Why is Fido Stressed? Crossover of Employees' Job Stress to their Pets

Tanya Mitropoulos

Thesis submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Online Master of Agricultural and Life Sciences

In

Applied Animal Behavior and Welfare

Allie Andrukonis (Co-Chair)

Erica Feuerbacher (Co-Chair)

Charles Calderwood

August 7, 2024

Keywords: crossover, emotional contagion, pet welfare, rumination, stress

Why is Fido Stressed? Crossover of Employees' Job Stress to their Pets

Tanya Mitropoulos

ABSTRACT

Job stress is an epidemic in the United States, with well-being consequences for the employee, their spouse, and their children. Pets, who most Americans view as family members, may also be susceptible to this crossover effect, or the transference of work-related stress and strains from an employee to their loved ones. Given prior support for cats and dogs' abilities to perceive, interpret, and absorb a human's emotions via emotional contagion, I expected that pet dogs and cats of owners with higher job stress would themselves be more stressed. I anticipated that work-related rumination, or the tendency to continue thinking about work during leisure time, would explain this relationship. All variables were measured using self-report scales administered in an online survey, and pets' stress was captured in two ways: as owner-perceived pet stress and as behaviorally indicated pet stress via separate measures for cats and dogs created for this study. The sample included 107 employees, together owning 85 dogs and 22 cats. Controlling for home stress, I found that job stress related to behaviorally indicated stress in dogs but not cats. Work-related rumination explained this relationship. This study unites organizational research with companion animal welfare and pinpoints a potential contributor to impaired canine welfare. This study also supports the presence of crossover and emotional contagion in the dog-owner bond. Employed dog owners should take care to avoid ruminating about work-related issues when at home to protect the well-being of man's best friend.

ACKNOWLEDGEMENTS

Dr. Andrukonis, Dr. Feuerbacher, and Dr. Calderwood. Thank you for your mentorship, feedback, and insight throughout this process. I have benefited from your different lines of expertise and believe they can be seen woven through this project.

Sonia Mitropoulos, Jim Mitropoulos, and Lauren DuBiner. Thank you for being my cheerleaders for this project. You gave it legs and were instrumental in empowering me to finish.

Evie Choi. Thank you for not accidentally deleting my document.

Andrew Choi. Thank you for making sure Evie didn't delete all of my work. Your unquestioning support means everything to me and I couldn't have finished without it.

Francie. Thank you for being my constant work buddy, foot heater, and inspiration for doing work that aims to protect our pets.

TABLE OF CONTENTS

Introduction

Organizational psychology has demonstrated that stress arising from an employee's job can have far-reaching detrimental effects. Job stress has been linked to poor well-being outcomes not only in the employee, but in their loved ones too. Most often studied between spouses, wives have been found to "catch" the work-related stress of their husbands (e.g., Westman & Etzion, 1995; Jones & Fletcher, 1993; Rook et al., 1991). Children of parents with more job stress had more negative interactions with their parents (Danner-Vlaardingerbroek et al., 2013b; Nelson et al., 2009). This contagion of work-related stress between loved ones is called crossover (Westman, 2001). While this phenomenon is well studied from an employee to the loved people of their households, other beloved, vulnerable, and under-studied household members exist: pets.

Recently, scholars in organizational literature called out the importance yet neglect of understanding how pets, owned by the majority of Americans (Brown, 2023), intersect with work life (Kelemen et al., 2020). To my knowledge, the impact of owners' job-related stress on their pets has not been explored. Yet, job stress is considered by many to be an epidemic in the United States (US; Robinson, 2021), affecting 77% of American workers (American Psychological Association, 2023), and is a major contributor to people's general stress, which has been shown to influence the well-being of pets (e.g., Sundman et al., 2019). Dogs are highly sensitive animals who experience emotional contagion and in other words "catch" the feelings of other individuals (Yong & Ruffman, 2014), not just between conspecifics but from people too. A body of evidence supports the notion that dogs react negatively to humans' stress (e.g., Yong & Ruffman, 2014; Huber et al., 2017; Buttner et al., 2015; Jones & Josephs, 2006). Albeit to a lesser extent, cats too have been shown to reference their owner's emotions and react

differentially to positive versus negative displays of emotion (e.g., Merola et al., 2015; Quaranta et al., 2020). If pet animals are experiencing greater stress due to their owner's experiences of job stress, this crossover effect could have important implications for pet health. In addition to suffering worse general well-being, pets who experience more stress may live shorter lives (Dreschel, 2010).

Thus, this thesis aims to shed light on a potential source of stress in pets with the ultimate goal of edifying owners on how they may be able to protect their pets' well-being. In this correlational study, I evaluate whether owners with more work-related stress have pets who are more stressed. I measure pets' typical stress level in two ways, first as the owner's perception of their pet's stress level and second through owner observations of pet behaviors indicative of stress, as a less subjective measurement of stress. I focus on dogs and cats, as 96% of pet-owning households in the US have only dogs and/or cats (Brown, 2023). I also propose and evaluate work-related rumination as a mechanism by which an employee's job stress may cross over to influence their pet. By pinpointing an explanatory mechanism, owners can focus on curbing work-related thoughts when outside of work as a means to relieve their pet's stress.

Literature Review

Emotional Contagion in Animals

Hatfield et al. (1993) coined the term "emotional contagion" to represent when one individual automatically mimics and synchronizes their mannerisms and qualities with another individual's such that they "converge emotionally" (p. 96). More recent treatment of the phrase focuses specifically on the sharing of an affective state from one individual to another (Preston, 2004; Yong & Ruffman, 2014). The individual experiencing emotional contagion does not need

to do so intentionally, nor even have the capacity to recognize that their emotions are separate entities from those of the other individual (Sumegi et al., 2014).

Emotional contagion has been extensively observed between conspecifics belonging to social species (de Waal, 2008). Studies of rodents (for a review, see Edgar et al., 2012), non-human primates (e.g., Parr, 2001), birds (e.g., Edgar & Nicol, 2018), and dogs (e.g., Quervel-Chaumette et al., 2016) have demonstrated that when one animal observed another conspecific (in some cases, even a stranger) experiencing distress, the observer indicated feeling distress too. This phenomenon promotes evolutionary and survival benefits for members of social groups by facilitating targeted helping, communication, social cohesion, and connectedness (Hiestand, 2023; de Waal, 2008).

An emotional contagion effect has also been seen between members of different species. In particular, human-animal dyads exist in a number of capacities, thus facilitating the possibility of emotional contagion. Animals that participate in animal-assisted therapy, which comprises any health-related treatment program that incorporates an animal (Bert et al., 2016), have a human handler who typically interacts closely with the animal and often in an emotional or stressful context (e.g., a hospital visit). Dogs are the most commonly used animal in animal-assisted therapy, but other animals like cats and horses are sometimes used (Bert et al., 2016). Similarly, competition animals are closely trained by a handler and can form a close bond together (Buttner et al., 2015). The most common human-animal dyad is the relationship that exists between an owner and their house pet, or companion animal. Dogs are even labeled as “man’s best friend” (Hiestand, 2023). A handful of empirical studies have been performed that test the possibility of heterospecific emotional contagion from humans to dogs and cats, and in particular whether a dog or cat may begin to experience stress when spending time with a human who is stressed.

Emotional Contagion from Humans to Dogs

The vast majority of research on human-animal emotional contagion focuses on dogs (Hiestand, 2023). Dogs are by far the most common therapy animal (Bert et al., 2016), thus providing researchers easy access to study a human-animal dyad in emotional situations. Dogs are also highly social animals who have co-evolved with humans to share a unique bond with them (Schleidt & Shalter, 2003).

The dog's evolutionary ancestor, the wolf, was the first animal to be domesticated (Serpell, 2021). Wolves comprise a highly social species that live in groups with complex social structures, engage in cooperative activities, and even pair bond (Schleidt & Shalter, 2003). These characteristics make emotional sensitivity highly beneficial to the species' survival and thus make intraspecific emotion contagion more likely to develop (Perez-Manrique & Gomila, 2022).

Dogs are similarly social animals and have co-evolved with humans over the past 15,000-40,000 years to give rise to a special relationship between dogs and humans (Hiestand, 2023; Udell et al., 2010). Domestication and selective breeding have accentuated social traits to produce a species that retained emotional sensitivity from their wolf ancestors, possesses complex socio-cognitive abilities, and can communicate with and react to humans in adaptive, flexible, and complex ways (Silva & Sousa, 2012). Now, dogs are more socially aware of and in tune with humans than any other animal (Udell et al., 2010). They can discriminate human emotions based on faces (Muller et al., 2015), voices (Andics et al., 2014), and even integrate affective information from faces and voices together (Albuquerque et al. 2016). In addition to being capable of processing emotional information from humans, researchers believe that dogs seek out this information from their owners (Merola et al., 2012) and that this engagement in

social referencing could explain a transmission of stress from an owner to their dog (Silas et al., 2019).

Dogs are so advanced in their tendencies and abilities to relate to humans that researchers consider the human-pet dog bond to be similar to a mother-young child bond (Buttner, 2016; Topál & Gácsi, 2012). Dogs have been suggested as alternative models for young children (Buttner, 2016), and the attachment that dogs feel to their owners has been compared to an infant's attachment to their mother (see Topál & Gácsi, 2012, for a review).

Just as infants have been found to react to their mothers' crying to suggest emotional contagion (Thompson, 1987), three studies have found similar responses by dogs to human crying (Yong & Ruffman, 2014; Huber et al., 2017; Custance & Mayer, 2012). In a study by Yong and Ruffman (2014), dogs displayed increased salivary cortisol levels upon hearing audio of human infants crying, suggesting an increase in stress due to the human's stress. In addition to the physiological response, these dogs emitted behavioral responses consistent with heightened stress, like a tucked tail and ears held flat and back.

In a study by Huber et al. (2017), dogs behaved differently when exposed to emotional versus non-emotional audio. For example, dogs were more likely to engage in behaviors like whining, yawning, panting, and lip licking when hearing emotional audio as opposed to non-emotional audio. Interestingly, the dogs displayed similar behavioral patterns in response to human versus conspecific sounds. These behavioral responses to emotional audio are consistent with negatively emotional and aroused states, suggesting heightened stress when perceiving the stress of other dogs and humans.

Finally, Custance and Mayer (2012) showed that when dogs experienced a stranger and their owner crying, they displayed a behavior pattern more suggestive of mild worry or concern

(e.g., with a slightly tucked tail and lowered body posture) relative to when they heard the stranger/owner humming or talking. Additionally, when a dog approached the person who was crying, they did so in this manner of mild worry in almost every case. This display of worry suggests concern, although the authors caution the reader from over-extrapolating their findings. Taken together, these studies provide evidence for pet dogs experiencing negative emotions in response to a typical human display of sadness.

Another study of emotional contagion in dogs by Sumegi et al. (2014) similarly used an experimental manipulation, but in this case the humans were the dogs' actual owners. Additionally, the experiment tested a cognitive reaction from the dogs. The researchers showed that dogs performed differently in a cognitive task based on whether their owner had been stressed or not. They went a step further and demonstrated that this change in performance mirrored that when the dogs themselves experienced stress, thus suggesting that dogs experienced stress when their owners did.

Turning to therapy contexts, a number of studies have examined how therapy dogs are influenced by treatment sessions (see Gandenberger et al., 2022, for a review). While this context is ecologically disparate from the home that is the focus of the current study, this set of empirical work provides further evidence toward the existence of emotional contagion from people to dogs. A subset of these studies has focused on the handler-dog dyad (Clark et al., 2020; Silas et al., 2019; Pirrone et al., 2017; Koda et al., 2015), for which the emotional contagion effect might be particularly acute due to the closeness in the handler-dog relationship. Communication is an important component of a functional therapy team (Clark et al., 2020), and so therapy dogs may be particularly receptive and thus vulnerable to their handler's emotions. In line with this notion, Silas et al. (2019) found that therapy dogs' stress level related to their handler's stress level but

not to that of the patients they attended to. In Pirrone et al.'s (2017) study of just four dog-handler teams, the dogs and handlers also showed stress synchrony, in that dyad members both displayed low stress levels.

The vast majority of therapy dogs in Koda et al.'s (2015) study similarly displayed low stress overall, but the authors identified a subpopulation of high-stress dogs. These high-stress dogs were much more likely than the low-stress dogs to have one of the few handlers in the study who reported high (as opposed to low) stress, suggesting that these dogs' stress level was linked more to their handler than to the patient. The authors do caution, however, that the handlers' ratings of their dogs may have been colored by their own feelings of stress (or lack thereof).

In a similar context, one of dog competitions, Buttner et al. (2015) again found a relationship between handlers' and dogs' stress levels. These authors observed that the rise in handlers' salivary cortisol levels from pre- to post-competition predicted a rise in their dogs' salivary cortisol levels from pre- to post-competition. Interestingly, the handlers' affiliative (e.g., praising) and punitive (e.g., pulling) behaviors did not mediate this correlation, supporting the notion that dogs can experience emotional contagion from just emotion-related physiological changes in humans. Indeed, a recent study found that dogs react differently to the odors of stressed versus relaxed humans (Parr-Cortes et al., 2024). In another study of dog-handler competition teams, researchers found an association between hormone levels in losing teams (Jones & Josephs, 2006). In this study of male handlers, increases in dogs' cortisol levels were related to decreases in handlers' testosterone levels after the competition loss, as well as to handlers' basal testosterone levels. In the latter case, the association was mediated by handlers' behaviors toward their dog and therefore the emotional contagion effect that seems to have occurred may result from social rather than physiological changes on the human's part.

The context most relevant to the current thesis is the home. In a groundbreaking study, Sundman et al. (2019) showed that long-term stress levels synchronized between dogs and their owners. This study sampled 58 dog-owner dyads, of which 26 were non-competing pets and 32 were competing dogs. The authors used hair cortisol concentration (HCC), as opposed to salivary cortisol, as a measurement of long-term stress level. They also measured the HCC of both owner and dog at two separate times of year to account for seasonal differences. They found a correlation between owner HCC and dog HCC at both time points. The authors did not find dogs' activity levels to explain this correlation, thus further bolstering the idea of an emotional contagion effect between owner and dog.

The owner's personality was also found to influence dog HCC, even though the dogs' personalities were not found to associate with their own stress level (Sundman et al., 2019). This finding echoes the results of another study of dogs and their owners, which focused on the impact of owners on their dogs' stress coping capabilities (Schoberl et al., 2017). These researchers turned to salivary cortisol variability as a measure of stress coping, where high variability reflects an ability to adapt to and successfully manage stressful situations. They found that dogs' stress coping was linked to their owner's personality and social characteristics, such as level of independence and (human-directed) separation anxiety. For example, owners higher in neuroticism and separation anxiety tended to have dogs with lower cortisol variability and thus less stress coping capability. Therefore, it appears that pet dogs may be affected by their owners' stress.

