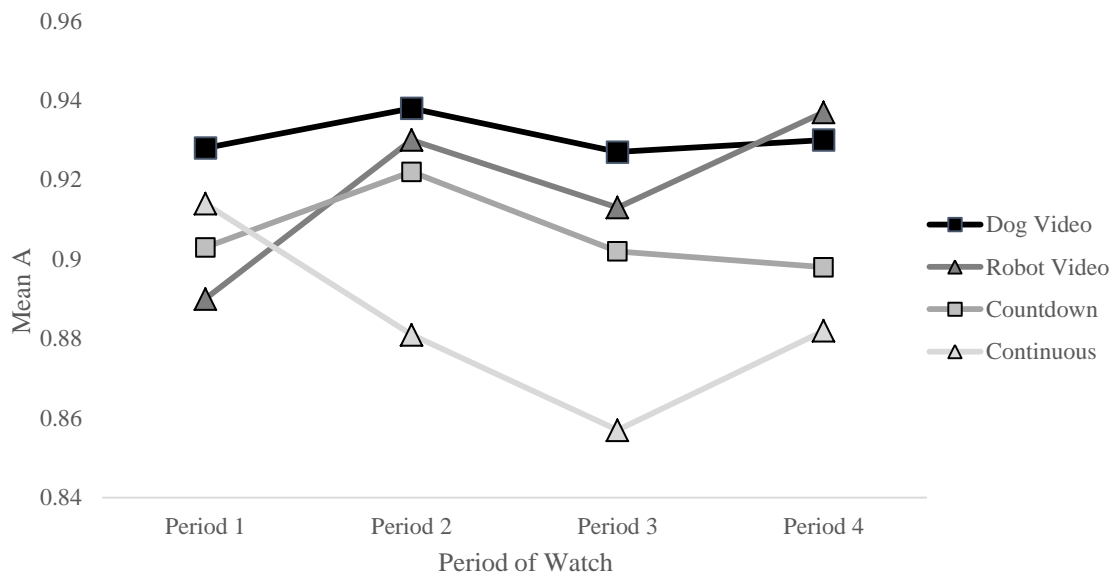
Figure 4.4. A interaction between experimental conditions (group) and periods of watch

4.4.4 Workload

The items of the modified NASA-TLX, rated on a 1 to 9 scale, were averaged to calculate a total workload score for each individual. These averages were then treated with an ANOVA to test for statistically significant condition differences. There was no significant condition main effect, $F(3, 99) = 1.19$, $p = .317$, $\eta_p^2 = .035$. The mean workload scores for the four conditions with 95% confidence intervals are displayed in Figure 4.5.
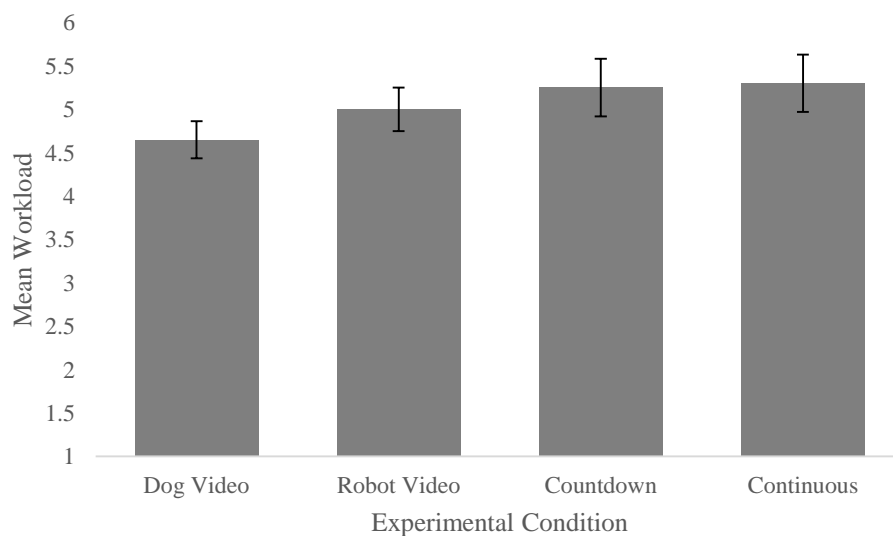
Figure 4.5. Mean Workload reports for the experimental conditions, with 95% CI error bars

4.4.5 Short Task-Relevant Evaluation of Stress State (STRESS)

A principal axis factor analysis (Varimax rotation) was conducted on the subjective stress state items (Nunnally, 1978). In this analysis, the following criteria were used to determine factor structure: eigenvectors greater than 1, an examination of the Scree plot, and interpretability. Presented in Table 1 is the resultant rotated matrix. The analysis resulted in a two-component solution, Spent and Task-Focus, which collectively explained 54.0% of the variance. Selection for retention of items was based on a component loading > .4 (Nunnally, 1978). Items loading negatively onto a component were reversed scored and the component scores were created by then averaging the remaining items. The factor comprised of Mental Fatigue, Tense, Unhappy, and Confidence (reverse-scored) was labelled Spent (a subjective indicator of feeling tense and tired), and the factor comprised of Motivation, Concentration, Task Interest, Task Related Thoughts, and Task Unrelated Thoughts (reverse-scored) was labelled Focus. The two factors were then analyzed with two ANOVAs for condition differences. For Spent there was a significant condition difference, $F(3, 99) = 5.56$, $p = .001$, $\eta_p^2 = .144$; however, for Focus there was no significant condition difference, $F(3, 99) = 1.05$, $p = .372$, $\eta_p^2 = .031$, as seen in Figure 4.6. The Spent and Focus factor scores are displayed in Table 4.1. Item level comparisons for the Spent Factor are displayed in Figure 4.7 with 95% confidence intervals (Cumming, 2012).
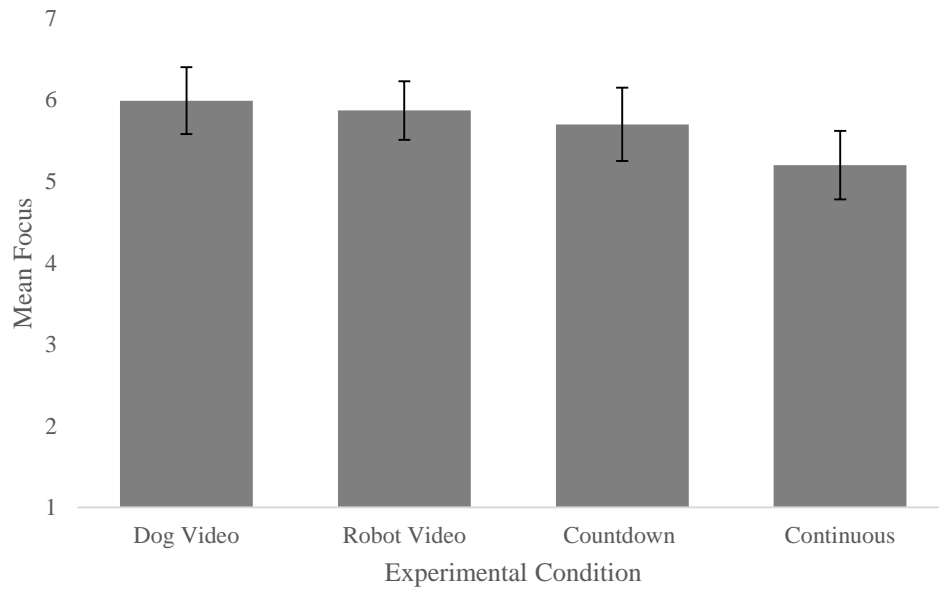
Figure 4.6. Mean Focus reports for the experimental conditions, with 95% CI error bars

Table 4.1. *Rotated factor loadings for Focus (1) and Spent (2)*

	Factor	
Items	1	2
Mental Fatigue	.008	**.707**
Tense	.106	**.846**
Unhappy	-.223	**.640**
Motivation	**.675**	-.021
Task Interest	**.451**	-.182
Concentration	**.883**	-.138
Confidence	.310	**-.429**
Task Related Thoughts	**.425**	.076
Task Unrelated Thoughts	**-.485**	.110
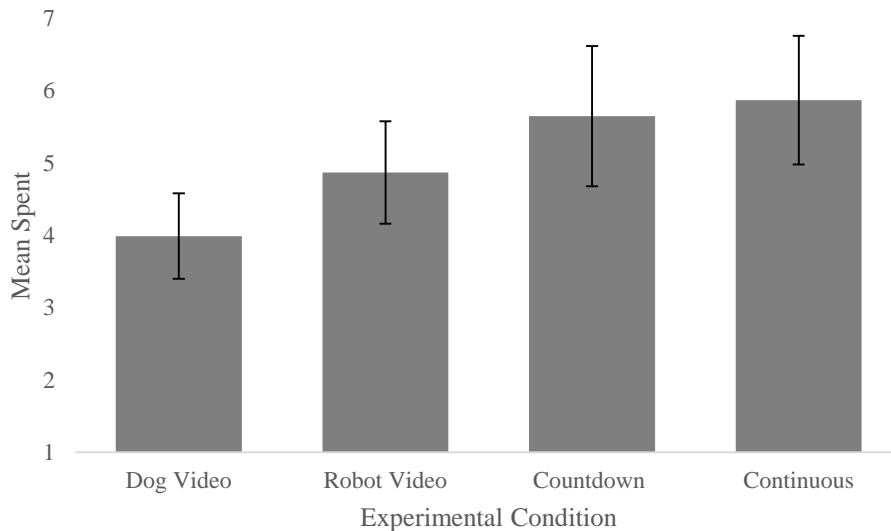
Figure 4.7. Mean Spent reports for the experimental conditions, with 95% CI error bars

4.5 Discussion

The lower performance levels of only the continuous group shows the demanding nature of the vigilance task. Without breaks there is a clear vigilance decrement. These findings are consistent with other research on the impact of breaks on the vigilance decrement (Ariga & Lieras, 2011; Helton & Russell, 2015; Ross, Russell & Helton, 2014). Breaks do appear to allow performance recovery. However, in regards to the other groups there were no significant differences between them in regards to performance. There is no evidence that natural dog stimuli (being biological agents) improved performance in comparison to artificial robot stimuli or a countdown, contrary to expectations based on attentional restoration theory (ART). Other researchers have pointed out limitations of ART in explaining performance. However, there are two possible issues regarding the test of ART in the present experiment. First, a proper test of ART may require more realistic natural stimuli to elicit a recovery response. Videos of dogs playing are still artificial stimuli and are not the same presumably as immersion in actual natural settings or direction interaction with biological agents. While videos allow increased experimental control, they may not be natural

enough to enable attention restoration to the same extent as truly natural stimuli. Second, performance subsequent to breaks may have been too high overall to enable a difference between the experimental conditions to be detectable. Basically, performance may have been at a ceiling level because of breaks. Thus, different breaks may not have been able to elicit different levels of recovery. Performance was not, however, perfect (percent hits for example were below 90%), suggesting the lack of condition differences was due to ceiling effects.

Regardless, we did find that people exposed to the dog videos during the vigilance breaks reported feeling better than those exposed to robot videos, countdowns or continuous vigilance. This is important not only because vigilance is difficult, but it is also mentally stressful for participants (Hancock, 2013; Szalma, Schmidt, Teo, & Hancock, 2014). It is interesting that there is a dissociation between subjective reports of Spent (feeling bad) and performance, and although dog videos do not improve performance notably, they do make people report feeling better. This suggests that feeling bad and performance can be separated in a vigil (if breaks are included, see Head & Helton, 2014). Future studies are needed to examine this potential dissociation.

Being exposed to a break in vigilance with natural or living images may be helpful in dealing with the stressful side of vigilance, but improved performance on a vigilance task may be best through a complete rest (Helton & Russell, 2015). Therefore, the best rest may be one that both allows the resources necessary for vigilance to recover, but also makes the participant feel subjectively better.

As technology advances, what was once viewed as machine may have gained biomimetic identities, such as ones crafted to reflect human or animal qualities and appearances (Bartlett et al., 2004), thereby influencing the perception of attraction to the stimuli, be it cute or interesting in nature. This may explain why there was not a significant difference on performance between participants exposed to robot videos or dog videos;

however, it does not explain why there was no difference between the passive countdowns versus the video breaks. Rather than restoring attention, the emotive aspect of nature watching is in need of further research as well. Again while vigilance tasks are hard to perform, they are also stressful. Anything mitigating the stress which does not impair performance itself is worth further examination (Szalma, 2014). Indeed some authors have suggested a hedonomic design approach (Fiore, Phillips, & Sellers, 2014).

The present findings regarding the recovery benefits of breaks are in line with expectations from a resource depletion perspective of the vigilance decrement. These performance findings may be explicable from alternative perspectives of the vigilance decrement; however, in regard to some current alternative theories of the vigilance decrement these findings may be harder to interpret than from a resource depletion perspective. For example, in regards to the goal habituation theory, there was no externally forced goal switch during the breaks. Individuals may automatically switch to internal goals during any break and this is plausible, but there were no significant differences in self-reports of task-focus. People did not report noticing improved subjective task focus due to breaks. Regarding alternative models of the decrement in which the decrement is directly attributed to subjective boredom, the fact that there were no significant differences in self-reports of task-focus may be challenging. Breaks improved performance, but did not significantly alter reports of task-focus. In addition, dog videos in particular resulted in improvements in subjective reports of feeling spent or distressed (tense and tired). If boredom is an affective state and the decrement was caused by this aversive affective state, then it is somewhat peculiar that the dog videos resulted in a relative improvement in affective state (feeling tense, unhappy, unconfident and fatigued), but no significant relative improvement in the decrement. Indeed the dissociation here between feelings of distress and performance is perhaps challenging to

theories which suggest a tighter coupling between feeling bad (presumably, boredom is bad) and the vigilance decrement.

4.5.1 Conclusion

This study has potential for practical application, such as taking a break at the workplace to watch animal videos on Youtube; although it may have the same effect on productivity as a complete break, the advantage is that a nature-laden break may aid human wellbeing by improving morale for the duration of the workday. Depending on the work environment, it may also be beneficial to facilitate pet friendly work environments. Many psychologists bring their pets to their practices, which helps establish the area as a safe environment for clients, thereby facilitating communication and interaction between client and therapist (Kruger et al., 2004; Rochberg-Halton, 1985). Animals are increasingly also being used as direct objects of therapy, where their presence often represents companionship and stability to patients (Banks & Banks, 2002; Flynn, 2000). Interestingly, Google has a pet friendly campus – for those that are friendly and toilet trained – and they are considerably one of the most productive companies on the planet (Kuntze & Matulich, 2010). It is possible that incorporating animal stimuli within the workplace will become a future movement, while more professionals are being educated on the benefits of animal-assisted interventions.

Chapter 5

Emotional Eating during a Vigilance Task: Dog Exposure promotes Wellbeing

5.1 Abstract

The abbreviated vigilance task is known to quickly and reliably induce cognitive stress, as well as a decline in performance known as the vigilance decrement (Helton & Russell, 2015; Temple et al., 2000). Recent literature shows that breaks in the vigilance task provide relief, and may reverse the decrement (Hancock & Warm, 1989). Finkbeiner et al. (2016) found that when participants are exposed to a break including videos of dogs, not only is the decrement reduced similarly to other breaks, but subjective reports of stress are decreased in comparison to other breaks. This suggests dissociation between stress and performance. However, there is still a debate as to whether boredom during the vigil decreases performance. The current experiment aimed to assess this, by measuring chocolate consumption for emotional eaters as a behavioral measure of boredom. We hypothesize that interruption of a stressful task with a time-out period involving friendly interaction with a dog will reduce excessive snacking more than control and comparable time-out activities, but there will not be a differential impact on performance. Seventy participants completed two sessions of the abbreviated vigilance task wearing a Galvanic Skin Response (GSR) module, after being told they were able to eat as much or as little chocolate as they desired (with the ability to request more if needed) during the task. The two sessions were separated by an 8 minute break during which different groups either interacted with a live dog, watched a dog video, or watched a digital countdown that presented the break duration remaining. An additional group continued the vigilance task without a break (control). It was found that task breaks helped to improve performance on the vigil, and those that engaged in dog petting during the break ate less chocolate compared to the other conditions, while those in the countdown condition consumed the most chocolate.

Additionally, overall stress levels were highest in the no break (continuous) group. These results suggest that exposure to dog stimuli may reduce stress or boredom-induced eating. More research is needed to address the dissociation between stress levels and performance in vigilance and monitoring tasks.

5.2 Introduction

So far throughout this research, the focus has been on static and dynamic stimuli of dogs, perceptions of such and how they influence cognitive performance (on vigilance and response inhibition tasks). Currently, the next logical step is to utilize live dog stimuli to see how performance is influenced on a vigilance task. Additionally, we will see how live dog stimuli might affect emotional eaters during a cognitively stressing situation.

The abbreviated vigilance task (Temple et al., 2000) has repeatedly been found to quickly and reliably induce stress in the absence of threat of psychophysiological risk (e.g. Helton & Russell, 2015; Temple et al., 2000). Many researchers have reported that the abbreviated vigilance task not only induces stress but is also associated with a quick onset of lapses in sustained attention that are revealed by a decline in the ability to detect rare target signals. This fall off in target detection with time on task is known as the *vigilance decrement*; this decrement has been extensively studied, and many researchers believe decline in performance is due to depleting cognitive resources needed to sustain attention during the vigil (Hancock & Warm, 1989; Helton & Russell, 2015; Mackworth, 1948). This perspective is known as resource theory (or over-load theory, see Hancock & Warm, 1989). However, there is some debate regarding whether the decrement is indeed due to loss of cognitive resources, or instead due to the monotonous nature of the task, which is thought to cause boredom in participants (Hancock & Warm, 1989; Langner & Eickhoff, 2010). The

subjective state of boredom then results in the disengagement of attention to the task. This alternative perspective is often referred to as the under-load theory.

In recent research, interruption of the abbreviated vigilance task by different kinds of break activities has been found to have differential impacts on subsequent performance. The positive or negative impact of interruption tasks on subsequent vigilance performance depends on the distracting nature of the interruption task and degree of specific resource overlap between the vigilance and break activities (Finkbeiner et al., 2014; Finkbeiner et al., 2016; Helton & Russell, 2015; Ossowski et al., 2011). The consensus seems to be that a complete rest is most beneficial to resource recovery and thus increased performance post-rest, but different types of breaks have been shown to influence subjective reports of participants. Finkbeiner et al. (2016) found that inclusion of a rest break of any kind (complete rest, dog video or countdown video) was able to reduce the vigilance decrement in comparison to performing a continuous vigil (a vigil without a break). However, participants in the dog video condition reported less stress and higher positive affect after the vigil than participants in the other conditions. This suggests that stress and performance may be somewhat independent in vigilance. You can improve self-reports of affective state without further improvements in performance. Indeed participants performing a vigilance task with a rest break perform better than participants without a rest break, but not report feeling better than those performing a vigil without a break. Generally, people report feeling bad after a vigil (tense, unhappy, etc.). Alternatively a rest break involving the watching dog videos may result in both improved performance compared to no rest, but also self-reports indicative of more positive affective state.

Additionally, there is research that suggests exposure to natural stimuli, like animals, may help promote attention (Berto, 2005; Kaplan, 1995), which is essential for vigilance tasks. Dogs specifically have been found to increase attention during cognitive tasks and

reduce levels of stress; these effects may vary based on cuteness ratings or temperament/calming nature, and level of exposure (static, dynamic or live) (Finkbeiner et al., 2014; Nittono et al., 2011; Wells, 2005). Nevertheless, dogs have been found to help fill our needs for social connectedness thereby increasing our happy-inducing hormones (Yuhas, 2015). While dog videos have been included as task interruption breaks during vigilance trials, the use of a live dog during such tasks has not yet been studied. Based on these recent studies, it is possible that interacting positively with a dog or watching positive videos during a break may actually help improve attentional resources during a vigilance task, or at least serve as a positive distractor that buffers task stress.

It is important to see not only how different break activities influence vigilance performance, but also how they influence stress reports and perceptions of boredom. Although many researchers believe that the vigilance task itself induces boredom, based on its monotony, few have analyzed if different types of breaks sustain this boredom or give relief from it. Although self-reports of boredom are often administered after vigilance tasks, there is also a need for a physical or behavioral measure of boredom to better understand the relationship between the over-load and under-load theories of vigilance. Research suggests that food intake increases with boredom (Abramson & Stinson, 1977; Macht, 2008; Pudel & Richter, 1980). Abramson and Stinson (1997) found that when faced with a boring task, obese individuals consumed significantly more food than did non-obese people; however, both obese and non-obese participants increased their food intake during a boring condition, compared to an interesting one. Dogs have been found to limit boredom (Chandler, 2001; Klemm et al., 2010).

Dallman et al's (2003) research with rats shows that when the rats are faced with a stressing situation, their food intake decreases except when they are presented with high energy foods (e.g. sugary, high fat content) their food intake increases. This suggests that

during stressing conditions sugary, fatty foods are preferred. In humans, it has been shown that during stress only about 30% of the population decreases food intake, while the other 70% increase their food intake (Adam & Epel, 2007; Stone & Brownell, 1994). This may be a direct consequence of the ready availability of processed high-energy foods in modern society. It is believed that the brain reward circuitry may be a key player in stress-induced food intake. High-energy processed food can stimulate endogenous opioid release, which is a part of an organism's defense mechanism against the effects of stress, and consequently eating these high-energy foods may help mitigate the effects of stress and boredom (Adam & Epel, 2007).

The aim of the current experiment is to see if task breaks benefit performance on a vigilance task, and if the *type* of break influences performance and stress/boredom measures for participants. We will compare types of break stimulation – live dog interaction, watching a dog video, watching a digital countdown– during a break in a cognitively demanding task, while examining impacts on vigilance performance, stress self-reports, food consumption and galvanic skin response (GSR). We also included a control group who did not experience a break but performed the vigil without interruption. Research suggests that subjects who experience no break during vigilance trials incur the steepest vigilance decrement and report the highest amount of stress (Finkbeiner et al., 2016; Helton & Russell, 2015). As a means of physically measuring boredom, chocolate (a high-energy food) will be administered to participants during the first and second vigilance blocks (not available during the task break). It may be that participants choose to eat the food provided because of hunger or to increase positive mood, even if they do not feel they need it due to boredom or stress. Therefore, we also included a questionnaire that assessed the reasons they chose to eat the snacks provided.

It is hypothesized that experiencing a task break during vigilance will reduce the decrement, in comparison to experiencing continuous vigilance. Additionally, it is

hypothesized that if participants are exposed to either of the dog break conditions, they will likely experience less boredom and therefore consume less food during post-break trials relative to the pre-break trials in comparison to participants exposed to countdown stimuli during the break. We also expect participants in the dog break conditions to report less stress and have reduced physiological indications of stress (reduced GSR).

5.3 Methods

5.3.1 Participants

Seventy students (17 males and 53 females) determined as emotional eaters (see *Questionnaires* section below) from the University of Canterbury, whose ages ranged from 14 to 52 years (M = 22.91 years, SD = 7.73), participated in the study. Students were recruited via poster advertisement, and were awarded with a $10 gift voucher upon completion. Each break condition had approximately the same number of participants (N = 18) with equal gender representation (~4 males and 14 females per condition). This study was approved by the university Human Ethics Committee, HEC 2015/26/LR-PS.

5.3.2 Materials and Stimuli

Chocolate. Participants were presented with a bowl of 50 pieces of Mars M&M's (240 cal, 10g fat, 30g sugars, per 47.9g serving) during each vigilance set in a ceramic bowl (100 pieces in total). The participants could request additional M&Ms during their vigilance task if they desired, which were delivered in increments of 20 M&M pieces per request. Fresh chocolate was provided for each participant, and hand sanitiser was provided if needed.

Galvanic Skin Response and Heart Rate. Galvanic skin response (GSR) and heart rate (HR) was recorded by e-Health Sensor Platform V2.0 for Arduino Uno. The e-Health

Sensor Platform used in the experiment included one heart rate tracker and two hand sensors to analyze GSR and HR (Figure 5.1).

Figure 5.1. Depiction of the Pulse and Oxygen in Blood monitor and the Galvanic Skin Response sensors

The GSR measures perspiration changes in the skin (sweat glands that are controlled by the sympathetic nervous system) with finger sensors, thus giving information about the emotional state of the users, measuring arousal and valence. This module also measures HR by placing a sensor on the tip of the participant's index finger for the duration of the activity, measuring heart rate changes as well. The raw data captured by the e-Health Sensor Platform were stored in csv files. Then the raw data was sent to an application programming interface (API) by Sensaura, 0-0.2 Hz, and then collected for analysis.

