DEVELOPMENT AND VALIDATION OF A BEHAVIORAL ASSESSMENT TOOL TO MONITOR SHELTER DOG COPING BEHAVIOR

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ABSTRACT

Dogs that enter animal shelters experience a variety of well-documented environmental stressors that may lead to chronic stress. Stress response can become maladaptive when shelter dogs are unable to effectively cope with their environments. Often pharmaceutical intervention is necessary to prevent further behavioral decline. However, access to pharmaceuticals is dependent on shelter resources with many lacking veterinary behaviorists on staff. Furthermore, a reliable assessment that would accurately communicate shelter dogs' needs to clinicians does not exist. In response, a novel behavior assessment was developed based on extant literature and expertise of a board-certified veterinarian behaviorist and doctorate in ethology, designed to provide enrichment while remaining feasible for shelter staff to implement. During the preliminary pilot, the tool went through several iterations based on evaluation of reliability and clinical relevance.

June-October 2022, 91 single-housed shelter dogs, ≥ 12 weeks of age were assessed either indoors (n = 43) or outdoors (n = 48). Dogs were assessed in real-time by two raters for inter-rater reliability and video recorded for intra-rater reliability. Inter- and intra-rater percent agreement was moderate to near perfect. To establish validity criterion, a board-certified veterinarian behaviorist blinded to coping score diagnosed participating dogs as either adaptive coping (AC), maladaptive coping anxious-avoidant (MC-AA) or excessive-aroused (MC-EA) using assessment video. There was no evidence of a difference in coping score between assessment areas; therefore, indoor and outdoor assessments were pooled for validity analysis. At statistical significance, the tool was able to differentiate MC-AA dogs from AC and MC-EA but was unable to differentiate MC-EA from AC, although MC-EA dogs had higher marginal mean total score than AC dogs. As expected, the marginal mean for MC-AA dogs was negative and MC-EA positive, between which fell the marginal mean for AC dogs. Based on reliability and validity, the tool was further refined for use in future studies including, establishment of a diagnostic scale for interpreting coping score, and evaluation of tool's ability to track changes in coping behavior over time and in response to pharmaceutical interventions.

This thesis is dedicated to Boone, forever in my heart.
Thank you for allowing me to experience the depth of your soul.

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1.1: Introduction

1.1.i: Domestication Juxtaposition: Dynamics of the Human-dog Co-evolution

Dogs (*Canis lupus familiaris*) have long forged an unparalleled bond with humans, becoming integral members of our community. The profound connection between humans and dogs tells the tale of co-evolution that has left an indelible mark on our emotional and physiological ties (for reviews see Gee et al., 2021; McNicholas et al., 2005). Yet, while domestication has endowed dogs with unique adaptations suited to enhancing our relationship, including the seemingly innate ability to read human facial expressions and preference for human proximity (Albuquerque & Resende, 2023; Lazzaroni et al., 2020; vonHoldt & Driscoll, 2017), they still retain ancestral traits that can put canine welfare at odds with modern expectations. Working and companion dogs often find themselves in environments far removed from the village settings that initially shaped our cross-species relationship. This disjunction arises, in part, from our advanced interconnectedness. In our efforts to integrate animals into our lifestyles, we frequently resort to physical confinement or impose restrictions on their natural behaviors. Nowhere is this contrast more apparent than in the environments where dogs are temporarily housed for re-homing. The stark disparity between the evolutionarily familiar surroundings of the ancestral dog and the contemporary confines of animal shelters often leaves many individuals struggling to navigate and adapt to their new circumstances.

1.1.ii: Animal Shelter Genesis

As invaluable as dogs are to the people they support, a myriad of complex factors contributes to the pervasive occurrence of pet relinquishment which leads to the necessity of re-homing shelters. While there are a handful of documented attempts to quantify shelter dogs nationwide, estimating the total population in any given region is difficult due to the lack of a complete national database (Downes et al., 2013; Patronek & Glickman, 1994; Rowan & Kartel, 2018). However, even considering the broad range possible indicated by the limited data available, a significant number of individuals enter shelters or animal rescues with the most recent scholarly data conglomerations floating around 5 million dogs annually (Rowan & Kartel,

2018; Woodruff & Smith, 2020), although national census data estimates that closer to 3.1 million dogs enter shelters nationwide (*Pet statistics*, ASPCA). However, the source census for ASPCA Pet Statistics is the Shelter Animals Count database which relies on volunteer reporting and therefore likely underestimates national intake. Often these shelters provide temporary housing for surrendered dogs, strays, and those removed from owners for reasons of neglect or abuse. During this transitional period, dogs are kenneled and cared for in these establishments, until they leave under circumstances of return-to-owner, new adoptions, transfers, or death. In the past, shelter overpopulation, exacerbated by resource shortages including staff labor, funding, and space, has contributed to high euthanasia rates (Salman et al., 1998). Concerned, people began to challenge the concept of the traditional shelter, defined as re-homing establishments that euthanize to control population in addition to medical and behavioral reasons.

Thereafter, many shelters enacted policies restricting instances of euthanasia to cases of critical illness or poor temperament; these shelters, in contrast to traditional shelters, are labeled “no-kill” shelters through definition by the American Veterinary Medical Association (Brown et al., 2013). In response to restricted use of euthanasia, communities have implemented various strategies to address overpopulation in shelters such as encouraging pet retention through supportive programs and moving animals to alternative housing through foster systems. However, relinquishment in combination with stray intake continues to fill shelters with available dogs. Data indicates that national euthanasia rates are declining (Bartlett et al., 2005; Protopopova, 2016; Rowan & Kartal, 2018), but concern for the potential increase of extended stays as available dogs await adoption has led researchers to investigate factors that impact length of stay. While there have not been studies directly comparing the length of stay of dogs in no-kill versus traditional shelters, many researchers have relied on induced cause and effect as the basis for identifying influential factors that may improve adoption rates (Bradley & Rajendran, 2021; Brown et al., 2013, Normando et al., 2006). Behavioral factors such body position in-kennel and activity have been shown to predict longer length of stay in shelters, supporting the belief that behavior influences adopter choice (Protopopova & Wynne, 2014; Protopopova et al., 2014; Wells et al., 2002). Aiming resources at targeted behavioral

modification programs may augment the movement of adoptable dogs from shelters to homes, leading many shelters to implement obedience and training classes, although few experimental studies on behavior modification and likelihood of adoption currently exist (Herron et al., 2014; Luescher & Medlock, 2009), as reviewed by Protopopova and Gunter (2017).

Compounded with previously established efforts at decreasing pet overpopulation, the Covid-19 pandemic ushered in a shift in national pet ownership characterized by fewer dogs entering shelters (Powell et al., 2021). Additionally, many sources anecdotally reported an increase in adoptions through the onset of the pandemic (Szydlowski & Gragg, 2020), although one study found that overall adoption rates have not changed with evidence of a decrease in number of adoptions, likely reflecting decreased intake (Powell et al., 2021). However, it is difficult to assess the degree to which the pandemic has influenced shelter trends due to conflicting results across studies with some showing evidence that shelters were already experiencing decreased intake and increased live release rates (Hawes et al., 2019) while others indicate a pre-pandemic increase in total dog intake (Hawes et al., 2021). In one retrospective study that spanned five years from 2016 through the first year of the pandemic in 2020, researchers found that total intake decreased, and live release rates increased (Rodriguez et al., 2022).

Contradictory to these findings, the most recent Shelter Animals Count report concludes that intake has been steadily increasing since 2021 (*Q2 2023 Analysis,* Shelter Animals Count). However, general intake/outcome trends may indicate that shelters are observing improved occupancy flow. Despite this, dogs that enter shelters continue to experience widely variable length of stays, creating situations in which dogs may spend several days to months housed at an animal shelter. On average, census data indicates that shelter dogs are experiencing longer length of stays (Brown et al., 2013; Wenstrup & Dowidchuk, 1999). Enabled to look beyond overpopulation control, the shelter community is eager to direct resources toward improving shelter dog welfare not only to appeal to potential adopters but also to provide individual dogs with the best possible opportunity to successfully transition through the shelter system.

1.2: Shelter Environment

1.2.i: Environmental and Social Stressors

The effects of shelter-specific environmental and social factors have been studied in dogs using physiological measures of stress such as cortisol, heart rate variability (HRV), and immune function, as well as behavioral measures including activity level and ethograms, as reviewed by Beerda and colleagues (1997) and Polgar and colleagues (2019) Studies of physiological outcomes in kenneled dogs predominately measure hypothalamic-pituitary-adrenal (HPA) axis activity (for review see Hennessy, 2013). The HPA axis is understood to be the primary system activated in response to a stressor. Upon perceiving a threat to homeostasis, the paraventricular nucleus (PVN) of the hypothalamus, a region of the brain, secretes corticotropin-releasing factor (CRF) to the anterior pituitary gland located near the hypothalamus. The anterior pituitary responds by releasing adreno-corticotropic hormone (ACTH) into circulation, principally targeting the adrenal cortex. There, glucocorticoids are released into circulation to receptive tissues and organs to prep the body for fight or flight responses (for review see Smith & Vale, 2006). Activation of the HPA axis can be measured through levels of glucocorticoids as cortisol concentration in plasma, saliva, urine, feces, or hair (for review see Polgar et al., 2019). Several environmental and social factors inherent to shelters have thus been identified as stressors that may illicit physiological stress responses and negative affective states in dogs (for review see Protopopova, 2016).