Emotional Contagion from Humans to Cats

Domestic cats have evolved from a species of cat that does not exhibit a complex social structure as in the case of dogs and their ancestor, the wolf (Hiestand, 2023). The house cat's

evolutionary ancestor is the African wildcat, who primarily engages in social behaviors just to mate and rear their young. While evidence for humans' association with cats and cats' self-domestication dates all the way back to 10,000 years ago (Driscoll et al., 2007), this cohabitation occurred long after that with dogs. Furthermore, the domestication process was far less intentional than in the case of dogs, who were selectively bred for jobs, obedience, and companionship (Trut, 2000; Driscoll et al. 2009). In fact, the breeding of most common house cats began just 150 years ago (Lipinski et al., 2008). Consequently, house cats tend to be less social towards humans than dogs and display less attachment to humans than dogs (Hiestand, 2023).

Despite being less social than dogs, house cats do display some level of sociality and attachment towards humans (Hiestand, 2023). In a study of both kittens and adult cats, pet cats were found to display distinct attachment styles to their owners (Vitale et al., 2019), reflective of "enduring emotional bond[s]" (Colin, 1991, p. 2). About two thirds of the sample of cats were observed to display a secure attachment style with their owner, while the remaining third displayed an insecure attachment style, showing behaviors associated with stress (Vitale et al., 2019). These proportions echo prior findings between dogs and their owner (Wanser & Udell, 2018; Schoberl et al., 2016) and, interestingly, between children and their caregivers (Colin, 1991).

The quality of relationship and degree of sociality between a cat and a human depends heavily on early experiences with humans. Cats have a sensitive period for socialization between approximately 2 and 7 weeks of age, and cats who are exposed to humans during this time of life are more likely to display social behaviors towards humans moving on into adulthood (Finka, 2022). These cats are, more colloquially, considered to be "friendlier" towards people (McCune,

1995). For example, in a controlled experiment, cats who were socialized during their sensitive period were found to be more talkative toward, less avoidant of, and spent more time touching both familiar and unfamiliar people (McCune, 1995). Cat friendliness can also be passed down genetically, even in cats who were not socialized during their sensitive period (McCune, 1995; Finka, 2022). Cats are even known to choose on their own volition to bond with people, "spending time near to human dwellings and eventually decid[ing] to 'move in'" (Finka, 2022, p. 298).

In their interactions with people, cats have displayed signs of distinguishing different emotions from humans. In an experimental setting, cats exposed to a novel stimulus behaved differently depending on their owners' emotions toward the stimulus (Merola et al., 2015). With their cat in the room, one group of owners spoke happily, maintained positive facial expressions, and approached a newly turned-on fan, while the other group of owners spoke fearfully, maintained negative facial expressions, and retreated from the fan. The majority of the cats looked toward the owner after the fan was turned on, suggesting that they were socially referencing how their owner behaved toward the new stimulus. Cats in the negative group were more likely to look toward the exit of the room and move earlier than those in the positive group, possibly indicating a desire to leave. These cats did not display more stress signals than did the cats in the positive group, although some researchers consider such escape cues to be stress signals (Hiestand, 2023). Additionally, while behavior differed between the two different groups of cats, the cats in the positive group did not follow their owners' lead in terms of their interaction with the fan. When owners later approached the fan when it was off, positive-group cats remained static for longer. Thus, cats did react differently to owners' emotions, but they did

not synchronize their behavior to their owners', as dogs have done under similar circumstances (Merola et al., 2012).

Another study similarly showed that cats are able to perceive human emotions and react differentially based on the valence of those emotions (Quaranta et al., 2020). These cats were also pets, and this experiment was performed in their home rather than a lab, giving the setting more ecological relevance. Quaranta and colleagues played either an angry or a happy human sound, at the same volume, while showing both an angry and a happy human face on a screen. In this congruence paradigm, cats spent more time looking at the face whose expression matched (i.e., was congruent with) the emotion of the sound. This response indicates that these cats recognize and can integrate multimodal emotional data. Further, the cats exposed to the angry sound emitted more stress signals in response to the stimulus. This result provides support for the phenomenon of heterospecific emotional contagion in cats, as the cats' own stress level began to align with the stress they perceived from a human.

The results of Galvan and Vonk (2015), on the other hand, call into question the extent of emotional contagion in house cats. This study consisted of two experiments with house cats. The first experiment took place in the home, and cats were exposed to either their owner or an unfamiliar experimenter displaying either an angry or happy emotion via facial expression and posture. When an unfamiliar experimenter displayed the emotion, cats did not differ in their behavior between angry and happy conditions. When their owner displayed the emotion, which is more ecologically similar to the current thesis's context, cats did spend more time with their owner and demonstrated more positive behaviors in the happy versus angry condition. The cats, however, did not differ in their latency to approach the owner between the two conditions.

Galvan and Vonk's (2015) second experiment occurred in a laboratory setting and consisted of cats being exposed to angry versus happy conversation between their owner and an experimenter. The cats' behavior did not vary between these two conditions, suggesting that they did not experience emotional contagion. While a lack of emotional contagion effect could lie in the emotion being faked, and possibly poorly, the cats did look towards their owners more often than the experimenter in an apparent display of social referencing. However, it seems that the cats failed to understand the emotional implications from this referencing. These results together suggest that cats may need time and familiarity with the human to achieve heterospecific emotional comprehension and, in turn, experience emotional contagion.

A study by Hiestand (2023) found a similar result, wherein the degree of bond that a cat (but not dog) shared with their owner influenced their amount of person-oriented behaviors. In this experiment involving a feigned injury protocol, cat and dog owners pretended to hurt their knee. A video recording captured the pets' responses to their owner's apparent distress. Both cats and dogs paid more attention to their owner when distressed than when reading aloud (the control condition). However, dogs moreso than cats emitted helping behaviors, such as actually approaching and touching their owner. Both cats and dogs displayed negatively emotional behaviors, though, providing support for emotional contagion in both species.

These studies presented experimental manipulations that mimicked the onset of negative emotions in owners to influence pets. A real-life circumstance that is likely to induce negative feelings and stress in an owner, with possible influence on their pet, is the owner's job.

Job Stress

At 77%, the vast majority of US employees reported experiencing job stress according to the 2023 Work in America survey (American Psychological Association, 2023). According to the

Centers for Disease Control's National Institute for Occupational Safety and Health (NIOSH), job stress is the "harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the worker" (NIOSH, 1999). Job stress can lead to strains like emotional exhaustion, physical fatigue, and cognitive weariness, each of which more than a third of workers reported experiencing due to their jobs in 2021 (Abramson, 2022). Job stress can also lead to burnout, which 57% of respondents reported signs of in the 2023 Work in America survey and is associated with severe problems like anxiety and depression (see Koutsimani et al., 2019, for a meta-analytic review).

In addition to these negative implications for one's self, job stress can affect one's home and loved ones, too. Spillover is the phenomenon where the stress experienced in one domain, in this case the workplace, influences another domain (Bakker et al., 2009), such as the home. Work-to-home spillover is well established in organizational literature (see Edwards & Rothbard, 2000, for a review) and has been found to lead to negative home life outcomes, like poor family functioning, fatigue during leisure time, and frustration. Work-to-home spillover can also have negative implications for the stressed employee's family members by way of crossover.

Conspecific Crossover in Humans

In organizational literature, crossover refers to the transmission of stress and strains related to one's job to another individual with whom they frequently interact (Westman, 2001). Thus, the term crossover is analogous to emotional contagion in the context of work-related stress. In the crossover of job stress, job stress serves as an emotion being contagiously passed from an employee to a partner.

Traditionally, the two members of a dyad experiencing crossover are spouses, and previous studies have supported crossover between spouses (see Li et al., 2021, for a meta-

analytic review). For example, an early study of stress synchronization between husbands and wives surveyed over a thousand married women and found that those wives whose husbands' job stress was higher themselves experienced more stress (Rook et al., 1991). These researchers ruled out other stressors, such as parenting demands, work demands, and even a lack of social support on the husband's part, as being responsible for this link between the husband's job stress and the wife's stress. Therefore, this study provided early support for the notion of crossover of job stress.

In a more recent study, Demerouti et al. (2005) found that the exhaustion experienced by the female half of dual-earning heterosexual couples crossed over to the male partner. Happily, the same was found for positive feelings, wherein life satisfaction crossed over, in this case from the male to the female member of the couple.

Limited empirical work has also indicated that children may be affected by the stressors their parents experience from work (Hart & Kelley, 2006; Vieira et al., 2016; Vahedi et al., 2019; Yucel & Latshaw, 2020; Nelson et al., 2009). Given that the relationship between pets and their owners is considered a similar one to that between young children and their parents (Buttner, 2016; Topál & Gácsi, 2012), a crossover effect from parents to their kids may suggest one between owners and their pets. Hart and Kelley (2006) found that work-related factors like worse work-family conflict and longer work hours predicted problem behaviors in young children, such as anxiety. Additional studies have observed a similar association between parents' experiences of work-family conflict and poor child mental health as demonstrated by problem behaviors (Vieira et al., 2016; Vahedi et al., 2019; Yucel & Latshaw, 2020), with the quality of the parent-child relationship (Vieira et al., 2016) and parenting irritability (Vahedi et al., 2019) supported as explanatory mechanisms for this association. Interestingly, Nelson et al. (2009) found that a

parent's job role dissatisfaction was related to poor emotional support of children by their spouse. This study highlights the complexity of interrelationships present in a household, especially with regard to stress, strains, and emotions.

Westman (2001) proposes three mechanisms by which stress and strains cross over from one dyad member to the other. First, the crossover effect may be a result of empathy, wherein an individual "feels" the stress of their partner. This mechanism describes a direct transmission of stress. Second, the crossover effect may occur due to side effects of the stress experienced by one member of the dyad. For example, an individual who experiences a higher level of job stress may shirk their home responsibilities to a greater extent, leaving their partner facing more demands and thus feeling more stress. This mechanism describes an indirect transmission of stress. Third, crossover may be a more spurious phenomenon, in which both members of a dyad experience the same stressors and therefore share a similar level of stress.

Heterospecific Crossover from Owners to Pets

Beyond the relationships they share with their human family members, a pet-owning employee belongs to another dyad in the home: the pet-owner dyad. In fact, 97% of American pet owners consider their pet to be a member of the family (Brown, 2023). Thus, a pet may also be vulnerable to the effects of crossover. However, to my knowledge, a relationship between pet stress and an owner's job stress has not yet been empirically tested.

Turning to theory, the mechanisms at play in human-to-human crossover could also function within a pet-owner dyad. The direct transmission of stress via an empathetic reaction mirrors the phenomenon of emotional contagion of stress from owners to pets. Dogs have been shown to be highly sensitive animals who have the capacity for emotional contagion (Yong & Ruffman, 2014). In heterospecific contexts, dogs have been shown to experience increases in

stress both behaviorally and physiologically and when their owner or handler experiences a rise in stress (Hiestand, 2023; Sumegi et al., 2014; Koda et al., 2015; Silas et al., 2019; Buttner et al., 2015; Jones & Josephs, 2006). Dogs have also displayed distress when hearing a human cry (Huber et al., 2017; Yong & Ruffman, 2014), and their long-term stress levels aligned with their owner's (Sundman et al., 2019).

Empirical support for a heterospecific emotional contagion effect in cats exists, albeit to a lesser extent. Evolutionarily speaking, cats experienced less evolutionary pressure to develop emotional contagion due to living in less complex social groups than dogs (Hiestand, 2023; Perez-Manrique & Gomila, 2022). Cats may also comprehend emotional cues from humans to a lesser extent than dogs (Galvan & Vonk, 2016). That said, cats have been shown to react differentially to their owners based on their owners' emotions (Hiestand, 2023; Galvan & Vonk, 2016; Merola et al., 2015; Quaranta et al., 2020). In some cases, these behaviors have aligned with the present human's emotions, in that cats displayed behaviors signaling stress when exposed to angry or hurt human vocalizations and expressions (Quaranta et al., 2020; Hiestand, 2023).

Pertaining to the second and indirect pathway for crossover, a human's experience of job stress may result in behavioral changes that influence the pet-owner relationship. For example, a stressed owner may interact less with their pet, as stressed employees have been shown to do with their spouse (King & DeLongis, 2014). Job stress may arise from long work hours (Harma, 2006), which could lead an owner to spend less time caring for their pet to a neglectful extent, such as forgetting to take their dog out to pee, clean their cat's litter box, or feed their pet. Without proper care and their basic needs attended to, a pet is likely to experience a rise in stress. An owner facing more job stress may also spend less time engaging with their pet in positive

ways. For example, they may spend less time playing with their pet, stroking their pet, and generally building a positive relationship with their pet. The lack of these activities due to job stress could result in a pet's level of stress rising too.

Finally, the third and spurious mechanism of stress crossover is likely less applicable to the pet-owner dyad, as pets and owners may not experience stressors in the same way, as spouses would. An example of this mechanism lies in the context of financial hardship (Li et al., 2021). When a married couple is low on money, both partners tend to share the burden of meeting demands with less resources and both feel anxiety related to their financial situation. A pet does not have to work harder or worry for the future as a direct result of the finance problems. However, a pet may experience an increase in stress due to recognizing the stress in their owner and feeling the same, aligning with the first and empathic mechanism, or due to receiving less attention or food, aligning with the second and indirect mechanism.

Synthesizing this theoretical reasoning with empirical support of emotional contagion from humans to pet dogs and cats, I expect that pet dogs and cats living with owners who experience more work-related stress will themselves experience more stress.

Hypothesis 1: An owner who experiences more job stress will have a pet who is more stressed.

Crossover of Job Stress via Work-Related Rumination

Work-related rumination is the engagement in perseverative thoughts about work during non-work time (Cropley & Zijlstra, 2011). Employees may be more likely to engage in ruminative thoughts about work when they have more work-related stress. Two studies of teachers demonstrated that those with higher job stress were more likely to continue ruminating about work during their leisure time (Cropley & Purvis, 2010; Wu & Zhou, 2023). At the daily

level, a daily diary study showed that on days when employees experienced more job stress, they engaged in more work-related rumination in the evening (Vahle-Hinz et al., 2014).

By continuing to think about work during leisure hours, engagement in work-related rumination extends strains from the workday into one's home life (Weigelt et al., 2019). This phenomenon has been found to relate to poor recovery from workday demands (Vahle-Hintz et al., 2017), fatigue (Minnen et al., 2020), and burnout (Weigelt et al., 2019). It is also believed to facilitate the spillover of job stress from work to home (Du et al., 2018), and it may exacerbate crossover too.

A handful of studies have demonstrated a link between work-related rumination and negative family outcomes. More work-related rumination was linked to more work-family conflict six weeks later at the between-person level (Junker et al., 2021). At the daily level, when employees spent more time ruminating about work, they reported more work-family conflict in the evening (Junker et al., 2021). Looking specifically at dyadic relationships, spouses who engaged in more work-related rumination reported less relationship satisfaction (Schoellbauer et al., 2023) and worse marital interactions (Danner-Vlaardingerbroek et al., 2013a) due to paying less attention to and being less psychologically available for one's spouse. A similar relationship was found in the parent-child dyad, where spouses who engaged in more work-related rumination engaged in worse interactions with their child through less psychological availability for their child (Danner-Vlaardingerbroek et al., 2013b).

King and DeLongis (2014) tested rumination and interpersonal withdrawal as linking mechanisms from job stress to an impaired marital relationship. This study was a daily diary study with a sample of paramedics and their spouses. Paramedics who reported more stress from the workday then reported engaging in more generally ruminative thoughts and interpersonal

withdrawal at home. In turn, both spouses and paramedics reported more marital tension, which is a key indicator of poor dyadic functioning (Bodenmann, 2000). Therefore, high job stress appears to keep employees connected to work and disengaged from their family members at home, which in turn hurts their relationships with their loved ones.