Questionnaires. Participants were required to complete a screening survey before they were eligible to participate in the study. This survey allowed us to screen for people who had no fears/allergies to dogs, and no allergies/dietary restrictions to milk chocolate. This screen also included the 13-item Emotional Eating subset of the Dutch Eating Behavior Questionnaire (DEBQ; Van Strien et al., 1986), to ensure the participants were emotional eaters. Participants were told to respond to each of the items (1 =*Strongly Disagree* to 5= *Strongly Agree)*, and a final score was computed for each participant after completion. If participants received a score of 40 points or more, they were considered on the emotional

eating spectrum, and disqualified if their score was lower than 40. Out of 129 interested participants, 59 were excluded from the experiment based on this survey, while the remaining 70 were selected for inclusion and labelled as emotional eaters ($M = 37.68$, $SD = 12.64$).

From the onset of the experiment, anxiety was measured from an adaptation of the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1999), condensed from 40 items to 22 items assessing current stress levels: baseline, post stressor and post treatment (activity) group. Items were measured through a 5 point Likert scale, 1 for *Strongly Disagree* and 5 for *Strongly Agree*. Participants quickly responded to the 22 items, which included examples such as "I feel tense", "I feel self-confident" and "I feel that something bad may happen today".

Along with the STAI, the full baseline questionnaire included demographic questions, such as age and gender. Heart rate was recorded by experimenter at this time as well. The questionnaire also included a self-report list of prior food consumption (e.g. "List all of the food items you have eaten so far today") and 4 item 8-point Likert scale (1 = *Not at All* to 8 = *Extremely*) assessing current hunger levels (e.g. "Do you have any current food cravings?", "Do you feel bloated?", "How hungry are you?" "Do you currently feel full?").

The post-vigilance questionnaire contained the same 22 item STAI, follow-up hunger report, perceptions of effort and performance during the vigilance (e.g. "Do you think you performed well during the vigil?", "How much did you focus on the task?"), and perceptions of break activity (e.g. "Did you enjoy your break activity?", "Do you wish you were assigned to a different break condition?" and "Why?"). Post-task heart rate was measured at this time.

Dog. A 3 year old Welsh corgi named Kenzi was used for the break period of condition 1. The dog had been previously kept in close proximity with staff and students of the university, ensuring well-mannered behavior and temperament. Kenzi was placed with

the participant during interaction, alongside two chew toys (her own possessions) and a bowl of water.

Dog Video. The video used for condition 2 was a dog contemplation video found from YouTube, a public domain for videos, https://www.youtube.com/watch?v=qiswC-GKs4. This video consisted of many different breeds of dogs, each displaying silly and happy behavior (e.g. tail wags, rolling, crawling) as well as displaying 'guilty' behavior when they were aware they misbehaved (e.g. head tucked, drooped eyes). There were no intervening agents displayed on screen (i.e. owners, pedestrians, etc.) after editing. The video was trimmed to last 8mins and displayed during the break period. Figure 5.2 displays the live dog (A), a screenshot of the dog video (B), and a screenshot of the countdown stimuli (C) used for the vigilance breaks.

Figure 5.2. The live dog used for interactions (A) and a screenshot of the dog video (B), with an example of the countdown stimuli (C) used in the break conditions.

5.3.3 Procedures

All persons participated voluntarily. It was emphasized that participation was dependent on enjoying milk chocolate and the ability to eat it with no adverse side effects. Participants were also screened for having no fears or allergies to dogs. Potential participants then were informed about the nature of the study, what would be required of them, assured

that all information was confidential and that they could remove their data at any point if they felt a need to. Participants signed a consent form if they agreed to the conditions of the experiment. Following consent, participants were then asked to turn off all electrical devices and instructed to complete a baseline questionnaire.

Participants were seated 50cm in front of a computer screen (377mm × 303mm, 75 Hz refresh rate). Stimuli presentation and recordings of reaction times and accuracy were performed by personal computers running E-prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). A baseline questionnaire was administered to each participant before engaging in the vigilance trials. Heart rate and GSR sensors were fitted on the participants's left hands at this time. Their right hand was kept free for making computer responses (the reverse was administered for those who were left-hand dominant).

After completion of the baseline questionnaire, participants were presented with a bowl of 50 M&Ms, and were instructed that they could eat as much or as little as they desired during the vigilance task, and were able to request more by raising a hand. Participants used their left hand to eat during the task.

The abbreviated vigilance task was used as the cognitive stressor in the experiment. This task requires attentive watch of 8 x 6mm light grey capital letter ('O', 'D' or backwards 'D'), displayed in Avant Garde font. The stimuli were exposed against a visual mask made up of unfilled black circles on a white background; the stimuli lasted for 50ms onscreen, while the mask alone lasted for 1100ms between each letter presentation. Participants were instructed to respond only to the 'O' by pressing the space bar, while withholding responses from the other letters (i.e. non-target stimuli). The target stimuli ('O') occurred with a probability of $p = .20$ for each period of watch, while the non-target stimuli ('D', backwards

'D') occurred $p = .40$, each. Figure 5.3 represents the computer task where A is an example of the vigilance stimuli, and B is an example of a participant engaging in the activity.
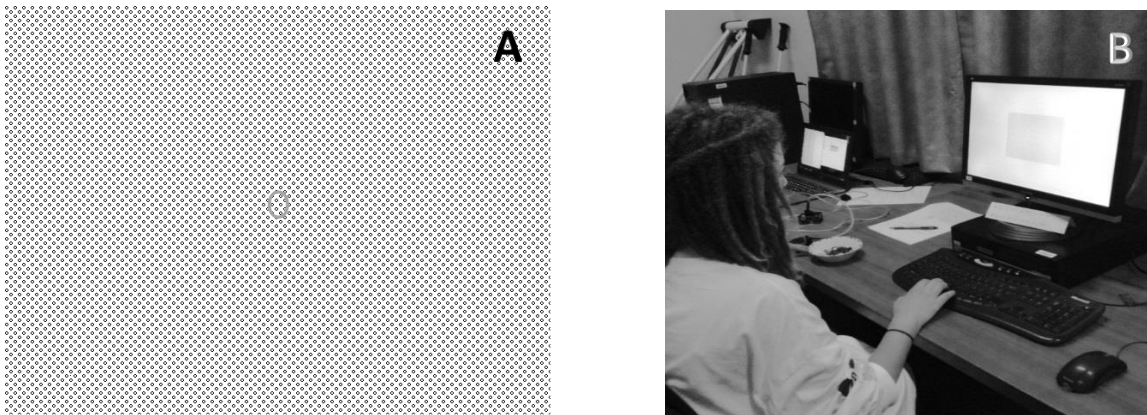
Figure 5.3. Example of the dot mask and letter stimuli (A) and a seated participant engaging in the vigilance task (B)

Participants were informed of the nature of the abbreviated vigilance task, and asked to complete 6 practice trials, each trial giving the participant feedback on whether the correct response had been made to the target stimuli 'O' and non-targets. Once practice trials were completed, a reminder to respond only to the 'O' was displayed onscreen and the test trials promptly followed.

Participants engaged in two vigilance blocks, one pre-break (Vigil Block 1) and one post-break (Vigil Block 2). Each vigilance block included 300 trials (with the target variable presented on 60 trials) and lasted approximately 6mins 29sec. After completion of the Vigil Block 1, participants were placed in a break condition of live dog interaction, dog video, a visual countdown or continuous vigilance (control group). Each break condition lasted 8mins. Chocolate was not available for participants to eat during the break period. For all conditions besides the continuous vigil, the sequence of the experimental task was 6min 29sec of vigil (Vigil Block 1), 8mins of break, and another 6mins 29sec of vigil (Vigil Block 2). For the

continuous vigil, participants experienced only one continuous vigil block of 12mins 58sec (600 trials), and were able to consume chocolate for the whole duration of the vigilance task.

All participants (besides the continuous group) received a notification on the computer screen once Vigil Block 1 was complete, explaining which break they would be experiencing and how they were expected to react during this time. Participants in the live dog break condition were instructed that they would be interacting with a live dog, and to engage in soft talking and touching of the dog for the duration of the break. Participants used their right hand for touching, as their left hand remained attached to the GSR kit, and so that the petting did not contaminate their chocolate upon the start of the next vigil. Immediately upon completion of the 8min break, participants were instructed to face the screen and begin the second set of vigilance trials.

Participants in the dog video break condition were asked to direct attention to watching a video (without sound) and to refrain from disruptive behaviors. These participants watched the dog video for 8mins. Upon completion of the video, the vigilance task resumed onscreen.

Participants in the countdown break condition viewed a visual countdown that was displayed onscreen; they were also asked to focus only on the countdown video in front of them. The video displayed a digital clock counting backwards in 1 second increments, beginning at 8mins (8:00). The numbers were displayed in black Avant Garde font on a white background.

Participants in the no-break continuous condition completed 600 consecutive vigilance trials, totaling 12mins 58sec.

Participants in the break conditions (excluding continuous) resumed the vigilance task (Vigil Block 2) immediately after their break. They were provided with a replenished bowl of chocolate and permitted to eat as much as they desired, and to request more if they wished.

After task completion, GSR and heart rate were recorded and then sensors were removed, while a follow-up questionnaire was administered. During this time, the experimenter counted the chocolate consumption for each vigilance block (pre and post break). Upon completion, participants were given time to ask questions/raise concerns about the experiment, as well as a $10 gift voucher in compensation for their participation.

5.4 Results

5.4.1 Correct detections (hits)

The percentage of correct detections (hits) and false alarms were recorded for each participant pre-break and post-break. The mean hits are reported in Table 1. We performed a four (experimental condition) x two (periods of watch) split-plot analysis of variance on the untransformed proportions of hits for both periods of watch and all break conditions. There was a significant main effect for periods of watch, $F(1, 66) = 4.196$, $p = .044$, $\eta^2_p = .060$, where Vigil Block 2, M = .855, SE = .016, 95% CIs [.822, .888], demonstrated worse performance than Vigil Block 1, M = .879, SE = .012, 95% CIs [.854, .902]. Importantly the break condition x periods of watch interaction effect was significant, $F(3, 66) = 3.15$, $p = .031$, $\eta^2_p = .125$ indicating that the effects of watch period on hits was moderated by condition.

We expected the continuous group (no break) to display a larger drop in hits between the two periods (larger vigilance decrement) than any of the break groups and we expected the break groups to lie in order live dog interaction, dog video, countdown from least to most

decrement. To test these predictions we computed the Vigil Block 2 – Vigil Block 1 decrement score for each participant and then ran contrasts comparing the decrement scores of each break condition against those of the continuous (no break) condition as the control and in a second batch the decrement scores of the live dog and dog video conditions against the countdown (which we regarded as an appropriate no dog control). Finally we compared the live dog and dog video groups. The mean decrement scores for each group and their 95% CI are displayed in Figure 4.

The decrement scores for all three break groups were significantly smaller than those of the continuous group: live dog interaction vs. continuous, $M_{decrement}$ = .093, 95% CIs [.016, .169], t (34) = 2.45, p = .020; dog video vs. continuous, $M_{decrement}$ = .074, 95% CIs [-.002, .149], t (32) = 1.99, p = .05; and countdown vs. continuous, $M_{decrement}$ = .079, 95% CIs [.002, .156], t (32) = 2.10, p = .044.

For the types of break comparisons (both dog breaks vs. countdown and live dog vs. dog video), there were no significant differences found in decrement size between conditions: live dog interaction vs. countdown, p = .098; dog video vs. countdown, p =.828; live dog interaction vs. dog video, p =.505.

Table 1

Percent correct detection means and standard deviations.

	Vigil Block 1	Vigil Block 2
Live dog interaction	.917 (.068)	.924 (.099)
Dog video	.915 (.079)	.903 (.087)
Countdown	.861 (.133)	.855 (.143)
Continuous	.841 (.108)	.737 (.152)
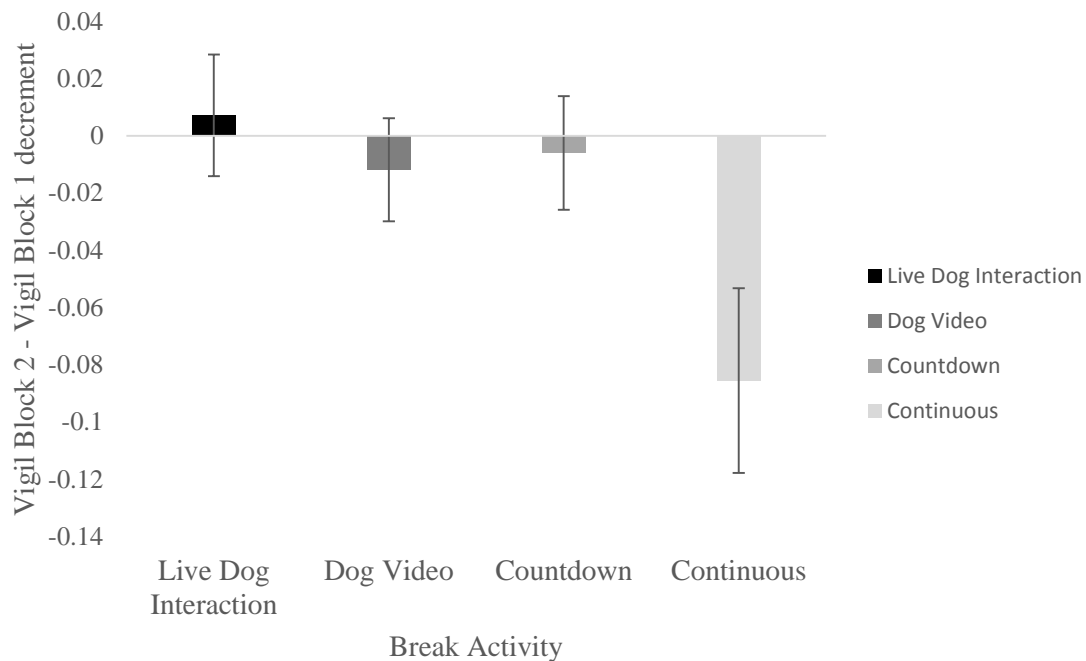
Figure 5.4. Mean decrement (correct detection Vigil Block 1 – Vigil Block 2) as a function of break activity. Error bars display 95% confidence intervals.

5.4.2 *False alarms*

Mean proportion of false alarms were calculated for each period, and even though false alarms are typically low for the abbreviated vigilance task, we performed the same significance testing as we did for the proportions of correct detections for each participant. There were no significant main effects of false alarms over periods of watch for the break conditions, all *p*'s > .05. The overall average false alarm rate was M = .025, SD = .005, 95% CI [.015, .035].

5.4.3 *Chocolate Intake*

A 3 (break conditions) x 2 (periods of watch) split-plot analysis of variance was performed on chocolate consumption for the conditions experiencing a break in vigilance (continuous was excluded). There was a significant interaction effect between condition and periods of watch, F (2, 50) = 7.917, p< .001, η^2_p = .241.

We expected to see chocolate consumption decrease in Vigil Block 2 following interaction with a live dog and watching the dog video, but to increase when exposed to the less engaging stimuli countdown break activity. To examine the relative change of chocolate intake, the difference in chocolate consumption between Vigil Blocks 1 and 2 was computed for each participant. A one way ANOVA was performed on these difference scores, showing that the change in chocolate consumption differed significantly with break activity, F (2, 50) = 7.92, p = .001. The mean change scores can be seen in Figure 5. We then ran contrasts comparing each of the dog break activities against the countdown (no dog control) and between the two dog groups. Significant differences were found for consumption change between dog and countdown conditions: live dog interaction vs. countdown, t (34) = -3.50, p < .001, with the live dog interaction condition consuming less chocolate, $M_{difference}$ = -7.12, 95% CIs [-11.24, -2.99]; dog video vs. countdown, t (32) = -3.14, p = .004, with the dog video condition consuming less chocolate, $M_{difference}$ = -8.77, 95% CIs [-14.46, -3.07]. No difference in consumption change was found between the two dog groups, p >.05.
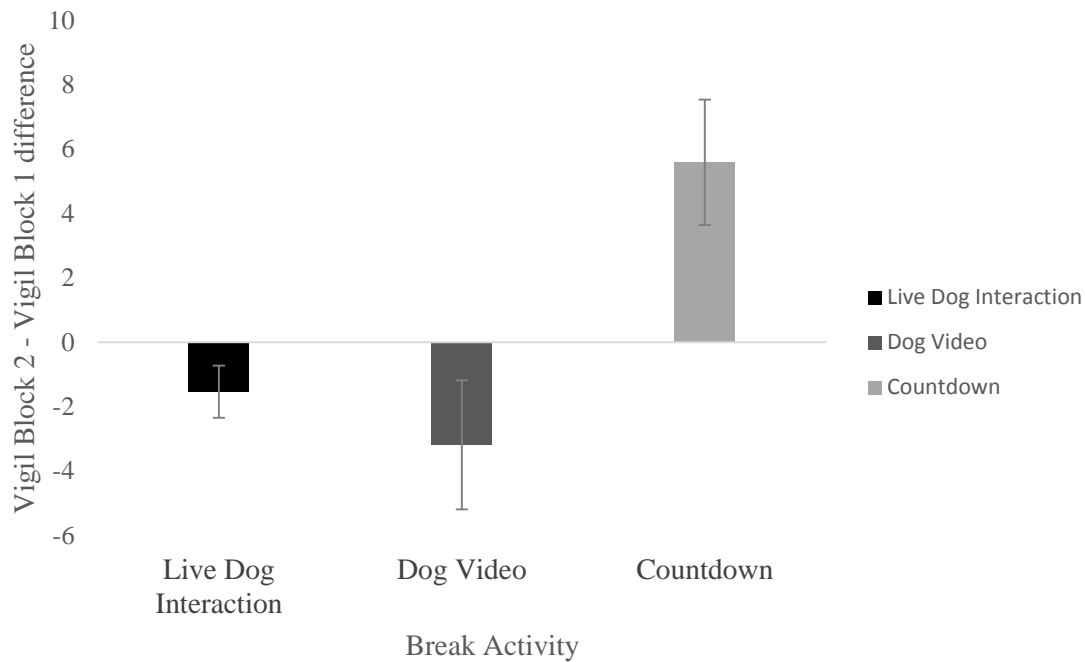
Figure 5.5. Mean Vigil Block 1 – Vigil Block 2 chocolate consumption difference as a function of break activity. Error bars display 95% confidence intervals around the mean group difference scores.

5.4.4 State Trait Anxiety Inventory (STAI)

For items of the STAI, we combined the *positive* item values (i.e. "I feel calm", "I feel optimistic about the day", etc.) with the recoded *negative* item values (i.e. "I feel tense", "I am currently worrying about life", etc.) for each participant and then computed the mean rating to derive an overall affect score for both STAI sets (baseline and post-vigilance). A 2 (occurrence) x 4 (condition) repeated measures ANOVA was performed on the derived affect measures. There were no significant main or interaction effects for time or break condition, p's > .05.

To assess relative differences in overall STAI between both vigils, we then calculated the change score baseline – post-vigilance for each participant in each break group. We expected that break activity would increase positive affect throughout the experiment compared to the no break (continuous) condition. To test these predictions, we ran contrasts comparing STAI differences for each break period to the continuous vigil condition (live dog

interaction vs. continuous, dog video vs. continuous and countdown vs. continuous). Positive affect differences were found for the live dog condition: live dog vs. continuous comparison, $t(34) = 2.53$, $p = .016$, with the live dog interaction condition increasing positive affect, $M_{difference} = .378$, 95% CIs [.075, .682], as seen in Figure 6. There was no significance found for dog video vs. continuous differences, $p = .087$, nor for countdown vs. continuous STAI differences, $p = .178$.

When comparing the break activity differences against one another (i.e. live dog interaction vs. countdown, dog video vs. countdown, and live dog interaction vs. dog video), no significant interactions were detected, all p's > .05.
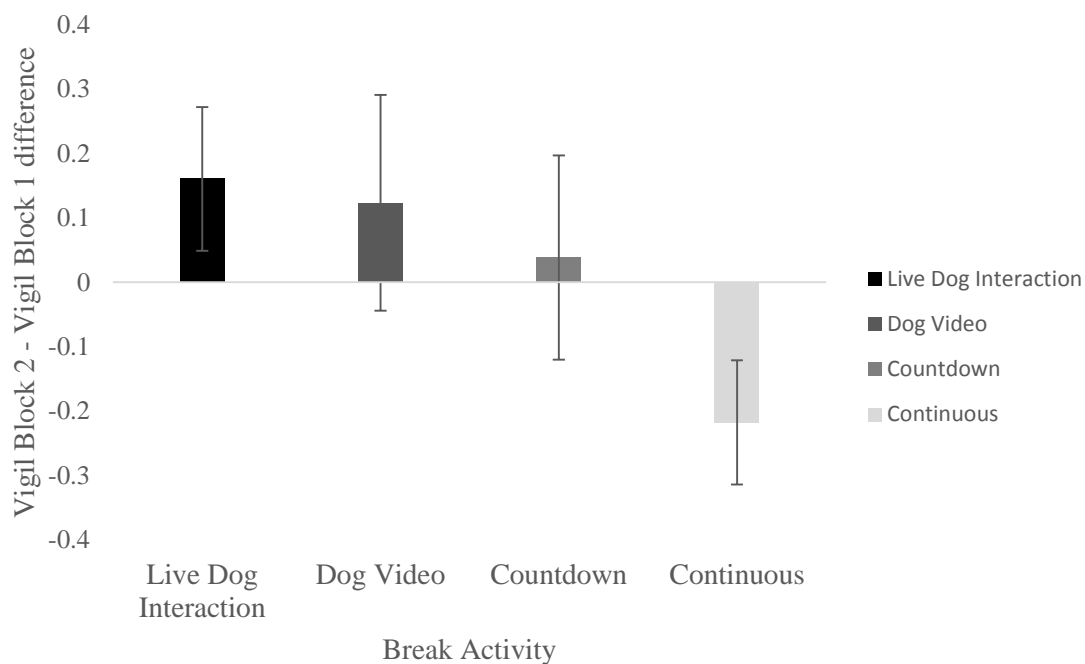
Figure 5.6. Mean affect STAI Vigil Block 1 – Vigil Block 2 difference as a function of break. Error bars display 95% confidence intervals around the mean group differences.

5.4.5 Heart Rate

Heart rate was recorded for each participant at baseline, after Vigil Block 1 and after Vigil Block 2 (post- break condition). A 3 (occasion) x 4 (experimental condition) mixed

ANOVA was performed to assess heart rate at various times throughout the experiment. There were no significant heart rate effects or interactions for break condition or watch period, all *p's* > .05.

5.4.6 Galvanic Skin Response (GSR)

Arousal. The mean levels of arousal were computed for each participant from measurements taken during Vigil Block 1, break session and Vigil Block 2, while wearing the GSR device. Output of the data ranged from -1 (not at all aroused) to 1 (extremely aroused). A 3 (break activity) x 3 (occasion) mixed analysis of variance was performed on the arousal data across the length of the experiment, comparing the break conditions. There were no significant main or interaction effects, *p's* > .05.

A total arousal measure was computed for each participant in the four conditions, to include continuous group data (as they experienced no breaks). A one way ANOVA was performed on total arousal scores, but no significant effects were found between conditions in overall levels of arousal, *p's* > .05.

Valence. Similarly to arousal, the mean emotional valence levels for each participant were computed from measurements taken during Vigil Block 1, break session and Vigil Block 2. Group means are displayed in Figure 7. Output of the data ranged from -1 (negative affect) to 1 (positive affect). A one way ANOVA was used to test for valence differences in Vigil Block 1, and no significant differences were found between conditions, *p* > .05.

Similarly, a one way ANOVA was performed on valence measures taken during the break and comparing break groups. There was a significant effect for break activity, $F_{(2, 42)}$ = 3.12, *p* = .05, η^2_p = .129, with participants in the live dog interaction condition experiencing the most positive valence during the break, M = .202 , SE = .025, 95% CIs [.15, .25], in

comparison to the dog video, M= .148, SE= .031, 95% CIs [.09, .21], and countdown, M= .111, SE = .028, 95% CIs [.6, .17], as displayed in Figure 7.

Lastly, a one way ANOVA was used to test for valence differences in Vigil Block 2, and there was no significant difference detected, $p > .05$.

Follow up tests were employed on valence readings for Vigil Block 1, Break period, and Vigil Block 2 for the break conditions. We separated the data file by break activity and performed a paired t-test to see if there were any differences between valence measures for break time and Vigil Block 2. A significant decline was found for valence between the break and Vigil Block 2 for the dog interaction condition, $t (17) = 2.63$, $p = .018$, $M_{difference} = -.045$, 95% CIs [-.008, -.080]. For all other conditions, no significant differences were found, p's > .05.