Kennel environments, as experienced not only by shelter dogs but also working dogs, laboratory animals, veterinary patients, and pets temporarily boarded away from their humans, present environmental stressors inherent to confined housing (for review see Taylor & Mills, 2007). Restricted kennel areas, typically consisting of limited outdoor access and potentially austere conditions, has been shown to increase stress behaviors and cortisol levels (Beerda et al., 1999a; Hubrecht et al., 1992; Normando et al., 2014). Limited exercise and barren environments may increase stress by restricting the extent of which a dog can express natural behaviors. In one study, 25-minutes of human-guided exercise lowered salivary cortisol and improved scores on a behavior test (Menor-Campos et al., 2011). Sensory stimuli can further contribute to shelter dog stress as shelter design and management can lead to olfactory and

auditory overload. Upon entering a shelter, dogs are assailed with multiple strong odors including conspecific pheromones and cleaning chemicals along with persistent exposure to noise from multiple dogs barking, exacerbated in buildings lacking acoustic design (Coppola et al., 2006a; Sales et al., 1997; Schiefele et al., 2012). Ambient shelter noise can reach over 100 dB, which in one study resulted in hearing damage for all dogs exposed for six months (Schiefele et al., 2012). Diet can have profound effects on physical welfare, often investigated in farm animals (Manteca et al., 2008) and companion animals within the framework of pet nutrition (Buff et al., 2014). Because of practicality, shelters often have a standardized feeding formula. However, there is only one known study directly investigating the effects of diet on shelter dog cortisol levels in which the authors found that dogs provided with both a premium diet and 20 minutes of supplemental human interaction per day saw a moderate decrease in plasma cortisol in response to a novel object, suggesting that both human interaction and nutritional enrichment can moderate HPA axis activity (Hennessy et al., 2002). The moderating effects of human interaction found by Hennessy and colleagues (2002) has been corroborated by other studies (Coppola et al., 2006b, Menor-Campos et al., 2011; Shiverdecker et al., 2013), although the effect is likely context dependent (Hennessy, 2013).

Social isolation, both intra-specific and inter-specific, typical of single-housed kennels and constricted time with human contact, respectively, can increase stress, particularly if the dog is isolated from a bonded individual (Coppola et al., 2006b; Walker et al., 2014). In most cases, shelter life comes as an abrupt change from the dog's previous living arrangement, whether that be in a home or as a stray. Novelty in and of itself has been shown to stimulate physiological stress responses (Ader & Cohen, 1993). Loss of control and predictability, characteristic of routine disruption and adherence to novel husbandry practices, cause activation of the HPA axis (for review see Hennessy, 2013). This not only impacts the dog physiologically, but when stress becomes chronic, also induces a negative affective state leading to poor welfare (for review see Taylor & Mills, 2007). Additionally, dogs that enter the shelter experience sudden disruption of relationships and separation from attachment figures (Tuber et al., 1996). Due to the social nature of the species this too can cause stress, and it has been shown that the presence of a caregiver can reduce canine stress when in a novel environment

(Tuber et al., 1996). Further illustrating the social needs of the species, pair or group housing has been shown to have a positive impact on behavior and separating bonded dogs can have negative impacts on immune system indicators (Mertens & Unshelm, 1996; Walker et al., 2014). Studies have found that solitary housing can exacerbate stereotypies (Beerda et al., 1999a; Hetts et al., 1992; Mertens & Unshelm, 1996), although differences in behavior descriptions complicates the ability to compare across studies (for review see Table 1 in Protopopova, 2016).

While shelter-typical stressors have been identified (refer to the introduction of Gunter et al., 2019 for succinct summary), staff are limited in their ability to mitigate exposure to said factors. Both available resources and practicality can impede environmental change. Land and building constraints dictate kennel size, sanitation requires the use of cleaning agents, and dogs will bark loudly. Additional design consideration requires substantial funding and increasing social interaction requires labor. While shelter resources vary, it is unrealistic to assume environmental stressors can be completely eliminated. To target resources effectively, substantial effort has gone into understanding the effect of environmental factors on the welfare of shelter dogs.

1.2.ii: Effects of Stress on Welfare

Definitions of animal welfare encompass diverse perspectives on the human-animal relationship (Carenzi & Verga, 2009). Scientifically, it pertains to biological, psychological, and natural aspects. Broom, oft referenced, writes “the welfare of an individual is its state as regards its attempt to cope with its environment” (Broom, 2019). Failure and difficulty to cope with environmental challenges, whether actual or perceived as threatening, leads to poor welfare (Broom, 1991). The shelter environment introduces external stressors documented to activate the HPA axis, discussed in the previous section and reviewed by Hennessy (2013). Exposure to shelter-typical stressors can interact with the length of stay and lead to dysregulation of the HPA axis (Hennessy et al., 2006). It is also shown that physiological response to stressors varies depending on an individual’s genetics and past experiences (Beerda et al., 1999b, Boxal et al., 2004; Hiby et al., 2006; Rooney et al., 2007). Therefore, dogs react uniquely to equivalent external cues, as well documented by studies evaluating behavioral and physiological measures to stressful situations.

Since Hennessy's 2013 review, extant literature has expanded to include investigations on long-term effects of the shelter environment and validation of stress measurements, with a focus on differentiating between acute versus chronic stress. Acute stress is indicative of a normal regulatory response to a physical or perceived threat followed by a return to homeostasis after the danger has passed. However, as length of stay increases, acute stress has the potential to become chronic. Chronic stress leads to dysregulation of the HPA axis and immune suppression (Hennessy, 2013). Yet, studies have failed to irrefutably determine whether the shelter environment induces chronic stress. This is largely due to the ambiguity of physiological measures, discussed by Protopopova (2016) in her review of the methodologies used to quantify shelter dog welfare through measures of physiology, immune function, and behavior. Prolonged exposure to stressors can lead to a state of chronic stress characterized by dysregulation of the HPA axis often accompanied by physiological and psychological disorders. However, it is unclear whether the average shelter dog is experiencing dysregulation or habituation, which similarly leads to an increase in cortisol followed by a decrease. Cortisol measures can increase during states of stress or arousal, the latter of which does not suppose valence (for review on the dysregulation hypothesis and habituation hypothesis, see Protopopova, 2016). In the instance of dysregulation due to chronic stress, immune function is also impaired but direct studies of immunosuppression in shelter dogs are complicated by individual immune differences and high exposure to infectious diseases. Extensive research has been done on the effects of sheltering on behavior with studies generally indicating differences in stereotypical and repetitive behaviors, stress and fear behaviors, and activity level. In conclusion, Protopopova (2016) recommended that future research focus on individual dogs rather than group averages when evaluating welfare.

As recently as 2020, Hennessy and colleagues reviewed laboratory literature as the guiding principle in describing the effects of shelter environments on dogs and the formulation of methods to reduce stress. While the review predominately focused on research regarding social buffering as stress remediation, the authors also discuss the difficulty in designing experiments to evaluate behavioral consequences of stress in shelter dogs due to obstacles such as accommodating shelter protocols, confounding environmental factors, and divergent past

experiences that influence individual dogs' behaviors. Despite the difficulties in researching shelter dog stress behavior, Hennessy and colleagues (2020) found evidence that psychological stress as experienced by shelter dogs may compromise sociality and cognition, both considered desirable traits in adoptable dogs. Additionally, the authors demonstrated how "insidious" consequences of shelter stress may be masked by developmental patterns that result in increased susceptibility to mental and physical disorders later in life. The "two-hit" model, applied in various scientific fields (Feigenson et al., 2014; Gold et al., 1988; van Rooij et al., 2018) and often first attributed to Knudson (1971), provides a framework for exploring long-term effects of shelter stress on dogs. In the model proposed by Hennessy and colleagues (2020), a sensitization of the stress response occurs via exposure to a strong or chronic stressor (first hit) which leads the individual susceptible to a more profound reaction to a later instance of stress (second hit) that causes dysregulation of the stress response with mental or physical consequences. Chronic stress or trauma, as could be experienced by a dog while in shelter, could be the first hit that leaves the individual susceptible to behavioral consequences post-adoption.

Despite the challenges of evaluating long-term effects of stress in shelter dogs, the wide variability in physiological and behavioral response exhibited by shelter dogs indicates that while some transition through the shelter with minimal long-term consequences, others may have lasting adverse reactions. Furthermore, the inability to cope with stressors in the shelter environment reduces welfare state, leading to immediate welfare concerns. Therefore, to address current shelter dog welfare, it is important to evaluate coping ability at the individual level.