For pet-owning employees, engagement in work-related rumination could facilitate the strains of job stress crossing over into the owner-pet relationship. Ruminating about work may lead owners to pay less attention to their pets. Consequent withdrawal and lack of social support from owners to their pets could lead to an impaired pet-owner relationship and a pet who shows more signs of stress. Relative to employees who are better able to shut off their work-related thoughts, employees who tend to ruminate may also show the signs of their job stress more often and more clearly. An increase in emotional cues and even stress-related hormones could extend from engagement in work-related rumination, particularly in negatively emotional thoughts about work called affective rumination (Cropley & Zijlstra, 2011), and thereby communicate the owner's stress to the pet. As demonstrated in prior work, communication of negative emotions from a human has associated with signs of increased stress in dogs (Hiestand, 2023; Yong & Ruffman, 2014; Huber et al., 2017; Sumegi et al., 2014; Silas et al., 2019; Koda et al., 2015; Buttner et al., 2015; Jones & Josephs, 2016; Sundman et al., 2019) and cats (Hiestand, 2023; Quaranta et al., 2020). Therefore, I propose that an owner's job stress is linked to their pet's level of stress by way of work-related rumination.

Hypothesis 2: Owners with more job stress will have a pet who is more stressed due to higher engagement in work-related rumination.

Method

Procedure

Employed pet owners were recruited by posting flyers to community boards and online ads to social media, as well as through snowball sampling beginning with the researcher's personal and professional network. To participate, an individual had to: a) be employed, b) own a pet dog or cat, c) be at least 18 years old, and d) be the only member of their household participating. Before completing the online survey, interested participants were first directed to the online consent form and screening questions to confirm that they met the inclusion criteria. The consent form, screening questions, and survey were all provided on QuestionPro, an online survey management system that is widely used in the social sciences. Data were collected under oversight of the Virginia Tech Institutional Review Board (IRB #24-538).

The survey was available in June and July of 2024 and took participants approximately 10 minutes to complete. At the beginning of the survey, to account for the possibility of participants owning multiple pets, participants were asked to select one pet to focus on for the duration of the survey. Participants were recurrently reminded to focus on this same pet in the pet-related portions of the survey. The survey asked questions about the participant's pet and themself. The pet-focused questions gathered information about the pet's demographics, as well as two scales regarding the pet's stress level that are described further in Measures. The owner-focused questions again asked for demographic information, details concerning the owner's employment, and a scale on job stress.

Sample

134 people consented to participate in the study. Twenty-seven participants were then screened out for not meeting inclusion criteria (n = 10) or providing incomplete responses (n = 17). The final sample contained 107 employed pet owners (N = 107). Two-thirds of the owners were women (67%), with the remaining individuals being men (30%), non-binary (2%), or

unspecified (1%). The majority of owners were White (87%), and the remaining owners were Asian (7%), Black or African American (2%), more than one race (3%), or unspecified (2%). Roughly half the sample was married (51%), with about a quarter having children living in the home (27%). The average age was 38 years old (*SD* = 14.0), ranging from 18 to 82 years old.

Most owners typically worked about 40 hours per week (*M* = 38.6, *SD* = 15.3), with about half of owners working from home at least occasionally (54%). Approximately half of owners had no supervisory function in their jobs (51%), while 39% were in a supervisory or top management position. Participants were largely in either healthcare and social services (35%) or professional, scientific, and technical services (22%), for example as a doctor or software engineer. Another large group of participants worked in hospitality (10%) and trade (8%) work, for example as a food server or business owner. Other professions represented included teacher, firefighter, finance worker, and executive assistant.

Of the pets, 85 were dogs and 22 were cats. A large portion of owners identified their dogs as poodle mixes (14%) and as terriers or terrier mixes (15%), especially pit bulls and pit bull mixes. Other dog breeds included Golden Retrievers, French Bulldogs, and Chihuahuas. Nearly half of the cats were identified as domestic shorthairs (41%), with the others identified as a variety of breeds like Manx, Ragdoll, and Russian Blue. The average age of pet was 7 years old (*SD* = 4.1), and the average time of ownership was 6 years (*SD* = 3.9). About a quarter of pets had experienced a stress- or anxiety-related medical event (29%), with higher rates for dogs (32%) than cats (18%). A quarter of dogs had been diagnosed (25%) with stress or anxiety issues, which aligns with previous rates found in dogs in the US (Bamberger & Houpt, 2006b), while none of the cats sampled had a diagnosis for stress or anxiety issues (0%), which also mirrors previous findings in US cats (Bamberger & Houpt, 2006a).

Measures

Pet Stress

The pet's typical level of stress was measured in two ways: via a visual analog scale (VAS), which in effect measured the owner's perception of their pet's level of stress, and via a behavior-based stress measure, which aimed to achieve an objective assessment of a pet's level of stress.

Owner's Perception of Pet Stress. Participants indicated their perception of their pet's level of stress using a VAS, which is a single-item scale. The Stress VAS (SVAS) is used in both applied research and clinical contexts to evaluate one's perceived level of stress (Lesage et al., 2012). Lesage and colleagues' (2012) study of 763 employees provided evidence that the scale shows good convergent validity, wherein results from a VAS measuring one's own stress level was highly correlated with the Hospital Anxiety and Depression Scale (HADS) and its subscales (ranging from .45-.66) and to a similar extent as the Perceived Stress Scale (correlations with HADS ranging from .52-.67). Participants were instructed to "Indicate how stressed you feel on the small ruler" and were given a 100mm ruler with endpoints marked as "none" and "as bad as it could be."

The SVAS has also been used in human-animal interaction contexts. Barker et al. (2012) asked pet-owning employees to rate their own stress with the SVAS in a study of how bringing one's pet to work influences their stress level. These employed pet owners were asked to rate their stress on a 15cm scale with endpoints labeled "none" and "the most severe imaginable." In Clark et al. (2020), therapy dogs' handlers reported their dog's stress level using a single item scale. These authors simply asked handlers to rate their perception of their dog's stress level as

low, medium, or high. Even with the simplicity of this scale, the authors found agreement between handlers' ratings and dogs' salivary cortisol levels.

In the current thesis, owners were asked "In general, how stressed is your pet?" In line with the traditional SVAS, participants were able to select a number from 0 to 100 as their response. To mimic a ruler as is typically used in an SVAS, the online survey displayed a sliding bar to report the answer. The sliding bar was a horizontal line ranging from 0 to 100, with endpoints labeled "0 is not at all; 100 is most severe imaginable." Participants moved a slider across the bar to the point they deemed appropriate, and the corresponding number showed to the side.

Behavioral Indicators of Pet Stress. Owners were also asked to report how often their pets typically emit behaviors that are indicative of stress. Prior research has shown that owners are often poor evaluators of their dog's stress level (Mariti et al., 2015). So, I supplemented the owner-perceived stress measurement above with a more pet-led measurement of stress. The aim of this assessment was to use pet behaviors that owners can identify even if they do not recognize them as stress indicators to gauge their pet's stress level (Mariti et al., 2012; 2017).

Two separate lists of behaviors were derived for dogs and cats, each containing 11 behavioral indicators of stress, based on prior empirical work and scientific literature evaluating dog and cat stress. For both animals, a multitude of behaviors have been described as indicating stress. I narrowed down possible behaviors to 11 each by looking for behaviors that were listed consistently (i.e., in multiple empirical and theoretical works), have empirical evidence suggesting that owners recognize these behaviors, and are not exclusively linked to acute stress or trauma responses, as the stress evaluated in this study is chronic (i.e., typical) in nature and

not necessarily severe. The set of behavioral indicators of stress, along with literature support for each indicator, are shown in Table 1a for dogs and Table 1b for cats.

The Canine Behavioral Assessment & Research Questionnaire (C-BARQ; Hsu & Serpell, 2003) is a very widely used questionnaire not only by animal professionals but also by pet owners to evaluate dogs' temperament and behavior. While the questionnaire does not directly measure stress level, it does contain a "Fear and anxiety" section that describes behaviors frequently observed in response to typical canine stressors, such as being approached by an unfamiliar person, heavy traffic, thunderstorms, and having nails clipped. The C-BARQ lists behaviors representative of "mild to moderate fear," which I consulted for this study rather than those pertaining to "extreme fear" due to relevance to the current context. Those mild-to-moderate behaviors include avoiding eye contact, tucking the tail between the legs, and whimpering.

In an empirical study of dog stress, Clark et al. (2020) followed nine therapy dog-handler teams on a hospital visit. During these visits, the research team noted the most commonly observed stress-related dog behaviors. These behaviors included "panting, lip licks, yawning, leaning into people, turning away from a stimulus, and 'wet dog' shake" (p. 6). Similarly, in Mariti et al. (2015), two researchers coded 3-minute video recordings of 45 dogs in a veterinary clinic waiting room to assess which stress indicators were most commonly shown by pet dogs. The researchers marked the proportion of dogs that emitted each of 19 pre-selected common stress indicators. As in Clark et al. (2020), panting and yawning were two of the most common stress-related behaviors emitted, with over half of dogs panting during the 3-minute segment and over a third yawning. By far the most common stress indicator in Mariti et al. (2015) was nose licking, which mirrors the activity of lip licking identified in Clark et al. (2020). Lowered ears

and crying were also frequently seen in Mariti et al. (2015), with nearly half of dogs showing these two signs of stress. Interestingly, leaning into people and turning away from a stimulus, common signs seen in Clark et al. (2020), were not among the 19 behaviors coded for in the dogs at the vet offices.

Mariti et al. (2012) asked 1190 dog owners to mark which of 19 stress-related behaviors they recognized as indicating stress. Dog owners most consistently recognized trembling, crying/whining, aggressiveness, excessive barking, and panting as stress indicators. Between a third and a fifth of the sample recognized high activity, low activity, low appetite, hypersalivation, and inappropriate urination and defecation as stress indicators. As described subsequently, a number of these behaviors mirror those emitted by cats when stressed, such as low appetite, restlessness, and inappropriate urination and defecation.

Synthesizing this literature, I composed the following list of 11 stress indicators as a behavioral measure of dog stress. I asked dog-owning participants "How often does your dog emit the following behaviors" on a 5-point Likert-type scale ranging from "Never" to "All the time." I found an average internal consistency of $\alpha = .632$.

1. Excessive nose or lip licking
2. Wet dog shake
3. Yawning
4. Leaning into people
5. Crying, whimpering, or whining
6. Avoiding eye contact
7. Tail lowered or tucked between the legs
8. Panting

9. Poor appetite
10. Inappropriate urinating or defecating
11. Excessive walking or pacing

Similar to the C-BARQ, the Feline Behavioral Assessment & Research Questionnaire (Fe-BARQ; Duffy et al., 2017) was developed to capture a pet cat's behavior and temperament. This evidence-based evaluation also contains information about how cats behave when they are stressed, albeit indirectly. I turned to the sets of behaviors describing anxiety and fear responses in cats to gather behaviors that are likely expected when a cat is stressed. The Fe-BARQ consistently lists restlessness, hyper-vigilance, hiding, and crying or meowing as common behaviors when a cat is in an anxiety- or fear-inducing situation.

As they did with dogs, Mariti and colleagues administered to 194 cat owners a list of 16 stress indicators in house cats (Mariti et al., 2017). They asked cat owners to identify which of these behaviors they recognized as signaling stress. The most recognized signs of stress (at 66% or more of owners) were hyper-vocalizing, ears laying back, and inappropriate urination. Roughly half of owners recognized trembling, inappropriate defecation, panting, and over-grooming as stress indicators.

In her compendium on domestic cat behavior, Atkinson (2018) lists 11 behavioral signs of stress. This list includes increased vigilance, flattened ears, tail tucked into body, poor appetite, excessive grooming, withdrawing from interaction, hiding, and inappropriate urination (p. 256). Given that less literature exists on cat behavior in general (Atkinson, 2018), including on those behaviors pertaining to stress, I relied heavily on the aforementioned methodological, empirical, and theory-based work to derive my behavioral measure of stress in house cats.

Combining this literature pertaining to behavioral indicators of stress in house cats, I composed the following list of 11 stress indicators for a behavioral measure of cat stress. In addition to presenting the same number of items as in the dogs' list, I asked cat-owning participants the same question as the dog owners: "How often does your cat emit the following behaviors" on a 5-point Likert-type scale ranging from "Never" to "All the time." I found an average internal consistency of $\alpha = .813$.

1. Hyper-vocalizing
2. Ears flattened sideways
3. Inappropriate urinating or defecating
4. Trembling
5. Panting
6. Over-grooming
7. Staying alone or hiding
8. Tucking tail in close to body
9. Poor appetite or not eating in the presence of others
10. Restlessness
11. Hyper-vigilance

Given the minimal research on cat owners' ability to identify cat behavior, I provided the following definitions:

Over-grooming: Grooming beyond cleanliness, especially if it creates bald spots

Restlessness: Actively investigating, pacing, or relaxing only for short period

Hyper-vigilance: Constant ear movement and watchful eyes

Ears flattened sideways: Example shown below

 (We Know Pets, 2023)

Job Stress

The owner's level of job stress was evaluated using the Subjective Job Stress Scale (SJSS; Motowidlo et al., 1986). This scale was chosen due to it capturing one's perceived level of stress arising from one's job in a simple self-report format. This scale demonstrated good internal consistency in its validation study ($\alpha = .83$; Motowidlo et al., 1986), as well as convergent validity in that responses to this scale were shown to correlate with both frequency of stressful events on the job and intensity of stressful events on the job. While this scale was derived using a sample of nurses, the scale has been used to measure job stress in employees from a range of industries (e.g., Bolino & Turnley, 2005; Abdelmoteleb, 2019). The SJSS contains four items measured on a 5-point Likert-type scale ranging from "Strongly disagree" to "Strongly agree." An example item is "Very few stressful things happen to me at work." I found an internal consistency of $\alpha = .858$.

Work-Related Rumination

Perseverative thoughts about work during leisure time were measured using the Work-Related Rumination Scale (Cropley et al., 2012). Specifically, participants completed the affective rumination subscale, which focuses on one's negatively emotional thoughts about work experienced during non-work time (Weigelt et al., 2019). This subscale was selected due to its relevance both to emotional contagion, in that it pertains to emotionally charged thoughts, and to stress, in that those emotional thoughts are negatively valenced. Furthermore, this subscale consistently relates to outcomes associated with job stress, like job burnout. An example item is "Are you irritated by work issues?" and the items were measured on a 5-point Likert-type scale

ranging from “Strongly disagree” to “Strongly agree.” I found an internal consistency of α = .880[1].

Home Stress

To isolate stress due to one’s job, I statistically controlled for stress arising from one’s home life using a scale developed to measure home-related stress in Fan et al. (2015). To mirror the scale of subjective job stress used in the current thesis, I specifically used the self-perceived stress at home subscale. In the original paper, this subscale had an internal consistency between α = .61-.88. This subscale contains four items, with an example item being “I feel stress at home.” Items were measured on a 5-point Likert-type scale ranging from “Strongly disagree” to “Strongly agree.” I found an internal consistency of α = .749.