Figure 5.7. Mean valence readings for the periods of watch, comparing break conditions

Lastly, follow-up questions from the questionnaire were analyzed. These questions included follow-up hunger ratings, perceptions of effort and performance during the vigilance (e.g. "Do you think you performed well during the vigil?", "How much did you focus on the

task*?"*), and perceptions of break activity (e.g. "Did you enjoy your break activity?", "Do you wish you were assigned to a different break condition?" and "Why?"), all scored with a 7-point Likert Scale (1= *Strongly Disagree* to 7=*Strongly Agree*). A set of univariate ANOVAs were conducted on the items of perception for the vigil task and break, comparing conditions. There were no significant differences between break activities for the perceptions of effort or perceptions of performance, all p's > .05. There was a significant break activity affect for enjoyment, F (3, 66) = 17.39, p < .001 , η^2_p = .441, with participants in the dog interaction, M = 6.42, SE = .287, 95% CIs [5.8, 6.99], and dog video conditions, M = 6.00, SE = .303, 95% CIs [5.40, 6.60], enjoying their break more than those in the countdown condition, M = 4.18, SE = .303, 95% CIs [3.57, 4.78], and continuous vigil , M = 4.00, SE = .303, 95% CIs [3.40, 4.60]. Additionally, expressed desire to participate in a different break activity differed between break groups, F (3, 66) = 16.22, p < .001 , η^2_p = .424, with the continuous group desiring a different condition the most, M = 5.53, SE = .419, 95% CIs [4.70, 6.37], in comparison to the dog interaction, M = 2.00, SE = .397, 95% CIs [1.21, 2.79], dog video, M = 3.00, SE = .419, 95% CIs [2.16, 3.84], and countdown, M = 4.94, SE = .419, 95% CIs [4.10, 5.78].

5.5 Discussion

Participants engaged in the abbreviated vigilance task in two separate vigils that were separated by different break activities involving interaction with a live dog, watching a dog video, a countdown to resumption of the vigil, and a continued performance of the vigilance task. It was hypothesized that those who experienced breaks in vigilance would perform better than those who engaged in continuous vigilance. Results do show that the continuous group had the steepest vigilance decrement. This supports previous research that suggests mental resources required for sustaining vigilance are quickly diminished without breaks,

decreasing performance (Finkbeiner et al., 2016; Helton & Russell, 2015). Inclusion of interruption breaks seems to neutralize the vigilance decrement, which has many workforce implications. However, in this study it does not seem that the type of task break significantly affects the overall vigilance performance.

It was also hypothesized that different types of breaks would impact behavioral measures of boredom or stress acquired during the vigil (chocolate consumption), specifically it was expected that those who interacted with a live dog during the eight minute break would reduce their consumption of chocolate more than those watching a video of a dog, watching a digital countdown or experiencing a continuous vigil without any interruption. The comparison of chocolate consumption difference between Vigil Block 1 and 2 shows a decline in chocolate intake when exposed to dog stimuli (with no difference between the two dog break activities) whereas by contrast, those in the countdown condition increased their chocolate consumption following the break. This is believed to have occurred because of monotonous aspect of the task, where those in the countdown condition had little relief from the persistent vigil from a digital countdown break (which may have served as an additional vigilance task they felt the need to monitor), and were therefore inclined to eat more chocolate to compensate for the experienced stress and/or boredom (Oliver, Wardle & Gibson, 2000; Spoor et al., 2007; Wallis & Hetherington, 2004). Unfortunately we were unable to include the continuous condition in the analysis because it was not possible to record consumption at the end of the first vigil period without disrupting the immediately following vigilance activity. Improved methods of measuring chocolate consumption without disrupting the vigil, such as incorporation of a digital counter, are needed for future research.

Nevertheless, it is still interesting (regardless of the medium), dogs seem to protect against *increased* chocolate consumption during a vigil. Although some may argue that it would be hard to eat when busy with your hands as interacting with a dog would be, no

participants were allowed to consume chocolate during the breaks — only during the vigil blocks— to prevent this possibility. Likewise, although the participant's "eating" hands never came into contact with the dog, sanitizer was provided for those wishing to clean their hands after interaction, hopefully eliminating fears of food contamination that would result in food restriction.

For the items of the State Trait Anxiety Index (STAI), there was an increase of positive affect following the live dog interaction compared to the continuous vigilance performance (where affect decreased over time). However, there were no significant differences between positivity ratings of the dog interaction, dog video or countdown conditions. This is interesting, as even though emotional eaters restricted their eating the most in the dog conditions, they did not report higher positivity measures than the countdown condition. Previous research suggests that people experiencing continuous vigilance typically rate higher stress than those who experience breaks of any sort; similarly, dog video breaks have been found to be rated with high positive affect (Finkbeiner et al., 2016). However, this was only weakly supported in the current study, which may be due to the nature of the video used or personal opinions about the breed of dog during the interaction. Nevertheless, in line with what would be expected, valence measures derived from the GSR were more positive among those interacting with the live dog. Perhaps the subjective STAI measure is not as sensitive to differences in stress or positive affect as measures used previously, and should be assessed for future inclusion or removal.

When assessing the GSR data, we see that the break activities appear not to affect arousal levels overall or between pre- and post- break vigilance blocks. However, we do see valence increase for live dog interaction during the break session (yields as happier), but these valence measures did not remain significantly different after the break. This leads to a question of persistence. The valence seems to suggest that the happiness measures increased

short term, but were not carried over after the break — seen from the non-significant STAI data — even though tangible measures are (i.e. slight reduction in chocolate intake, maintaining vigilance performance). The current study was limited to analyzing GSR valence by computing means for each experimental period (Vigil Block 1, Break Condition, Vigil Block 2), in contrast to analyzes of changes in GSR over short periods (e.g. per second) which would have more power to detect carry-over of positive effects into early trials in the post break trial (Vigil Block 2). As the breaks lasted for only 8 minutes, it may be that a longer interaction with the dog is required (or a more positively viewed dog) to make the effects persist for longer.

Other researchers such as Dweck and colleagues (2014) have used GSR to detect arousal differences for emotional eaters, although no such distinction presents itself in the current study. Through valence measurements, however, it does seem that participants had a much higher positive affect when they were directly interacting with the dog, versus just watching videos of dogs, which is seemingly associated with maintained vigil performance and slight consumption decrease. This highlights the beneficial properties of live interaction, and suggests that just watching a positive video may slightly improve wellbeing measurements, but ultimately the most benefits seem to come from direct interaction with a live dog.

It is possible that in the current study, the dog video used was not the most beneficial option; some people might have interpreted it to be playful, others might have been concerned for the dog when they displayed guilty behavior (e.g. tail tucked, submissive stance). This in turn might have made emotional eaters — already in a state of cognitive stress — even more stressed, thereby eating more during the following vigilance block. A more neutral dog video, ideally of the same dog used for live interaction, may be better to use in future endeavors assessing the positive-wellbeing inducing properties of dog stimuli.

There seems to be dissociation between performance and chocolate consumption. The countdown break helped individuals perform better on the vigilance task compared to the continuous vigil, but participants in the countdown condition eat more perhaps because that task is actually more boring (which is driving the eating). Significant follow-up analysis shows us that people in both dog conditions enjoyed their breaks much more than the countdown condition participants. In turn, we see those in the countdown condition increase their chocolate consumption post-break, likely due to the monotonous environments — as both the vigil and the countdown break only incorporate basic stimuli.

A future study should assess the length of the break period between vigilance blocks. The length may have led to a ceiling effect, where all three break conditions had equal chance to recover mental resources that were depleted during the first vigilance block (Helton & Russell, 2015). This may be especially true for the countdown group, where participants did not have to execute any direct or indirect attention, essentially having the opportunity to completely rest for 8 minutes. This may help explain why STAI measures after break interaction were so similar for all three break groups, as the long duration for all breaks may have helped to alleviate any stress experienced during the vigil. Alternatively, as previously mentioned it is possible that some participants in the countdown condition felt compelled to monitor the remaining break time, which may have translated into poorer performance on the vigil post-break.

A possible increase in break length should be assessed particularly for dog interaction, as it may lead to a more sophisticated examination of time-dependent effects; it is possible with a longer interaction, food restriction and positive affect might also lengthen (i.e. carry-over affect). Lastly, cortisol levels should be assessed in future studies, specifically to better measure how positive dog interaction affects hormonal levels.

5.5.1   Conclusion

In the present study there was dissociation between behavioral measures of stress acquired during the task, chocolate consumption, and performance recovery after different breaks. Compared to breaks with dog stimuli, a countdown break resulted in similar performance recovery but resulted in increased chocolate consumption post break. Participants in the countdown break may be eating to alleviate sensory-related boredom, or they might be eating because of the stress caused by intense concentration during the vigil (which would be the same for all experimental conditions). Nevertheless, their break itself still staved off the vigilance decrement. Boredom and performance may be to some degree independent in vigilance tasks.

Positive affect has been shown to be increased during dog breaks in vigilance (Finkbeiner et al, 2016), and in the current study, although differences in self-report stress measures were non-significant, valence measures based on GSR increased during dog interaction, which may partly explain positively influence behavior (i.e. inhibiting emotional eating). This would add support to the literature that claims dog interaction is beneficial for emotional (less stress) and physical wellbeing (less emotional eating) if so. Though results suggest dog interaction may have helped to sustain vigil performance, the jury is still out as to whether the "restorative" properties of dogs (e.g. natural stimuli) exists (Kaplan, 1995). We are left wondering why arousal was unaffected during the change in valence state. Similarly, it is uncertain if dog interaction actually influences performance, or why happiness and performance measures are independent in certain instances, as one would expect increased performance when experiencing more relaxation and stress reduction (e.g. dog conditions) than other conditions. The dissociation between happiness and vigilance performance needs to be explored further.

Chapter 6

The Dimensions of Dog Petting: Comparison of Post-Stressor Activity Groups on Social Stress Relief

6.1 Abstract

Animal therapy is a rapidly growing contemporary medicine, where dogs are often employed for their high probability of positive interactions with humans (Barker & Dawson, 1998; Odendaal & Meintjes, 2003; Solomon, 2010; Wohlfarth et al., 2013). Many studies suggest that interacting positively with a dog provides a plethora of therapeutic benefits, such as increased sociality, stress and heart rate reduction, including increased overall reports of wellbeing (Banks & Banks, 2002; Barker & Dawson, 1998; Odendaal & Meintjes, 2003; Solomon, 2010; Wohlfarth et al., 2013). It is believed that interacting with a dog may provide more instantaneous benefits towards stress reduction relative to other occupational therapies, such as reading and meditation. Fifty two participants from Ohio were divided equally between the three therapy activities (dog petting, reading and meditation). Participants experienced a social stressor (reading aloud an embarrassing memory and attempting verbal mathematical problems), which was followed up by a therapy activity. It was found that all groups experienced a reduction in heart rate during their activity, but the dog petting group experienced the greatest stress-reduction. This provides support for the psychophysiological benefits of animal therapies, specifically canine. Future studies should focus on reduction of extraneous variables and look at species-based differences when implementing animal therapies.

6.2 Introduction

We have seen that positive interaction with a dog can help restrict emotional eating during a *cognitive stressor*, as well as provide performance and stress reduction benefits, and now it is worthwhile to see if a dog may help relieve *social stress* through interaction therapy. Additionally, a longer interaction with a dog might provide more positive mental benefits, which hopefully will be reflected in stress reports.

As contemporary therapies are coming to the forefront of health science (i.e. art therapy, music therapy and meditation-facilitated therapies) targeting stress and physiological relief (i.e. headaches, heart rate), within recent years many studies have specifically targeted the health benefits from companion animals and animal-assisted therapies (Banks & Banks, 2002; Barker & Dawson, 1998; Chiesa & Serretti, 2009; Flynn, 2000; Odendaal, 2000). Although there are many programs implementing animal accompanied therapies, such as with equine and cats, it appears a main focus in the clinical realm has been with dogs (Barker & Dawson, 1998; Odendaal & Meintjes, 2003; Solomon, 2010; Wohlfarth et al., 2013).

Flynn (2000) believes that companion animals serve three main functions within society: projective function (as an extension of the self), sociability (facilitating social interaction between people) and surrogate function (substituting animal contact for human contact). Although these are very viable likelihoods, it is possible that the physical closeness of a pet goes beyond narcissistic wants/needs and boils down to a more primal compromising bond, allowing the human to be the benefactor and the one benefitted.

Studies have shown that both human and dog blood pressure decreased as petting ensued during physical interaction, suggesting both counterparts are physiologically affected by the encounter (Barker & Dawson, 1998; Odendaal & Meintjes, 2003). Research offers a few explanations why positive physical interaction with animals is beneficial for decreased

mental and physical stress. The need for positive interaction with others (interspecially) exists in the basic behavioral patterns for many living organisms, where touching and close encounters represent primal feelings of being wanted and belonging (i.e. the "skin hungry" theory") (Odendaal, 2000; Odendaal & Meintjes, 2003). The soothing, rhythmic breathing and petting action might help to regulate heartbeat within the individuals involved. It is also possible that the human places the concerns and wellbeing of the animal momentarily over their own, promoting attachment, reducing loneliness measures and resulting overall in reduced bodily stress (Banks & Banks, 2002; Solomon, 2010; Wohlfarth et al., 2013).

Within the scope of companion animals, it is believed that dogs are the prototype of human-animal interaction (Odendaal, 2000; Odendaal & Meintjes, 2003; Wohlfarth et al., 2013; McNicholas & Collis, 2000). One of the main reasons dogs are so beloved is the high probabilities of a positive interaction. Unless a dog had a distorted puppyhood or was conditioned to fear/intimidate humans, there is a high chance that an encounter with a canine will result in lots of sniffing and licking from the four-legged counterpart. Being in close proximity with humans since domestication, dogs have learned how to coordinate with them sophisticatedly in reciprocal relationships (Sanders, 1993; Solomon, 2010). As dogs and humans are no longer in competition for food and shelter, their relationships have been built on trust of the other, seen through invitations of play and communication of needs (Gaunet, 2010; Odendaal, 2000). It is believed that dogs fulfill the universal emotional need for positive interaction often more directly than cats, or other companion animals that are less reciprocating of attention (Miklosi et al., 2005).

The companionship of a dog has also been shown to foster social interactions and maintain social networks (Solomon, 2010; McNicholas & Collis, 2000). Dogs have been found to sense human emotion (i.e. micro-changes in blood scent, facial expressions, etc.) and react to that emotion, typically with comfort; As pack animals bred to serve humans (e.g.

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guiding, hunting, protecting), it is believed they wish to satisfy humans not only thorough performances, but on an emotional level as well (Barker & Dawson, 1998; Warden & Warner, 1928). However, recent research shows a mixed view towards dog's sensitivity of human emotion recognition; Dogs seem to respond to crying infants (increase in cortisol) and display apparent aversion to sad faces, but they might not properly recognize and compute fear expressions (Yong & Ruffman, 2014; 2015; 2016). Still, dogs are believed to be therapeutic because they give attention when it is desperately sought after (attentionis egens) (Miklosi et al., 2005; Odendaal, 2000). Just watching positive videos of dogs has been seen to increase positive wellbeing during stressful situations (Finkbeiner et al., 2016).

The benefits of dog-human interaction have been presented very clearly from past research. If petting a dog is likely to be the best form of animal-assisted therapies, then it is important to compare this therapy to other contemporary therapeutic practices.

In the current study, a simple petting intervention was arranged to explore its effects on a social stressing situation, in comparison with other stress reducing activities. Current literature shows that other effective and well-received types of non-animal assisted therapies include common relaxation practices, such as reading and meditation (Carrington et al., 1980; Chiesa & Serretti, 2009; Irvin et al., 1996). These two groups will be used as contrast groups in the current study.

6.3 Methods

6.3.1 Participants

This sample consisted of 52 participants from Wilmington College of Ohio, (44 female, 8 male) ages ranging from 14 to 31 years old (M = 18.62, SD = 2.61) who were assigned approximately 17 to each stress reduction activity (petting, reading and meditating).

Students were recruited via poster advertisement, and were given baked goods upon completion. Only those prepared to sign a consent form confirming that they had no fears of dogs or dog induced allergies and that they were willing to give a speech and do simple math problems in front of the class and release their heart rates over interval testing periods were included in the study. Participants were ensured that their unique IDs would keep their information completely confidential during and after data analysis. Ethics was approved for this experiment by the Institutional Review Board of Wilmington College, 9/22/2014.

6.3.2 Materials and Stimuli

State Trait Anxiety Inventory. Anxiety was measured from an adaptation of the State-Trait Anxiety Inventory (STAI; Speilberger et al., 1999), condensed from 40 items to 22 items assessing current stress levels at baseline, after the stressor activity and again after completion of the stress reduction intervention. Items were measured using a 5 point Likert scale, 1 for Strongly Disagree and 5 for Strongly Agree. Participants quickly responded to the 22 items, including "I feel tense", "I feel self-confident" and "I feel that something bad may happen today".

The baseline STAI included demographic questions, such as age, gender, race, years of experience with dogs and negative encounters with dogs. Cronbach's Alpha (.872) suggests inter-rater reliability between the items of the STAI.

Heart Rate Measurement. Participant heart rate was recorded from the Instant Heart Rate- Heart Rate Monitor by Azumio app, version 4.5.0, software updated on October 4, 2014. The application was installed on two IPhone 6s devices. This program measures heart rate by having participants place the tip of their index fingers over the camera lens, and the lens detects color changes in the finger for blood flow, delivering an accurate heart rate measure in less than 10 seconds (Scully et al., 2012).

Social Stressor Activities. An adaptation of the Trier Social Stress Test was used (Kirschbaum et al, 1993) to show that stress inducing activities were in fact stress inducing. The social stress inducing situation involved making a 2- minute speech about an embarrassing personal experience followed by a counting backwards exercise (either counting from 125 in intervals of 7, from 150 in intervals of 13 or from 115 in intervals of 9) in public for 1 minute (totalling to 3 minute exercises for each participant). The particular version of the counting backwards task was determined randomly for each subject. Participants were instructed to recommence the task following any mistakes.

Dogs. Two dogs were used to satisfy the petting condition of the experiment: A 12-year-old Labrador-Border Collie mix, named Zach, and a four-year-old black Labrador mix named Titan. Two Labrador mixes were chosen for the experiment because Labs are generally known for their stability and mild temperament, and are often used as guide dogs for those reasons (Wilsson & Sundgren, 1997). Zach and Titan were socially trained for temperament and behavior, checked by a veterinarian to ensure they were free from all diseases, as well as up to date on all vaccinations. The dogs had average hair length, were not overly energetic and weighed approximately 80 lbs (see Figure 6.1).
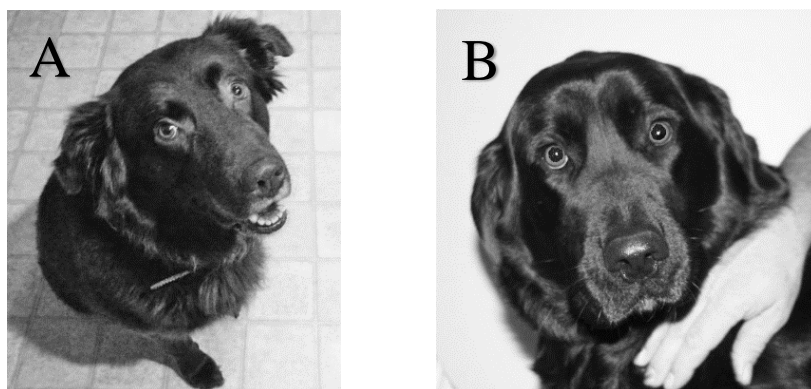
Figure 6.1. Images of the dogs used in the interaction group, Zach (A) and Titan (B)

Reading Activity. Participants assigned to the reading activity read a short story titled "A Pair of Silk Stockings" by Kate Chopin, which was chosen because it was mildly entertaining did not induce extreme feelings (positive or negative); required only basic reading skills and was of appropriate length for a 10 minutes activity.

Meditation Activity. No materials were provided for the students subject to the meditation activity.

6.3.3 Procedures

Participants were gathered in a white 6.7 m x 8 m classroom. Two research assistants were present for heart rate monitoring with their IPhones, both unfamiliar with the projected hypothesis. Participants were informed of the procedures that would follow, and were told that as part of their participation they would be required to consent to giving a speech, agree to withhold any information they gained regarding other students in the room (i.e. information during the embarrassing speech) and allow their personal heart rate to be measured on three occasions. All participants also had to confirm that they had no fears or allergies to any types of dogs. Participants were also informed on how to contact the main researcher if they wished to know more after data analysis or if they wished to have their data withdrawn from the study.

The researcher assigned letters to the participants (P, R or M) in sequential order throughout the room. Participants were told to compose their unique ID, containing their initials, the letter they had been assigned and their class number (e.g. KMF-R-1). Participants were ensured that their unique IDs would keep their information completely confidential during and after data analysis.

Once issued IDs, all participants were given a baseline state-trait anxiety inventory (STAI) while the two research assistants moved around the room checking everyone's baseline heart rate and writing it on top of their STAI. Basic demographic information was collected at this time as well on the baseline questionnaire.

After completion of all baseline STAIs, participants separated into three focus groups to reduce numbers (approx. 17 in each). At this stage each participant in turn delivered their speech and performed the reverse counting task in front of their focus group audience. Participants were reminded that their speech was to be about an embarrassing moment in their life, and they should speak only of events that they were willing to share with the group. They were timed for 2 minutes during the speech, and after the time was up they were to be immediately issued a verbal reverse counting exercise (i.e. counting backward from a designated number by a designated interval). The reverse counting exercise lasted one minute out loud in front of the focus group. Immediately after completion of both the speech and the reverse counting, research assistants recorded the participant's new heart rate on the second STAI response sheet, and participants were told to complete the second STAI questionnaire. As soon as one participant completed their 3 minute tasks, the next participant began their speech and following reverse counting exercise. This pattern was completed around the room for the 18 participants in each group (52 participants total), totalling to 54 minutes.

After all participants had completed their speeches, reverse counting and second STAIs, participants were divided into focus groups based on the letters they had been issued as part of their IDs (P, R or M). They were informed that all participants in the P group would be pet a dog, the R group would read a short story and the M group would meditate for the duration of the session. Each group was assigned to a different room where they were monitored by a researcher (one of the two research assistants or the main researcher). The rooms were identical in their measurements to the original room. The researcher and

assistants accompanied the participants during the stress reduction activity sessions, but did not interact in any way during the commencement of activities. These sessions were timed to 10 minutes duration and participants were not permitted to speak during this time. The petting group was instructed to be gentle, to avoid the face of the dog while petting, and be respectful of the dog if it wished to move during the 10 minutes. The reading group was instructed to begin reading the story a second time if they had completed the entire story before the 10 minutes were up. The meditation group was told to clear their mind, and not to directly focus their attention on anything in specific. Examples of the stress reduction groups are displayed in Figure 6.2. Upon completion of the each stress reduction activity, a final STAI was completed by each participant, and a final heart rate reading taken.

Participants all relocated to the original lab room after the activities, where they were thanked for their participation and offered homemade baking for compensation.

Figure 6.2. Example images depicting the petting (A), reading (B) and meditation (C) stress reduction activities.