1.2.iii: Coping Styles

Identifying dogs that struggle to cope in the shelter setting is complicated by the behavioral variation seen among individuals. Coping has been defined as the behavioral reaction to situations that activate neuroendocrine pathways involved in physiological response to aversive situations (Wechsler, 1995). When successful, coping behavior reduces physiological measures of stress and is considered adaptive. However, if the behavior is ineffective at either removing the animal from the aversive situation or restoring physiological measures to baseline,

an individual is at risk for chronic stress at which point coping strategies can become maladaptive. Research on stress response in rodents and farm animals supports the adaptive evolution of two different coping styles characterized by consistent behavioral and physiological reactions in response to environmental challenges (for review see Koolhaas et al., 1999). The dichotomous framework of coping styles, first introduced by Henry and Stephens (1977), synthesized early work on the active fight-flight responses by Cannon (1915) and the conservation-withdrawal response originally described by Engel and Schmale (1972). However, it is important to note that response to stress lies along a continuum of active to inactive physiological and behavioral responses and one individual may rely on a variety of strategies depending on the environmental context and past experiences. Subsequent scientific discussion differentiated between the two coping styles as either active or passive, but use of this terminology masks the agency of individuals that react to aversive stimuli by decreasing activity (Wechsler, 1995).

More recently, scientists have categorized coping styles as either proactive in lieu of active or reactive in lieu of passive (Koolhaas et al., 1999). Understanding that coping style can be flexible dependent on adaptive value in current situations, when behavioral response fails to eliminate the perception of danger, individuals will tend toward the extreme ends of the spectrum, resulting in either a learned helplessness (reactive) or excessive activation of energetic output often recognized as stereotypies or loss of impulse control (proactive). Here the terms reactive and proactive refer to the coping styles representative of the maladaptive behavior patterns seen in shelter dogs.

1.2.iv: Maladaptive Coping Behavior

Evolutionarily, if the coping behavior is successful in achieving environmental control, then fitness of the individual increases and the coping style is adaptive (Wechsler, 1995). However, if the animal's behavior fails to either remove the aversive stimuli or return neuroendocrine systems to homeostasis, then the coping response can have deleterious effects on fitness rendering the behavior maladaptive. When animals are placed in situations that are evolutionarily unnatural, such as housing systems that restrict natural behavior, individuals may lack innate or learned adaptive coping strategies. Several studies have investigated changes in

cortisol levels over time as a measure of acclimation to the shelter environment (Coppola et al., 2006b; Hennessy et al., 1997; Hennessy et al., 1998). While some shelter studies found an increase of cortisol followed by a decrease before plateauing, others found less defined patterns (for review see Lamon et al., 2021, section 3.4). The variability found across studies could be due to a variety of factors such as collection methods, individual variability, and environmental factors, but it may also suggest that each dog experiences a unique stress response independent of average trends. For the dogs that are incapable of adjusting to the shelter environment, coping style may impact which behavior patterns manifest while in-shelter.

Dogs with a predominately reactive coping style would likely demonstrate anxious-avoidant behaviors and may become despondent or withdrawn. Animals with a reactive coping style will respond to aversive stimuli with decreased physical activity, commonly demonstrated in animal studies as longer attack latencies and conditioned immobility along with increased HPA axis and parasympathetic reactivity; those with a predominately proactive coping style can progress to excessive-arousal behaviors and stereotypic activity such as pacing in-kennel or persistent barking. Proactive coping is associated with increased activity, demonstrated by decreased attack latency, and increased active avoidance along with decreased HPA axis and parasympathetic reactivity (Benus et al., 1989; De Boer et al., 1990; Hessing et al., 1994; Korte et al., 1992; Korte et al., 1999; Ruis et al., 2000; Schouten et al., 1997; van Oortmerssen & Bakker, 1981). For comparison of behavioral and physiological differences between reactive and proactive coping styles, see review by Koolhaas et al. (1999).

The exact combination and extremity of behaviors is influenced not only by the individual's coping style but also genetics and past experiences. Individual coping style may correlate with personality. Considering the shy-bold continuum, proactive behaviors, such as increased locomotion, align with bold type personalities characterized in part by exploration and risk-taking (Sloan Wilson et al., 1994). Shy type personalities, generally less likely to engage in risk-taking, are frequently identified using behavioral responses associated with reactive coping styles in studies using novel object or novel environment tests. In dogs, boldness has been shown to correlate with playfulness, interest in chase, exploratory behavior and sociability towards strangers while shyness is correlated with avoidance behavior (Svartberg & Forkman,

2002). In a study on coping response of police dogs during an acute challenge, the authors found fearfulness or aggressiveness to be primary personality factors that differentiate between coping styles (Horvath et al., 2007). Fearfulness, measured by behaviors related to flight or withdrawal, was predominant in individuals that responded to the threatening approach of a human with behavior demonstrative of a reactive coping style, the characteristics of which align with previous findings on shy personalities (Horvath et al., 2007; Sloan Wilson et al., 1994). Aggressiveness, measured by behaviors such as barking, was predominant in individuals that demonstrated a proactive coping style, which has also been shown to align with bold personalities (Horvath et al., 2007; Sloan Wilson et al., 1994). While the authors identified a third primary coping factor of ambivalence which included behavioral responses that indicate uncertainty, the described behavior patterns, i.e., paw lifting, mouth licking, and looking away, have also been categorized elsewhere as displacement behaviors, hypothesized to function as appeasement signals (Overall, 2017). Displacement activity includes behaviors without an apparent function and are correlated with situations of psychosocial stress (Maestripieri et al. 1992; Zeigler 1964). Appeasement behaviors are intended to communicate non-aggressive intent during conflict (Kuhne et al. 2014; Pastore et al. 2011). There is an ongoing debate on whether dog displacement behaviors do function as appeasement signals (Pedretti et al., 2023); however, it is possible that by measuring displacement behaviors during testing, the researchers may be capturing indicators of affective state in lieu of coping response.

Past experiences can also affect individuals' ability to cope. Hiby and colleagues (2006) found that cortisol/creatinine ratios (C/C) tended to decrease over time in dogs returned to a shelter while increasing in those relinquished from homes. Rooney and colleagues (2007) found that C/C increased in all dogs entering a training establishment but was significantly higher in dogs that were not previously habituated to kenneling. Therefore, there is evidence that prior experience with kenneling may mitigate the stress response. Additionally, several studies have found that early life experiences can have a profound impact on behavior later in life (Appleby et al., 2002; Boxall et al., 2004). Beerda and colleagues (1999b) found that weather influenced physiological stress response of beagles entering restricted housing, suggesting that certain environmental conditions may even impact individual response to kenneling. Because of the

complex relationship between coping style, genetics, environmental context, and previous experience, individual dogs may be better or worse suited for adapting to the shelter environment.

Dogs experiencing physiological and psychological states of stress will show repeated or extreme behaviors correlated with proactive or reactive coping, such as hyper-activity or despondence respectively. Relying on behavior alone as an indicator of stress is complicated due to considerable individual variability (Part et al., 2014). However, species-specific stress signals have been well-documented in kenneled dogs (for review see Polgar et al., 2019). Increased activity or avoidance indicates stress in dogs, both of which are considered undesirable in-kennel behaviors found to increase length of stay (Protopopova et al., 2014). In a questionnaire distributed to potential adopters after interactions with shelter dogs, people chose not to adopt based on perception of high activity level and insufficient attentiveness while those who did adopt described the dog as calm, friendly, and/or playful (Protopopova & Wynne, 2014). Adoptable dogs generally viewed as less desirable are often those that are struggling to cope with environmental stressors and are exhibiting maladaptive coping behaviors. It may take considerably longer for these dogs to get adopted, prolonging exposure to an environment the dog finds stressful.

Furthermore, to fully consider the success of adoption, pet retention must also be considered. While relinquishment is a complex dilemma, surveys that examine factors related to relinquishment have validated the impact behavior can have on the decision to surrender a pet, with behavioral problems frequently cited as a determinant (for review see Marston & Bennett, 2003). Additionally, strength of attachment has been shown to correlate with likelihood of relinquishment (Patronek et al., 1996; Serpell, 1996) and there is some evidence that shelter dog human-attachment may be characterized by higher levels of anxiety when compared to pets who were homed as puppies (Previde & Valsecchi, 2007). Long-term behavioral consequences of exposure to shelter stressors may impact the development of the human-pet bond post-adoption, creating additional challenges for pet ownership.

To encourage successful adoptions, shelters that have the capacity to implement behavioral modification plans to support those that exhibit concerning behavior (signals

indicative of fear, aggression, or high arousal) have begun to use a holistic approach toward assessment, including context specific observations (in-kennel, outside, in-building), supplemented with behavioral and/or medical interventions with the goal of decreasing undesirable behaviors. Dogs that struggle to cope will continue to perform maladaptive behaviors and may be overlooked by potential adopters, ultimately decreasing their welfare due to prolonged stays in the shelter. Behavioral or medical interventions may help these dogs cope with their environment and ultimately improve their welfare, however, these cases need to be accurately identified by shelter staff.

1.3: Interventions to Assist with Kennel Coping

1.3.i: Enrichment and Behavioral Modification

Behavioral intervention encompasses strategies aimed at mitigating the effects of external stressors. In a review on shelter adoption and relinquishment interventions, Protopopova and Gunter (2017) categorize behavioral intervention strategies under object enrichment, sensory enrichment, conspecific interaction, or human interaction. While object enrichment has been shown to influence dog activity, the impact on dog behavior and adopter choice remains unclear (Protopopova & Gunter, 2017). Sensory enrichment, such as the use of odors and music, shows potential to alter behavior but more research is needed to understand the magnitude of effect (Wells, 2009). Conspecific interaction, such as pair-housing, has been a particular area of interest due to the social nature of the species. Many studies have found that conspecific contact can reduce abnormal behavior, but confounding factors such as pen size and personality complicate conclusions. Other forms of social enrichment include increased positive human interaction (Shiverdecker et al., 2013), including behavior training methods (for review see Protopopova & Gunter, 2017), to foster behaviors attractive to potential adopters and indicative of improved welfare. Habituation and desensitization programs aim to decrease sensitivity to specific stimuli that cause an individual stress.