Analytic Approach

To evaluate Hypothesis 1 that tested the direct effect of job stress on pet stress, I used general linear modeling (GLM). The focal independent variable of job stress and the control variable of home stress were entered as predictors of a single criterion. The two criterion variables, perception- and behavior-based stress, were entered into the model separately. In the case of owner-perceived stress, the outcome was represented by a single-item score ranging from no stress at 0 to the “most severe imaginable” stress at 100. The behavioral stress variable was formed by taking the average score of the 11 items (i.e., behavioral indicators of stress) comprising the measure. Thus, this outcome ranges from low stress at 1 (“Never” showing signs of stress) to high stress at 5 (“All the time” showing signs of stress). The type of pet (i.e., cat or dog) was tested as a moderator. If the type of pet was found to influence the results, then the

[1] The original validation paper does not present internal consistency estimates

model was again computed, with dogs and cats separately. Otherwise, the moderator was removed from the model to simplify the model used for hypothesis testing.

To evaluate Hypothesis 2 that tested the indirect effect of job stress on pet stress through work-related rumination, I performed path analyses with bootstrapping. As in the tests of Hypothesis 1, job stress and home stress were input as predictor variables, with job stress serving as the focal independent variable and home stress serving as a control variable. Work-related rumination was input into the models as a mediator variable, and the dependent variable was owner-perceived pet stress and the behavioral measure of stress, modeled separately. The type of pet was again tested as a moderator, specifically in the path from work-related rumination to pet stress. Where a moderation effect was found, the model was computed for dogs and cats separately. Otherwise, the moderator was removed from the model for parsimony in hypothesis testing. These analyses were performed with 10,000 bootstrapped samples. All analyses were computed in Mplus Version 8.4 (Muthen & Muthen, 2017).

Results

Univariate outlier analyses were performed by computing z-scores for each variable. In the behavioral stress measure for dogs, one participant's z-score exceeded the 3.29 threshold recommended by Tabachnick and Fidell (2001, p. 67) and was therefore removed from all analyses. Computation of the Mahalanobis distance did not indicate any multivariate outliers in the data.

Correlations, means, standard deviations, skewness, and kurtosis are shown in Table 2. On a scale of 0-100, participants reported perceiving an average stress level of 27.613 (*SD* = 21.792, range: 0-88) in their pets, aligning with a low-to-moderate level of stress. Similar levels were reported for dogs (*M* = 28.929, *SD* = 22.488, range: 0-88) and cats (*M* = 22.591, *SD* =

18.503, range: 3-70). Behaviorally speaking, participants observed that, on average, their pets emitted stress-related behaviors "Rarely" (M = 1.997, SD = .459, range: 1.18-3.00). Looking at each type of pet, dogs emitted stress-related behaviors "Rarely" (M = 2.061, SD = .433, range: 1.18-3.00), and cats to a slightly lesser extent, between "Never" and "Rarely" (M = 1.752, SD = .483, range: 1.18-2.91). The frequencies of each behavior are depicted in Figure 1 for dogs and Figure 2 for cats.

Perceived pet stress was highly correlated with the behavioral measure of cat stress (r = .705, $p < .01$; Cohen, 1988) but only moderately correlated with dog stress (r = .335, $p < .01$). Thus, the perceptual and behavioral measures of pet stress in cats were more likely to be measuring the same construct than in dogs. The skewness and kurtosis for each variable remained within a range of +/-1.5, suggesting normality in the variable distributions (Tabachnik & Fidell, 2001).

Hypothesis 1 stated that pet owners who experience more job stress would have pets who are more stressed. The first criterion tested was behaviorally indicated pet stress. Including the type of pet as a moderator indicated that the nature of the relationship between job stress and behavioral pet stress was different between dogs and cats, wherein a simple main effect for dogs (γ = .100, SE = .041, z = 2.460, $p < .05$) but not cats (γ = -.034, SE = .073, z = -.457, *ns*) was detected. The full results for the moderated model are shown in Table 3. Therefore, I proceeded to test the relationship between job stress and behavioral pet stress separately for dogs versus cats, displayed in Table 4. Job stress and stress in dogs were found to relate, as job stress co-varied with the behavioral measure of dog stress (γ = .101, SE = .040, z = 2.534, $p < .05$). The simple scatter plot for the relationship between job stress and behavioral dog stress is illustrated

in Figure 3. I did not find support for a relationship between job stress and the behavioral measure of cat stress (γ = -.031, *SE* = .077, z = -.398, *ns*).

The second criterion tested was owner-perceived pet stress. I did not find that the type of pet influenced the relationship between job stress and perceived pet stress, as shown in Table 3, and so I did not proceed to run separate analyses between dogs and cats. I did not find support for an association between job stress and perceived pet stress (γ = -2.175, *SE* = 1.782, z = -1.221, *ns*), as indicated in Table 4. Thus, overall, I only found partial support for Hypothesis 1.

Although input into the model as a control variable, it is interesting to note the link detected between an owner's home-related stress and their pet's stress. Looking at behavioral pet stress, home stress predicted pet stress in both dogs (γ = .149, *SE* = .065, z = 2.281, $p < .05$) and cats (γ = .252, *SE* = .123, z = 2.045, $p < .05$). Home stress also predicted perceived pet stress in the full sample of pets (γ = 8.440, *SE* = 2.779, z = 3.037, $p < .01$). These results are displayed in Table 4.

Hypothesis 2 evaluated the indirect effect of job stress on pet stress through work-related rumination. I similarly found partial support for Hypothesis 2. Including the type of pet as a moderator in the link to behavioral pet stress again indicated disparate relationships for dogs versus cats, wherein the interaction effect between work-related rumination and behavioral stress was statistically significant (γ = .246, *SE* = .103, z = 2.376, $p < .05$). The full results for the model of moderated mediation are shown in Table 5. Therefore, I computed separate models for dogs and cats with behaviorally indicated stress as the criterion, as shown in Table 6 and Figure 4. In dogs, job stress was related to the behavioral measure of dog stress through work-related rumination (γ = .088, *SE* = .037, z = 2.353, $p < .05$). With the inclusion of work-related rumination in the model, no direct effect between job stress and dog stress remained (γ = .022,

SE = .053, *z* = .415, *ns*), suggesting full mediation (Baron & Kenny, 1986). On the other hand, in cats, no indirect effect was found between job stress and behavioral stress via work-related rumination (γ = -.022, *SE* = .091, *z* = -0.239, *ns*).

With respect to perceived stress, the type of pet was not found to influence the nature of the relationship between job stress and perceived stress (see Table 5 for full model results). Therefore, I did not proceed to run separate analyses between dogs and cats. No indirect effect was found between job stress and perceived pet stress via work-related rumination (γ = -.151, *SE* = 1.521, *z* = -.100, *ns*). Full model results are displayed in Table 6. The results of Hypothesis 2 are also shown in Figure 4. Taken together, the results of Hypotheses 1 and 2 suggest that job-stressed pet owners have more stressed dogs, as indicated by their dog's behavior, and by way of thinking more about work during their leisure time.

Discussion

I found partial support for my two hypotheses related to the link between a pet owner's job stress and their pet's level of stress. Hypothesis 1 focused on the direct relationship between the owner's work-related stress and their pet's stress and was evaluated in three separate ways. The pet's stress was captured by a measure of the owner's perception of their pet's stress, with the corresponding model including the full sample of pets, and more objectively by a behavioral measure of stress, which necessitated separate models for cats versus dogs due to each species having different behavioral indicators of stress. Hypothesis 1 was partially supported, in that dogs owned by more job-stressed owners displayed more signs of stress. I did not find this relationship in my sample of cats, which as I detail further below was a very small sample. I also did not find an association between job stress and perceived pet stress. That said, a link was found between an owner's home-related stress and their pet's stress, both perceived and

behavioral in both species. Hypothesis 2 showed a similar pattern of results, wherein work-related rumination served as a linking mechanism between job stress and behavioral pet stress in dogs, but no support was found for an indirect relationship between job stress and behavioral cat stress or perceived stress through work-related rumination.

Crossover and Emotional Contagion from Owners to Pets

This thesis provides support for the notion that an owner's stress from work may cross over to their pet dogs. This finding aligns with that of Sundman and colleagues (2019), who observed that a dog's level of stress synchronizes with their owner's general level of stress. The novelty in the current study lies in its organizational focus – the stress specifically related to one's job appears to cross over to dogs. The crossover effect has been well supported between family members (see Edwards & Rothbard, 2000, for a review), and pets are viewed by the vast majority of Americans as family members (Brown, 2023). Dogs with their special ability to bond with humans thus appear to be vulnerable to negative experiences from that connection just like spouses and children (Li et al., 2021). With the high prevalence of work-related stress throughout the US (American Psychological Association, 2023), it is important not to neglect one's pets in the consideration of how job stress may impair the well-being of an employee and their loved ones.

The means by which job stress associated with dog stress was work-related rumination, or the engagement in continued thoughts about work during off-job hours. Within human samples, work-related rumination has similarly been found to associate with worse relationships at home (Junker et al., 2021; Schoellbauer et al., 2023; Danner-Vlaardingerbroek et al., 2013a; Danner-Vlaardingerbroek et al., 2013b). Ruminative thoughts even served as a link from job-related stress to marital tension in a sample of paramedics (King & DeLongis, 2014).

Engagement in ruminative thoughts about work may make owners less mindful and supportive of their dogs' needs, as was shown between human dyads (Schoellbauer et al., 2023; Danner-Vlaardingerbroek et al., 2013a; Danner-Vlaardingerbroek et al., 2013b), which could result in a dog who is more neglected and stressed. This reasoning aligns with the second and indirect mechanism of crossover proposed by Westman (2001), wherein crossover occurs due to side effects of the stress experienced by the employee.

Work-related rumination could also facilitate the first and direct mechanism of crossover offered by Westman (2001). In a display of emotional contagion, dogs may pick up on their owner's job stress more when the owner is ruminating about work more. Owners may have behavioral signs of stress that they are more likely to show when mentally engaging with work stressors. Like dogs and cats, humans emit certain behavioral patterns when experiencing negative emotions, such as using particular facial expressions (Ekman, 1992), bodily movements and postures (Dael et al., 2012), and vocalizations (Scherer et al., 2003). Experimental manipulations of each of these modalities have demonstrated that dogs can interpret and react to such emotional cues from humans (Muller et al., 2015; Huber et al., 2017; Albuquerque et al. 2016; Custance & Mayer, 2012). Dogs also appear to engage in social referencing, in which they look to their owner to determine how they should interpret a situation (Merola et al., 2012). Therefore, as an owner spends more time muddling through negatively emotional thoughts, they likely send more negatively emotional signals that their dogs perceive to their own detriment. The conversion of these emotional signals into feelings of their own is a display of emotional contagion.

In addition to behavioral changes, dogs may even perceive physiological changes induced by work-related rumination. A study of dogs' responses to the smells left by stressed versus

relaxed human strangers indicated that dogs behave differently in response to, and thus differentially perceive, stressed versus non-stressed human odors. Further, dogs have displayed hormonal stress synchrony, wherein their own cortisol levels increased in line with their owner's even when the owner's behaviors did not change (Buttner et al., 2015). Prior research has demonstrated that rumination can induce changes in cortisol (see Zoccola & Dickerson, 2012, for a review), and perhaps dogs perceive this change in their owners. Transferring this perception into stress of their own would again be a display of emotional contagion. A crossover effect occurring by this mechanism would resemble the empathic mechanism of crossover, wherein an individual "feels" the stress of their partner (Westman, 2001).

Therefore, this thesis adds to the growing body of support for heterospecific emotional contagion between dogs and humans, and in particular between pets and their owners. While most studies of human-dog emotional contagion have focused on working dyads, especially therapy teams and competition dogs, the current thesis looks at companion animals, which comprise the overwhelming majority of dogs in the US. As an additional contribution to the literatures surrounding emotional contagion in pets and companion animal welfare, I observed this phenomenon with regard to a chronic and typical form of stress, rather than an acute and event-based stress as a therapy session or competition would entail. Furthermore, this thesis has ecological relevance by pertaining to the home context as opposed to a lab space, which is an issue found in many studies of heterospecific emotional contagion (Hiestand, 2023).

The results of this thesis did not support a crossover effect in cats, but due to the very low sample size of cats ($N = 22$) and therefore low statistical power, I cannot infer that no relationship exists between owners' job stress and their cats' stress. Despite not finding empirical support for crossover, the results do suggest an emotional contagion effect in this small sample of

house cats. Cats did show levels of stress that aligned with their owner's home-related stress level. This association suggests that cats may "catch" the stress of their owners that is related to the owner's home life, the domain in which the cats reside. The domain relevance of this stress to the cats may facilitate the emotional contagion effect such that this kind of owner stress, but not job-related stress, predicted cats' stress levels. Thus, this thesis contributes additional support to the limited work on emotional contagion in house cats.

This thesis also adds to the literature on social-emotional capabilities of house cats more generally. This thesis improves upon an unfortunate tendency in studies of cats to simply copy the methods used in a canine study and apply it directly to cats (Hiestand, 2023). To avoid mistreatment of cats, I created a separate behavioral measures of stress for cats, basing the measure on literature specifically pertaining to cats. Furthermore, only a handful of studies exist that evaluate emotional contagion in house cats, and most of these studies lay outside the home context. I am also not aware of studies that have examined a link between chronic stress felt by owners and their cats' welfare.

However, it does appear that the link between job stress and pet stress is stronger in dogs than cats. This finding is mirrored in the empirical work on heterospecific emotional contagion, where the presence of this phenomenon is supported moreso in dogs than cats (Hiestand, 2023). This finding also makes sense evolutionarily. Dogs and their evolutionary ancestors have more complex social structures than cats and their ancestors (Driscoll et al. 2007), which likely better facilitated the development of emotional contagion in dogs relative to cats. Furthermore, dogs have evolved alongside humans more closely, more intentionally through selective breeding, and for longer than cats (Driscoll et al. 2009; Lipinski, 2008). Of all non-human animals, dogs are most adept at perceiving and interpreting emotional signals from humans (Udell et al., 2010).

Therefore, dogs are more likely than cats to pick up on signs of distress that humans may be communicating subtly or unintentionally, for example through their posture or facial expressions while ruminating about work.

Perceptual and Behavioral Measures of Stress in Cats versus Dogs

Turning to measures, I found an interesting discrepancy between how closely the two types of measures of pet stress, perception- and behavior-based, matched in cats versus dogs. In cats, owner-perceived stress and behaviorally indicated stress were highly correlated. In dogs, however, these two measurements of stress were only moderately correlated. One interpretation of these results is that cat owners are more tuned into their pets' stress levels. Cat owners may be better educated in the signs of stress in cats or instinctively recognize stressful behaviors as indicating stress and thus can more precisely pinpoint their cat's level of stress. A comparison of two studies by Mariti and colleagues (2017; 2012) on how well cat and dog owners know cat/dog behavioral signs of stress suggests that cat owners are more knowledgeable than dog owners in this area. Cat owners correctly identified stress-related behaviors as indicators of stress at a consistently higher rate than dog owners.