6.4 Results

6.4.1 State Trait Anxiety Inventory

For items of the STAI, we combined the *positive* item values (i.e. "I feel calm", "I feel optimistic about the day", etc.) with the recoded *negative* item values (i.e. "I feel tense", "I

am currently worrying about life", etc.) for each participant and then computed the mean

rating to derive an overall affect score for both STAI sets (baseline and post-vigilance). A

mixed 3 (period: baseline, post-social stressor and post-activity) by 3 (activity: petting,

reading and meditating) ANOVA was conducted on the STAI data. A main effect was found

for occurrence, $F(2, 92) = 23.62$, $p < .001$, $\eta^2_p = .339$, where positive ratings were the lowest

following the stressor activities, M = 3.44, SE = .102, 95% CIs [3.23, 3.64], in comparison to

baseline, M = 3.67, SE = .097, 95% CIs [3.48, 3.87], and following the stress reduction

activity, M = 3.97, SE = .085, 95% CIs [3.79, 4.14], seen in Figure 6.3. There was also an

interaction effect found for occurrence and stress reducing activity, $F(4, 92) = 2.91$, $p = .026$,

$\eta^2_p = .112$.
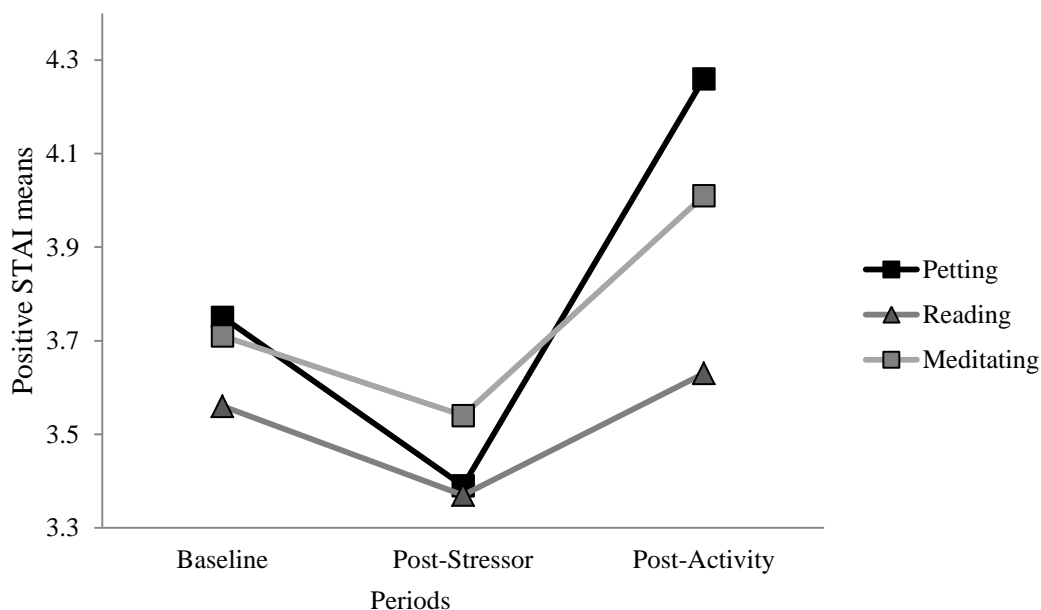
Figure 6.3. Mean positive STAI ratings for the stress reduction activities over the duration of the experiment

To assess relative difference in positive STAI data for occurrence and stress reducing

activity, we then calculated the change score post-stressor – post-stress reducing activity for

each participant in each group. We expected that the petting activity would increase positive

affect after stress reducing activity compared to the other activities. To test these predictions, we ran contrasts comparing the positive STAI difference score for each activity group against one another (i.e. petting vs. reading, petting vs. meditation, reading vs. meditation). Positive affect differences were found for the petting activity vs. reading activity, $t (33) = 2.61$, $p = .013$, with the petting group increasing positive affect after interaction, $M_{difference} = .568$, 95% CIs [0.13, 1.01], as seen in Figure 6.4. There were no significant difference found for petting vs. meditating scores, $p = .067$, and similarly no significance found for reading vs. meditation scores, $p = .384$.
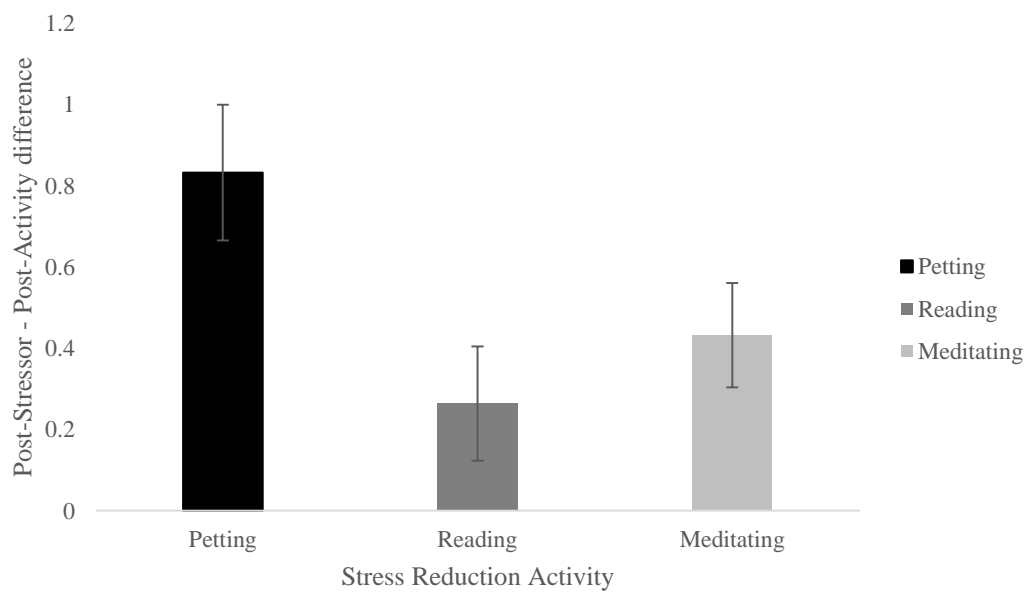
Figure 6.4. Mean affect STAI post-stressor – post-activity difference as a function of stress reduction activity. Error bars display 95% confidence intervals around the mean group differences.

6.4.2 Heart Rate

Similarly to STAI measures, a 3 (period) by 3 (stress reduction activity) mixed ANOVA was completed for heart rate. A significant period main effect was found, $F (2, 88) = 5.347$, $p =. 006$, $\eta^2_p = .108$. Heart rates were highest following the stress inducing activities,

M = 95.29, SE = 3.25, 95% CIs [88.73, 101.85], and lowest following stress reduction, M = 84.95, SE = 2.39, 95% CIs [80.13, 89.77].There were no significant differences found between heart rate and activity group between participants, *p* >.05.

To assess relative change in heart rate between the social stressor and stress reduction activity, a difference score was computed (post-stressor – post-activity) for each participant. We expected that the petting activity would decrease heart rate the most compared to the other activities. To test these predictions, we ran contrasts comparing the heart rate change for each activity group against one another (i.e. petting vs. reading, petting vs. meditation, reading vs. meditation). There were no significant differences found for heart rate changes between conditions, all *p's* >. 05.

6.4.3 Demographics

Independent t-tests indicate there were no significant gender differences in heart rates and STAI ratings, *p* >.05, nor any difference between ethnic and socioeconomic groups, *p* >.05; *t*-tests also indicate there was no significant effect of experience with dogs (*no experience*, *used to own a dog*, *currently own a dog*, *professional knowledge*) and STAI/ heart rate levels for the participants engaged in the petting interaction, *p* >.05.

As there were approximately 17 participants per activity group, the majority of individuals in the dog group reported to 'really enjoyed' the activity session (N = 16), while many people in the reading group said that it was 'pretty boring' (N = 8), and most people in the meditation group reported 'it was alright' (N = 9). Twenty-two individuals asserted that they wish they had a different activity session after the stressor (39.6%), and out of those individuals, 95.5% wished they were assigned to the petting activity group (N = 21).

6.5 Discussion

Stress reduction activities were analyzed after a social stressor for their potential effects on heart rate and stress reduction. Participants experienced a rise in stress-related reports and heart rate after a social stressor, but they were able to recover from this stress by engaging in stress reduction activities (petting, reading and meditating) after completion of the stress inducing activities. Although post-stressor positive STAI ratings were the highest for the petting intervention, there was no overall relative change difference in ratings between the petting and meditation interventions – significant difference was only found when compared to the reading activity group. Heart rates were lowest during the stress reduction activity sessions, but there were no heart rate differences between groups; this may be greatly affected by the length of time between stressor and therapy condition, which resulted as a major limitation to true heart rate assessment between conditions. Future studies should allow for less time to pass before administering therapy sessions for more time-accurate heart rate readings.

After completion of the petting condition, many participants reported that they enjoyed the dog(s) because they reminded them of their own companion dog. Past research by Banks and Banks (2002) showed that therapy dogs increased the wellbeing of elderly patients in long-term care facilities, but the strongest effect was found if the patient had a pet in the past; some chose not to participate because they had a dislike of animals. Although in the current experiment, level of experience and relationship to dogs did not significantly reflect STAI or heart rate differences in the participants of the petting condition. It is possible that those familiar with the breed may have found the interaction more pleasurable. As Labradors are a very common dog breed in the US known for its well-mannered temperament (Wilsson & Sundgren, 1997), it might have been seen as more favourable than another, more aggressive stereotyped breed (i.e. Pitbull or Doberman pinscher; see Finkbeiner et al., 2014).

Future endeavours should incorporate breed specific stereotypes, and examine the effect of many dog breeds on potential stress reduction when used in therapeutic settings.

To properly assess potential gender differences, the gender variable must be more equally represented in follow-up studies. It is possible that unmeasured personality types serve as a limitation for the current study as well, considering differences in personality may account for how much stress one experiences during an embarrassing oral narrative and mathematical problem solving, depending on age, group orientation and introvert/extrovert tendencies. It is also very possible that participants withheld a true account of an embarrassing memory (or memory fabrication) due to the extreme social anxiety they might experience if they were completely honest, whereas to which they would likely not experience any direct social-related stress. Similarly, it is also possible that some participants might have found it easier to simply speak publicly than others within the study. Therefore, it would be beneficial to take these possibilities into account, to limit extraneous factors within the population sample.

One major limitation of the current study is that we failed to assess if positive interaction with a dog helps participants to retain positive affect when faced with a future stressor. Though stress affects every individual, it is possible that the positive benefits gained from interacting with a dog may increase resilience in the short term. Resilience helps individuals perceive stress as minimally threatening and are able to develop adaptable and effective psychophysiological responses that stress susceptible individuals cannot (Franklin et al., 2012), which would have therapeutic implications. In future studies, it is important to include a follow-up stressor post interaction, to get a more elaborate depiction of the interaction and to assess if positive affect during the break is able to prevent, defer or dull future stress responses. As well, it will be important to incorporate a no-activity control group to assess the effectiveness of the stress reduction activities on a holistic level.

6.5.1 Conclusions

It is concluded that all the forms of stress reduction activities utilized did provide an increase in positive affect after a social stressor and reducing heart rate responses to stress, therefore a positive interaction with dogs as simple as petting has the potential to buffer interactees from anxiety and increasing positive affect, at least in short term. In the future, it would be important to look at different types of positive dog interaction (talking, playing, teaching, feeding, etc.) and timeframe of activity (before and after stressor) to determine the strength of human-dog interaction on stress relief and stress prevention.

Animal therapy – specifically with dogs – is becoming an increasingly popular therapeutic intervention, especially in abuse therapy and geriatric care (Banks & Banks, 2002; Barker & Dawson, 1998; Lefkowitz et al., 2005; Odendaal; 2000). However, some applied psychologist believe that proper seriousness has not been placed on animal therapy, which is often regarded as a placebo effect (Odendaal, 2000). More insight needs to be developed with regards to specific psychophysiological benefits from animal therapies – including species (and subtype) based research –to help assist the continuing growth of the field.

Chapter 7

Physical Encouragement through Isometric Holds: Exposure to Dogs and Robots as 'Motivators'

7.1 Abstract

The Attentional Restoration Theory (ART) suggests interacting with nature (animals) is restorative to directed attention, via activation of involuntary attention (Kaplan, 1995). Dogs specifically have been linked to promoting exercise and stress reduction (Wells, 2009; Wohlfarth et al., 2013). The application of ART to the expenditure of physical effort was explored. It was hypothesized that live dog interaction may increase effects of ART during an isometric hold. Sixty participants randomly assigned to an interaction group (dog, robot or toy) completed two isometric holds at maximal effort (before and after interaction) while reporting ratings of perceived effort (RPE) and stress. No significant differences between conditions for duration of holds or RPE were found. However, ratings of stress were lower for dog interaction than other conditions, implying the presence of dogs help alleviate stress, without affecting performance. Further studies are needed to determine whether ART impacts executive control (directed attention) or affect.

7.2 Introduction

Positive interaction with a dog has now been shown to limit task stress measured through decreased chocolate consumption during a *cognitive stressor* (Chapter 5) as well as improving perceptual wellbeing during a *social stressor* (Chapter 6). Now it is pertinent to assess if interaction with a dog helps promote physical performance and feelings of wellbeing during a *physically stressing* situation. Additionally since Chapter 6 failed to assess whether the positive benefits following stress reduction activities persist to facilitate performance and feelings of coping and wellbeing when encountering later stressors. Similar to Chapter 5, this

chapter compares performance and stress before and after interaction, and in addition to assess whether such effects persist.

Researchers have suggested that interaction with nature is mentally restorative (Atchley et al., 2012; Herzog et al., 1997; Kaplan, 1995). This perspective is known as the Attentional Restoration Theory (ART; Kaplan, 1995). In the ART, attention is divided into involuntary and directed attention. Involuntary attention does not require effort and is activated by natural stimuli, such as natural scenery, vegetation, and animals. Directed attention, alternatively, requires executive or top-down control and is subject to fatigue after sustained activity. In ART, activation of involuntary attention is useful for the rest and recovery of fatigued directed attention (James, 1962; Taylor et al., 2001). Evidence of this attention rejuvenation has been found through improvements in performance after participants are exposed to natural-setting pictures in comparison to pictures of non-restorative urban environments (Herzog et al., 1997; Berto, 2005).

A number of recent studies have supported ART; Taylor et al. (2001) found that when children are put in "natural" environments rather than urban ones, they are better at sustaining attention, even for children with Attention Deficit Disorder (ADD).

There have, however been some studies challenging ART (Emfield & Neider, 2014). Few doubt the benefits of natural stimuli, but the effects of natural stimuli may be on the result of affect (emotions and feelings), not the restoration of executive or directed attention resources per se (Mantler & Logan, 2015). A previous study by Finkbeiner and colleagues (2016) examined the effects of ART with a traditional vigilance task. They found that exposure to videos of biological agents (dogs) helped decrease self-reports of stress, in comparison to exposure to robot videos and random motion videos. However, they found that exposure to dog videos did not actually facilitate performance recovery on the vigilance task,

as would be expected from ART. Research by Barton and Pretty (2010) similarly suggests that short-term exposure to nature during exercise helps improve self-esteem and mood, irrespective of duration, intensity or health status.

While most researchers have used laboratory cognitive tasks requiring executive control (such as vigilance) to test ART, the ART should apply to any task sensitive to executive or directed attentional control. Mental fatigue is often a determining component of exercise endurance and withdrawal of effort (Blakely et al., 2015; Bray et al., 2011; Hampson et al., 2013). Marcora et al. (2009) found people who were mentally fatigued due to demanding cognitive tasks reported exerting more effort during their exercise, compared to control groups. Similarly, Mehta and Agnew (2012) found that physical exertion during isometric tasks paired with mental fatiguing tasks (arithmetic tasks) was extremely challenging. Mental fatigue limits exercise tolerance in people, not through cardiorespiratory (harsh breathing) and musculo-energetic (muscles hurting) mechanisms, but through higher perception of effort (Marcora et al., 2009).

Specifically, anaerobic exercise such as isometric holds – sustained tension in a muscle group without contraction (see Alessio et al., 2000) – are sensitive to executive control and mental fatigue. Isometric holds often focus on static positions that require sustained effort (i.e. Pilates, yoga, and grip strength) rather than applying rhythmic changes in muscle activity (Wiley et al., 1992). Participants often release isometric holds due to a failure of executive control (sometimes referred to as a failure of willpower; Baumeister & Vohs, 2007; Bray et al., 2011; White et al., 2008). The limited-strength model, for example, suggests that tasks involving executive control processes (self-control) deplete the capacity to sustain activity of executive control, similar to the proposal in ART of depletion or fatigue of directed attention (Bray et al., 2011). One may try to exert self-control to continue to hold an

uncomfortable pose or an isometric hold, but this effort will be taxing on executive or directed attention and control (Bray et al., 2011; Muraven & Baumeister, 2000).

Therefore, from an ART perspective, people sustaining isometric holds may experience physical and mental rejuvenation if presented with natural stimuli during or prior to the task, possibly even helping to decrease perceptions of effort. Viewing animals has been linked to mood improvement, anxiety buffering and lower heart rates after exposure (Myers et al., 2004; Wells, 2005); therefore, it is imperative to see if the presence of animals is restorative to physical tasks requiring sustained executive control. Dogs, specifically, have been shown to motivate people to exercise (Coleman et al., 2008; Cutt et al., 2008; Wohlfarth et al., 2013), encourage socialization (Gaunet, 2010; McNicholas & Collis, 2000), help relieve patients from stress (Lund et al, 1999; Odendaal & Meintjes, 2003) and increase overall positive feelings of security, companionship and wellbeing (Budge et al., 1998; Crawford et al., 2006; Pachana et al., 2005; Siegel, 1993; Wells, 2007; Wells, 2009). An open question is whether exposure to dog stimuli actually improves the ability of a participant to sustain physical performance or alternatively, elicits positive affective feelings, but has no direct impact on sustained performance.

Previous research by Finkbeiner et al. (2016) utilized video stimuli of dogs, but one limitation acknowledged by the authors was that videos may not be powerful enough natural stimuli to elicit the restoration proposed in ART. In the current study live interaction with a dog is contrasted with interaction with non-living agents rather than video recordings. Instead of a cognitive task requiring sustained attention directed or executive attention, in the current study ART is explored in the context of isometric physical exertion.

Most studies have examined exercise endurance via known performance enhancers, such as caffeine where the magnitude and duration of the effect has been observed (Bell &

McLellan, 2003). Few studies have explored the effects of interaction or exposure to natural stimuli on exercise endurance.

The aim of this study was to examine participants' persistence and perceived physical exertion during basic isometric holds. We sought to examine the effect of exposure to a natural agent (a live dog) and non-living control stimuli (a robot and a stuffed toy) on physical persistence. We also measured perceptions of physical effort, self-reports of state anxiety, and heart rate. If ART is broadly accurate then we hypothesize participants experiencing interaction with a live dog may increase exercise persistence and endurance in comparison to participants exposed to artefacts (a robot and a toy). Alternatively, if the findings of Finkbeiner and colleagues (2016) generalize to physical as well as cognitive tasks, then the interaction with the dog should alleviate feelings of anxiety, but have little impact on actual performance. Dogs may make you feel good, but they may not help with physical persistence or sustained performance per se.

7.3 Methods

7.3.1 Participants

Sixty students (18 males, 42 females) from the University of Canterbury, ages ranging from 17 years to 42 years (M= 24.17, SD= 4.847) participated in the isometric hold study. Each activity condition had an equal number of participants (N=20), with equal gender representation (approximately 6 males and 14 females per condition). Students were recruited via poster advertisement, and were awarded with a $10 gift voucher upon completion. This study was approved by the university Human Ethics Committee, HEC 2015/26/LR-PS.

7.3.2 Materials and Stimuli

Questionnaire and Ratings of Perceived Effort (RPE). A modified version of the ratings of perceived exertion scale (RPE scale; Borg, 1971; 1973; 1990) was used to capture perceptions of workload during the isometric holds. These modified items required participants to rate statements after each isometric hold, such as "Effort it took to hold position", "Effort to breathe", "Muscle Activation", "Mental Activation", "Focus on Task" and "Total Energy Used" with a 9-point RPE scale, 1 being "no exertion" to 9 being "maximal exertion".

State Trait Anxiety Index (STAI). Anxiety was measured from an adaptation of the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1999), condensed from 40 items to 20 items assessing current or state anxiety levels, with positive and negative reflection. The STAI was completed 3 times by each participant at baseline, post-hold and post treatment (activity). Items were measured utilizing a 5 point Likert scale, 1 for Strongly Disagree to 5 for Strongly Agree. Participants quickly responded to the 20 items, including "I feel tense", "I feel self-confident", "I feel that something bad may happen today", etc (see Appendix B).

Infrared Beam and Timer. Two photoelectric motion sensors *(*SenSource, BEN series*)* mounted to an adjustable metal stand were used to record hand/arm movement. The metal stand was adjusted to the participants shoulder height. When a participant's hand passed through the center of the motion beam (e.g. start position: single hand front dumbbell hold), a SenSource digital counter (FX6Y digital LCD display) would activate, and deactivate when their arm wavered above or below the central position. Figure 1(A, B) displays the infrared beam with a participant's arm in correct position during an isometric hold alongside the timer.

Heart Rate Monitor. Participant heart rate was recorded from the Instant Heart Rate-Heart Rate Monitor by Azumio app, version 4.5.0, software updated on October 4, 2014. The application was initiated on two IPhone 6s. This program measures heart rate by having participants place their tip of their index fingers over the camera lens, and the lens detects colour changes in the finger for blood flow, delivering a reliable heart rate measure in less than 10 seconds (Scully et al., 2012).

Stop Watch. An electronic stop watch (Emerson), was used during the agent interaction portion of the experiment to ensure equal exposure between participants.

Video Recordings. The isometric holds were recorded with an Acer Crystal Eye Webcam (Windows 8, version 2.0.8, 2.77MB) to ensure the timing of the infrared beam's timer aligned with the video recording of the held position. Faces of the participants were not displayed on video to maintain confidentiality.

A random selection of participants was recorded during the interaction group (to ensure all aspects of the interaction requirements were completed) with Acer Crystal Eye Webcam software. Faces were not displayed in videos to maintain confidentiality. Figure 7.1 (C) shows the setup of the interaction group.
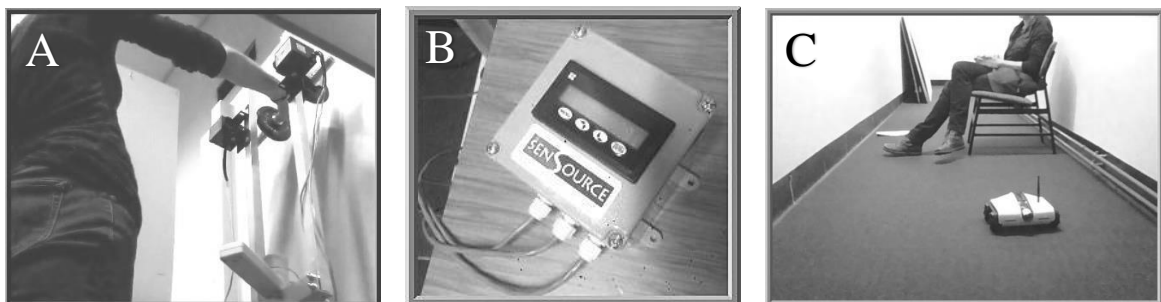
Figure 7.1. Examples of a participant engaging in the isometric hold (A), the timer box (B) and an example of a participant engaging in a robot interaction session (C).

Dog Stimuli. The dog used for this experiment was a 4 year old border terrier female named Molly. This dog has been previously used in clinical psychological circumstances – including child patients – which ensured well-mannered behavior and temperament. Molly was placed with the participant during interaction, alongside two chew toys (her own possessions) and a bowl of water. Molly was assisted by her handler before and after interaction, but the handler left the interaction cubicle just before the participant entered to prevent handler contamination; a one-way mirror was monitored by the researcher to assure participant and dog safety during the interaction.

Robot Stimuli. For the robot stimulus, a Rover App-Controlled Wireless Spy Tank (Brookstone 1.0, 1.6 MB, iOS 3.0 compatible) was used. The participant would be directed by a sheet of paper how to use the iPod to control the robot, with the option of going forwards and backwards while turning both left and right. The Rover was also equipped with a manually adjustable camera streaming live video of the path during the interaction.

Stuffed Toy Stimuli. A 20cm stuffed toy bear was used as the control stimulus. It came with a removable jersey, which the participant could play with if they chose. Figure 7.2 displays the stimuli used during the interaction groups.
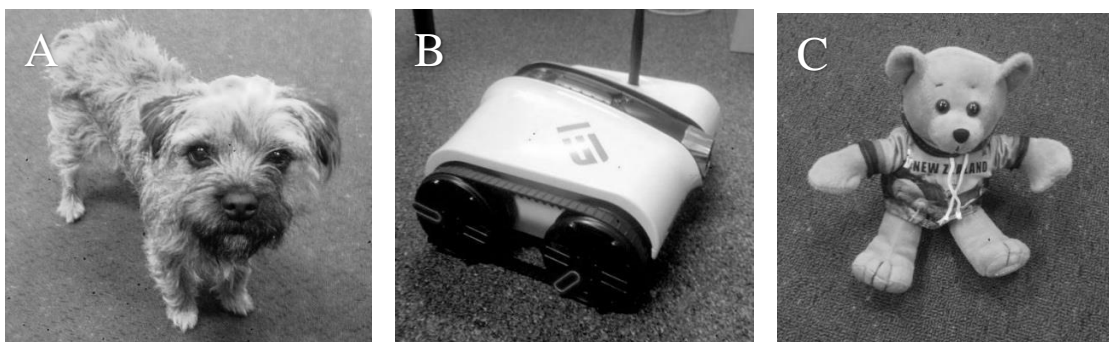
Figure 7.2. The dog (A), robot (B) and toy (C) used during the interaction sessions

7.3.3 Procedures

To meet the criteria of the study, participants confirmed that they had no allergies to dogs, and no fears or extreme feelings to dogs, robots or toys. Participants also had to confirm that they were willing to sustain a pre-determined pose until they could no longer sustain effort and that they had no ailments that may prevent them or cause harm from such physical activity. During debriefing participants were assured of confidentiality and anonymity, and those that agreed to consent to photographs and videos during the procedures, were assured that these were for data analytic purposes and that no further personal identifying information (i.e. name, identification numbers, etc.) would be used. Those individuals that agreed to the conditions signed the consent form and completed the baseline questionnaire including STAI measures, a baseline fitness/persistence report (e.g. "Do you consider yourself physically fit?" "Do you consider yourself a persistent person?"), as well as given a baseline heart rate reading. The baseline questionnaire also included demographic questions, such as age, gender, race, years of experience with dogs and possible negative encounters with dogs.