Popular support for environmental enrichment to improve welfare has caused a burgeoning collection of scientific literature regarding the benefits and methodology of encouraging species-specific behaviors and maintenance of the healthy physiological reactions essential to homeostasis. While many studies have been conducted on environmental

enrichment for kennels (for reviews see Taylor & Mills, 2007; Wells, 2004), sample populations are often restricted by the region served by the shelter, demographic representation of sex, neuter status, age, breed, and disposition as most participants consist of adoptable dogs deemed medically healthy and available for adoption. Furthermore, as a safety precaution, individuals exhibiting aggressive behavior are often excluded from studies. Therefore, there remains a portion of the shelter dog population that require additional support for behavior intervention beyond conventional intervention programs.

In instances where behavioral intervention programs are ineffective at decreasing concerning behaviors, shelter dogs may benefit from pharmaceutical intervention. Anxiolytic treatment on dogs experiencing anxiety disorder has shown promise (Ballantyne, 2018; Gilbert-Gregory et al., 2016; Gruen & Sherman, 2008). Anxiolytic medications encompass pharmaceuticals designed to target neural pathways involved in physiological stress responses. However, there have been few studies on use of drug therapy specifically on shelter dogs (Abrams et al., 2020; Corsetti et al., 2021; Tod et al., 2005). This may be due largely to the many obstacles in providing shelter dogs with anxiolytic medications. For a dog to receive pharmaceutical treatment, a veterinarian must write a prescription. Shelters vary greatly in resources and not all have veterinarians on staff. Illustrating the disparity in available resources and need, through a survey intended to evaluate community programming offered by animal shelter organizations, Russo and colleagues (2021) found that reasons for discontinuing community assistance included lack of funding, improper staffing, and lack of space; inconclusion, collaboration between shelters, veterinarians, and animal behaviorists would benefit communities by effectively addressing canine behavior problems.

To facilitate collaboration, accurate assessment of individual dogs from shelter staff may save veterinarians consultation time and decrease professional costs. This would alleviate some of the financial burden on shelters to provide dogs with anxiolytic medications. Veterinarian services are partially reliant on third-party observations and clinical appointments include pet-owner interview for a better understanding of the animal's clinical needs. This is necessary as clinicians are unable to directly observe the animal in all situations. However, communication between veterinarians and caretakers inherently poses a potential for disconnect between

actual behavior and perceived meaning. In one study where dog-owners, veterinarians, dog trainers, and non-owners were asked to describe dog behavior using adjectives, there was little agreement when classifying behaviors associated with aggression, confidence, and actual-play (Tami & Gallagher, 2009). While this study only involved nine dogs and 60 observers, other studies have shown how experience and education may influence interpretation of animal behavior (Diesel et al., 2008; Fidler et al., 1996). On the contrary, one study found no difference in ability to interpret behaviors based on experience factors between 47 veterinary students; however, given that participants were veterinary students, a degree of training and/or familiarity could be assumed (Meyer et al., 2014). Therefore, to ensure quality standard of care, a reliable behavior assessment for shelter staff use would provide veterinarians with accurate information by minimizing observer bias. However, a validated behavior assessment intended to diagnose coping behavior does not exist. Instead, current behavior assessments used in shelters are focused on temperament testing or broad indication of welfare within shelter establishments.

1.4: Assessments

1.4.i: Existing In-shelter Assessments

Temperament assessments are frequently used in shelters by staff, often to assist in decisions on suitability for adoption. Despite the prevalence of assessments in shelter management, exact methodology and use varies by shelter (Clay et al., 2020; Marston & Bennett, 2003; Taylor & Mills, 2006). Evaluating the public safety risk of shelter dogs is an important responsibility of staff and previous efforts have gone into developing assessments that rate temperament to assist in decision-making (Luicidi et al., 2005; Mornement et al., 2014; Mugenda et al., 2019). To assess companion pet suitability, temperament tests focus on the dog's response to certain scenarios designed to mimic potential at-home situations. However, studies evaluating the predictive validity of temperament testing for shelter dogs have found no correlation between behaviors observed during assessments to post-adoption behavior (Christensen et al., 2007; Mornement et al., 2014; Mornement et al., 2015), with the implication that several dogs are falsely identified for aggression and deemed unsuitable for adoption (Patronek & Bradley, 2016). While some studies have utilized principal component

analysis to determine the ability of temperament testing to detect personality factors, e.g., fearfulness, friendliness, and aggressiveness with limited success (de Palma et al., 2005; Dowling-Guyer et al., 2011), in their review on validation of shelter assessments, Patronek and colleagues (2019) conclude that existing temperament assessments used to screen shelter dogs for adoption suitability do not meet accepted standards of validity due to confusion between colloquial and scientific definitions of measurement, limitations in analysis, and the inability to extrapolate beyond the research subjects to shelter dogs . The discrepancy between in-shelter and post-adoption behavior within an individual can largely be explained by the effects on behavior of the shelter environment and unnatural testing scenarios. Despite the inability to predict behavior, many justify the use of temperament tests as one source of information that can contribute to a broader behavior profile consisting of multiple observations of the dog made in several situations. However, it is important to note that studies have failed to show practical benefits of temperament testing for either the dog or for adopters.

As such, current temperament assessments used in shelters are not suited for evaluating shelter dog welfare. Beyond temperament tests, there are few shelter-specific Quality-of-Life (QoL) assessments developed to either assess acclimation to the environment or measure impact of an intervention program, primarily measuring effect of human interaction but also used in some instances for measuring the impact of varying housing environments. In a review on shelter dog QoL assessments, Lamon and colleagues (2021) identified five validated ethogram-based assessments, one validated interaction test, and one validated behavior test (Table 1.1). While these assessments provide a way to compare the welfare of dogs across shelters, results do not indicate individual needs in terms of additional mental support. Furthermore, several are time-consuming and unpractical for staff to repeatedly administer to all dogs. Therefore, there remains a need for a practical behavior assessment that can communicate current coping state and indicate anxiolytic needs.

Table 1.1. Existing shelter dog QoL assessments. Validation methods for assessments used for evaluating shelter dog welfare published between 2000 and 2020 (adapted from Table 1 in Lamon et al., 2021).

Method	Study Focus	Assessment Tool	Validation	Reference
Ethogram-based	Intervention: Human interaction[1] Intervention: Socialization program[2]	Quality of Life (QOL) Assessment	Quality of life (QL) score calculated using positive and negative indicator behaviors validated against treatment groups	Kiddie & Collins, 2014[1]; Popescu et al, 2018[2]
Ethogram-based	Acclimation	Shelter Quality Protocol (SQP)	Management, resource, and animal-based measures used to identify welfare hazards; individual measures validated observing individual twice (at a distance and again close-up)	Barnard et al., 2016; Arena et al., 2019a
Ethogram-based	Acclimation	Shelter Quality Protocol 2 (SQP 2)	Refined version of SQP validated against climatic conditions	Berteselli et al., 2019
Ethogram-based	Acclimation[3] Intervention: Different housing environments and length of stay[4]	Qualitative Behavioral Assessment (QBA)	Descriptive terms analyzed for consensus dimensions to describe emotional state of shelter dogs	Arena et al, 2017[3]; Arena et al., 2019b; Berteselli et al., 2019[3]; Walker et al., 2016[4]
Ethogram-based	Acclimation	Multi-operator Qualitative Behavioral Assessment	Stress level score based on brief description of the dog's behavior; stress level score did not correlate between raters, suggesting the score is situation dependent and not a comprehensive indication of welfare	Menchetti et al., 2019

Table 1.1 (cont'd)

Interaction test	Intervention: Human interaction	Approach test	Approach behavior categorized as "contact possible" or "no contact possible" validated against attitude of shelter staff via questionnaire	Arhant &Troxler, 2014
Behavior test	Intervention: Exercise and human contact	Behavior test	Test is not described in study and previously validated by authors (not published)	Menor-Campos et al., 2011

1.4.ii: Development of a Novel Coping Behavior Assessment

Due to the wide variation of dogs' ability to adapt to the shelter environment, not all dogs successfully acclimate, resulting in the manifestation of maladaptive coping behaviors that are indicative of a negative affective state and contributory to decreased desirability to potential adopters. When behavioral intervention programs focused on environmental and social enrichment fail to decrease concerning behaviors, anxiolytic pharmaceuticals may benefit current welfare of shelter dogs. However, not all shelters have access to anxiolytics due to the requirement of veterinarian prescription. Future efforts to develop a reliable and validated assessment for use by shelter staff to quantify coping behavior and communicate meaningful information to veterinarians would facilitate communication between shelters and clinics. The assessment should not only differentiate between dogs in need of medical intervention and those not in need, but also allow veterinarians to make informed decisions on which medications to prescribe by indicating whether the maladaptive coping behaviors are manifesting as anxious-avoidance or excessive-arousal. By resulting in a total coping score, the assessment could also be useful in monitoring efficacy of behavioral interventions through ranked outcomes. Not only would this provide a standardized method to provide individualized care to shelter dogs, but also further use of assessment outcomes could result in a national database of shelter dog behavior available for studies on welfare.