Cats are also free of the label "man's best friend" and the stereotypes and biases that may accompany it, such as a feeling of understanding one's pet even if the reality is not so. Dogs have been shown to be vulnerable to anthropomorphization, which can bias owners' attitudes toward their dogs (Szantho et al., 2017). Specifically, owners who viewed their dogs like children believed their dogs to be more empathetic and responsive to their own behavior (Szantho et al., 2017). Dog owners were also more likely to attribute complex emotions to dogs than cats (Martens et al., 2016). These biases could make dog owners more likely than cat owners to

overlook behavioral signs of stress in favor of their own musings or projections of their pet's stress level.

Methodological differences could exist between the two behavioral measures that I developed such that the cat measure aligns more with stress perception than the dog measure. The stress level meant to be measured in the current thesis was chronic in nature, developing across months or years of interactions with one's owner. The signs of chronic stress may differ from the signs of acute stress common in dogs and cats. For example, Alburquerque et al. (2018) found dogs' lip licking to be a functional response to a stressful event. Thus, dogs may not emit this behavior as a response to their typical stress level. Most canine stress indicators were based on empirical studies that took place in acutely stressful settings like a veterinarian waiting room and unlike the home, and so this literature may have been inappropriate for the current thesis context. Finally, I included explanations for a few of the feline indicators of stress, but I did not do so for the canine indicators. It is possible that the dog-owning participants were more likely to misunderstand the behavioral indicators. I further discuss possible limitations of these measures in the following section.

Limitations and Future Directions

The sample used was a convenience sample not representative of all pets. In particular, a significant limitation in the current thesis is the sample size of cats. Only 22 cats were sample and as a result, all analyses pertaining to cats were underpowered. Unfortunately, despite equal recruitment efforts for dogs and cats, this thesis falls into the pattern where companion animal research tends to be more dog- than cat-focused (Hiestand, 2023). Therefore, companion animal researchers may be advised to specifically target cat owners in their recruitment efforts. Social media groups focused on cats may provide an avenue for targeted recruitment of cat owners.

Researchers may also want to institute sample quotas and allow recruitment to extend longer for cat than dog owners, such that a minimum threshold is reached.

Companion animal researchers of pet welfare would also benefit from a standardized and validated behavior-based measure of pet stress. Many behavioral indicators of stress in dogs and cats exist, for example with Mariti and colleagues (2012; 2017) identifying 19 and 16 behaviors, respectively, in their non-exhaustive list. I selected 11 indicators each for my behavioral measure of cat and dog stress based on prior empirical and theory-based work, but it is possible that these measures suffer from poor validity. Some indicators may be emitted more consistently by pets, making them applicable to a wider range of the pet population. Certain indicators may also be noticed by pet owners more reliably, making them more useful to an owner-reported measure. Mariti and colleagues' studies on owners' understanding of dog and cat stress provide evidence that owners do vary in what behaviors they recognize as indicating stress; owners may also vary in what stress indicators they perceive at all. Therefore, there may be a set of behavioral indicators of stress that together most accurately pinpoints a pet's actual level of stress.

Supplementing the perceptual and behavioral measures of stress in the current thesis with a physiological measure of stress would have improved concerns of measurement validity. Including a measure of hair cortisol concentration would indicate chronic stress levels in pets (Sundman et al., 2019). Another compelling adaptation would be taking daily measures of job and pet stress to explore whether fluctuations in daily work-related stress are transmitted to pets. Measurement of salivary cortisol to capture acute stress level could further inform the link between owner and pet stress.

Practical Implications

This thesis uncovers another victim of an employee's job stress: the employee's pet dog. In addition to the physical and mental well-being impairments that accompany maintaining a high degree of job stress (American Psychological Association, 2023), job stress can impact loved ones through crossover (Westman, 2001). Given that 97% of Americans view their house pets as family members (Brown, 2023), protecting one's pet dog may serve as a motivator to improve one's level of work stress.

To alleviate the link between job stress and dog stress, employees can focus on reducing their engagement in ruminative thoughts about work when at home. Employees should avoid engaging in work-related activities when at home, which exacerbate work-related rumination (e.g., Park et al., 2020). Instead they should engage in leisurely activities during their home time, such as mastering a new skill or relaxing, which relate to improved detachment from work-related thoughts (Sonnentag & Fritz, 2015). Even if an employee works from home, there are a number of steps they can take to keep their work and home lives separate in an attempt to alleviate work-related rumination. For example, they can work in a dedicated home office, maintain routines at the start and end of the workday, and maintain a strict schedule of work hours (Ashforth et al., 2000). By doing so, one's home life can still be protected from work when teleworking.

Mindfulness interventions and cognitive behavioral therapy (CBT) have been widely supported as effective means of reducing ruminative tendencies (see Mao et al., 2022, for a meta-analytic review), even work-related rumination specifically (e.g., Querstret et al., 2017). The practice of mindfulness involves actively attending to one's present circumstances, and doing so without judgement or emotion (Querstret et al., 2017). CBT is a type of therapy that focuses on restructuring a person's style of thinking to become more positive, concrete, and constructive

(Querstret & Cropley, 2013). Both interventions have been successful in reducing ruminative thoughts when delivered online (Querstret & Cropley, 2013), making treatment accessible. For example, employees who took a 4-week online mindfulness course (consisting of 10 sessions typically 20-30 minutes long) continued to show improvements in work-related rumination six months later (Querstret et al., 2017). Organizations can also host mindfulness or CBT interventions for their employees in an effort to protect occupational health (and, in turn, the well-being of employees' loved ones). A one-day CBT workshop completed in person in the office was also linked to continued reductions in work-related rumination 6 months later (Querstret, 2014).

Employees should also take care to attend to their dog during leisure hours, as work-related rumination has been found to pull one's attention and psychological availability away from their loved ones to the detriment of their relationships (Schoellbauer et al., 2023; Danner-Vlaardingerbroek et al., 2013a; Danner-Vlaardingerbroek et al., 2013b). By focusing more mindfully on their pet dogs, employees may be able to combat the means by which ruminative tendencies can harm their loved ones. Furthermore, focusing on one's dog will likely combat work-related rumination itself, as the owner must pull their thoughts away from work and onto their dog. Doing so may, in turn, alleviate a dog's current stress level by allowing the owner to provide any support the dog may need.

Finally, the disparity between perceived and observed stress in pet dogs found in this study suggests that dog owners may lack a clear understanding of their dog's stress level and canine stress in general. Dogs' well-being may be improved by dog owners learning how to recognize signs of stress in their pet, as well as learning to avoid projecting their own thoughts and feelings onto their dog.

Conclusion

A pet's level of stress can have important consequences for their physical health (Dreschel, 2010) and has been shown to align with the stress level of their owner (Sundman et al., 2019). A common source of stress for people in the US is their job (American Psychological Association, 2023). This study united companion animal welfare with organizational research to explore how an employee's job stress may relate to their pet's stress. A crossover effect has been observed between employees and their spouses and children, wherein the stress experienced by an employee due to their job is felt by their loved ones (Edwards & Rothbard, 2000). This phenomenon, to my knowledge, had not yet been studied between employees and their pets despite the close bond that owners and pets share. Furthermore, support exists for emotional contagion between owners and pets (Hiestand, 2023), suggesting that pets can absorb their owner's feelings and thereby may be vulnerable to their owner's job stress.

This thesis provides further support for emotional contagion between owners and their pet dogs, as dogs belonging to employees with higher job stress tended to emit more behavioral indicators of stress. This finding also provides support for a crossover effect between an employee and their pet dog, a valued family member (Brown, 2023) that has been neglected by organizational literature (Kelemen et al., 2020). A crossover effect was not found in cats, but due to the small sample size of cats, I caution the reader from lending substantive interpretation to this non-statistically significant finding. The crossover effect between owners and their dog was explained by an owner's tendency to engage in work-related rumination, or continued thoughts about work after work. Prior work on rumination suggests that this tendency may remove the owner's attention from their pet (Schoellbauer et al., 2023), leading to neglect, or may induce physiological and behavioral changes that communicate the owner's negative feelings to their pet

dog (Zoccola & Dickerson, 2012). I encourage employees and organizations to combat work-related rumination through targeted interventions like mindfulness practice or CBT and being intentional in using leisure time for leisure.

References

Abdelmoteleb, S. A. (2019). A new look at the relationship between job stress and organizational commitment: A three-wave longitudinal study. *Journal of Business and Psychology*, *34*, 321-336.

Abramson, A. (2022). Burnout and stress are everywhere. *Monitor on Psychology*, *53*(1), 72-73.

Albuquerque, N., Guo, K., Wilkinson, A., Savalli, C., Otta, E., & Mills, D. (2016). Dogs recognize dog and human emotions. *Biology Letters, 12*(1), 20150883.

American Psychological Association. (2023). *2023 Work in America Survey: Workplaces as engines of psychological health and well-being*. American Psychological Association. https://www.apa.org/pubs/reports/work-in-america/2023-workplace-health-well-being

Andics, A., Gácsi, M., Faragó, T., Kis, A., & Miklósi, Á. (2014). Voice-sensitive regions in the dog and human brain are revealed by comparative fMRI. *Current Biology*, *24*(5), 574-578.

Ashforth, B. E., Kreiner, G. E., & Fugate, M. (2000). All in a day's work: Boundaries and micro role transitions. *Academy of Management review*, *25*(3), 472-491.

Atkinson, T. (2018). *Practical feline behaviour: understanding cat behaviour and improving welfare*. CABI.

Bakker, A. B., Westman, M., & van Emmerik, I. H. (2009). Advancements in crossover theory. *Journal of Managerial Psychology*, *24*(3), 206-219.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, *51*(6), 1173.

Bert, F., Gualano, M. R., Camussi, E., Pieve, G., Voglino, G., & Siliquini, R. (2016). Animal assisted intervention: A systematic review of benefits and risks. *European journal of integrative medicine*, *8*(5), 695-706.

Bodenmann, G. (2000). *Stress und Coping bei Paaren* [Stress and coping in couples]. Göttingen, Germany: Hogrefe.

Bolino, M. C., & Turnley, W. H. (2005). The personal costs of citizenship behavior: the relationship between individual initiative and role overload, job stress, and work-family conflict. *Journal of applied psychology*, *90*(4), 740-748.

Briefer, E. F. (2018). Vocal contagion of emotions in non-human animals. *Proceedings of the Royal Society B: Biological Sciences*, *285*(1873), 20172783.

Brown, A. (2023, July). *About half of U.S. pet owners say their pets are as much a part of their family as a human member*. Pew Research Center. https://www.pewresearch.org/short-reads/2023/07/07/about-half-us-of-pet-owners-say-their-pets-are-as-much-a-part-of-their-family-as-a-human-member/#:~:text=And%20for%20a%20majority%20of,of%20men%20who%20own%20pets

Buttner, A. P. (2016). Neurobiological underpinnings of dogs' human-like social competence: How interactions between stress response systems and oxytocin mediate dogs' social skills. *Neuroscience & Biobehavioral Reviews*, *71*, 198-214.

Buttner, A. P., Thompson, B., Strasser, R., & Santo, J. (2015). Evidence for a synchronization of hormonal states between humans and dogs during competition. *Physiology & Behavior*, *147*, 54-62.

Clark, S. D., Smidt, J. M., & Bauer, B. A. (2020). Therapy dogs' and handlers' behavior and salivary cortisol during initial visits in a complex medical institution: a pilot study. *Frontiers in Veterinary Science*, *7*, 564201.

Cohen, J. (1988). Set correlation and contingency tables. *Applied psychological measurement*, *12*(4), 425-434.

Colin, V. L., & Low, N. (1991). Infant attachment: What we know now. *Washington, DC: US Department of Health and Human Services*.

Cropley, M., Michalianou, G., Pravettoni, G., & Millward, L. J. (2012). The relation of post work ruminative thinking with eating behaviour. *Stress and Health, 28*(1), 23-30.

Cropley, M., & Millward Purvis, L. (2003). Job strain and rumination about work issues during leisure time: A diary study. *European journal of work and organizational psychology*, *12*(3), 195-207.

Cropley, M., & Zijlstra, F. R. H. (2011). Work and rumination. In J. Langan-Fox & C. L. Cooper (Eds.), *Handbook of stress in the occupations* (pp. 487-501). Northampton, MA: Edward Elgar Publishing.

Custance, D., & Mayer, J. (2012). Empathic-like responding by domestic dogs (Canis familiaris) to distress in humans: an exploratory study. *Animal cognition*, *15*, 851-859.

Dael, N., Mortillaro, M., & Scherer, K. R. (2012). Emotion expression in body action and posture. *Emotion, 12*(5), 1085–1101.

Danner-Vlaardingerbroek, G., Kluwer, E. S., Van Steenbergen, E. F., & van der Lippe, T. (2013a). Knock, knock, anybody home? Psychological availability as link between work and relationship. *Personal Relationships*, *20*(1), 52-68.

Danner-Vlaardingerbroek, G., Kluwer, E. S., van Steenbergen, E. F., & van der Lippe, T. (2013b). The psychological availability of dual-earner parents for their children after work. *Family Relations*, *62*(5), 741-754.

De Waal, F. B. (2008). Putting the altruism back into altruism: The evolution of empathy. *Annual Review of Psychology*, *59*(1), 279-300.

Demerouti, E., Bakker, A. B., & Schaufeli, W. B. (2005). Spillover and crossover of exhaustion and life satisfaction among dual-earner parents. *Journal of Vocational Behavior*, *67*(2), 266-289.

Dreschel, N. A. (2010). The effects of fear and anxiety on health and lifespan in pet dogs. *Applied Animal Behaviour Science*, *125*(3-4), 157-162.

Driscoll, C. A., Macdonald, D. W., & O'Brien, S. J. (2009). From wild animals to domestic pets, an evolutionary view of domestication. *Proceedings of the National Academy of Sciences*, *106*(supplement_1), 9971-9978.

Driscoll, C. A., Menotti-Raymond, M., Roca, A. L., Hupe, K., Johnson, W. E., Geffen, E., ... & Macdonald, D. W. (2007). The Near Eastern origin of cat domestication. *Science*, *317*(5837), 519-523.

Du, D., Derks, D., & Bakker, A. B. (2018). Daily spillover from family to work: A test of the work–home resources model. *Journal of occupational health psychology, 23*(2), 237-247.

Duffy, D. L., de Moura, R. T. D., & Serpell, J. A. (2017). Development and evaluation of the Fe-BARQ: A new survey instrument for measuring behavior in domestic cats (Felis s. catus). *Behavioural processes*, *141*, 329-341.

Edgar, J. L., & Nicol, C. J. (2018). Socially-mediated arousal and contagion within domestic chick broods. *Scientific Reports*, *8*(1), 10509.

Edgar, J. L., Nicol, C. J., Clark, C. C., & Paul, E. S. (2012). Measuring empathic responses in animals. *Applied Animal Behaviour Science*, *138*(3-4), 182-193.

Edwards, J. R., & Rothbard, N. P. (2000). Mechanisms linking work and family: Clarifying the relationship between work and family constructs. *Academy of Management Review*, *25*(1), 178-199.

Ekman, P. (1992). Are there basic emotions? *Psychological Review, 99*(3), 550–553.

Fan, L. B., Blumenthal, J. A., Watkins, L. L., & Sherwood, A. (2015). Work and home stress: associations with anxiety and depression symptoms. *Occupational medicine*, *65*(2), 110-116.