Once the baseline questionnaire was completed, participants were placed in a cubical in front of the sensor where they were given a description of the isometric hold they were to perform (e.g. single hand front dumbbell hold). Participants were told to hold this position for as long as possible and strongly encouraged to use maximal effort, unless experiencing unusual discomfort. Once the participant understood the task, they were given a 5 kg dumbbell to hold during their arm extension to accelerate fatigue. As soon as the participant positioned their arm in front of the motion beam, the timer activated; when the participant's hand wavered above or below this central position, the detector would cause the counter to deactivate, revealing the duration of the hold (e.g. Hold 1). Participants were asked to

complete a post-hold questionnaire, measuring heart rate and recording hold duration, STAI and RPE ratings.

Following the completion of the questionnaire, participants were placed in an interaction group, resulting in 20 participants per experimental condition (i.e. dog interaction, robot interaction and toy interaction). This interaction resided in a separate cubicle (6 m x 1.5 m) with no interfering stimuli. Participants were informed that they must complete all of the following interactions with their agent (e.g. dog, robot or toy) at least once interaction period: Look at their agent, talk to their agent, touch their agent and play/interact with their agent. These requirements were listed on a piece of paper the participant could see at all times during the interactions. All other interaction types that occurred were classed as participant improvisation. Interactions were recorded on video for a random selection of participants, and total interaction time lasted precisely 10min for each participant. Heart rates were recorded immediately after the interaction.

Participants were immediately placed back into the cubicle with the motion beam following their interaction, and asked to initiate the same hold (called Hold 2). Once a participant released the isometric hold (as dictated by the counter), they were asked to complete a final questionnaire including final heart rate and STAI measures. They then were given time to ask questions/raise concerns about the experiment, and ensured that their data would be withdrawn from the study if they decide to do so at any point while the experiment was active. They were given a $10 gift voucher in compensation for their participation.

The recovery time of force and a return to normal muscle pH values following engagement in low-impact isometric contractions is approximately 10-15 min (Miller et al., 1987). The spaced time between the first isometric hold and the second is approximately 20

minutes for each participant, which should account for any residual fatigue that the participant might experience during their initial isometric hold.

7.4 Results

7.4.1 Sustained Effort (duration)

To analyze the impact of break activity on the duration of the isometric hold, we performed a two (first hold duration and second hold duration) by three (dog interaction, robot interaction and toy interaction) by two (male and female) mixed measures analysis of variance. There was a significant effect for duration of hold based on occasion, F (1, 54) = 5.94, p =.018, η^2_p =.099, with Hold 2, M = 27.88 seconds, SE = 2.62, 95% CIs [22.62, 33.15], lasting longer than Hold 1, M = 22.09 sec, SE = 2.03, 95% CIs [18.01, 26.18], across participants.

There were no other significant main effects and no significant interactions, all *p's* > .05.

7.4.2 Perceived Effort (RPE)

For RPE items, we computed a total RPE score for each participant on each occasion (post-Hold 1 and post-Hold 2). These scores were treated by 2 occasions (first and second RPE) by 3 interaction condition (dog, robot or toy) by 2 (gender) mixed analysis of variance. No main or interaction effects were significant, all *p's* > .05, as ratings for the Hold 1, M =

5.244, SE = .221, 95% CIs [4.802, 5.686], and Hold 2, M = 5.389, SE = .259, 95% CIs [4.869, 5.910], remained consistent.

7.4.3 Heart Rate

We performed a 4 occasion (Heart rate at baseline, after first hold, after interaction activity and after second hold) by 3 (condition) by 2 (gender) mixed analysis of variance. The occasion main effect was significant, $F (3,159) = 10.679$, $p = .000$, $\eta^2_p = .168$, where baseline heart rates were the lowest, M=79.87, SE = 2.45, 95% CIs [74.904, 84.826] across participants, compared to post-Hold 1 heart rate, M = 91.832, SE = 2.918, 95% CIs [85.930, 97.734], post-activity heart rate, M = 81.805, SE = 2.236, 95% CIs [77.320, 86.289], and post-Hold 2 heart rate, M = 90.031, SE = 2.535, 95% CIs [84.904, 95.158]. There were no main or interaction effects involving occasion or interaction group, $p's > .05$.

To assess relative change in heart rate after engaging in an interaction activity, a difference score was computed (post-Hold 1 − activity) for each participant. We expected that live dog interaction would decrease heart rate the most compared to the other activities. To test these predictions, we ran contrasts comparing the heart rate change for each activity group against one another (i.e. live dog interaction vs. robot interaction, live dog vs. stuffed toy, and robot vs. toy). There were no significant differences found for heart rate changes between conditions, all $p's > .05$.

7.4.4 State Trait Anxiety Inventory

For items of the STAI, we reverse scored the responses for the "positive" items (i.e. "*I feel calm*", "*I feel optimistic about the day*", etc.) for each participant, then combined with the responses for the "negative" items (i.e. "*I feel tense*", "*I am currently worrying about life*", etc.), computing a total state anxiety mean response for all three STAI sets (baseline, post-

Hold 1 and post-Hold 2) within participants. A 3 (occasion) by 3 (interaction activity group) by 2 (gender) mixed ANOVA was performed on total STAI scores. The occasion and interaction group interaction effect was significant, $F (4, 112) = 3.363$, $p =.012$, $\eta^2_p =.107$. The interaction means are displayed in Figure 7.3.
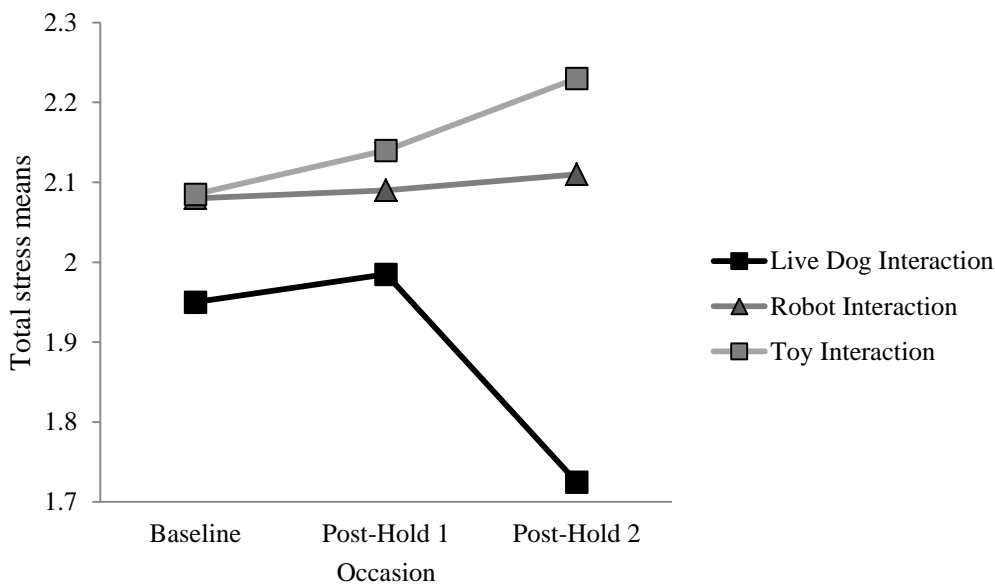
Figure 7.3. Total stress means for the experimental groups at baseline measure, post-Hold 1 and post-Hold 2.

To assess changes in anxiety after activity – and to assess potential persistence effects – difference scores were computed (post-Hold 1 – post-Hold 2) for each participant in each activity condition. We expected that exposure to a live dog would help reduce anxiety throughout the experiment compared to the other interaction groups. To test these predictions, we ran contrasts comparing the STAI difference for each interaction activity against one another (i.e. live dog interaction vs. robot interaction, live dog vs. stuffed toy, and robot vs. toy). A significant effect was found for the live dog interaction vs. robot interaction difference, $t (38) = -2.37$, $p = .023$, with the live dog interaction reducing anxiety the most, $M_{difference} = -.270$, 95% CIs [-.50, -.039], as seen in Figure 7.4. Similarly, a significant effect was found for the live dog interaction vs. stuffed toy interaction difference, $t (38) = -2.94$, $p =$

.006, with the live dog interaction reducing anxiety the most, $M_{difference} = -.322$, 95% CIs [-.54, -.10]. Effects for robot interaction vs. stuffed toy interaction difference were nonsignificant, $p > .05$.
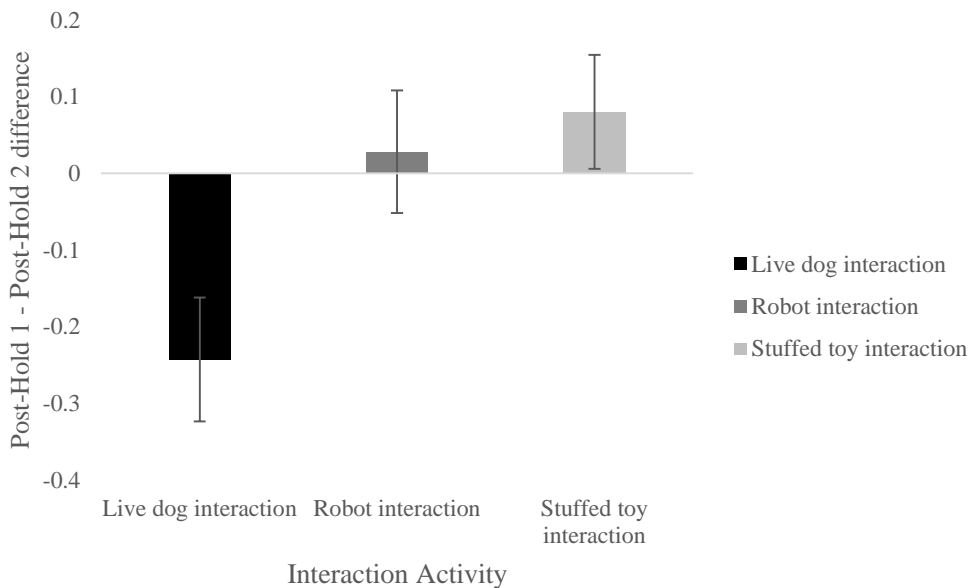
Figure 7.4. Mean STAI Vigil Block 1 – Vigil Block 2 difference as a function of interaction condition. Error bars display 95% confidence intervals around the mean group differences.

We also examined some correlations between measures. Participants who enjoyed their group tended to rate less state anxiety post-Hold 2 (post-interaction), $r = -.457$, $n = 60$, $p = .000$, and more positive feelings, $r = .378$, $n = 60$, $p = .003$. Past experience with their interacting agent (dog, robot or toy) did not have any effect on perceptual reports or physiological data, $p > .05$.

7.5 Discussion

Differences between the interaction conditions were analyzed for their effects on state anxiety, heart rate, perceived effort and physical performance during a set of isometric holds. Interacting positively with a dog before an isometric hold for 10mins seemed to render the

participant less stressed and increased positive feelings for the participant- compared to interaction with the robot or stuffed toy interaction conditions.

Contrary to the hypothesis, however, there was no significant impact of interaction agent on physiological responses or hold duration. Interaction breaks had no effect on the duration of the isometric holds in participants, although post-interaction holds were held for a greater length of time across participants. This is possibly due to task-familiarity or ego driven persistence (i.e. wished to last longer than their first attempt) aided in the overall increase in second-isometric hold durations.

Though hold durations overall increased in the second hold, RPE reports remained consistent for both first and second holds, with no significant effects between conditions. In addition, mean RPEs were mid-scale for both first hold and second hold (e.g. light exertion), so this is suggestive of stopping resulting from a choice to break the hold (central command), rather than from muscular failure. Although RPE has been shown to be affected by motivational factors in previous research (Rejeski, 1981) the current interaction conditions did not appear to significantly impact RPE. Even though participants' post-dog interaction reported less state anxiety, they did not report less RPE.

Current findings were similar to that of Finkbeiner and colleagues (2016), in which video dog stimuli did not affect performance of an individual, but did impact overall subjective reports of stress and wellbeing. This is important to note, suggesting that happiness and performance can be independent, as a person can experience a change in one without the other. There is much to be said with increasing happiness during stressing trials, where low stress might not increase performance in the short term, but may aide to help promote psychological wellbeing in the long term (Miller et al., 1995). Nevertheless, the current findings and those of Finkbeiner and colleagues (2016) with independent impacts of dog

stimuli on self-reports of affective state and actual performance persistence have broader theoretical implications. Many models of sustained effort or sustained attention may overemphasize general affective factors in performance persistence (Kurzban, Duckworth, Kable, & Myers, 2013). Instead sustained performance may be limited by the depletion of cognitive resources fairly specific to the task being performed and not to a general displeasure with the setting or task resulting in effort reduction (Helton & Russell, 2015). The current and previous results suggest people can manipulate affective reports without having much, if any, impact on actual performance persistence. Employing means to improve people's affect, while a noble goal in of itself, may have little impact on actual improvements in performance.

Also similar to the current study, Mehta and Agnew (2012) had participants perform static shoulder abductions, with the presence of mental arithmetic in certain trials, and found that physical strength declined when the mental workload was higher, and that RPE ratings were increased when physical and mental workload was maximal. Perhaps it is necessary to provide cognitive tasks in conjunction with the physical tasks to assure mental fatigue during isometric holds, and thus produce more sensitive measures of lapses in willpower. It is possible that isometric holds do not serve as willpower measures per se, but more so self-regulation; *willpower* is thought to address the decision to initiate or control an action (Benabou & Tirole, 2004), while *self-regulation* represents people's capacity to alter their inner states or outward responses, based on personality traits (Bray et al., 2011). Research shows that people who score highly on self-regulation scales often engage in more physical activity, and tend to stick to a task or goal (Bray et al., 2011). Perhaps personality traits rather than decisions in an immediate situation are more responsible to the ability to sustain physically enduring exercises such as isometric holds and this could be explored in future studies.

Alongside the physical components of isometric holds, the mental costs behind physical load (i.e. perceptual measurements) must be taken into account to better understand work overload and endurance effects (Borg, 1990). It is possible that there may be very minimal levels of emotional/mental stress while participants engage in the isometric holds, trying hard to hold the position until they can no longer hold. There should have been little emotional/mental stress present when interacting with the dog/robot, as they were asked about fears and obsessions of these agents before the onset of the experiment.

However, the potential dog motivation effect may be stronger in individuals who enjoy dogs in general. These individual differences should be explored in further research. The dog motivation effect may differ between participants depending on their perception of the particular dog interacting with them, and for their relationship to the particular dog (i.e. benefits from own pet, not strange dogs as used in the study). Interacting with a familiar dog may have even stronger effects than a strange, though friendly, dog.

Perhaps a better choice of robot comparison agent is needed, as the current study compared dog interaction and biomimetic toy interaction to mechanistic robotic interaction. This could have affected the participant in a number of negative ways, based on visual aesthetic (i.e. natural vs. artificial) and tactile value (i.e. hard plastic vs. soft fur/fabric). Further, in the robot condition the participant had to control the movement of the agent on their own (compared to the unpredictable movement of the dog), which might have introduced a confounding factor as it was too similar to the control condition (stuffed toy). More deliberate consideration is needed to select a future comparison agent for similar physical motivation studies. It is also that interacting with any agent for the current 10 min duration may not be long enough to produce strong effects, and should be considered when implementing future studies.

While there are many studies that aim to analyze intervention-induced changes during physical activity, Westerterp (2009) believes that intervention-induced changes would be quite small – if any – as physical activity is mainly determined by predisposition and not manipulations from the environment. Aforementioned, it may be that individuals who are predisposed with persistence in physical endurance are more inclined to be less stressed, and equally open to different types of motivation interactions (i.e. dog, robot or too) whether a significant effect is gained from them or not. To be able to assess this potential affect, more in depth data collection is required for future endeavours.

Chapter 8

"What an Emotionless Robot!": Visuomotor Priming from Video Stimuli Influences the Emotion Recognition of Static Faces

8.1 Abstract

Evolutionarily, humans are well-equipped at recognizing emotions in other humans, and priming is believed to affect this ability. Research suggests exposure to dogs influences social and emotional abilities. Similarly, robots are sometimes seen as social agents, but little emotional priming research exists with robots. We hypothesized that exposure to dogs may help improve performance in an emotion recognition task, where robot priming is believed to have less of an effect on emotion recognition. Fifty-nine participants each completed three sessions of an emotional recognition task, primed with a dog video, robot video or a random motion (control) video. There was no significant effect from exposure to dog videos (or control) on emotional recognition; however, participants performed significantly worse on the task following robot exposure. A follow up study was conducted (184 participants) and new videos of all stimuli were used. Similarly, no significant priming effects occurred after dog exposure, but robot priming led to significantly worse performance. This suggests exposure to dynamic dog stimuli does not affect emotional recognition for static faces, or effects are subtle. Regardless, the finding that robot priming appears to worsen emotion recognition is particularly interesting. This may be due to motor resonance, which describes humans' ability to mimic observed behavior and actions, or may be due to pre-existing stereotypes of robots and levels of exposure to them. Further studies with more diverse populations should be undertaken, including live interactions to see if alternative priming effects are displayed for emotional recognition.

8.2 Introduction

So far, live dog interaction has been found to provide benefits – subjective wellbeing and, less often, actual performance – to participants who are experiencing cognitive, social and physical stressors. The focus now turns to the effects of dog interaction on emotion functioning. In particular, the goal is to see whether positive interaction with a dog affects people's ability to recognize emotions from facial expressions. This will broaden our understanding of the dog's role in facilitating emotional functions and as a potentially positive therapeutic influence.

From as early as 12 days old, humans are able to correctly identify facial expressions corresponding to an emotion. Children at the age of 3 years old are able to understand various emotions via words, as well as differentiating between the causes and traits of various emotions (Silver & Oakes, 2001). Evolutionary psychologists believe that women may be better equipped to recognize emotions because they are required to recognize discomfort in their infant offspring to guarantee the child's wellbeing (Rotter & Rotter, 1988).

In addition to being better at perceiving emotion, women are believed to be better signallers of emotion than men because this facilitates communication between mother and child (Rotter & Rotter, 1988; Wojciechowski et al., 2014). However, this may be in part because women are often socialized differently from men in early development; Research shows that men may be better responders to certain transmissions of emotion, where men have been found to recognize anger at a higher frequency than women when anger is conveyed dynamically rather than in static depiction (Biele & Grabowska, 2006). Regardless of gender, evidence from previous research suggests that people generally perceive emotions from facial expression in a similar manner, including across cultures (Ekman et al., 1987). Small differences in facial expression are more likely to be perceived more readily when they

denote different emotions, compared to variations (e.g. intensity) within an emotion (Donato et al., 1999). This suggests that people are generally better at recognising type, rather than intensity, of a presented emotion.

The ability to recognize and perceive expressions of emotions appears to be universal among humans (Wan et al., 2012). The human brain is especially good at detecting the primary emotions expressed by others (Adolphs et al., 1996); such as their happiness, surprise, fear, anger, disgust or state of depression (Kanade et al., 2000; Wan et al., 2012). However, there are some individual differences in emotion perception. The spectrum of Autisms and Asperger's Syndrome are widely associated with difficulties in understanding emotion, and it has been suggested that children who perform poorly on emotional recognition tasks perform poorly on other measures of social skills (Silver & Oakes, 2001).

8.2.1 Emotional Processing due to Priming Stimuli

Exposing participants to stimuli during emotion recognition may affect their ability to accurately identify emotions from facial expressions. Exposure to socially relevant stimuli during a situation or task, commonly known as *priming*, has been used to explain context behaviors, judgments and actions developed during emotion recognition tasks, even when the priming occurred outside of participant awareness (unconscious priming, see Molden, 2014). Priming has been linked to emotion recognition, where the pairing of a priming stimulus (e.g. word) and a target (e.g. facial expression) that shares a common emotional category yields better performance (Carrol & Young, 2005).

Biological agents themselves may influence emotion processing, as many domesticated mammalian species (i.e. dogs, cats) are believed to have emotional states that may influence human interaction (i.e. attachment) (Crawford et al., 2006).

Research has shown that simply watching biological movement (i.e. natural elements) promotes increased attention and fine-tunes sensory capabilities, and many researchers have linked viewing videos of animals to lowered heart rates and increased overall subjective wellbeing (Crawford et al., 2006; Myers et al., 2004; Wells, 2005). Simply viewing living agents may activate systems that process emotion signalling stimuli. Darwin (1965) believed certain expressions of emotion were universal in both man and animal, and exposure to animals is believed to activate dormant emotional processing systems to prepare for a possible interaction, where it would be imperative to read the emotions and facial actions of the interactee (i.e. hissing snake) to adequately react. With regards to a specific animal, the collaborative relationships between dogs and humans for thousands of years has aided in the ability for humans to correctly identify emotional states of dogs from their facial expressions, to prevent overworking and mistreatment of working dogs (Helton, 2009); the reciprocal is also true, as dogs have the ability to recognize minute changes in human facial expressions that denote different emotions and their intensity (Hare & Tomasello, 2005; Warden & Warner, 1928). Due to their unique personal relationship with humans, dogs are a top candidate for such investigations (Wan et al., 2012), including their potential role in emotion priming through simple exposure.

People viewing videos of dogs report increased wellbeing compared to those watching equivalent control videos (Finkbeiner et al., 2016) and this emotional reaction may trigger or prime emotion processing systems. Dogs promote emotion recognition in Autistic and Asperger's Syndrome children, where dogs exist in the moment and deliver the "patience" needed for social development in these children that humans often might not offer (Solomon, 2010). Studies have shown that dogs also promote other types of social functioning, such as increasing social networks (McNicholas & Collis, 2000) and emotional security/recovery (Banks & Banks, 2002; Flynn, 2000; Kruger et al., 2004; Odendaal, 2000).

Robots, unlike dogs, are not living beings that rely on experiencing direct emotions to sustain themselves. However, with advances in technology robots are increasingly described as "social agents" (e.g. Apple's Siri, see Moore, in press), especially when they are biomimetically designed to appear as a human or an animal. Studies show the more a robot looks like a living being, the more often people ascribe emotional qualities to it (Breazeal, 2003; Shibata et al., 1999). Bartlett et al. (2004) reports that when many children interacted with the Sony Aibo, a robotic toy dog, they suggested that the "dog" needed food and love, suggesting the robot was deserving of ethical treatment. However, few studies have explored the priming effect of exposure to robots on emotion recognition. It is possible that exposure to robots before an emotion priming task may affect performance, as more robots are being viewed in a social nature. However, the priming effect of robots on emotion detection may not be as direct as exposure to a dog; dogs are often in need of immediate emotional response from a caregiver which robots are not (Helton, 2009).

While evidence consistent with the priming of emotion processing systems exists, there are still many who challenge the view that priming is the mechanism responsible for the observed findings. Failure to replicate priming studies (Harris et al., 2013; Shanks et al., 2013) has led some researchers to doubt the reliability or even existence of social priming. Molden (2014) believes that researchers do not fully appreciate the range of phenomena that involve priming, nor the mechanisms for which it supposedly occurs. Nevertheless, it is still worthwhile to assess the effects of different types of priming stimuli on emotion recognition and to continue to develop a theoretical framework for such effects, if they are shown to exist.

8.2.2 Hypotheses

As dogs have been shown to be consistent promoters of emotion functioning in others, even simple exposure to dog stimuli may increase performance on an emotion rating task. In the current experiment, it was thought that participants watching videos of dogs will be more likely to correctly recognize the emotion portrayed by a human facial expression than people primed with videos of robots or a control comprising random movement of lines. People's general affiliation with dogs may increase their positive mood and activate the emotion processing networks of the brain, while viewing non-biological agents like robots or random motion may lead to less positive reports of emotion or even inhibition of the networks that process emotion signalling stimuli (Simmons et al., 2011).

For this study, it is hypothesised that dog videos will enable participants to more accurately recognize the emotions depicted by human faces than those exposed to a robot video. A video of random motion will be used as a control, and it is expected that it will have little effect on emotion recognition.