CHAPTER 2: DEVELOPMENT OF A RELIABLE BEHAVIOR ASSESSMENT TO MEASURE COPING BEHAVIOR OF SHELTER DOGS

2.1: Introduction

2.1.i: Stress in the Shelter Environment

Dogs that enter animal shelters experience a variety of well-documented environmental stressors such as restricted space, novelty, sensory overload, and limited social interaction (Hennessy, 2013; Marston & Bennett, 2003; Protopopova, 2016). Prolonged exposure to stressors can result in states of chronic stress, in turn leading to dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis (Protopopova, 2016). Persistent activation of the HPA axis is considered maladaptive and can lead to stress associated behavior changes and compromised health through immunosuppression (Hennessy, 2013). Individuals respond differently to environmental stressors based on genetics, past life experiences, and current motivational state and health (for review see Marston & Bennett, 2003), but those that fail to adjust to the shelter environment are at risk of developing maladaptive coping behaviors due to chronic stress (Corson & O'Leary Corson, 1976; Hubrecht et al., 2017; Koolhaas et al., 1999).

Dogs that develop maladaptive coping may either exhibit anxious-avoidant behaviors such as despondency, reflective of a proactive coping style, or excessive-aroused behaviors such as lack of impulse control, correlated with reactive coping styles (Koolhaas et al., 1999). These behaviors have been shown to decrease desirability to potential adopters, increase length of stay, and indicate negative affective state, thus impacting current welfare as well as the likelihood of exiting the stressful environment (Cohen & Todd, 2019; Protopopova et al., 2014).

2.1.ii: Indicators of coping ability and welfare state

The measurement of stress in animals is a crucial aspect of understanding their welfare state and ability to cope with environmental stressors. Physiological markers of stress such as increased cortisol levels and decreased heart rate variability may provide objective measurements of the neuroendocrine stress response. While these measures have been validated as indicators of physiological arousal, they do not indicate valence (Polgar et al., 2019). Further complicating interpretation, collection methods can impact plasma cortisol levels by acting as an acute stressor and baseline hormone levels vary among individuals. Beerda and

colleagues (1997) propose the use of ethological observations and behavioral assessments to complement physiological measurements, as they provide valuable insights into an animal's subjective experience of stress. While dual collection of physiological and behavioral measures may be plausible for experimental designs, application of physiological measures in shelters would be impractical. Due to resource constraints, shelter staff evaluate the coping ability of individual dogs primarily through behavioral observation. However, training amongst shelter staff is highly variable and there is no standardization across shelters.

Several ethograms have been developed for measuring behavioral indicators of stress in dogs (for reviews see Kartashova et al., 2021; Protopopova, 2016) with many authors agreeing that stress behaviors include paw-lifting, self-grooming, lip-licking, panting, vocalizing, scratching self, digging, yawning, trembling, body shake-off, averting gaze, and sniffing (Barnard et al., 2018; Bauer et al., 2017; Gilbert-Gregory et al., 2016; Morris et al., 2020). However, several of these behaviors manifest in diverse circumstances and can serve many functions (Protopopova, 2016). Certain behaviors correlated with stress may also serve as appeasement signals (for review see Pedretti et al., 2023). Additionally, there is some discrepancy between labeling behaviors as indicative of stress or of fear (Barnard et al., 2018; Bauer et al., 2017; Gilbert-Gregory et al., 2016). While stress is often synonymous with physiological arousal which by itself does not reveal valence, fear is arguably negative (Jones & Boissy, 2011). Many authors choose to differentiate stress induced physiological arousal as distress when accompanied with a negative affective state or eustress when in positive affective state. Within this paper, stress is used to connotate negative valence unless otherwise specified. Similar to stress, fear activates the HPA-axis and is correlated with behaviors observed in maladaptive coping shelter dogs, e.g., trembling, cowering, wall bouncing, bar pawing, high tail position, lunging, biting, or non-responsiveness (Barnard et al., 2018; Bauer et al., 2017; Gilbert-Gregory et al., 2016; Morris et al., 2020; Tod et al., 2005). Other canine behavioral responses seen in shelters, e.g., crouching, raised hackles, hiding, and growling, are considered freeze, flight, or fight behaviors, labels traditionally used to categorize behavioral responses to threats (Bauer et al., 2017; Lindsay, 2005). Additionally, stereotypic and abnormal behaviors are frequently measured as indicative of negative affective state despite a lack of definition and standardized methods across shelter

studies (Protopopova, 2016). However, several authors agree that circling, spinning, pacing, tail chasing, wall bouncing, jumping, and continuous vocalizations are correlated with kennel stress (Barnard et al, 2018; Bauer et al., 2017; Gilbert-Gregory et al., 2016). Considered in isolation, meaning of certain behavior can be ambiguous but taken in context, correlation to affective state is revealed. Therefore, it is important to consider the combination of multiple behaviors and environmental context when interpreting behaviors associated with stress and fear.

To understand maladaptive coping behaviors, it is also essential to identify behaviors indicative of positive affective state. Body posture indicative of good welfare includes relaxed ears and tail with a loose to neutral body posture (Barnard et al., 2018; Morris et al., 2020). Social, exploratory, and play behaviors have been used as good welfare indicators and can indicate healthy adjustment to the shelter environment. Social behaviors, such as affiliative behavior, solicitation of attention, willingness to approach people, and facing toward the front of the kennel indicate positive affective state (Bauer et al., 2017) and are preferred by potential adopters (Protopopova & Wynne, 2014; Wells & Hepper, 2000). Exploratory behavior includes sniffing and engagement with an object by licking, nosing, pawing, chewing, and/or carrying (Ley et al., 2007; Tod et al., 2005). Object play includes the interaction with toys by grabbing or holding an object in the mouth (Barnard et al., 2018; Pullen et al., 2010).

2.1.iii: Assessment Development

A novel behavioral assessment must be both reliable and valid to be scientifically supported (Harvey, 2021). Reliability refers to the proportion of measurement error or degree of consistency across raters and time, while validity refers to the ability of the assessment to measure the intended outcome or degree of applicability (McCall, 1984; Taylor & Mills, 2006).

To report reliability, inter- and intra-rater agreement is analyzed through the appropriate statistical tests. Kappa values, which report on percent agreement corrected for chance, are often the accepted standards for rater reliability. Inter-rater agreement requires a minimum of two different raters assessing equivalent scenarios. This is to provide transparency when results could be subject to reporting bias. Several research ethicists have documented observer effects prevalent in subjective scoring systems (Burghardt et al., 2012). The degree to which expectation bias affects observers has varied across studies (Marsh & Hanlon 2007; Tuyttens et

al., 2014), but the prevalence of observer preconceptions, vested interest, and ambiguity within subjectivity, predisposes animal behavior research to interpretation errors (Tuyttens et al., 2014). Anthropomorphism, which is the attribution of human mental characteristics to non-human individuals, is particularly salient in the interpretation of companion animal behavior (Serpell, 2019). Many behavior assessments attempt to mitigate the effects of observer bias by relying on the establishment of categorical variables, such as ethograms, or by quantifying results through creation of ranked scales, e.g., visual analog scales (for review see Kartashova et al., 2021).

Consistency of repeat measures is established through intra-rater agreement, which can be interpreted as the degree of which individuals are subject to observer drift. In ethological studies, observer drift refers to the phenomena of observer performance variability over time (McCall, 1984). For behavioral assessments, reporting on intra-rater reliability is accomplished through repeat measures using video of the original observation interval after sufficient time has passed. Inherent to human observation, bias and drift can lead to inter- and intra-rater disagreement, respectively; however, acceptable standards for percent agreement function to inform users of the magnitude of estimated measurement error within the assessment.

An assessment that measures coping behavior can further be considered a diagnostic test, in which the results are applied to categorize dogs as either adaptive coping or maladaptive coping. Content validity, the adequacy in sampling intended behavior (McCall, 1984), can be optimized by targeting species-specific stress behaviors and is critical during tool development. To establish criterion validity, a reference standard, i.e., gold-standard, is required for confirmatory diagnostics (Akobeng, 2007a; Akobeng, 2007b; Akobeng, 2007c; Patronek & Bradley, 2016). Current accepted diagnostics for identifying dogs that could benefit from anxiolytic treatment is veterinarian evaluation consisting of medical and behavioral review with direct observation (Stelow, 2018). Criterion validity will be analyzed in Chapter 3.

2.1.iv: Establishing Content Validity: Existing Behavioral Tests

While a comprehensive evaluation of coping behavior in shelter dogs is not currently available, behavioral tests have been used to measure welfare components by using behavioral response as evaluation of affective state (Titulaer et al., 2013). Validated behavior tests and

welfare indicators can serve as a basis for content validity when developing a novel coping behavior assessment. Behavior assessments should be standardized to minimize variability between assessments and be feasible for most shelters to implement (Diederich & Giffroy, 2006; Jones & Gosling, 2005; Taylor & Mills, 2006), with the goal of providing a quantifiable basis of behavior (Marston & Bennet, 2003). Human-approach, startle, and model dog tests have been used to assess behavioral response of dogs to certain stimuli. Other behavioral responses used as welfare indicators include play behavior, activity level, and eating behavior.