Finka, L. R. (2022). Conspecific and human sociality in the domestic cat: consideration of proximate mechanisms, human selection and implications for cat welfare. *Animals*, *12*(3), 298.

Galvan, M., & Vonk, J. (2016). Man's other best friend: domestic cats (F. silvestris catus) and their discrimination of human emotion cues. *Animal Cognition*, *19*, 193-205.

Härmä, M. (2006). Workhours in relation to work stress, recovery and health. *Scandinavian journal of work, environment & health*, 502-514.

Hatfield, E., Cacioppo, J. T., & Rapson, R. L. (1993). Emotional contagion. *Current Directions in Psychological Science*, *2*(3), 96-100.

Hiestand, K. (2023). *Empathy across the species barrier: are dogs really 'man's' best friend, or are cats just as empathetic?* (Doctoral dissertation, University of Sussex).

Hsu, Y., & Serpell, J. A. (2003). Development and validation of a questionnaire for measuring behavior and temperament traits in pet dogs. *Journal of the American Veterinary Medical Association*, *223*(9), 1293-1300.

Huber, A., Barber, A. L., Faragó, T., Müller, C. A., & Huber, L. (2017). Investigating emotional contagion in dogs (Canis familiaris) to emotional sounds of humans and conspecifics. *Animal Cognition*, *20*, 703-715.

Jones, F. & Fletcher, B. (1993). An empirical study of occupational stress transmission in working couples. *Human Relations, 46*, 881–902.

Jones, A. C., & Josephs, R. A. (2006). Interspecies hormonal interactions between man and the domestic dog (Canis familiaris). *Hormones and Behavior*, *50*(3), 393-400.

Junker, N. M., Baumeister, R. F., Straub, K., & Greenhaus, J. H. (2021). When forgetting what happened at work matters: The role of affective rumination, problem-solving pondering, and self-control in work–family conflict and enrichment. *Journal of Applied Psychology, 106*(11), 1750–1766.

Kelemen, T. K., Matthews, S. H., Wan, M., & Zhang, Y. (2020). The secret life of pets: The intersection of animals and organizational life. *Journal of Organizational Behavior*, *41*(7), 694-697.

King, D. B., & DeLongis, A. (2014). When couples disconnect: Rumination and withdrawal as maladaptive responses to everyday stress. *Journal of Family Psychology*, *28*(4), 460.

Koda, N., Miyaji, Y., Kuniyoshi, M., Adachi, Y., Watababe, G., Miyaji, C., & Yamada, K. (2015). Effects of a dog-assisted program in a Japanese prison. *Asian Journal of Criminology*, *10*, 193-208.

Koutsimani, P., Montgomery, A., & Georganta, K. (2019). The relationship between burnout, depression, and anxiety: A systematic review and meta-analysis. *Frontiers in psychology*, *10*, 284.

Li, A., Cropanzano, R., Butler, A., Shao, P., & Westman, M. (2021). Work–family crossover: A meta-analytic review. *International Journal of Stress Management*, *28*(2), 89.

Lipinski, M. J., Froenicke, L., Baysac, K. C., Billings, N. C., Leutenegger, C. M., Levy, A. M., ... & Lyons, L. A. (2008). The ascent of cat breeds: genetic evaluations of breeds and worldwide random-bred populations. *Genomics*, *91*(1), 12-21.

Mao, L., Li, P., Wu, Y., Luo, L., & Hu, M. (2023). The effectiveness of mindfulness-based interventions for ruminative thinking: A systematic review and meta-analysis of randomized controlled trials. *Journal of Affective Disorders*, *321*, 83-95.

Martens, P., Enders-Slegers, M. J., & Walker, J. K. (2016). The emotional lives of companion animals: Attachment and subjective claims by owners of cats and dogs. *Anthrozoös*, *29*(1), 73-88.

McCune, S. (1995). The impact of paternity and early socialisation on the development of cats' behaviour to people and novel objects. *Applied Animal Behaviour Science*, *45*(1-2), 109-124.

Merola, I., Lazzaroni, M., Marshall-Pescini, S., & Prato-Previde, E. (2015). Social referencing and cat–human communication. *Animal cognition*, *18*, 639-648.

Merola, I., Prato-Previde, E., & Marshall-Pescini, S. (2012). Social referencing in dog-owner dyads?. *Animal cognition*, *15*, 175-185.

Minnen, M. E., Mitropoulos, T., Rosenblatt, A. K., & Calderwood, C. (2021). The incessant inbox: Evaluating the relevance of after-hours e-mail characteristics for work-related rumination and well-being. *Stress and Health*, *37*(2), 341-352.

Motowidlo, S. J., Packard, J. S., & Manning, M. R. (1986). Occupational stress: its causes and consequences for job performance. *Journal of applied psychology*, *71*(4), 618-629.

Müller, C. A. A., Schmitt, K., Barber, A. L., & Huber, L. (2015). Dogs can discriminate emotional expressions of human faces. *Current Biology, 25*(5), 601 605.

Muthén, L.K. & Muthén, B.O. (1998-2017). Mplus User's Guide. Eighth Edition. Los Angeles, CA: Muthén & Muthén.

Nelson, J. A., O'Brien, M., Blankson, A. N., Calkins, S. D., & Keane, S. P. (2009). Family stress and parental responses to children's negative emotions: Tests of the spillover, crossover, and compensatory hypotheses. *Journal of Family Psychology*, *23*(5), 671-679.

NIOSH. (1999). *Stress ...At Work* (DHHS [NIOSH] Publication No. 99–101). U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. https://www.cdc.gov/niosh/docs/99-101/pdfs/99-101.pdf

Park, Y., Liu, Y., & Headrick, L. (2020). When work is wanted after hours: Testing weekly stress of information communication technology demands using boundary theory. *Journal of Organizational Behavior*, *41*(6), 518-534.

Parr, L. A. (2001). Cognitive and physiological markers of emotional awareness in chimpanzees (Pan troglodytes). *Animal Cognition*, *4*, 223-229.

Parr-Cortes, Z., Müller, C. T., Talas, L., Mendl, M., Guest, C., & Rooney, N. J. (2024). The odour of an unfamiliar stressed or relaxed person affects dogs' responses to a cognitive bias test. *Scientific Reports*, *14*(1), 15843.

Pérez-Manrique, A., & Gomila, A. (2022). Emotional contagion in nonhuman animals: A review. *Wiley Interdisciplinary Reviews: Cognitive Science*, *13*(1), e1560.

Pirrone, F., Ripamonti, A., Garoni, E. C., Stradiotti, S., & Albertini, M. (2017). Measuring social synchrony and stress in the handler-dog dyad during animal-assisted activities: A pilot study. *Journal of Veterinary Behavior*, *21*, 45-52.

Quaranta, A., d'Ingeo, S., Amoruso, R., & Siniscalchi, M. (2020). Emotion recognition in cats. *Animals*, *10*(7), 1107-1119.

Querstret, D. (2014). *Recovery From Work: The Link Between Work-Related Rumination, Fatigue and Sleep*. University of Surrey (United Kingdom).

Querstret, D., & Cropley, M. (2013). Assessing treatments used to reduce rumination and/or worry: A systematic review. *Clinical psychology review*, *33*(8), 996-1009.

Querstret, D., Cropley, M., & Fife-Schaw, C. (2017). Internet-based instructor-led mindfulness for work-related rumination, fatigue, and sleep: Assessing facets of mindfulness as mechanisms of change. A randomized waitlist control trial. *Journal of occupational health psychology*, *22*(2), 153.

Quervel-Chaumette, M., Faerber, V., Faragó, T., Marshall-Pescini, S., & Range, F. (2016). Investigating empathy-like responding to conspecifics' distress in pet dogs. *PLoS One*, *11*(4), e0152920.

Robinson, B. (2021, April). The Work Stress Epidemic: 7 Steps You Must Take To Sustain Career Success. *Forbes*. https://www.forbes.com/sites/bryanrobinson/2021/04/01/the-work-stress-epidemic-7-steps-you-must-take-to-sustain-career-success/

Rook, S. K., Dooley, D. & Catalano, R. (1991). Stress transmission: The effects of husbands' job stressors on emotional health of their wives. *Journal of Marriage and the Family*, *53*, 165–77.

Scherer, K. R. (2003). Vocal communication of emotion: A review of research paradigms. *Speech communication*, *40*(1-2), 227-256.

Schleidt, W. M., & Shalter, M. D. (2003). Co-evolution of humans and canids. *Evolution and Cognition*, *9*(1), 57-72.

Schöberl, I., Beetz, A., Solomon, J., Wedl, M., Gee, N., & Kotrschal, K. (2016). Social factors influencing cortisol modulation in dogs during a strange situation procedure. *Journal of Veterinary Behavior*, *11*, 77-85.

Schöberl, I., Wedl, M., Beetz, A., & Kotrschal, K. (2017). Psychobiological factors affecting cortisol variability in human-dog dyads. *PLoS One*, *12*(2), e0170707.

Schoellbauer, J., Tement, S., & Korunka, C. (2023). Honey, There´ s Something on My Mind… Adverse Consequences of Negative and Positive Work Rumination on Attention to the Partner, and the Advantage of Talking About it. *Journal of Happiness Studies*, *24*(3), 917-944.

Serpell, J. A. (2021). Commensalism or cross-species adoption? A critical review of theories of wolf domestication. *Frontiers in Veterinary Science*, *8*, 662370.

Silas, H. J., Binfet, J. T., & Ford, A. T. (2019). Therapeutic for all? Observational assessments of therapy canine stress in an on-campus stress-reduction program. *Journal of Veterinary Behavior*, *32*, 6-13.

Silva, K., Bessa, J., & De Sousa, L. (2012). Auditory contagious yawning in domestic dogs (Canis familiaris): first evidence for social modulation. *Animal cognition*, *15*, 721-724.

Sonnentag, S., & Fritz, C. (2015). Recovery from job stress: The stressor-detachment model as an integrative framework. *Journal of organizational behavior*, *36*(S1), S72-S103.

Sundman, A. S., Van Poucke, E., Svensson Holm, A. C., Faresjö, Å., Theodorsson, E., Jensen, P., & Roth, L. S. (2019). Long-term stress levels are synchronized in dogs and their owners. *Scientific reports*, *9*(1), 7391.

Sümegi, Z., Oláh, K., & Topál, J. (2014). Emotional contagion in dogs as measured by change in cognitive task performance. *Applied Animal Behaviour Science*, *160*, 106-115.

Szantho, F., Miklósi, Á., & Kubinyi, E. (2017). Is your dog empathic? Developing a dog emotional reactivity survey. *PloS one*, *12*(2), e0170397.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (5th ed.). Pearson.

Thompson, R. A. (1987). Empathy and emotional understanding: The early development of empathy. *Empathy and its development*, *119*, 145.

Topál, J., & Gácsi, M. (2012). Lessons we should learn from our unique relationship with dogs: an ethological approach. In *Crossing boundaries* (pp. 161-186). Brill.

Tracy, J. L., & Randles, D. (2011). Four models of basic emotions: A review of Ekman and Cordaro, Izard, Levenson, and Panksepp and Watt. *Emotion review*, *3*(4), 397-405.

Trut, L. N. (2000). Early canid domestication: the farm-fox experiment. *Scientifur*, *24*(2), 124-132.

Udell, M. A. R., Dorey, N. R., & Wynne, C. D. L. (2010). What did domestication do to dogs? A new account of dogs' sensitivity to human actions. *Biological Reviews, 85*(2), 327–345.

Vahle-Hinz, T., Bamberg, E., Dettmers, J., Friedrich, N., & Keller, M. (2014). Effects of work stress on work-related rumination, restful sleep, and nocturnal heart rate variability experienced on workdays and weekends. *Journal of occupational health psychology*, *19*(2), 217.

Vahle-Hinz, T., Mauno, S., De Bloom, J., & Kinnunen, U. (2017). Rumination for innovation? Analysing the longitudinal effects of work-related rumination on creativity at work and off-job recovery. *Work & Stress*, *31*(4), 315-337.

Vitale, K. R., Behnke, A. C., & Udell, M. A. (2019). Attachment bonds between domestic cats and humans. *Current Biology*, *29*(18), R864-R865.

Wanser, S. H., & Udell, M. A. (2019). Does attachment security to a human handler influence the behavior of dogs who engage in animal assisted activities?. *Applied Animal Behaviour Science*, *210*, 88-94.

We Know Pets. (2023, July 14). *When Furry Ears Go Flat: What Your Cat's Ear Position Says About Their Mood*. We Know Pets. https://www.weknowpets.com.au/blogs/news/when-furry-ears-go-flat-what-your-cats-ear-position-says-about-their-mood

Weigelt, O., Gierer, P., & Syrek, C. J. (2019). My mind is working overtime—towards an integrative perspective of psychological detachment, work-related rumination, and work reflection. *International journal of environmental research and public health*, *16*(16), 2987.

Westman, M. (2001). Stress and strain crossover. *Human relations*, *54*(6), 717-751.

Westman, M., & Etzion, D. (1995). Crossover of stress, strain and resources from one spouse to another. *Journal of Organizational Behavior*, *16*(2), 169-181.

Wu, Q., & Zhou, N. (2023). Work stress and personal and relational well-being among Chinese college teachers: the indirect roles of sense of control and work-related rumination. *Psychology Research and Behavior Management*, 2819-2828.

Yong, M. H., & Ruffman, T. (2014). Emotional contagion: Dogs and humans show a similar physiological response to human infant crying. *Behavioural processes*, *108*, 155-165.

Zoccola, P. M., & Dickerson, S. S. (2012). Assessing the relationship between rumination and cortisol: A review. *Journal of psychosomatic research*, *73*(1), 1-9.

Tables and Figures

Table 1a

Behavioral Indicators of Stress for Pet Dogs and Supporting Literature

Behavioral Indicator of Stress	Examples of Literature Support
Excessive nose or lip licking	Clark et al. (2020), Mariti et al. (2012), Mariti et al. (2015)
Wet dog shake	Clark et al. (2020), Mariti et al. (2015), Hsu & Serpell (2003)
Yawning	Clark et al. (2020), Mariti et al. (2012), Mariti et al. (2015)
Leaning into people	Clark et al. (2020)
Crying, whimpering, or whining	Mariti et al. (2012), Mariti et al. (2015), Hsu & Serpell (2003)
Avoiding eye contact	Mariti et al. (2012), Hsu & Serpell (2003)
Tail lowered or tucked between the legs	Mariti et al. (2015), Hsu & Serpell (2003)
Panting	Clark et al. (2020), Mariti et al. (2012)
Poor appetite	Mariti et al. (2012)
Inappropriate urinating or defecating	Mariti et al. (2012)
Excessive walking or pacing	Mariti et al. (2012), Mariti et al. (2015)

Table 1b

Behavioral Indicators of Stress for Pet Cats and Supporting Literature

Behavioral Indicator of Stress	Examples of Literature Support
Hyper-vocalizing	Mariti et al. (2017), Duffy et al. (2017)
Ears flattened sideways	Mariti et al. (2017), Atkinson (2018)
Inappropriate urinating or defecating	Mariti et al. (2017), Atkinson (2018)
Trembling	Mariti et al. (2017)
Panting	Mariti et al. (2017), Atkinson (2018)
Over-grooming	Mariti et al. (2017), Atkinson (2018)
Staying alone or hiding	Mariti et al. (2017), Duffy et al. (2017), Atkinson (2018)
Tucking tail in close to body	Mariti et al. (2017), Atkinson (2018)
Poor appetite or not eating in the presence of others	Atkinson (2018)
Restlessness	Duffy et al. (2017), Atkinson (2018)
Hyper-vigilance	Duffy et al. (2017), Atkinson (2018)

Table 2

Descriptive Statistics and Inter-Correlations of Study Variables

	N	*M*	*SD*	Skewness	Kurtosis	1	2	3	4	5	6
Focal Variables											
1. Job stress	107	3.126	1.130	-.067	-.941	(.858)					
2. Rumination	107	2.561	.941	.337	-.517	.643**	(.880)				
3. Perceived pet stress	106	27.613	21.792	.795	-.331	-.101	-.073	--			
4. Behavioral stress in dogs	84	2.061	.433	.293	-.570	.278*	.404**	.335**	(.632)		
5. Behavioral stress in cats	22	1.752	.483	1.072	.376	-.100	-.107	.705**	--	(.813)	
Control Variable											
6. Home stress	107	1.685	.725	1.140	.760	.044	.106	.277*	.254*	.403**	(.749)

Note. Internal consistencies are displayed in parentheses.