Additionally, based on previous research we expect to see a difference in ratings for the intensity of the emotion and the emotion type itself (Donato et al., 1999). This is of interest because it may help paint a more precise explanation of priming, and the types of mental mechanisms it can affect.

8.3 Experiment 1

8.3.1 Methods

Participants. Fifty nine students (8 males, 51 females), ages ranging from 16 to 44 years (M = 20.15 years, SD = 3.89) participated in the study for a laboratory elective, and were granted course credits upon completion. Informed consent was obtained from

participants, and the experiment was approved by the University of Canterbury's Human Ethics Committee.

Materials. All stimuli were presented on a computer screen (60 Hz, 40 cm, 96 DPI) in colour. Viewing was unrestricted at a distance of approximately 50 cm. Each video was preceded by a warning message, alerting the viewer of an upcoming video; they were asked to watch the video for the whole duration, without sound, and to begin an emotion recognition task after viewing each video. Participants were not aware of the nature of videos they were about to see.

The dog video was obtained through YouTube, a non-restricted public domain for videos, https://www.youtube.com/watch?v=ug9V5ybP0W0. This video displayed a montage of dog faces, of many different breeds and ages, close up with what appears to be a fisheye lens GoPro camera. The screen occasionally displayed interfering agents (i.e. owners, pedestrians) in the background setting. This video lasted approximately 4 min.

The robot video was also obtained from YouTube, https://www.youtube.com/watch?v=PO76QkJDTas, displaying a montage of vehicular robotic toys, all displaying their unique characteristics (i.e. rolling, crawling, and swimming) and text descriptions of the robots onscreen, with no human interference throughout. This video was externally clipped with free online media conversion software (Clip Converter, Lunaweb Ltd, Garching, Germany) to also last 4 min.

For the control video, random movement was obtained from a screensaver on YouTube, https://www.youtube.com/watch?v=YlsvTNk4SiE, slowly displaying diverse mathematical line equations across a matrix (e.g. parabolas, logarithmic spirals, hyperbolic spirals, etc.) for the duration of the video, also externally clipped to last approximately 4 min. Figure 8.1

displays snapshots of the agents from the video stimuli displayed, including the random motion.
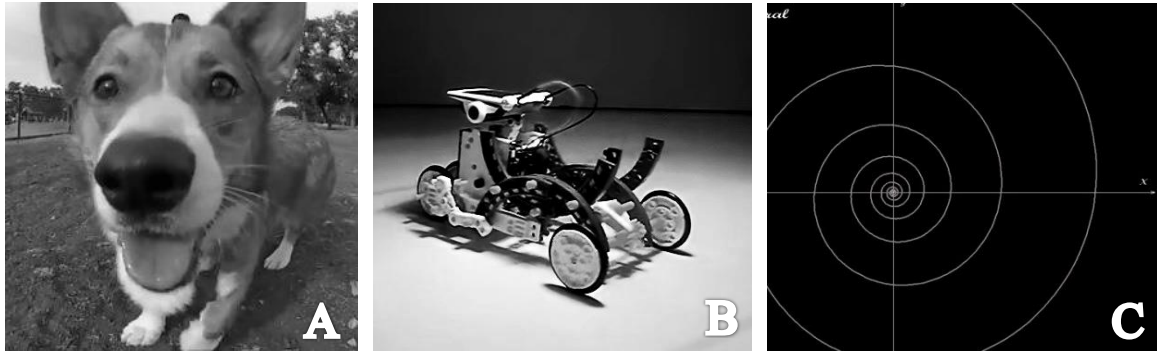
Figure 8.1. Examples of agents used in the (A) dog video, (B) robot video and (C) random motion video displayed for participants during Experiment 1.

The Diagnostic Analysis of Nonverbal Accuracy (DANVA FACES 2) is a photograph database consisting of 48 adult and 48 child facial expressions, reliably displaying facial expressions corresponding to emotions as well as their intensity levels (Nowicki & Carton, 2010). Four emotions are represented in the DANVA FACES 2: happiness, sadness, anger and fear. Two intensities for emotion are also present, high and low. Equal emotion type representation is displayed in the adult and child photos (e.g. 1 Happy: 1 Sad: 1 Angry: 1 Fearful), as well as intensity, and rating by original observers as correct emotions by at least 80% of the participants (Nowicki & Carton, 2010). Twenty-four adult faces as well as twenty-four child faces were selected from the DANVA FACES 2 for use in the current study (48 in total, seen in Appendix C). The selection contains equal numbers of male and female, as well as displaying different age ranges and ethnicities.

Procedures. Participants were gathered in a computer room at individual cubicles and instructed to turn off all cell phones, refrain from talking, and to remove watches. Participants were informed that they would watch a silent video and then complete an emotion

recognition task, which required them to select the best description (happy, sad, angry or fearful) of the emotion portrayed by a photographed face, and to indicate the intensity of the emotion portrayed by the face. Every participant watched all three videos and made emotion and intensity judgments to all 48 photographs after watching each video. Participants were given unlimited time to respond.

Participants were randomly assigned to one of the six groups which gave complete counterbalancing of the order of presentation of the videos. The 48 facial photographs were presented in the same order for each participant throughout the experiment; only the video presentation order (dog video, robot video and random motion control) differed between participants.

After viewing the first video, the participants were presented with a sequence of eight photographs of adults and then a sequence of eight photographs of children. Participants had to choose the emotion (*happy*, *sad*, *angry* or *fearful*) portrayed by the facial expression in each photograph, and select its intensity (*high*, *neutral* or *low*). Once answers were selected, participants could move on to the next photograph, until all 16 photographs had been labelled, and they were directed to their next video. This process was repeated over the two subsequent video/picture blocks, for a total of 48 pictures.

After completing all recognition and intensity judgments, participants completed follow up questions. These asked participants to indicate which photographs they found harder to rate, by selecting (all that apply) from the options of *males*, *females*, *adults*, *children*, *equally easy*, or *equally challenging*. Questions also examined the participant's relationship with dogs (selecting either *I dislike dogs*, *indifferent to dogs*, *some dogs are great* or *all dogs are great*) and their past experience with dogs (selecting *no experience*, *I know someone that owns a dog*, *I used to own a dog*, *I currently own a dog* or *I have a professional*

knowledge of dogs). Similar relationship and experience questions were examined with regards to robot perceptions (e.g. "What is your relationship with robots?", "What is your past experience with robots?", etc.).

8.3.2 Results

A 2 (participant gender: male vs female) by 3 (preceding video: dog, robot vs screensaver control) by 2 (emotion vs intensity ratings) mixed-design ANOVA was performed on the percent correct emotion recognition and intensity judgments from the emotion recognition task, where gender served as the between-subjects factor and video condition and emotional ratings as the within-subjects factors. There was a main effect for video, F (2, 114) = 14.39, p < .001, η_p^2 = .202, with robot priming video eliciting worst emotion recognition performance between subjects, M =.702 , SE = .015, 95% CIs [.671, .733], in comparison to the dog priming video, M = .772, SE = .011, 95% CIs [.749, .794], and the random motion video, M = .808, SE = .020, 95% CIs [.768, .848]. There was also a main effect for emotion versus intensity ratings, F (1, 57) = 106.80, p < .001, η_p^2 = .652, with overall accuracy of intensity ratings, M = .677, SE = .010, 95% CIs [.656, .698] being lower than correct emotion ratings, M = .844, SE =.016, 95% CIs [.812, .877]. There was no significant gender difference, F (1, 57) = 1.44, p = .235, η_p^2 = .025, and there were no significant interactions, all p's > .20. To follow up on the significant video difference we compared both the dog and robot videos with the control (screensaver). The dog video (M = .782) was not significantly different from the control video (M = .805), t (59) = 1.43, p = .157, $M_{difference}$ = .023, 95% CI [-.009, .055], whereas the robot video (M = .725) was significantly lower than the control, t (59) = 6.02, p < .001, $M_{difference}$ = .080, 95% CI [.053, .107]. The video means are displayed in Figure 8.2.

Follow up correlations revealed no statistically significant effects of prior experience or relationship with dogs or robots, or with difficulty and ability to correctly identify emotions and/or their intensity, all *p*'s > .05.
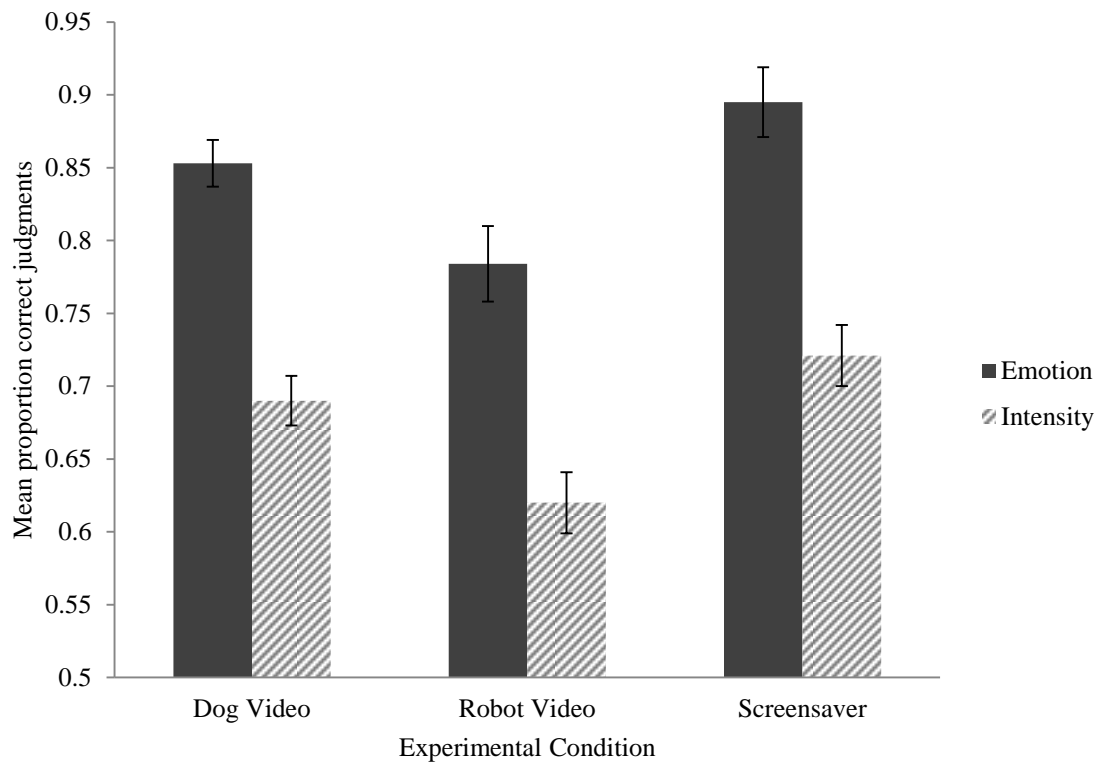
Figure 8.2. Mean proportion correct judgments of emotion and intensity for each static face during the emotion recognition tasks of Experiment 1. Error bars represent standard error of the mean.

8.3.3 Discussion

Video clips of dogs, robots and random motion were used to prime participants before an emotional recognition task, to see if the priming stimuli affected emotion recognition performance. As predicted by the literature, it seems that actual recognition of the static emotions was much more easily performed than the rating of the intensity of these emotions in all video conditions. This may be due to the nature of the task, where identifying emotions is easier than identifying the emotion's intensity. Most photographic emotion recognition

tests only include photographs of emotions containing certain facial actions associated with that emotion (e.g. an "anger" photo requires lowering of the eyebrows, wrinkle of the forehead and typically pursing/stretching of the lips) which have been validated for their emotion component over diverse populations, where intensity is rarely explored (Lucey et al., 2009; Nowicki & Carton, 2010). It may be much easier to detect slight differences in facial actions of separate emotions (i.e. furrowed brows, down-turned lips), but much harder to process the subtle changes of intensity of the same emotion.

However, *both* intensity and emotion ratings themselves were worst for the robot primed trials – seemingly rendering participants less capable of performing correct emotion recognition – when compared to their exposure of either the dog video or random motion control video. This was not expected, as we had hypothesised that priming with dog (animal) videos would activate emotion processing systems, leading to better performance on the task compared to the robot and the control video. Researchers have found that interacting with or simply viewing dogs or other animals alters people's moods and therefore, elicits an emotional response (Finkbeiner et al., 2016). We assumed this activation may trigger improved extraction of emotion identifying information. Relative to the neutral control condition, no evidence was found that prior viewing of dog videos produced improved emotion processing. However, relative to the neutral control, prior viewing of a robot video did impair the ability to correctly identify emotions from photographs of facial expressions. This is interesting, and warrants an additional study to examine this relationship further.

As the observed effects for robotic priming were unexpected, a second study is needed to see if effects can be duplicated. The generalizability of the actual videos used needs to be addressed. It is possible that particular properties of the current robotic video may have induced negative feelings within participants; and similarly the fisheye version of the dogs may have undermined their "doggy-ness", resulting in a reduced potential to prime emotion

processing systems. In a similar vein, Simmons et al (2011) looked at priming by robots to elicit user's social response with anthropomorphic robots. The present robots were not anthropomorphic (i.e. they mimicked vehicles, as opposed to biological agents), so it is possible we may see better emotion processing after viewing anthropomorphic robots.

In a second study, it is important to utilize a new video set: a random motion video with different patterns, a different dog video, and robots that display biomimetic properties (versus vehicular mimicry), to see if similar emotion recognition effects replicate.

8.4 Experiment 2

A follow up study was initiated to examine further emotion recognition based on priming exposure through dog and robotic agents, again examining overall perceptions to robots as well as dogs. Therefore, in Experiment 2 we collected a larger sample and utilized different priming videos, both to test the replication of the overall findings in Experiment 1 and to explore further potential priming effects from exposure to robots and dogs.

8.4.1 Methods

Participants. 184 students (53 males, 131 females), ages ranging from 17 to 58 years (M= 22.01, SD= 6.93) were recruited from psychology courses at the University of Canterbury to participate in the video watching and emotional recognition task. Students completed the experiment during a laboratory course, and were given course credit for participation.

Materials. Materials and methods are parallel to those of Experiment 1, except the change of videos based on previous limitations. Videos were also chosen that were approximately double the time of original exposure, to explore the length of possible exposure effects.

The dog video used in Experiment 1 was replaced with a personally recorded video of a 12 year old male chocolate Labrador – Border collie cross. The 8 min 7 sec video recorded the dog walking in a park, fetching a stick and doing tricks. No people or other dogs appeared in the video which was recorded in full color using a Canon EOS Rebel T3i Digital SLR camera, 18-55mm IS lens, 18.0 megapixels, full HD without audio.

The robot video used in Experiment 1 was replaced with a 2ft-tall performing robot (spinning, lifting its appendages, etc.), https://www.youtube.com/watch?v=4sW3PG48Zqo. The robot was modelled after human movements, and was specifically chosen to explore biomimetic robot exposure. The robot video was displayed for 8 min 3 sec with no sound.

Lastly, the random motion video used in Experiment 1 was replaced by a Windows' 3D pipe screensaver available from YouTube, https://www.youtube.com/watch?v=Uzx9ArZ7MUU. This video was made up of computerized lines moving in random directions all over the screen. This screensaver was edited to display on the computer for 8min with no sound. Figure 8.3 displays snapshots from the three videos.
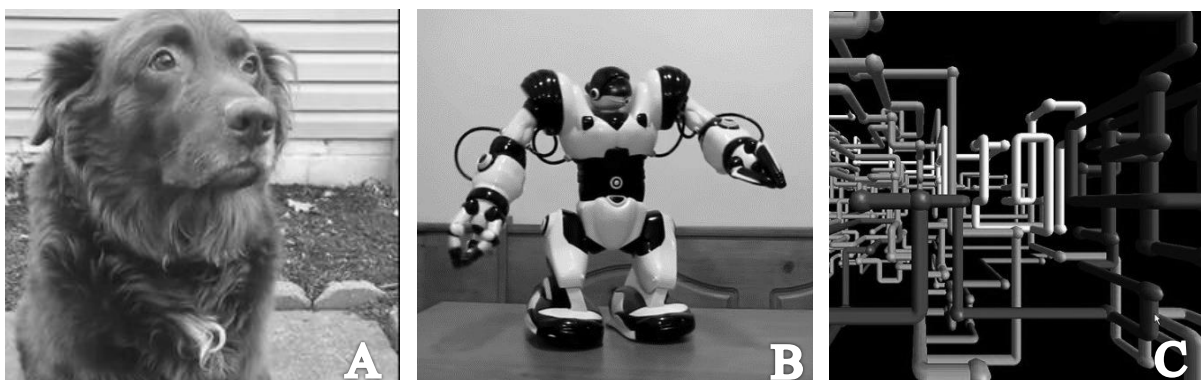
Figure 8.3. Examples of agents used in the (A) dog video, (B) robot video and (C) random motion video used in Experiment 2.

Procedures. Procedures were identical to those of Experiment 1.

8.4.2 Results

Overall Accuracy. We performed a 3 (preceding video: dog, robot, screensaver control) by 2 (total accuracy: emotion vs intensity ratings) mixed analysis of variance on the percent correct scores from the emotion recognition task. There was a main effect for accuracy, $F(1, 549) = 921.33$, $p < .001$, $\eta_p^2 = .627$, with proportion correct emotion judgements, $M = .855$, $SE = .005$, 95% CIs [.846, .864] being more accurate than intensity judgements, $M = .679$, $SE = .005$, 95% CIs [.670, .688]. There was also an interaction effect for accuracy and video exposure, $F(2, 549) = 4.44$, $p = .012$, $\eta_p^2 = .016$, where total accuracy of emotion recognition was lowest when subjects were primed with the robot video, $M = .747$, $SE = .006$, 95% CIs [.735, .759] in comparison to the dog video, $M = .774$, $SE = .006$, 95% CIs [.762, .786], and random motion video, $M = .780$, $SE = .006$, 95% CIs [.768, .792]. Mean emotion recognition accuracy for the priming conditions, separated by emotion and intensity, are displayed in Figure 8.4.

To address this interaction, a separate one-way analysis of variance was performed on accuracy of both emotion type and intensity ratings, comparing video exposure. For emotion type accuracy, there was a significant effect for video, $F(2, 549) = 10.28$, $p < .001$, where exposure to the robot video elicited the least accurate judgments in emotion type, $M = .828$, $SD = .107$, 95% CIs [.813, .844], when compared to emotion type accuracy after exposure to the dog, $M = .856$, $SD = .113$, 95% CIs [.840, .873], and random motion videos, $M = .880$, $SD = .107$, 95% CIs [.865, .896]. Correct intensity judgment differences were non-significant for video, $p > .05$.

A similar one-way ANOVA was performed on total emotion recognition accuracy and *order* of video presentation. There was no significant effect for video presentation, $p > .05$.
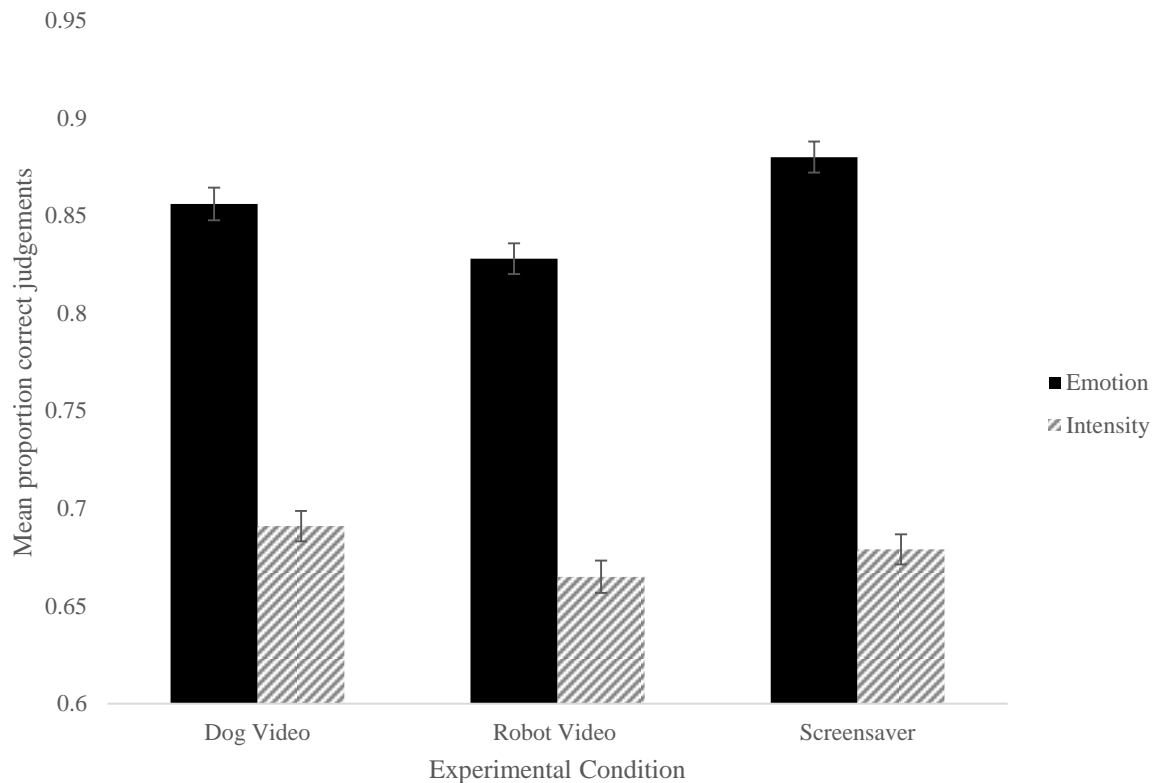
Figure 8.4. Mean proportion correct emotion and intensity judgments for Experiment 2, as a function of priming video. Standard errors are represented in the figure by error bars.

Emotion Analysis. Post-hoc analyses were used to look at the data for patterns that were not specified a priori, to explore the emotion judgements of participants based on the type of emotion and time-relevance of response in relation to the priming conditions. The means of emotion selection were computed for each picture block, in order to assess if some emotional category selections (e.g. happy, sad, angry and fearful) were more prevalent dependent on the priming video that participants were exposed to during that picture block. A 4 (emotion category) x 3 (priming video) mixed analysis of variance was performed on this data. There was a main effect for emotion category, $F (3, 549) = 129.51$, $p < .001$, $\eta_p^2 = .414$, with fear judgements occurring the least frequently for the facial photographs, $M = .761$, SE $= .011$, 95% CIs [.739, .784], in comparison to happiness judgements, $M = .938$, SE $= .006$, 95% CIs [.927, .949], sadness judgements, $M = .930$, SE $= .007$, 95% CIs [.917, .944], or

anger judgements, M = .776, SE = .012, 95% CIs [.752, .799], as seen in Figure 8.5. There

was also a significant effect for video exposure, $F (2, 366) = 44.73$, $p < .001$, $\eta_p^2 = .196$,

where after random motion exposure subjects were more likely to equally represent all of the

four emotion categories within their judgements for that block, M = .896, SE = .007, 95% CIs

[.883, .910], in comparison to dog video exposure, M = .853, SE = .009, 95% CIs [.835,

.870], and robot video exposure, M = .805, SE = .008, 95% CIs [.789, .822].There was also

an interaction effect for emotion category and video, $F (6, 1098) = 37.25$, $p < .001$, $\eta_p^2 =$

.169.
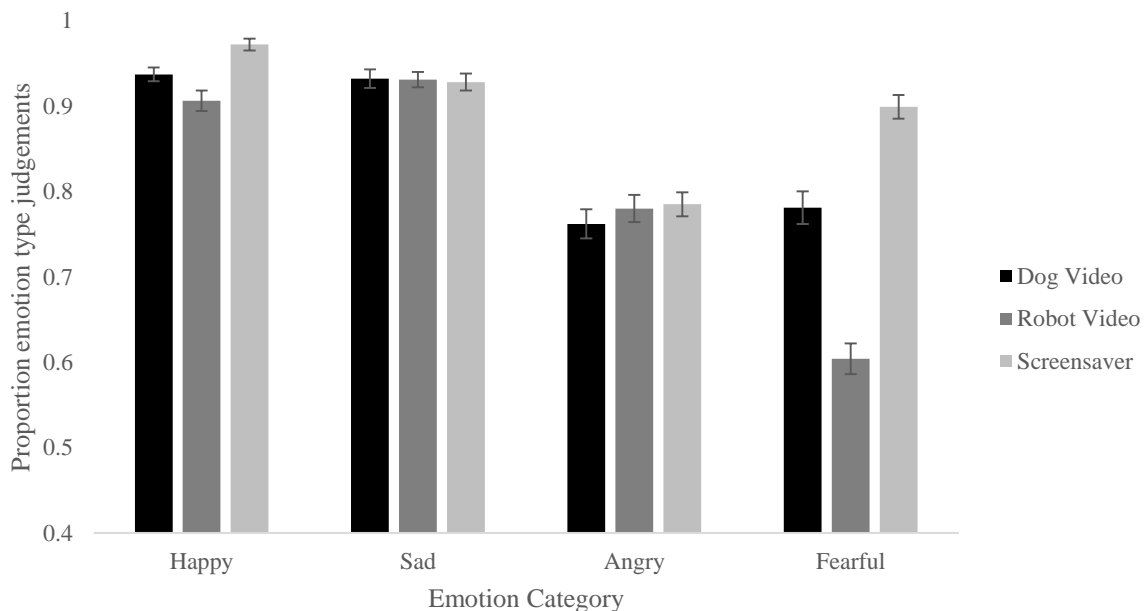
Figure 8.5. Proportion of emotion category judgments for Experiment 2, after exposure to priming
video. Standard errors are represented in the figure by error bars.