Human-approach tests evaluate fear of humans in dogs and have been used as a welfare indicator in kenneling facilities (Bauer et al., 2017). Approaching the shelter dog in a non-threatening way has been validated as an indirect measure of affect towards humans (Arhant & Troxler, 2014) and found to have high inter- and intra-rater agreement among novice raters (Mugenda et al., 2019). The human approach test formalizes a typical interaction between staff and dogs, standardizing the protocol for observing presentation in-kennel.

Startle tests involve sudden exposure to visual or acoustic cues to observe the dog's reaction to unexpected stimuli. Variations include the opening of an umbrella (Bray et al., 2017; Goddard & Beilharz, 1985; King et al., 2003; Netto & Planta, 1997; Sherman et al., 2015), the movement of a remote control car (Goddard & Beilharz, 1985; Haverbeke et al., 2008; Sherman et al., 2015), gunfire or air blast (Murphy, 1998; Haverbeke et al., 2008; Sherman et al., 2015), loud noise made by metal objects (Foyer et al., 2016; Goddard & Beilharz, 1985; Sherman et al., 2015; Wilsson & Sinn, 2012), and the sudden dropping or raising of an object (Foyer et al., 2016; Wilsson & Sinn, 2012; Sherman et al., 2015). A startling stimulus triggers an acute stress response, of which the behavioral consequences can provide insight into affective state. If the brain perceives the stimuli as non-threatening, rapid return to system balance occurs. Initial response may correlate with physiological state; dogs that are in a state of chronic stress may respond more strongly to the stimulus or take longer to recover, as can be measured by initial behavioral response and latency to resume baseline activity. Currently, it is routine for clinicians to rely on visual assessment of behavior under acute stress, such as exposure to a startling stimulus, when developing behavioral intervention strategies for individual dogs (for review see Kartashova et al., 2021). However, while commonly used for temperament testing in shelters,

concerns exist about the content validity (for reviews see Patronek & Bradley, 2016; Taylor & Mills, 2006). Several versions of the startle test have been shown to invoke fear, which may be a context dependent response irrespective of welfare state, whereas a stimulus that invokes a startle reaction below the threshold of fear may serve as a measure of coping ability.

Many shelters utilize a version of a 'Model Dog' test in which a fake dog is introduced to the shelter dog to assess behavior toward conspecifics (Bennett et al., 2012; Assess-A-Pet™ Bollen & Horowitz, 2008; Match-Up II Shelter Dog Rehoming Program™ Dowling-Guyer et al., 2011; SAFER® Aggression Assessment Weiss, 2007; for review see Taylor & Mills, 2006). While some disagreement exists over whether a model dog accurately elicits either affiliative or aggressive behavior towards conspecifics, general census is favorable that behavior toward a model dog correlates with conspecifics (Barnard et al., 2012; Goddard & Beilharz, 1984; Reid & Collins, 2012; Shabelansky et al., 2015). In the context of a shelter, the model dog offers a way to simulate encounters with unfamiliar conspecifics without exposing individuals to a potential safety risk.

Play behavior in mammals has been considered an indicator of positive welfare (Dawkins, 1998) primarily because it is self-rewarding and associated with health (Burghardt, 2005; Fraser & Duncan, 1998), although frequency and duration of play behavior is influenced by a variety of factors, e.g., species, age, genetics, and environment (Martin & Caro, 1985; Rezac et al., 2011; Smaldino et al., 2019; Sundman, et al., 2016; Svartberg et al., 2005). Evidence suggests that play indicates a positive affective state (Bateson, 2014) by functioning to reinforce social cohesion during initiation (Horowitz, 2009) and cessation, e.g., return to restful state (Prato-Previde et al., 2003), while a lack of play may be demonstrative of a reduced behavioral repertoire seen in instances of learned helplessness brought on by chronic stress (Maier, 1984). Despite some debate on the reliability of play as a welfare indicator (Sommerville et al., 2017), observing behavior at the beginning and end of dog-human play can provide insight into coping behavior in shelter dogs while also contributing to improved welfare, as affiliative play between humans and dogs has been shown to reduce stress (Horvath et al., 2008).

Current methods of assessing behavior, e.g., human approach and model dog, capture a small snapshot of welfare state and do not quantify coping behavior in a clinically meaningful

way without further context. Identification of dogs in need of anxiolytic prescription is often initiated by shelter staff despite considerable variation in training and experience. Furthermore, shelters vary considerably in available resources, and many do not have access to veterinary specialists in behavior (Russo et al., 2021). A reliable tool for staff that accurately communicates shelter dogs' behavioral needs to veterinary staff would facilitate communication and partnerships between caregivers and clinicians, thereby providing the sheltering community a means to better support shelter dog welfare.

2.2: Materials and Methods

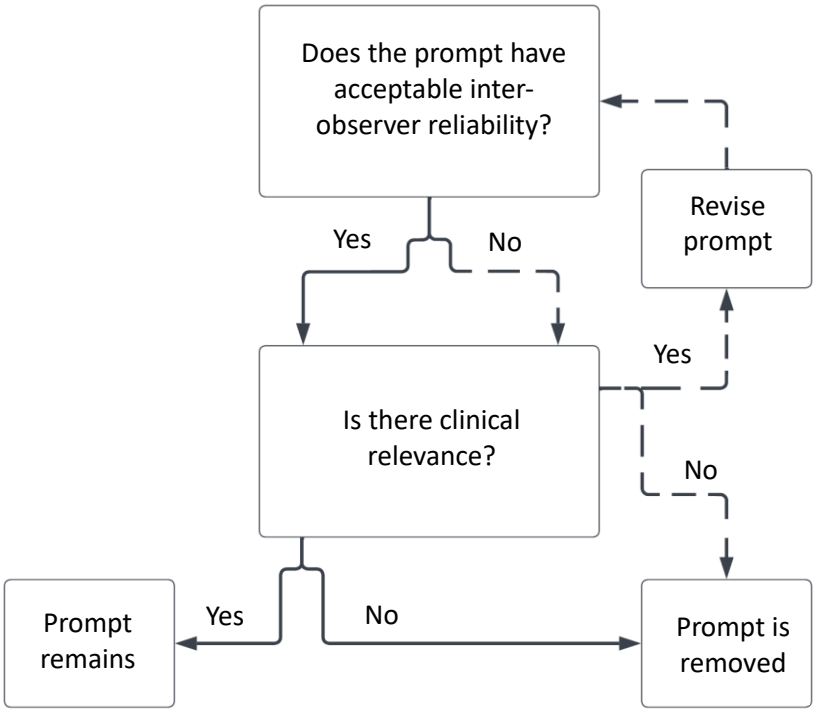
2.2.i: Protocol Development

The novel assessment protocol and accompanying form were developed based on the expertise of a board-certified veterinarian behaviorist and doctorate in ethology, extant literature on species-specific stress behavior, existing validated behavior tests, and conversation with shelter staff regarding practicality. From the humane society staff, typical human-dog interactions that influence staff's informal assessment of the dog were considered for ease of implementation of the protocol to shelter routine. Human-animal interactions (HAI's) were designed to allow observation of behavior that indicates the dog's coping state based on previously validated behavioral tests, species-specific stress behavior, and expert discussion.

From January-June 2022, the assessment went through several iterations, i.e., 11 drafts (see Appendix A), during which time the protocol was piloted at Capital Area Humane Society (CAHS) in Lansing, Michigan on single-housed, healthy dogs aged 12 weeks and older (n = 107). During the iteration process, components, i.e., prompts, within the assessment form were revised, added, or eliminated to better reflect the range of coping behaviors exhibited by shelter dogs (Figure 2.1). A focal group of pilot subjects (n = 17) were selected to represent a range of coping ability and the assessment videos were reviewed by a board-certified veterinarian behaviorist, doctorate in ethology, and MS candidate in animal behavior and welfare (the thesis author). Videos were used to evaluate the clinical relevance of human-animal interactions and accuracy of the assessment forms. Of the focal dogs, two subjects were chosen for in-depth review based on severity of behaviors indicating either excessive-arousal (subject named Diesel) or anxious-avoidance (subject named Tiger). Diesel consistently exhibited problematic behaviors

such as humping, hard mouthing, and difficulty disengaging across repeat assessments using assessment form drafts 2-3 (see Appendix A.3 and A.4). Tiger was assessed once using assessment form draft 10 (see Appendix A.10) and demonstrated reluctance to leave the kennel, tense body posture, and avoidance throughout the assessment. The behaviors of Diesel and Tiger partially informed prompt revisions to portray biologically relevant responses more accurately, e.g., disengagement in play, activity during and after treat consumption, and exit/return to kennel.

Figure 2.1. Decision tree for protocol development. Components of the assessment were reviewed for reliability and clinical relevance during the iterative revision process.