* $p < .05$. ** $p < .01$.

Table 3

Direct Effect of Job Stress on Pet Stress with Pet Type Moderator

	Perceived Pet Stress[†]			Behavioral Measure of Pet Stress[‡]		
	Est.	*SE*	*z*	Est.	*SE*	*z*
Intercept	18.758	14.397	1.303	1.540**	.290	5.312
Statistical Control						
Home stress	8.943**	2.769	3.230	.174**	.058	3.011
Focal Variable						
Job stress	-3.781	3.674	-1.029	-.034	.073	-.457
Pet type[§]	-.733	14.877	-.049	-.067	.299	-.223
Job stress x Pet type	2.572	4.197	.613	.134	.084	1.590
Simple main effect: Dogs	-1.209s	2.026	-0.597	.100*	.041	2.460
Simple main effect: Cats	-3.781	3.674	-1.029	-.034	.073	-.457
Residual variance	417.038**	57.284	7.280	.167**	.023	7.280
Pseudo-R^2	.113	.058	1.956	.200**	.069	2.877

Note. $N = 106$ participants, consisting of both cats and dogs.

* $p < .05$. ** $p < .01$.

[†] Perceived pet stress was measured on a scale of 0-100, with higher values representing higher stress.

[‡] The behavioral measure of stress was measured on a scale of 1-5, with higher values representing higher stress.

[§] Pet type = 0 is cats; pet type = 1 is dogs.

Table 4

Direct Effect of Job Stress on Pet Stress

	Perceived Pet Stress: All Pets[†]			Behavioral Measure of Stress: Dogs[‡]			Behavioral Measure of Stress: Cats[§]		
	Est.	*SE*	*z*	Est.	*SE*	*z*	Est.	*SE*	*z*
Intercept	20.212**	7.390	2.735	1.510**	.161	9.392	1.385**	.373	3.715
Statistical Control									
Home stress	8.440**	2.779	3.037	.149*	.065	2.281	.252*	.123	2.045
Focal Variable									
Job stress	-2.175	1.782	-1.221	.101*	.040	2.534	-.031	.077	-.398
Residual variance	428.314**	58.833	7.280	.161**	.025	6.481	.185**	.056	3.317
Pseudo-R^2	.089	.053	1.691	.131	.069	1.908	.168	.145	1.156

Note. * $p < .05$. ** $p < .01$.

[†] $N = 106$ participants, consisting of both cats and dogs. Perceived pet stress was measured on a scale of 0-100, with higher values representing higher stress.

[‡] $N = 84$ participants. The behavioral measure of stress was measured on a scale of 1-5, with higher values representing higher stress.

[§] $N = 22$ participants. The behavioral measure of stress was measured on a scale of 1-5, with higher values representing higher stress.

Table 5

Indirect Effect of Job Stress on Pet Stress through Work-Related Rumination with Pet Type Moderator

	Work-Related Rumination			Perceived Pet Stress[†]			Behavioral Measure of Pet Stress[‡]		
	Est.	*SE*	*z*	Est.	*SE*	*z*	Est.	*SE*	*z*
Intercept	.725**	.226	3.209	40.738**	13.113	3.107	1.863**	.287	6.492
Statistical Control									
Home stress	.101	.092	1.101						
Focal Variable									
Job stress	.532**	.057	9.385	-1.434	2.348	-.611	.015	.049	.310
Work-related rumination				-4.808	4.243	-1.133	-.059	.094	-.631
Pet type[§]				-11.012	15.094	-.730	-.320	.302	-1.061
Work-related rumination x Pet type				6.224	4.612	1.350	.246*	.103	2.376
Index of moderated mediation				3.314	2.455	1.350	.131*	.057	2.275
Simple indirect effect: Dogs				.754	1.677	.450	.099*	.039	2.563
Simple indirect effect: Cats				-2.560	2.283	-1.121	-.032	.050	-.631
Residual variance	.509**	.059	8.670	453.546**	54.225	8.364	.168	.022	7.586
Pseudo-R^2	.419**	.060	6.945	.079	.071	1.108	.233*	.103	2.265

Note. $N = 106$ participants, consisting of both cats and dogs.

* $p < .05$. ** $p < .01$.

† Perceived pet stress was measured on a scale of 0-100, with higher values representing higher stress.

‡ The behavioral measure of stress was measured on a scale of 1-5, with higher values representing higher stress.

§ Pet type = 0 is cats; pet type = 1 is dogs.

Table 6a

Indirect Effect of Job Stress on Perceived Pet Stress via Work-Related Rumination in Both Dogs and Cats

	Work-Related Rumination			Perceived Pet Stress		
	Est.	*SE*	*z*	Est.	*SE*	*z*
Intercept	.725**	.226	3.209	33.935**	7.161	4.739
Statistical Control						
Home stress	.101	.092	1.100	---	---	---
Focal Variables						
Job stress	.532**	.057	9.385	-1.791	2.331	-.768
Work-related rumination	---	---	---	-.284	2.834	-.100
Residual variance	.509**	.059	8.671	465.555**	56.077	8.302
Pseudo-R^2	.419**	.060	6.945	.010	.025	0.413
Indirect effect	---	---	---	-.151	1.521	-.100

Note. N = 106 participants (cats and dogs). Perceived pet stress was measured on a scale of 0-100, with higher values representing higher stress.

* $p < .05$. ** $p < .01$.

Table 6b

Indirect Effect of Job Stress on Behavioral Measure of Pet Stress via Work-Related Rumination in Dogs

	Work-Related Rumination			Observed Pet Stress		
	Est.	*SE*	*z*	Est.	*SE*	*z*
Intercept	.864**	.257	3.367	1.535**	.134	11.425
Statistical Control						
Home stress	.105	.113	.928	---	---	---
Focal Variables						
Job stress	.484**	.065	7.404	.022	.053	.415
Work-related rumination	---	---	---	.181*	.071	2.542
Residual variance	.500**	.064	7.771	.155**	.022	7.089
Pseudo-R^2	.367**	.070	5.266	.168*	.083	2.012
Indirect effect	---	---	---	.088*	.037	2.353

Note. N = 84 participants (dogs). Observed pet stress was measured on a scale of 1-5, with higher values representing higher stress.

* $p < .05$. ** $p < .01$.

Table 6c

Indirect Effect of Job Stress on Behavioral Measure of Pet Stress via Work-Related Rumination in Cats

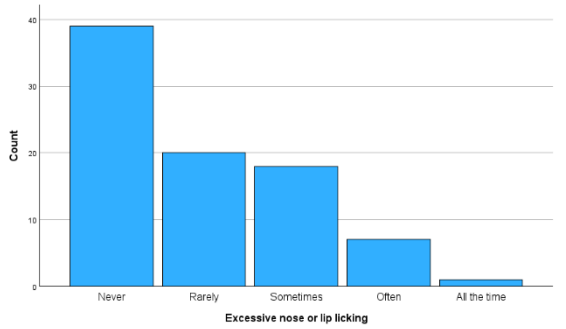
	Work-Related Rumination			Observed Pet Stress		
	Est.	*SE*	*z*	Est.	*SE*	*z*
Intercept	.196	.523	.374	1.901**	.355	5.348
Statistical Control						
Home stress	.109	.217	.500	---	---	---
Focal Variables						
Job stress	.688**	.108	6.368	-.018	.143	-.127
Work-related rumination	---	---	---	-.032	.128	-.248
Residual variance	.498**	.136	3.660	.220**	.063	3.475
Pseudo-R^2	.572**	.120	4.762	.012	.090	.136
Indirect effect	---	---	---	-.022	.091	-.239

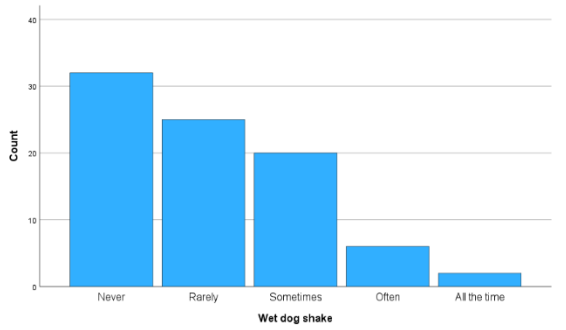
Note. $N = 22$ participants (cats). Observed pet stress was measured on a scale of 1-5, with higher values representing higher stress.

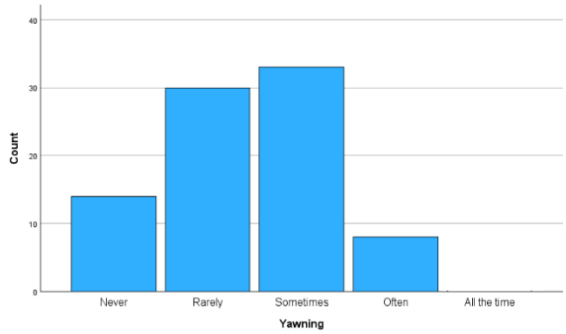
* $p < .05$. ** $p < .01$.

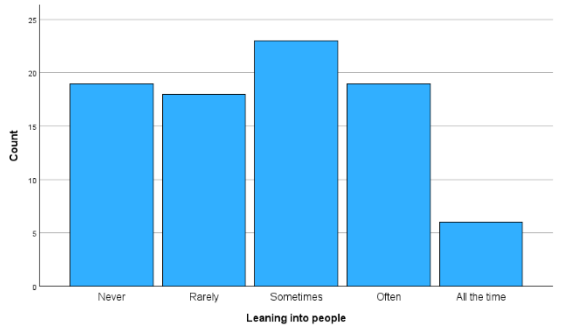
Figure 1

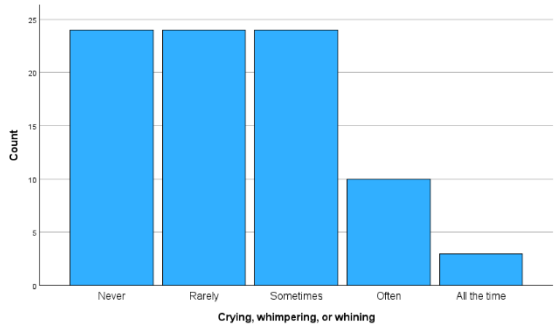
Frequencies of stress-related behaviors emitted by dogs as rated by owners

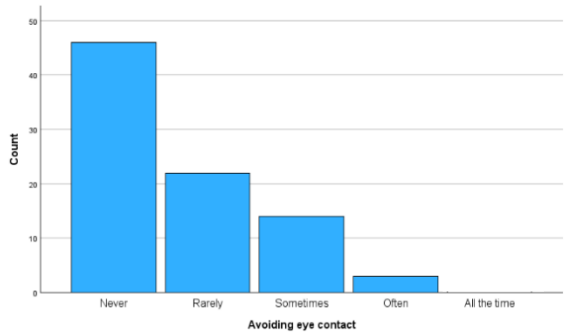


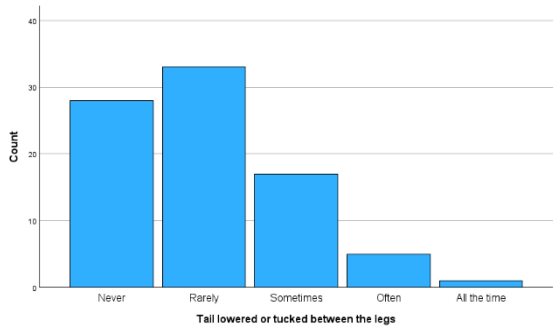


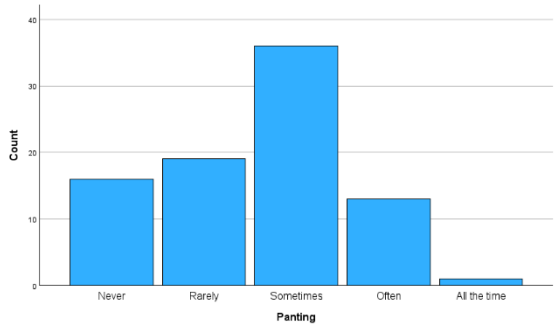


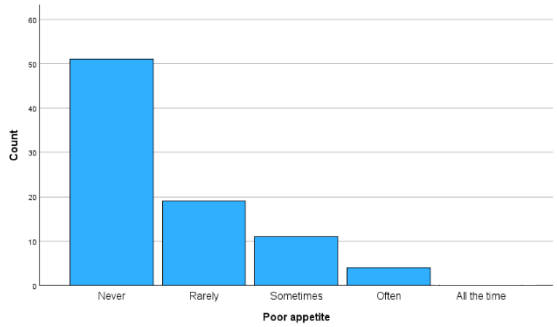


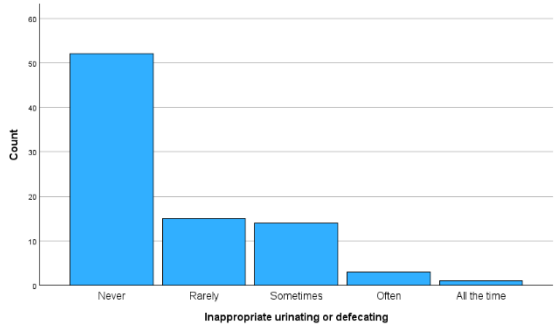

Count
25
20
15
10
5
0
Never
Rarely
Sometimes
Often
All the time
Crying, whimpering, or whining


Count
50
40
30
20
10
0
Never
Rarely
Sometimes
Often
All the time
Avoiding eye contact


Count
40
30
20
10
0
Never
Rarely
Sometimes
Often
All the time
Tail lowered or tucked between the legs


Count
40
30
20
10
0
Never
Rarely
Sometimes
Often
All the time
Panting


Count
60
50
40
30
20
10
0
Never
Rarely
Sometimes
Often
All the time
Poor appetite


Count
60
50
40
30
20
10
0
Never
Rarely
Sometimes
Often
All the time
Inappropriate urinating or defecating