To follow up on the interaction, a separate one-way within subjects ANOVA was

conducted between priming videos for each emotion category. For happiness, there was a

main effect for video, $F (2, 364) = 14.96$, $p < .001$, $\eta_p^2 = .076$,where happiness ratings

occurred the least after participants were exposed to the robot video, M = .897, SE = .013,

95% CIs [.87, .92], than when participants were exposed to the dog, M = .935, SE = .009, 95% CIs [.92, .95], or control videos, M = .976, SE = .008, 95% CIs [.96, .99].

For sadness, there were no significant differences between priming videos for rating occurrences, *p* > .05. For anger means, similarly there were no significant differences between priming videos, *p* > .05

For fear, there was a significant effect for video exposure, F (2, 364) = 70.19, *p* < .001, η_p^2 = .278, where fear ratings occurred the least after a participant was exposed to the robot video, M = .605, SE = .020, 95% CIs [.57, .65], than when participants were exposed to the dog, M = .783, SE = .021, 95% CIs [.74, .83], or control videos, M = .897, SE = .015, 95% CIs [.87, .93]. Table 1 displays the means and standard deviations for the correct emotional valence selections, compared between priming videos.

Table 1
Means and standard deviations of emotional valence selected after exposure to the priming videos.

	Happiness	Sadness	Anger	Fear
Dog	0.937 (.107)	0.932 (.152)	0.762 (.236)	0.781 (.261)
Robot	0.905 (.165)	0.931 (.118)	0.779 (.221)	0.604 (.248)
Screensaver	0.972 (.099)	0.928 (.134)	0.785 (.194)	0.899 (.183)

Presentation of Photographs. Although presentation of photographs remained the same for all conditions, it was important to break the picture blocks into halves (e.g. first 8 photographs and last 8 photographs), to explore priming effects based on the relative means assessed at different time levels post exposure to each priming video. Separate one-way within subjects ANOVAs were performed on the mean correct detections of both subsets of each picture block, dependent on priming video. From exposure to the dog video, there was no significant effect for time differences, p > .05. After robot video exposure, there was a

significant effect for time, $F (1, 182) = 9.21$, $p = .003$, $\eta_p^2 = .048$, where emotion recognition ratings were the most accurate in the first half of the picture block trials, M = .748, SE = .009, 95% CIs [.73, .77], in comparison to the second half, M = .712, SE = .009, 95% CIs [.69, .73]. Likewise from exposure to the screensaver video, there was a significant effect for time, $F (1, 182) = 9.11$, $p = .003$, $\eta_p^2 = .048$, although in this case emotion recognition ratings were the most accurate in the second half of the picture block trials, M = .807, SE = .009, 95% CIs [.79, .83], in comparison to the first half, M = .774, SE = .008, 95% CIs [.76, .79].

Follow up questions about perceptions of robots and dogs and their relation to percent correct emotion judgements were analyzed for significance using Pearson correlations. A positive correlation was found between participant's experience with dogs and their feelings towards them, $r = .486$, $p < .001$. No other significant correlations were found between reported relationship and experience with robots or dogs and accuracy on the emotion recognition task, all p's $>.05$. Table 2 displays the response frequencies of feelings towards agent (i.e. *I dislike agent*, *indifferent to agent*, *some are great* **or** *all are great*) and experience with agent (i.e. *no experience*, *I know someone who interacts with agent*, *I used to interact with agent*, *I currently interact with agent* **or** *I have a professional knowledge of agent*) for both dogs and robots.

Table 2

Frequencies (%) for 'feelings toward agent' and 'experience with agent'

	Feelings towards agent (%)			Experience with agent (%)	
	Positive	Negative	Indifferent	None	Some
Robots	55.9	20.3	23.7	74.6	25.4
Dogs	88.1	6.8	5.1	3.4	96.6

8.4.3 Discussion

Experiment 2 served as a follow up examination for the possible priming effects of video stimuli on emotion recognition, and again we see that a robotic priming video seems to have a negative effect on emotion recognition, while both the dog and control videos seem to have no impact on this same recognition in comparison.

Follow up measures indicate that the majority of participants held positive (or neutral) feelings towards robots in general, which leads researchers to believe the effect from robot priming was not due to negative feelings aroused from exposure to the robots. However, the current measures only addressed robots in general, which might have targeted a different set of opinions altogether from the stimuli which the subjects were presented with. Unfortunately poor face validity might have limited our interpretation of the produced effects. Future endeavours should assess attitudes and feelings towards the specific robot video shown, as their pre-existing beliefs of robots might not always coincide with certain robotic exposures (i.e. just as a dog owner may love dogs, they might not be fond of a particular breed).

Nevertheless, the significant results are intriguing, as they suggests something about exposure to robot videos is influencing or inhibiting emotion recognition in static faces. In attempts to make the effects consistent, a longitudinal study should be undertaken to assess if long-term exposure to robotics – in various forms – affects emotion recognition, not only in static photographs, but in real-life contexts. A no-video control condition is needed to further inspect reliability. In both Experiment 1 and 2 the dog stimuli failed to produce any improvement in the emotion recognition task. It is uncertain whether this was due to the particular stimuli used (e.g. dog stimuli) or if it is a general flaw of the procedure. In order to check this, an additional condition which is generally believed to produce improvements in emotion recognition should be incorporated in the experiment (i.e. exposure to adult humans

or infants during priming trials); likewise, to secure a control condition that is known to have a negative influence on emotion recognition, as the current control condition is not very helpful by means of extracting these effects.

8.5 General Discussion

Contrary to the hypothesis, dog videos viewed before classifying the emotions and intensity of emotions portrayed in still photographs of human facial expressions did not enhance either accurate identification of emotions or their intensity. Surprisingly, when participants were primed with robot videos, accuracy of both emotion identification and intensity reduced relative to dog and control videos.

By means of attempting to interpret the dog video vs. robot video effect, it was originally believed that exposure to dog stimuli would lead to an enhancement of subjective emotion evaluation, whereas when primed with robots, the processes required to recognize such emotions would be simply left inactivated/idle. This was not observed, but in fact a negative effect was found for robotic priming compared to the other conditions. Why when both the robotic and the neutral condition should fail to activate –or inhibit– emotional processing, it seems that only the former does this? Considering the neutral stimuli used during the control primed trials would display a simple absence of activation regarding emotional processes, the robot effect observed must be considered a specific form of inhibition of the functional network responsible for processing emotional expressions. This suggests that there are causal mechanisms at play during robot exposure when subjects attempt to classify facial expressions, of which need to be considered.

Deactivation through the resonance system and visuomotor priming. Emotional processing capabilities have the potential to be affected – or even deactivated – by the result of another executive function simultaneously at play. The resonance system, or mirror

neuron system (MNS; see Rizzolatti & Craighero, 2004) describes a number of neural network modules that activate during action and observation. During this activation, items belonging to a stimulus are more likely to be recalled or responded to, during the time which the stimulus is being currently dealt with (Roeckelein, 1998). The presentation of robotic stimuli has been found to activate such systems (Sciutti et al, 2012). The state of this mirror network at any moment may be causally responsible for the subject's performance on the emotional recognition task or only indirectly responsible for the same performance. Simply viewing the robotic videos might have automatically activated said resonance network, which in turn deactivated emotional processing networks and directly affects subject performance.

While activation of the resonance theory can be applied on many levels, and may have led to the *deactivation* of emotional processing, the activation of a certain type of resonance – visuomotor priming – may have been responsible for the observed robotic effect on task judgements.

The famous study by Bargh, Chen and Burrows (1996) – although see Doyen et al. (2012) for a failed replication – shows that participants primed with elderly stereotypes walked more slowly when leaving the experiment than did the control group; this suggests that exposure to a stimulus agent may prime behavior associated with that agent. It is possible that when exposed to the robot videos, participants were primed to behave in context with robotic nature, responding mechanically and repetitively during the emotion recognition task.

There is much literature dedicated to imitative behaviors following priming agents, often referred to as visuomotor priming (Press et al., 2005; Sciutti et al., 2012), utilizing a variety of stimuli which have impacted a variety of behavioral responses (e.g. hand grasping, visual decision tasks). Perhaps seeing robotic agents acting resulted in some mimicry of "robotic behavior" and actually inhibited emotional processing, reducing recognition of the emotions

portrayed by still photographs. There is evidence that patients with diseases that paralyze facial muscles (i.e. Moebius syndrome) have difficulty rating emotions because of an absence of visuomotor priming (Cole, 2001); it may not be farfetched to believe that emotion recognition can be equally affected by the lack of exposure to facial expressiveness in priming agents, such as the robots used in this study. Most current visuomotor priming and motor resonance theorists suggest that mimicking behavior of a mirror agent involves mimicking their motor responses (Press et al., 2005; Sciutti et al., 2012), but there is no research which suggests this may apply to the processing of stimuli that carry emotion information. However, emotion itself may be grounded in motor behavior (Leventhal, 1984). This is even a hallmark of early theories of emotion processing; the James-Lange theory (Cannon, 1927) and modern embodied approaches to emotion also suggest grounding of emotional labeling on motor behavior.

It may be possible that when exposed to the robot group, participants are visuomotor primed which impairs emotion recognition further from the robotic, emotionless movement (Press et al., 2005). Press et al. (2005) tested this visuomotor priming theory with robotic movement and human movement stimuli, and though they found that exposure to the human movement stimuli more effectively primed participants to repeat three desired hand movements (e.g. opened hand, closed hand and gripping hand), they also found that the robotic movement was sufficient to elicit automatic imitation (i.e. imitating the robotic movement, although it did not completely match the desired hand movement).

Automatic imitation has traditionally been examined in most behavioral studies through means of reaction time and performance error measurements, analyzing its "priming component" (Sciutti et al., 2012). It is possible that this idea stems from the "chameleon effect", unconscious mimicking of mannerisms, expressions and other behaviors of one's interaction partners so that the participants behaviors unintentionally matches the other; this

phenomenon is important in human behavior, relating to acceptance into environments (Chartrand & Bargh, 1999; Sciutti et al., 2012). This imitative interaction (i.e. humans mimicking robots) is believed to be amplified with direct interaction with robotic agents, versus the use of robot videos (Sciutti et al., 2012). Similarly, mimicking robotic "emotiveness" may essentially be a further form of motor resonance, influencing the observer's motor control system during action perception (Sciutti et al., 2012). Motor resonance has been researched in context mostly with humans mimicking robotic movements and actions, rather than cognitive robotic mimicking (i.e. displaying 'robotic', mechanical judgments in context) (Sciutti et al., 2012). This coincides with the theory of visuomotor priming, suggesting observing the monotonous, mechanical nature of robotic movement may have elicited monotonous, robotic behavior during the emotion recognition task (Press et al., 2005; Sciutti et al., 2012; Craighero et al., 1996).

However, many researchers argue that robotics do not support visuomotor priming. Meltzoff (1995) found that infants (18 months old) could complete a task after demonstration by a human adult, but not when it was demonstrated by a mechanical device. Similarly, Castiello and colleagues (2002) reported that a human model of grasping an object influences maximum grip strength and velocity in participants, but no such influences were found through exposure to a robotic model performing the same task with the same object. It is possible that robots do not affect visuomotor priming as the main function of this imitation and the cognitive systems involved (i.e. mirror neurons) are thought to be linked to mental states of biological agents, of which robots are not (Gallese & Goldman, 1998; Press et al., 2005). To effectively test the hypothesis of visuomotor priming relating to the current study, reaction times must be recorded and test trial should immediately follow each priming trial, to gauge the most accurate responses in the attempt of study replication. Both of the current

studies failed to record reaction time during emotion labelling, due to software limitations, which might have provided a more sensitive measure towards assessing the priming effect.

Inhibition through robot perceptions and exposure. It is possible that the trends we are seeing within the robotic videos are not due to visuomotor priming per se, but due to a separate occurrence entirely. One possibility, aside from a kind of behavioral mimicry, is that viewing unemotional robotic agents in some manner prevented, or inhibited, the emotional processing networks of the human brain. No one expects to make emotion ratings of robots because everyone knows robots do not have emotions; therefore, just as one does not activate "speech" mental tools when attempting to prepare a meal, "emotion processing" tools are likely actively put away from reach when looking at robots. A current example of inhibited emotional processes can be seen from activity changes in the default mode network (DMN), which has been linked to impairments in internal monitoring and emotional regulation ability in major depressive disorder patients (Shi et al., 2015). One way to follow up on this possibility would be to replicate the study using brain imaging.

Perhaps the results obtained in the robot-priming condition could have been attributed to pre-existing attitudes towards robotic agents, which may in some part be influenced by media exposure where robotic agents are typically associated with unemotional and sometimes negative actions (such as the movie *Terminator*). In a study by Williams and Bargh (2008), they found that when participants were unknowingly asked to hold a cup of hot coffee before engaging in a personality judgment task, they judged a target person as having a significantly "warmer" personality (i.e. generous, caring) without the person's awareness, in comparison to those holding a cup of iced coffee. Although their results did not show an inverse priming effect like the current experiment (they did not incorporate a control condition to assess such things), this phenomenon may still transfer over to robot exposure, where a preconceived notion affects actions subliminally (i.e. seeing a robot, associating it with negativity, and

reacting negatively). Similar studies have explored negative attention-capturing stimuli and the disruption towards cognitive performance (Eastwood et al., 2003). It is not far-fetched to believe that priming, even at the minimal level, has vast effects on subjective and objective performance.

Some may refuse the notion that robotics in media are always represented in negative terms, as there are many positive robotic agents all throughout media (e.g. the movie *Wall-E*) and have everyday impacts (e.g. Apple's *Siri*). Despite the amount of positive robotic agents, a negative representation towards robotics nevertheless does occur on occasion (i.e. similarly as Pitbulls get a negative reputation, although Pitbull owners would often claim otherwise), and may have impacts on negative feelings towards robotic agents, such as anger or fear (which might be explained through the emotional valence recordings). In actuality, based on follow up questions we see that many participants reported holding positive feelings, if not at least intrigue, towards robots. This may mean that the robot stimuli used in the current studies might have induced a different psychological reaction than what encompassed the participant's personal "robot" schema.

In comparison, the uncanny-valley theory (Mori, 1970) asserts that the more a robot resembles a human, the more the observers' emotional response to the robot will become increasingly positive and empathic to a point where the reaction abruptly turns into a repulsive one (where detections in the minute differences of facial expressions are seen as disturbing). The robot stimuli displayed in the current videos were actually much different from human beings; whereas according to the uncanny valley theory, they would produce positive reactions in the human observers. Although, considering the uncanny valley asserts that human-like robots increase empathy to a certain point, maybe the biomimetic robots displayed in the current videos did not increase "empathy" and therefore did not increase

emotional functioning during the robotic exposure. However, this holds little relevance to the current study, as humanness simply was not manipulated.

Apart from *opinions* about robots, maybe the observed effect can be linked to exposure levels, as the majority of subjects reported having little previous robot exposure/knowledge (where virtually all participants had some past experience with dogs). Maybe this perceived mystery led to biased judgments, therefore affected the emotional processing needed to perform well on the task. A study by Riek and colleagues (2011) found that the more movies a person has seen involving robots (regardless if the movie was positive or negative), the more likely a person was to report positive feelings towards robots. This suggests that increased exposure to robots may increase positive feelings towards them, which may in turn affect emotion recognition or other dependent variables.

Post-hoc assessments (valence and recency). While subjects performed the emotion recognition tasks, they were exposed to human faces and human emotion for a certain duration, which may have inadvertently influenced subject performance like previously mentioned. It is possible that performance was greater affected immediately after priming than it would be later on in the trials; similarly, it is possible that exposure to the priming content (either video conditions or facial photographs) alluded to emotion categories being chosen at a higher frequency by participants when primed with the corresponding emotional state. In order to better understand the obtained effect and at an attempt to clarify the nature of the unexpected outcome, post-hoc analyses were ran on the data for Experiment 2, examining the rate of emotion categorization and evaluation of possible recency effects.

For emotion selection and categorization, we would expect to see that when subjects were primed via robot video, they would make more 'negative judgements' or increase in the ability to detect levels of fear and anger (if based on negative attitude assumptions).

Similarly, we might expect that when primed with dog stimuli, subjects made more 'positive judgements' or increase in the ability to detect levels of happiness, whereas one would expect the neutral priming to produce unbiased judgements.

Emotional categorization differences show that when participants were primed with a robot video before emotion recognition, they were less able to correctly recognize happiness and fear from the photographs, than after exposure to the dog and control videos. As previously described, some may argue that this may be because of the nature of the priming videos (i.e. emotional valence inducing emotional judgments). However, we would expect accuracy to be high for happiness when primed with the dog video, in comparison to the other priming videos, which is not apparent. Instead we see that when exposed to the control video, the most accurate emotion categorization judgments occur; the "neutral" state of the control video may have enabled participants to make the most accurate judgments, untampered by induced emotional states. Still, it is curious that some emotions were not impaired (e.g. sadness, anger) whereas others were (e.g. happiness, fear), thus would be a noteworthy avenue for future investigation.

To assess possible contamination of human facial exposure during the emotion recognition trials, means of recognition scores were divided into two halves for each priming block to enable us to assess a possible recency effect. While results indicate that emotion recognition after dog video exposure was non-significant, we do see relative changes based on time assessments post-exposure to the robot video and screensaver video stimuli. Results suggest that correct detection of emotion was initially impaired after exposure to the screensaver (control), although it appears this was only confined to the initial photographs displayed as emotion detection ability was quickly rectified post-exposure (as there are no long-term effects on emotion recognition capability visible from exposure to the control video). However, for the robot priming trials, it seems that the effect towards emotion recognition

had a time delay, where ratings during the last half of the trials post robot exposure show to be more negatively affected.

Although it appears emotion inaccuracy is most prominent in the later trials (when we would expect to see the most influence from robot stimuli immediately after exposure), it is uncertain to make judgments regarding the effect as there are many shortcomings present in this analysis. A no-video control was needed to assess the relative effects the videos had on recognition judgements, and to see if time effects were actually present. Similarly, because all pictures were presented in the same order to all participants, a confound would have existed between picture order and picture identity, making it uncertain to know if the effects found were due to time assessment or picture difference. Even considering these limitations to assess a potential "recency effect" based on inadvertent human facial contamination, it now seems there is potential for a "latency effect" (i.e. the trials may take a longer time to produce true effects based on the priming videos), as seen in evidence of a delay in the robot priming effect. While it may require a human stimulus control group to assess emotional contamination in further investigations, it may also require prolonged stimulus exposure (regarding the latency hypothesis) to observe a "true" priming effect, for robotics and even dog-primed trials.

Apart from the discussion surrounding the causal mechanisms underlying the observed robot priming effect, it is still worth noting that overall intensity ratings were worse than emotion categorization ratings after all priming videos in Experiment 2. A potential issue for this assessment is that intensity values are likely not categorized as an absolute in real life; one may be sensitive to an intensity of a facial expression without the ability to settle on the same absolute level as the standard for the Nowicki and Carton (2010) facial database. This warrants future studies on the impact of correctly identifying intensities of facial expressions, and what constitutes a "correct" labelling. Additionally, altering the presentation of facial

photographs during the task (i.e. containing like-valence depictions to different trial blocks) might help elaborate on the potential priming effect gathered from the facial photographs alone, and in conjunction with the priming videos.

Another possibility which should be explored is whether this simply resulted from a demand characteristic of the task itself. Perhaps, participants thought they should be more unemotional after viewing the robotic videos and simply performed in compliance with this belief. Similarly, the task itself may have elicited a self-fulfilling prophecy where participants may have produced what they thought were deemed "appropriate" results in context of the study, based on their own personal hypotheses and willingness to help; To prevent this possibility in the future, withholding information about the nature of the videos to potential participants and collecting questionnaire data relative to socially desirable responding (e.g. "Do you always respect authority?", "Do you shout when you are angry?", etc.) may help assess the real reason behind the effects produced.

8.5.1 Conclusion

Despite our failure to predict what would happen as we believed viewing the dog videos would activate emotional processing systems and thus, facilitate emotional categorization, these two independent studies both produced similar results. Viewing dogs was not found to facilitate emotional recognition and categorization (at least in comparisons to the control videos), but instead viewing robot videos did impair the accuracy of identifying the emotions portrayed by photographs of human facial expressions. These findings should be considered preliminary; further research is necessary to determine if this is an acute or potentially chronic effect, as it was uncertain in these experiments if the priming effect could be long-lasting or if it would only limited in time or to a small number of photographs after each displayed video (we see a little bit of dissonance for this time effect between

conditions). It has been reported that people with emotional processing disabilities are benefitted by long term interactions with dogs and other animal agents (Hare & Tomasello, 2005); although again we did not see a short-term effect here with nondisabled individuals. Does long term interaction with robotic agents or simulated robotic agents impair emotional processing? Similar questions have been raised about long term video game playing impairing empathy (Bartholow et al., 2005; Hare & Tomasello, 2005). Although, if it is possible that robotic frequentation could "dehumanize" human beings, it is even possible that the prolonged interaction between humans and robots would induce humans to "humanize" robots, which may have reverse effect on emotion than those observed in the current study. Nevertheless, this requires immediate research attention as robots are and will become ever more present in our lives.

Chapter 9

9.1 Overview of Experiments

9.1.2 Chapter 2

Chapter 2 served as a preliminary study, investigating the perceptions of dog breed characteristics through facial photograph ratings, with an inclusion of insights for quadrupedal robots. Factor analysis indicated that people generally have pre-established perceptions of breeds that seem to be influenced by physical appearance; generally medium-sized fluffy dogs were rated positive on all aspects, dogs that are large with erect ears were rated negatively on temperament (not nice) but positive on the other two factors, while breeds that are small or extra-large were rated negatively on two of the three factors (drive, usefulness and niceness). This classification is, of course, an examination at a holistic level, where personal opinions of dogs will always be dependent on past experiences and preferences of breed characteristics. Although limited participation did not allow for in-depth analysis, classification is still important to note, as it may affect day to day interaction with certain breeds and gives a broader scope of breed perception and the consequential effects they may have on the wellbeing of participants in the following studies.

9.1.3 Chapter 3

Pertaining to the overarching thesis of dog's effects on psychological wellbeing, dogs are believed to help sustain attention and relieve stress in participants; Chapter 3 begins the investigative research by assessing if the cuteness of a dog helps participates sustain attention during a cognitive stressor. Four blocks of vigilance were interspersed with flashing pictures, where two contained pictures of cute dogs (puppies) and two contained pictures of mature (adult) dogs. In addition, in two of the vigilance blocks (one containing cute pictures and the

other containing mature pictures), the target variables were preceded with a picture (predictive), while the other two blocks displayed the pictures randomly (unpredictive). It was found that cuteness ratings of dog faces had no effect on cognitive performance. However, participants performed better on the vigilance task in the predictive trials versus the unpredictive trials, suggesting that participants were able to anticipate when they needed to respond to a target variable based on the salience of the dog stimuli. This suggests that predictively-paired stimuli can often be predictive of correct responses, if used in context of vigilant performance, which has applications for predictable situations (e.g. dental surgery) but not so for randomly occurring targets (i.e. friendly fire scenario). However it does not provide any support to the attention-promoting theory of 'cuteness', much less to general dog exposure.

9.1.4 Chapter 4

Chapter 4 extends the cognitive performance examinations, but this time rather than static pictures of dogs, videos of dogs were used. The aim was to assess whether viewing dynamic motion of dogs may help sustain attention during a vigilance task. To this effect, a vigilance task was interrupted midway by a break in which people witnessed either a dog video, robot videos, or a countdown displays. It was found that a control group who experienced a continuous unbroken vigilance task with no break displayed the poorest overall detection performance, but no significant differences in performance were evident between groups viewing a dog, a robot, or countdown during the break interval. However, subjective reports of stress indicate that watching a dog video during the break interval reduces stress and increases positive indicators of wellbeing more than watching a robot or experiencing a complete break with countdown. This suggests that exposure to dogs (in dynamic form) has a positive effect on the emotive state during a cognitively stressing task, although there is no evidence that witnessing dogs aids performance.