The 11th iteration was approved for data collection (see Appendix A.11) and consisted of eight HAI's (Table 2.1.a). The HAI's, explained in more detail during methods, included a human-approach and startle tests (acoustic and visual) that were modified to simulate typical environmental stimuli in shelters, namely a friendly human approach and exposure to a startling stimulus intended to provoke a response below the threshold of fear. Furthermore, a play and

treat component served the dual purpose of social, object, and food enrichment while observing welfare indicators, i.e., play behavior, eating behavior, and return to base activity state. A variation of the model dog test was designed to mimic a typical shelter scenario, while additionally simulating conspecific socialization to provide a potentially enriching experience. In a reverse of the approach test, the manner of return to kennel was included to observe behavioral response and a final food enrichment was provided in-kennel. Earlier versions of the assessment were more extensive, including the additional elements, leash-walk (drafts 1-6), treat dispersal (drafts 1-10), and anxiety score (see Appendix B.1) during acclimation (draft 9); but upon evaluation for reliability and clinical relevance, they were deemed unnecessary and therefore removed for practicality and feasibility of the tool. The approved draft had a total of 22 multiple-choice prompts across eight HAI's. Fifteen of the prompts were selected to contribute to the coping score, sc01-sc15 (Table 2.1.b). The remaining seven prompts (usc01-usc07), eight instances of piloerection (pilo1-pilo8), and the single open-ended question observed during HAI 6 (supp.01), did not contribute to coping score (hence described as "unscored prompts") but were collected for supplemental information on the individual's behavioral profile (Table 2.1.c).

To develop the scoring rubric (see Appendix D), each response for sc01-sc15 was assigned a value from –3 to +3 by a board-certified veterinarian behaviorist. Positive values were assigned to responses representative of behaviors associated with excessive-arousal, negative values for behaviors associated with anxious-avoidance, and zero for behaviors associated with adaptive coping. Responses that were coded as either positive or negative were further ranked by severity. Maladaptive coping behaviors considered mild were valued as ±1, moderate as ±2 and severe as ±3. Since not all prompts had equal number of response options, a multiplication factor was applied to balance the minimum and maximum contribution to total coping score among all 15 scored prompts, resulting in a total coping score range of –45 to +45.

Table 2.1. Abbreviations for assessment components. Abbreviations used for assessment components. **(a)** The assessment consists of eight Human-animal interactions (HAI's) which are comprised of either scored prompts and/or unscored prompts. **(b)** Scored prompts (sc01-sc15) consist of mutually exclusive multiple-choice questions. Each response abbreviated using letters of the alphabet (e.g., a, b, c), contribute to the total coping score the amount designated by the corresponding score value. **(c)** Unscored prompts (usc01-usc07, pilo1-pilo8, and supp.01) consist of mutually exclusive multiple-choice questions (usc01 and usc03), nonexclusive multiple-choice questions (usc02, usc04-usc07), binary present/absent (pilo1-pilo8) and open-ended written responses (supp.01). Written responses (supp.01) were not analyzed. Each response abbreviated using letters of the alphabet (e.g., a, b, c), were coded as present/absent for reliability analysis. Image responses for 'Overall Body Language' (usc02 and usc04) were grouped by association and responses for individual dogs were further analyzed for reliability when groups consisted of more than one image (Groups 1-4 and Group 8).

(a) Components of the eight human-animal interactions (HAI's)

Abbrev.	HAI	Scored Prompts	Unscored Prompts
HAI 1	In-kennel: Begin	sc01, sc02, sc03, sc04	usc01, usc02, usc03, pilo1
HAI 2	Play	sc05, sc06, sc07	usc04, pilo2
HAI 3	Settle	sc08, sc09	usc05, pilo3
HAI 4	Acoustic Startle	sc10	pilo4
HAI 5	Visual Startle	sc11	pilo5
HAI 6	Distraction	sc12, sc13	supp.01, pilo6
HAI 7	In-kennel: Return	sc14, sc15	pilo7
HAI 8	Activity		usc06, usc07, pilo8

(b) Scored prompts

Abbrev.	Scored Prompt	
	Response	**Score Value**
sc01	**Presentation with closed door**	
sc01(a)	Friendly/attentive/neutral	0
sc01(b)	Dissociated (fearful/stressed	-3
sc01(c)	Aware (fearful/stressed)	-1.5
sc01(d)	Hyper-active	1.5
sc01(e)	Aggression	2
sc01(f)	Hidden from view	null
sc02	**Ability to take treat**	**If sc01 =0 pts[1], <0 pts[2], >0 pts[3]**
sc02(a)	Consumes treat from hand	0^1, 0^2, 0^3
sc02(b)	Takes treat from hand but does not consume	0^1, -1^2, 1^3

Table 2.1 (cont'd)

sc02(c)	Consumes treat from floor	0^1, -2^2, 2^3
sc02(d)	No interest in treat	0^1, -3^2, 3^3
sc03	**Presentation with open door**	
sc03(a)	Friendly/attentive/neutral	0
sc03(b)	Dissociated (fearful/stressed	-3
sc03(c)	Aware (fearful/stressed)	-1.5
sc03(d)	Hyper-active	1.5
sc03(e)	Aggression	2
sc03(f)	Hidden from view	null
sc04	**Latency to exit**	
sc04(a)	Bolts	3
sc04(b)	Efficient	0
sc04(c)	Delayed	-3
sc04(d)	Refuses to exit	null
sc04(e)	Unsafe to allow exit	null
sc05	**Initial reaction to play**	
sc05(a)	Engages in play	0
sc05(b)	Approach - does not engage	3
sc05(c)	No approach - does not engage	-3
sc06	**Ease of putting away toys**	
sc06(a)	Easy - not engaged with toy	-3
sc06(b)	Easy with trade for treat	0
sc06(c)	Difficult - multiple trades required	3
sc07	**Was play ended early?**	
sc07(a)	Yes - over-stimulated	3
sc07(b)	Yes - fearful	-3
sc07(c)	No	0
sc08	**Response to treat**	
sc08(a)	Consumes while standing or moving	3
sc08(b)	Consumes while lying/sitting or plays with treat	0
sc08(c)	Ignores treat/brief interest or holds treat in mouth without consuming	-3

Table 2.1 (cont'd)

sc09	**Activity (last 15 sec.)**	
sc09(a)	Neutral - stationary	0
sc09(b)	Neutral - active	0
sc09(c)	Stressed - stationary	-3
sc09(d)	Stressed - active	3
sc10	**Reaction to acoustic startle**	
sc10(a)	Retreat	-3
sc10(b)	Immediate approach	1.5
sc10(c)	Freeze - upright	3
sc10(d)	Freeze - cower	-1.5
sc10(e)	Flinches/startles	0
sc10(f)	Stops briefly/orients	0
sc10(g)	No reaction	0
sc11	**Reaction to visual startle**	
sc11(a)	Retreat	-3
sc11(b)	Immediate approach	1.5
sc11(c)	Freeze - upright	3
sc11(d)	Freeze - cower	-1.5
sc11(e)	Flinches/startles	0
sc11(f)	Stops briefly/orients	0
sc11(g)	No reaction	0
sc12	**Overall body language while stimulus is moving***	
sc12(a)	Image A 	-2
sc12(b)	Image B 	-1
sc12(c)	Image C 	0
sc12(d)	Image D 	0
sc12(e)	Image E 	1

Table 2.1 (cont'd)

sc12(f)	Image F 	-3
sc12(g)	Image G 	3
sc13	**Can you obtain the dog's attention?**	
sc13(a)	No - oriented toward stimulus	3
sc13(b)	No - retreat from stimulus	-3
sc13(c)	No - uninterested	0
sc13(d)	Yes	0
sc14	**Approach to kennel entry**	
sc14(a)	Actively pulling towards entry	-3
sc14(b)	Actively pulling away from entry	1.5
sc14(c)	Actively pulling/darting in multiple directions	3
sc14(d)	Requires encouragement	0
sc14(e)	Cooperative	0
sc15	**In-kennel behavior post-return**	
sc15(a)	Hyper-active	3
sc15(b)	Fearful	-3
sc15(c)	Calm	0

*Images adapted from "Doggie Language" by Lili Chen (doggiedrawings.net/freeposters)

(c) Unscored Prompts

Abbrev.	**Unscored Prompt**	**Characteristics**
	Response	
usc01	**Location after approach**	Multiple-choice, mutually exclusive
usc01(a)	Front	
usc01(b)	Back	
usc01(c)	Middle	
usc01(d)	Not stationary	
usc02, usc04	**Overall body language***	Multiple-choice, nonexclusive
usc02(a), usc04(a)	Image 1 	Group 1 (Images 1-2)
usc02(b), usc04(b)	Image 2 	

Table 2.1 (cont'd)

usc02(c), usc04(c)	Image 3 	Group 2 (Images 3-6)
usc02(d), usc04(d)	Image 4 	
usc02(e), usc04(e)	Image 5 	
usc02(f), usc04(f)	Image 6 	
usc02(g), usc04(g)	Image 7 	Group 3 (Images 7-10)
usc02(h), usc04(h)	Image 8 	
usc02(i), usc04(i)	Image 9 	
usc02(j), usc04(j)	Image 10 	
usc02(k), usc04(k)	Image 11 	Group 4 (Images 11-13)
usc02(l), usc04(l)	Image 12 	
usc02(m), usc04(m)	Image 13 	
usc02(n), usc04(n)	Image 14 	Group 5 (Image 14)
usc02(o), usc04(o)	Image 15 	Group 6 (Image 15)
usc02(p), usc04(p)	Image 16 	Group 7 (Image 16)
usc02(q), usc04(q)	Image 17 	Group 8 (Images 17-20)
usc02(r), usc04(r)	Image 18 	