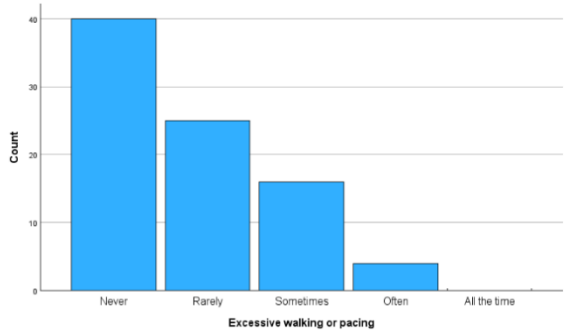
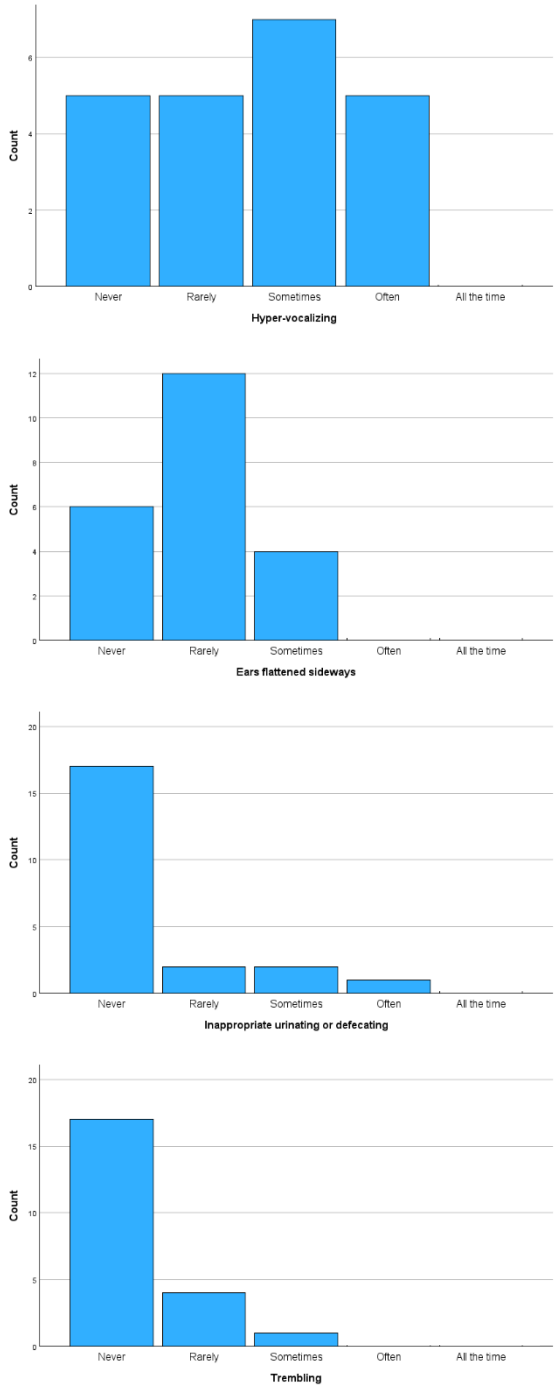
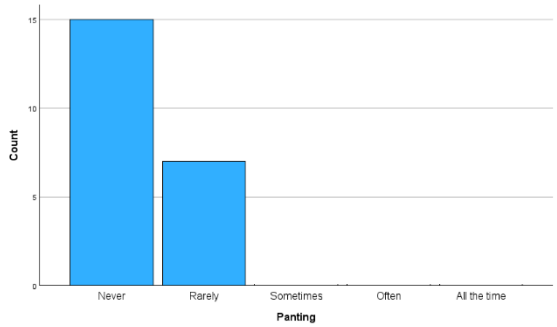
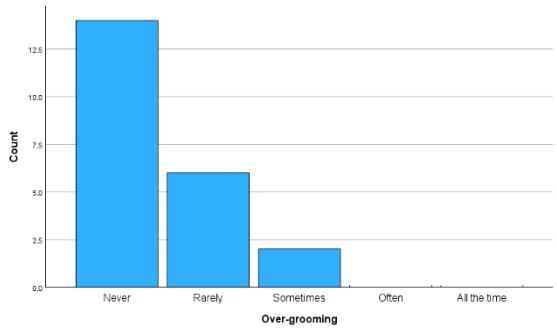

Count
40
30
20
10
0
Never
Rarely
Sometimes
Often
All the time
Excessive walking or pacing

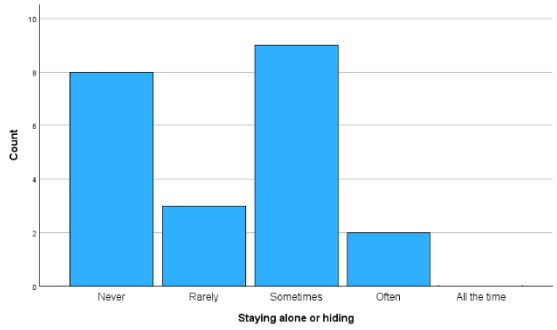
Figure 2

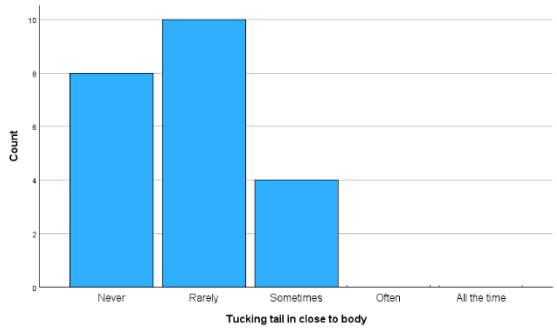
Frequencies of stress-related behaviors emitted by cats as rated by owners

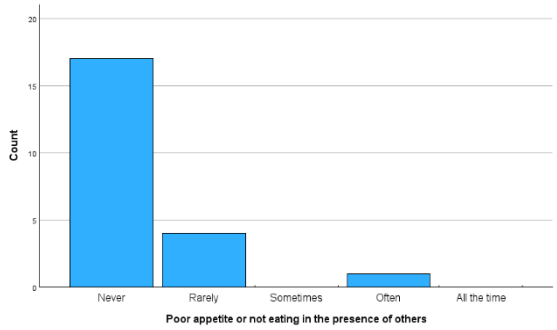


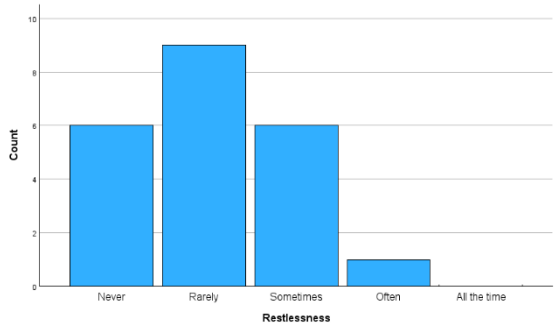

Count
15
10
5
0
Never
Rarely
Sometimes
Often
All the time
Panting


Count
12.5
10.0
7.5
5.0
2.5
0.0
Never
Rarely
Sometimes
Often
All the time
Over-grooming


Count
10
8
6
4
2
0
Never
Rarely
Sometimes
Often
All the time
Staying alone or hiding


Count
10
8
6
4
2
0
Never
Rarely
Sometimes
Often
All the time
Tucking tail in close to body


Count
20
15
10
5
0
Never
Rarely
Sometimes
Often
All the time
Poor appetite or not eating in the presence of others


Count
10
8
6
4
2
0
Never
Rarely
Sometimes
Often
All the time
Restlessness

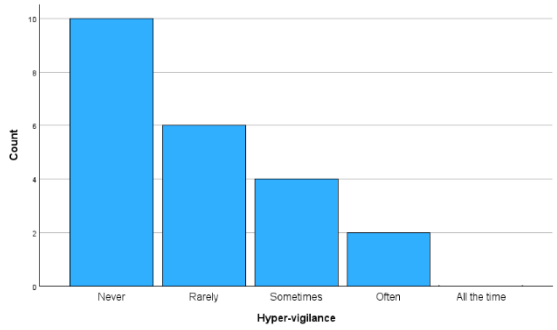

Count
10
8
6
4
2
0
Never
Rarely
Sometimes
Often
All the time
Hyper-vigilance

Figure 3

Dogs' behaviorally-indicated stress as predicted by their owner's job stress

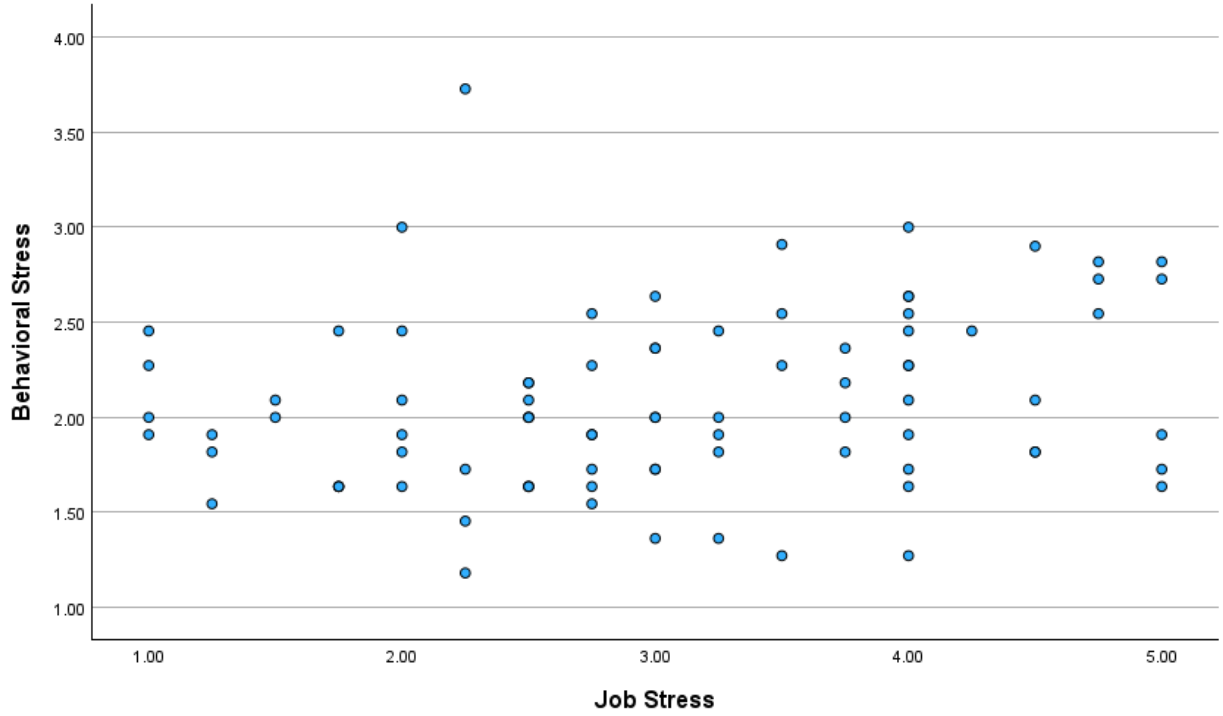
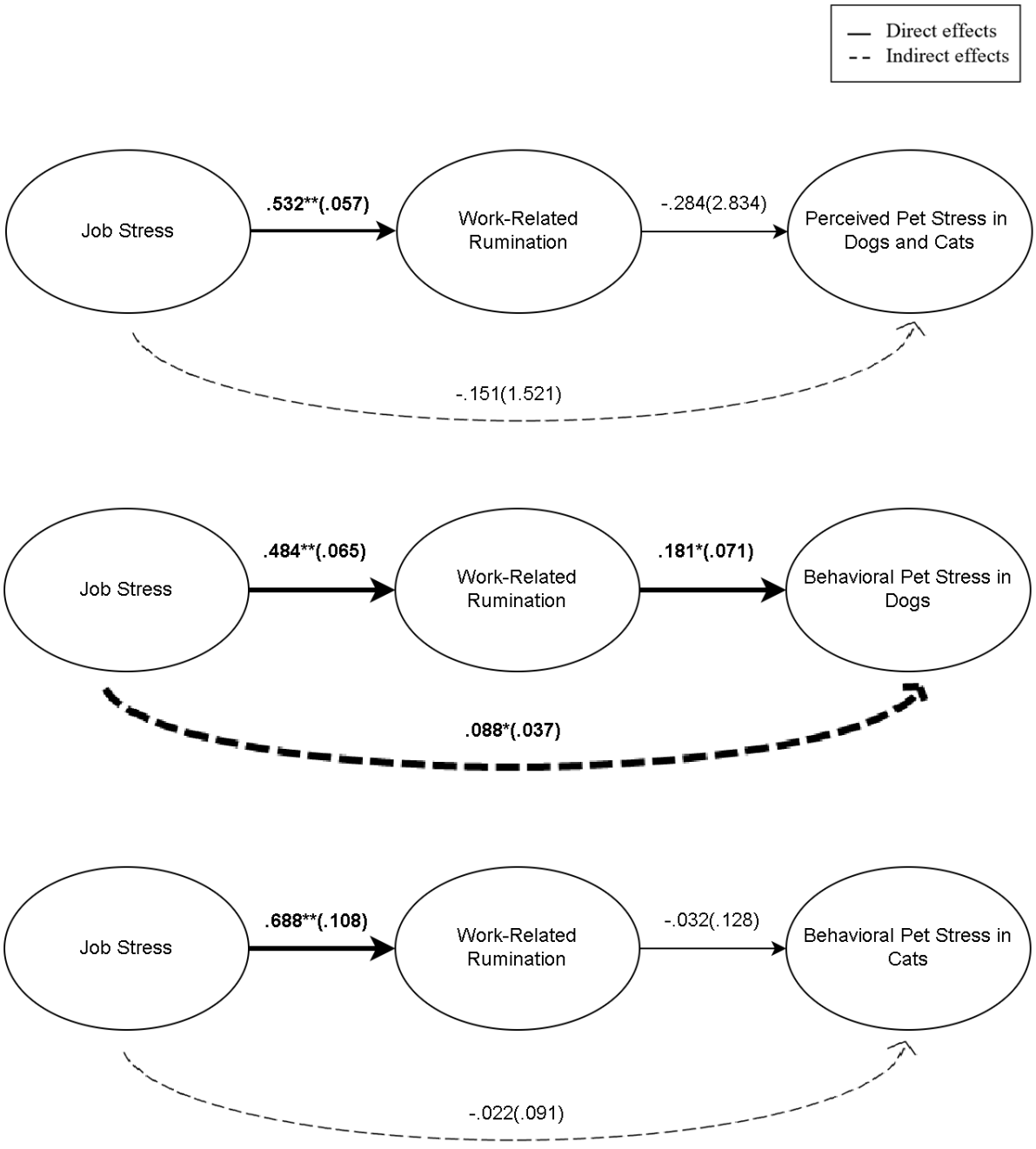


Figure 4

Estimated models for Hypothesis 2: Evaluating the link from an employee's job stress to their pet's stress (measured three ways) through work-related rumination



Note. Statistically significant paths are depicted in bold.

* $p < .05$. ** $p < .01$.