9.1.5 Chapter 5

The preceding experiments failed to produce evidence that exposure to static and dynamic images of dogs facilitates cognitive functioning during vigilance tasks. In Chapter 5 rather than use captured images of dogs, interaction with a real live dog was introduced to see whether such interaction has sufficient therapeutic capacity to reduce emotional eating habits during a cognitively stressing task. Results suggest that exposure to live dog interaction during a break in vigilance task led to decreased task stress and/or boredom which manifested in "emotional eaters" eating less over the course of the cognitively stressing task, in comparison to a break of dog videos, countdown display or continuous vigil; however the causal relationship between stress, emotional eating and interacting with a dog is unconfirmed. GSR measures of positive emotional valence and self-reports of positive affect were highest during the break session for participants who experienced live dog interaction, relative to those watching a dog video or an empty break with countdown. This illustrates that live dog interaction has at least short-term capability to reduce experienced stress levels. Results also indicate that relative to an unbroken vigil, a break of any kind facilitates greater detection performance and reduces negative valence.

9.1.6 Chapter 6

The role of live dog interaction is extended to the wider domain of emotion functioning in Chapter 6. Specifically the potential for petting a live dog to relieve stress and promote heart rate reduction is compared to common relaxation activities. Ten minutes of positive interaction with a Labrador retriever increased self-reported feelings of wellbeing and decreased negative reports following a socially stressful situation (public speaking and public performance of demanding mental arithmetic) similar to meditation, but more so than a simple reading intervention. This suggests that comparable with other forms of therapies,

positive dog interaction may reduce stress and enhance feelings of wellbeing after a

experiencing a socially stressful situation. However, Chapter 6 failed to include a follow-up

stressor following the dog interaction to see if the positive affect experienced during the dog

interaction period persisted to have beneficial effects when encountering later a stressful

situation.

9.1.7 Chapter 7

Chapter 7 examines motivation effects through exposure to a live dog (Border terrier),

in comparison to other physical stimuli, mobile (a robot) and immobile (a stuffed toy), for 10

minutes. This experiment used two isometric holds (e.g. baseline and post-interaction) to

assess physical endurance, while the 'motivator agents' (e.g. stimulus conditions) were

assessed for their ability to relieve stress and promote endurance during these exercises.

Duration times for the post-interaction isometric holds were not affected differently by the

interaction stimuli, and heart rates for participants were the lowest during the interaction

activities, which accounted for the rest in physical activity with no relevance to the stimulus

condition a participant experienced. No differences in ratings of perceived effort were found

between exposures to dogs, robot, and stuffed toy, but participants in the dog petting

condition reported experiencing lower levels of stress during the second exercise in than the

robot and soft toy conditions. It is evident from the previous experiments that while

participant performance (cognitive and physical) is not affected by dog exposure, the emotive

state of a participant may be altered through exposure to dogs.

9.1.8 Chapter 8

In the last experiments, the focus is once again returned to emotion processing, this

time to assess if recognition of the emotions portrayed in static facial photographs is more

accurate when participants are primed by viewing positive dog stimuli, in comparison to

other stimuli. For this experiment, it was appropriate to revert back to dynamic stimuli to control for the exact amount of time a participant was exposed to a priming agent; robot videos were again used as comparison to a dog video, and a new control video featured random movement of line and curve segments. Analysis of emotion identification accuracy indicated an unexpected result; relative to a neutral control condition priming participants with dog videos had no effect on emotion recognition accuracy, but priming participants with robots videos rendered them relatively incapable of correctly identifying emotions or the intensity of emotion portrayed in static pictures of facial expressions. Therefore, a follow-up experiment was implemented using different stimulus sets and an increased number of participants to see if the findings could be replicated. Again, it was found that dog and random motion videos had no effect on the recognition of emotion type or its intensity, but robot priming seemed to 'dim' this ability.

Initial hypotheses anticipated that being primed with positive dog videos would enable subjects to detect facial expressions from static photographs more accurately, compared to priming from robot videos and random motion (control) videos. It was believed this occurred because of the close relationship between humans and dogs, where even minuscule changes in facial expressions (for both humans and dogs) help promote reciprocal communication. However, no differences in face recognition accuracy were found between the dog and control priming conditions, but those witnessed robot videos displayed significantly poorer emotion recognition. Under a host of possible influences, it is proposed that *visuomotor* priming might be in play – where participants are almost primed to act in a "robotic" manner when presented with an emotion recognition task immediately after viewing a video of a dynamically moving robot and therefore incapable of being attuned to the nuances of expressions. Additionally, the amount of exposure a person has had previously with robots (i.e. less exposure may lead to harsher priming effects, affecting task

performance) may have influenced these findings. Although intriguing, unfortunately this unexpected result did not give us the insight into dog-primed emotional functioning that was hoped.

9.2 General Discussion

All of the experiments included in this dissertation were designed to assess the overarching theme of wellbeing via canine association using a top-down approach. The degrees of short-term canine exposure in a laboratory setting (static, dynamic and live) and types of psycho-physio-social benefits gained were analysed using different exposure types during different situational stressors. The combined results from the seven separate experiments presented in this thesis provide indication of the effects of dogs on mental wellbeing. None of the experimental results suggest that inclusion of dog stimuli during a cognitive task aid cognitive performance thus provides little support for the Attentional Restoration Theory - when exposure to dogs is regarded as a natural stimulus for promoting attention. Similarly, little evidence was found that exposure to dog stimuli affects performance during emotion-associated tasks. However, exposure to dog stimuli seems to repeatedly decrease subjective reports of stress, and promote positive feelings of wellbeing. This indicates that people are able to feel positive moods and even enjoyment through exposure to canines during – and in some cases *after*– experiencing a task that is demanding of them mentally, physically or emotionally. In the workforce it is possible to complete a job when experiencing stress and a negative outlook, but ensuring task enjoyment and positive affect may prevent work burn-out. The finding that dogs enhance positive affect has applications for animal-therapy practices, and suggests that animal-friendly offices and campuses may be beneficial.

In Chapter 5, it becomes observable that dog exposure may be influencing more than subjective reports. Here we see physical evidence of decreased chocolate consumption during a cognitive stressor in emotional eaters for both of the dog conditions – compared to a countdown and a continuous vigilance control. While it is uncertain if chocolate intake was reduced over the course of the vigil due to extraneous variables (i.e. time of day, cravings), there was still a reduction in eating after exposure to the dog break conditions. This suggests that simple dog exposure – not just through ownership like much of the literature suggests (see Siegel, 1993) – can have positive effects on physical health and it is possible benefits may expand (i.e. decrease in weight over time) based on increased exposure. However, it is more probable that rather than directly reducing emotional eating, the dog interventions simply relieved momentary or state stress caused by the vigil and this impacted food consumption (which may have been boredom driven) for the short period. There is a need for further research to determine why lack of novel stimulation or intense concentration may increase food intake, which may help to explain some of the underlying mechanisms at play in such scenarios.

While the majority of the current dissertation's chapters provide subjective evidence of a dog-effect (i.e. increased positivity), the null effect of dog priming and *negative* effect of robot priming displayed Chapter 8 seems somewhat divergent in comparison to the preceding experimental findings. It was not an objective of Chapter 8 to find priming effects from robots on emotion recognition, but the results are still fascinating; this suggests that robots may be subconsciously affecting people more negatively than is believed (which may be extraneously affected by experience, exposure levels and stereotypes).

However, can the same negative effect be a potential issue for robotic dogs (or robo-pets)? On the contrary, the Sony Aibo has been seen hyper-anthropomorphized by toddler-age children, suggesting that the robo-dog possessed more dog qualities than robotic, and was

deserving of basic welfare needs including "love" (Bartlett et al., 2004). More human-interface engineers are designing robotic technology that mimics the human-dog interaction, and because of which, it is evident that many already intrinsically believe in the importance of such a bond (Bartlett et al., 2004; Szabo et al., 2010). There seems to be uniqueness to the animal-human relationship from evidence of its heightened value within modern society and family networks (i.e. the rise of animal welfare groups, veganism and hunting laws). As social media trends highlight, animal tragedies involving human force often circulate globally (e.g. Cecil the Lion, Harambe the Gorilla) while fatal animal attacks rarely do – a surprising moral complexity. The animal-human bond often elicits a certain level of empathy (animals being non-malicious) that human tragedy seldom does based on human capability to harm out of spite and ill-intention; although see Herzog (2010) for a broader discussion on the dilemmas surrounding the *types* of animals people often subject to compassion, hatred and consumption. This sheds light on the reasons humans often seek out animals, for comfort and restoration through companionship or simple observation. As human affinity for mammalian animals continue to grow, it is possible that animal-mimetic robotics may be perceived in a more positive light for a prolonged period compared to human-mimetic robots.

Can future engineering create companion/service robots to assist, or essentially take the place of dogs when the situation requires it? All dog owners are familiar with the financial costs of their canine companion (e.g. feed, veterinary care, hygiene products). Utilizing robo-dog companions will cut a lot of these costs while posing less of a threat (e.g. dog bites) and increasing reliability compared to their unpredictable models, which can assure a job is completed without any extraneous circumstances (e.g. distraction, temperament, disease, starvation) to prevent performance. It remains a question as to whether the human-dog bond can ever be replicated, and if so, by what means. Is fur, sound and physical warmth needed in a robot to make the intractability levels match the positivity of a

live dog, or will this incur a separate reaction altogether? As the uncanny valley theory (Mori, 1970) insists, robots replicated from humans reach a critical point of similarity to where their minute distinctions invoke disgust within the observer. It is possible that a robo-dog replicated as an 'exact' copy of a canine may actually elicit negative arousal, inducing feelings such as hatred and fear.

Even *if* a robot can mimic all of the benefits that encompass dog ownership, there is still debate on the mechanisms involved in positive and negative arousal produced by exposure to animals of any kind based on how they appear (i.e. scary animals vs. cute animals vs. sweet animals). The theory of cute aggression has been recently proposed by Dyer et al. (2013), who found that when people were given bubble wrap to play with as they wished during a photo slide show presentation, people tended to press more bubbles aggressively when exposed to the cutest animals, versus seemingly neutral ones. Similarly, the need to embrace or be "aggressive" towards a cute animal may result in eating more frequently, as the participant may not know how to express the displaced affection, resulting in mild frustration. Chapter 2 similarly highlights that stereotypes and perceptions can have bases in the physical appearances of dogs. These physical properties of dogs will likely be customizable when transferred to robotics (e.g. length of fur, nose size selection, eye color preference).

Humans are accustomed to choosing a "model" – car, house, dog, etc. – of their desire. If robo-dogs are mimicked as a certain breed (which in and of itself is attached with certain pre-existing stereotypes) including temperament-programming, it is possible that the traits the robot was selected for initially may produce unintended negative effects down the line, based on the breed it is modelled after (i.e. if a robot is selected for protection, subjective fear may increase if it is modelled after a breed that is often deemed as "scary"). Further, temperament-programmed robotics themselves have been found to elicit anger and

aggression within subjects, especially when the robotic agent is perceived to be less-human (Di Nucci & Santoni de Sio, 2016; Greitemeyer & McLatchie, 2011). As Chapter 8 clearly shows, we still are unclear about how underlying perceptions of robots can affect our subconscious thoughts, and therefore our actions. As this exists, it may be wise for ergonomic researchers to further their investigation with human-interface technology and perceptions of such, by means of preventing automatonophobia, before mechanic attempts to replicate the human-dog bond are implemented out of necessity if dogs cease to exist – in the *hopefully* distant future.

9.2.1   *Novel Scholarly Contributions, Limitations and Implications*

The collective studies have many real-world implications, providing a wide overview of dog perceptions and the role they play in our everyday. It shows for the most part, that dogs are viewed positively within western society, as they tend to elicit positive affect measures from observers/interactees. However, stereotypes still exist. Dog selection may be affected via stereotypes, such as promoting false assumptions that may lead to future complications in the selection process (i.e. individuals against a dog because it was 'bred' to fight, even though not all are aggressive) and could potentially impact health (i.e. mine-detection dog that prevents leg explosion because of its small size, when normally a larger dog would be assumed for the task). Then comes into question what types of dogs are on the market and *who* is providing them (i.e. backyard breeders tend to breed "bully" dogs, while Kennel Associations breed "beautiful" dogs, but who is breeding "happy" dogs?), increasing these perpetuating stereotypes – though the association may not be wholly relevant to the current depictions (Bennett, 2016).

As selection biases already occur within dog selection, the three types of live breeds used within the current research may aid in breed-based knowledge and specific benefits.

Although all three breeds in Chapters 5, 6 and 7 provided similar insights into the specific psycho-physio-social benefits of brief, positive dog interactions, there seemed to be mixed responses when participant opinions were accounted for. The Welsh corgi used in Chapter 5 mostly provoked positive reactions. Many people enjoyed this dog, commenting on its friendly nature and soft fur. However, a few participants expressed a desire for the dog to be more social, as often it moved away from the participant and wished to be solitary. In Chapter 6, two Labrador retriever mixes were used for live dog interaction, and participants overwhelmingly reported more positive responses after completion of the task (many responses unprompted), in comparison to other dogs used in the separate studies.

A small Border terrier was used in Chapter 7, and while participants in the dog condition reported more positive subjective experience in comparison to the other experimental conditions, many still made responses of preferences for a different breed of dog, and many noted on the hyperactive temperament of the dog used. Though these subjective reports are anecdotal, it may pay to evaluate dog interaction in a qualitative way in future research, in conjunction with the quantifiable data demonstrated. All of the dogs used were free roaming within the lab room and were not pushed to interact with participants when they did not wish to do so, though this may have prevented a quality interaction session for some participants. Additionally, these dogs were not certified therapy dogs which may have limited the therapeutic benefits.

Time existed as a limiting factor when generating interest in university-level analyses; experiments of 30mins to 1hr were needed to draw in the number of participants anticipated. This meant that as well as only assessing short-term exposure to dogs, participants were often one-off and could not be cross-analysed when comparing the separate experiments. While the immediate aspects of dog exposure was the main interest of the presented research,

longitudinal studies may be beneficial to examine the length of effect dogs have towards wellbeing outputs.

The value of reliability comes into question when assessing the differences in samples sizes of the separate experiments, as well as the differential stimuli used for each of the collective hypotheses. Button and colleagues (2013) suggest that, while it is often ignored in current scientific methodologies, the majority of results cannot be reproduced when implementing the same methods in different scenarios and reduces the chances of detecting a true effect, which may be problematic when attempting to replicate the current findings. With that being said, the time of day and placement in the week university participants chose to complete the experiment(s) may factor into overall performance levels and perceptual ratings (i.e. participants in the morning may be more focused and in a more positive emotional state than those who participated later in the day). Comparisons of timestamp relative data would be a good inclusion in future endeavors. Additionally, the participants themselves – as university students – may be difficult to generalize from, as motivations for participating in such tasks (e.g. course credit, financial compensation, desiring dog exposure, etc.) and directed effort towards the tasks may vary across students, and would be worth assessing in follow-up measures.

Supplementary breed-based interactions are needed to make comparisons and generalizations about the implementation of dog-based therapies. During these analyses, caution should be executed as negative perceptions are often found to elicit more powerful reactions and have more an influence on effect than a positive perception (which would likely transfer to breed perception), as evolutionarily, negative stimuli has a major impact on behavior (i.e. threat vs. contempt). Research by Wilson and colleagues (2016) found that when participants were primed with pictures of perceived negative stimuli (e.g. spiders, guns) during an attention task, performance was impacted negatively; in comparison, neutral

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stimuli (e.g. chairs, pencils) had no effect on performance outputs. This suggests it is possible that the performance may be linked to bad experiences with certain stimuli presented, or at least a subject's perceptions of them.

However, often when it comes to canine breeds, the perceived "negative" breeds in fact comes into play with stereotypes more so than experience. As the algorithmic phrase "all A's can be B's, but does not mean all B's are A's" suggests, just because the majority of fatal dog attacks occur in "fighting dog" breeds such as the Pitbull or Doberman Pinscher, in fact most members of these breeds are placid, and the breed-attack overlap is in many ways inconclusive. Therefore, it is integral to test the effects of dog exposure within a variety of different breeds, to see if perceptions affect output in a predictable way, or if the positive interactions experienced may hold influence towards reducing future breed discrimination. Chapter 3 hypothesized (although relevant results were inconclusive) that it is possible exposure to different ages and attractiveness levels of dogs may elicit different reactions within the observer. Age-based comparisons (i.e. puppies vs. adult dogs) and attraction ratings (i.e. cute vs. ugly vs. neutral) are needed to provide more substantial evidence towards applications of dog therapies.

We have provided evidence for temporary positive impacts of dog exposure, but there remains a literature gap for longitudinal effects and long-term exposure benefits towards wellbeing. These types of studies should assess the effectiveness of longitudinal exposure, and also the quality of the methodologies. Studies of this extent should regulate the environment as much as effectively possible, such as controlling for novel experiences the dog might be subject to (i.e. ensuring same styles of interaction across participants [petting, tone of voice] and same toys present to prevent negative reactions) and preventing data contamination from the human handlers for each dog. In addition, more physiological measurements – such as cortisol saliva testing, oxytocin blood analysis if presented with

correct equipment, to see if cortisol levels are lowered and oxytocin increases, and to what extent, during the different means of canine exposure.

It is possible that further experimentation may be performed examining stress and attention during dog interaction in more applied settings (e.g. clinical), however these may be independent of findings from the experiments outlined here (depending if the environment is relaxing or unnerving for the dog). Although many animal-assisted therapies have been implemented in special populations (i.e. Alzheimer's, Autism spectrum, etc.) there is still a need to ascertain long-term effects. There is a potential noted for using quadrupeds and robo-dogs in therapeutic studies, but current literature remains uncertain if the benefits will match that of skin contact with a live dog in these situations.

9.3 Concluding Statement

The purpose of this thesis was to perform a series of experiments which systematically assess participant exposure to dogs, and the possible mental benefits a given interaction yields. Each chapter serves to assess this question through different limbs and means of experimentation, existing as separate journal articles, but combining to provide to the general knowledge of dog association and objective- subjective differences. Although the collective results are far explaining intricacies of the human-dog relationship, they do establish a good foundation for future research. Above all else, this dissertation has concluded that whilst dogs do not help improve personal performance, they do help make people feel better, which is arguably the most desirable outcome for therapeutic implications.

The remaining question then becomes, why are dogs making people feel good? While dogs themselves may be positive to look at (aesthetically pleasing), do people automatically associate happiness with dogs based on happy personal experiences, or happiness/friendliness judgements that have been perpetuated through stereotypes? Alternatively, perhaps this

observed effect may be less about the dog, and more so about a possible egotistical reflection as a consequence of dog exposure. While dogs have a reputation for delivering constant affection towards owners and acquaintances, a counter argument to the 'human-canine bond' could be that dog exposure primes feelings of personal praise and gratitude – therefore self-worth – that may not be generated through inter-human relations for some individuals, increasing a personal desire to be around canines. Some dog owners have been found to value ownership as a safe way to feed hidden dominance and power desires, as dogs are often submissive to alpha behavior (Alba & Haslam, 2015). This would also give strength to the debate of dog-owners exhibiting more masculine qualities than feminine (and the reverse found for cat ownership, see Perrine & Osbourne, 1998), as masculinity and power are often associated. Mere dog exposure may induce a similar 'power trip', but that is only speculation. Many of the State Trait Anxiety Index items used were made up of implicit trait factors, such as feelings of 'confidence' and 'life satisfaction', and a breakdown of these separate traits and their scaled ratings would serve beneficial in further exploration. Similarly, specific personality and identification factors (i.e. narcissism, low self-esteem, self-identified masculinity/femininity, etc.) should be assessed when attempting to critique dog therapy effectiveness.

It is apparent within the general anthrozoology (human-animal interaction) literature, there seems to be far more evidence of positive pet effect (i.e. less reported loneliness, lower heart rates, happier, more physically active) vs. no evidence – or even negative evidence – of the pet affect (i.e. no effect on longevity or physical activity, increased reported fatigue, depression, higher heart rate). Is this evidence of cherry-picking studies that only support the assumption that pets are good for us? It is hard to be sure, although an increase in publishing null and negative results would add knowledge to the overall theories surrounding the pet

effect. The current existing body of research seems to conflate a positive cause and effect from pet ownership.

Aside, some may also question the direction of the causal arrow when it comes to the pet effect, or more so, how pets affect our wellbeing. Do pets actually make people happy, or are optimistically-dispositioned people inclined to harbor an innate love for animals more than negative-dispositioned people? The mechanisms required to test this may be more than the current psychometric resources available. It is important to look at human-animal relationships in certain contexts (i.e. preferred activities, proximity, and physical contact) and see if effect differs when in separate contexts (i.e. surrounded by another dog, unpleasant activities, etc.). Even then, it is likely that dog-human relationship dynamics are just as complex as human-human relationships (i.e. friends becoming foes in alternate contexts).

Dog owners themselves often assert that there exists more than a 'bond' between themselves and their canine companion, and would more so describe it as an intrinsic reciprocal 'love' – often highlighting the willingness to share living quarters and limited financial resources with a biologically unmatched being that cannot verbally express gratitude (Coren,1998). However, defining the mechanisms of 'love' within scientific observation continues to remain a nearly impossible task. While genuine feelings of affinity may exist between both pet and owner, it is more likely that feelings transposed on a pet are often based on self-focused perceptions and projected affection, rather than perceptions based on the observable animal behavior, of which is often biased and over-anthropomorphized. For example, instead of observing human-canine 'love', a more accurate explanation of the given situation may be that a pet enjoys an owner's pampered treatment, enjoys owner presence by means of protection and food security, or at a harsher level, a pet manipulates owner actions via reciprocating affection. It is important to satisfy the balance of skepticism and conviction by not only considering anthropomorphic views (i.e. transposing human

feelings on these animals) but also egopomorphic ones (i.e. recognizing the animal as its own entity, of which may possess its own unmeasurable capacities of empathy and love). As such, empathy has a basis in anthropomorphism, so it may be critical to establish if individuals with a higher emotional intelligence will exist as the population that may benefit from dog therapies most.

'Man's best friend' is still in need of further adequate research, being a functioning, highly prevalent member of society. As the canine's role in today's rapidly growing world will continue to expand between disciplines, an urgent call to researchers is needed for examining the complex relationship developed between dog and man, thereby increasing not only knowledge for workforce sectors (all types of service dogs) and positive affect implementations, but also providing baseline insight into canine companionship and love. Dogs often accompany our everyday lives, while habitually assisting our everyday lives, so it is imperative to give canines the proper research attention they deserve.

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Appendix A - Picture stimuli used in Chapter 2, divided into breed categorization clusters based on ratings of drive, usefulness and niceness

Cluster 1: Higher Drive, Useful, Nice

Cluster 2: Higher Drive, Useful, Not so Nice

Cluster 3: Higher Drive, Not so Useful, Not so Nice

Cluster 4: Lower Drive, Not so Useful, Nice

Appendix B - State Trait Anxiety Index (STAI) used in Chapters 5, 6 and 7

*You will now respond to statements regarding **current** stress levels. Do not spend too much time on deciding; just respond with your honest answer. Please **circle** the best answer to each statement (20) that describes how you are feeling AT THIS MOMENT.*

As of right now:	Strongly Disagree	Kind of Disagree	Neither Agree nor Disagree	Kind of Agree	Strongly Agree
I feel calm	SD	KD	N	KA	SA
I feel secure	SD	KD	N	KA	SA
I feel tense	SD	KD	N	KA	SA
I feel strained	SD	KD	N	KA	SA
I feel at ease	SD	KD	N	KA	SA
I feel upset	SD	KD	N	KA	SA
I am worrying about life	SD	KD	N	KA	SA
I feel satisfied with life	SD	KD	N	KA	SA
I feel frightened bad things might happen	SD	KD	N	KA	SA
I feel comfortable	SD	KD	N	KA	SA
I feel self-confident	SD	KD	N	KA	SA
I feel nervous	SD	KD	N	KA	SA
I am jittery	SD	KD	N	KA	SA
I feel relaxed	SD	KD	N	KA	SA
I feel confused	SD	KD	N	KA	SA
I feel pleasant	SD	KD	N	KA	SA
I feel mentally fatigued	SD	KD	N	KA	SA
I feel energetic	SD	KD	N	KA	SA
I feel optimistic about the day	SD	KD	N	KA	SA
I feel easily annoyed	SD	KD	N	KA	SA

Appendix C - DANVA facial photographs displayed in Chapter 8

Adults

Children