Table 2.1 (cont'd)

usc02(s), usc04(s)	Image 19 	
usc02(t), usc04(t)	Image 20 	
usc03	**Location with open door**	Multiple-choice, mutually exclusive
usc03(a)	Front	
usc03(b)	Back	
usc03(c)	Middle	
usc03(d)	Not stationary	
usc05	**Misc. behavior**	Multiple-choice, nonexclusive
usc05(a)	Pawing at exit	
usc05(b)	Pacing	
usc05(c)	Whining	
usc05(d)	Barking	
usc05(e)	Other	
usc05(f)	None	
usc06	**In-kennel misc. behavior**	Multiple-choice, nonexclusive
usc06(a)	Spinning	
usc06(b)	Excessive jumping	
usc06(c)	Whining	
usc06(d)	Excessive barking	
usc06(e)	Pacing	
usc06(f)	Frantic pawing at door	
usc06(g)	Smeared feces in kennel	
usc06(h)	Other	
usc07	**Out-of-kennel misc. behavior**	Multiple-choice, nonexclusive
usc07(a)	Dog directed reactivity (e.g., barrier aggression)	
usc07(b)	Other	
pilo1	**Piloerection**	Present/absent
pilo2	**Piloerection**	Present/absent
pilo3	**Piloerection**	Present/absent

Table 2.1 (cont'd)

pilo4	**Piloerection**	Present/absent
pilo5	**Piloerection**	Present/absent
pilo6	**Piloerection**	Present/absent
pilo7	**Piloerection**	Present/absent
pilo8	**Piloerection**	Present/absent
supp.01	**Note behavior after dog is let off-leash**	Open-ended written response

*Images adapted from "Doggie Language" by Lili Chen (doggiedrawings.net/freeposters)

During development, kennel cards (see Appendix B.2) were attached to the staff side of the kennels and filled out twice daily by staff until the dog left the shelter for dogs assessed using assessment form drafts 4-6 (n = 20). Kennel cards collected information on the dog's appetite, elimination, and in-kennel behavior. However, since shelter medical and behavioral records were collected for the dogs assessed for reliability and validity testing, the use of kennel cards was eliminated.

2.2.ii: Sample Population

From June 2022 through October 2022, all healthy dogs 12 weeks or older maintained in solitary housing at Capital Area Humane Society (Lansing, MI) overnight for at least one night prior to assessment were eligible for assessment. Of total intake (n = 344), 98 dogs were assessed but seven were excluded before analysis due to health reasons (n = 1) and refusal to exit kennel (n = 6) resulting in 91 assessments. Dogs were not eligible for assessment if they were previously assessed during the protocol development (n = 5), group housed and 12 weeks or older (n = 60), less than 12 weeks of age (n = 72), had medical difficulties (broken bones or recent amputations n = 4, malignant mammary cancer n = 1), received for owner-requested euthanasia services (n = 36), or were designated staff only handling by the shelter due to extreme aggression, i.e. human safety risk (n = 4). Dogs that were initially considered for inclusion but were no longer at the shelter at time of assessment because they were adopted, transferred, went into foster, reclaimed by owner, or euthanized for medical reasons (n = 64) were not assessed.

Per shelter policy, dogs without known breed history were designated “mixed breed”. As such, there were 85 mixed breed dogs, one German Shepherd, one Siberian Husky, one Golden Retriever, one Bichon Friese/mix, one French Bulldog, and one American Cocker Spaniel. The mean age was 2.32 ± 2.41 years and ranged from 0.275 (0y 3m 9d) to 10.753 (10y 9m 1d) years; however, it should be noted that age was often estimated by shelter clinicians. The mean weight was 42.07 ± 18.08 lbs., ranging from 6.58 lbs. to 90 lbs., but several dogs (n = 30) were less than 12 months old, and weight may not be representative of adult size. Of total included dogs (n = 91), 44 were female (33 spayed, 11 intact) and 47 were male (29 neutered, 18 intact). Dogs that were intact on intake were spayed/neutered according to shelter protocol. The shelter performed all surgeries on select days of the week, therefore if a dog was eligible for assessment prior to surgery, they were enrolled and assessed regardless of reproductive status. Dogs that had received surgery on the day of designated assessment were not eligible until the following assessment day.

2.2.iii: Shelter Housing and Care

Dogs were housed in kennels located in four different rooms in the shelter; kennel sizes were either 4’-0” x 8’-0” or 4’-0” x 12’-0”. All kennels were guillotine style with opaque panels between dogs, an open metal door at the front, and an opaque door at the back of the kennels. The guillotine door remained open with the exception of kennel cleaning. Items in the kennel included a Kuranda bed, blankets, and toys. Fresh water was provided ad libitum and dogs were fed per shelter standards twice a day. Dogs were exercised four times daily in an outdoor fenced-in yard (lasting approximately five minutes each) and once with a leash walk around the perimeter of the shelter.

2.2.iv: Protocol

Behavior assessments took place Monday-Friday between 1:00 pm and 5:00 pm to avoid meal-time disruption. The exact days of the week depended on the available dogs, assessors’ schedules, and shelter events. Eligible dogs were determined through review of intake reports based on age and arrival date. After enrollment, assessment order was randomized, and subsequent enrollments were added to the end of the list in a randomized order. A maximum of five dogs were assessed daily. If a dog was unavailable at the time of assessment, they were

moved to the bottom of the daily order. If they were unavailable for the entire shift, they were moved to the following assessment day. Assessments either took place in an indoor room (594 S.F.) or an outdoor fenced area (545 S.F.). Location was based on room availability and weather but kept consistent through the day and dogs were assigned to location on a rolling basis according to the randomized enrollment order. Of the 91 dogs included for analysis, 43 were assessed indoors and 48 outdoors.

Assessments occurred a minimum 20 hours after intake and were recorded using GoPro Hero7 Black video recording devices from two perspectives. Assessment forms were completed in real-time by two raters for inter-rater reliability. Assessment video was viewed a minimum of 4 months post-assessment for intra-rater reliability by one rater. Rater A, the first author, scored all dogs and administered the behavior assessments. Depending on the schedule of the second rater, Rater B, C, or E observed the assessments in-field and scored the dogs blinded from Rater A's scoring. This resulted in three rater pairs; all raters were female. Raters were trained using ethograms and a written in-field protocol (see Appendix C). Except for the assessor (Rater A), raters were asked not to interact with the dog during testing by remaining at a distance and avoiding eye contact. Raters were also trained with practice assessments on dogs that were ineligible for enrollment due to previous assessment during the pilot. Practice assessments were carried out in-field and by watching video of pilot assessments. During training, assessment forms were compared between the two raters and disagreements discussed using the ethogram until both raters agreed on assessment response.

Medical and behavioral reports of the dogs while in-shelter were collected once the dog had left the shelter via adoption (n = 79), foster (n = 4), return to owner (n = 2), or euthanasia (n = 6). Shelter records were used for demographic information of participating dogs, discussed in Chapter 3.

2.2.v: The Behavior Assessment

The coping behavior assessment consisted of the following human-animal interactions: In-Kennel: Begin (HAI 1), Play (HAI 2), Settle (HAI 3), Acoustic Startle (HAI 4), Visual Startle (HAI 5), Distraction (HAI 6), and In-Kennel: Return (HAI 7). An additional category, Activity (HAI 8), was included to gather supplementary information on the dog's behavior while in-kennel and

during transition between the kennel and the assessment area, both between HAI 1-HAI 2 and HAI 6-HAI 7. Each interaction has a series of prompted observations for record of the dog's response to the interaction. The order of interactions was intentionally designed so that potential excitability of each category increased over time except for Play (HAI 2) which is meant to provide the dog with a positive stimulating experience in the beginning to properly assess the individual's ability to down-regulate afterward during Settle (HAI 3).

2.2.vi: Human-animal Interactions

In-kennel: Begin (HAI 1)

The assessor approached the front of the dog's kennel and stood facing the kennel gate, calling to the dog in a friendly manner and offering a treat (Zukes Mini Natural). If the dog approached the human, she held the treat through the gate. If the dog did not take the treat, she dropped it on the floor. If the dog does not remain near the gate, the assessor lightly tossed the treat further into the enclosure. After allowing the dog the opportunity to consume the treat, the assessor slowly opened the gate so that the dog could exit while the assessor secured the dog using a slip lead. If the dog did not exit within 90 seconds of coaxing, the assessor shut the gate and tried from the backside gate. If again the dog did not exit within 90 seconds, the assessor recorded refusal of exit and ended assessment. For the dogs that did exit, they were led outside for a brief walk (approximately 1 minute) before entering the assessment area and let off lead. While the dog was given 1-2 minutes to acclimate, the assessor sat in a relaxed manner on a low crate in the middle of the area. If the dog approached the assessor, she would interact with the dog by talking calmly or petting the dog.

Play (HAI 2)

The assessor stood and called to the dog to get its attention. With the dog looking in the direction of the human, the assessor would gently toss a tennis ball, a rope toy, and a dog toy (stuffless stuffy) one at a time a few feet in front of her and attempt to engage the dog in play. If the dog showed interest in interaction, the assessor would either play or pet the dog according to its interest. If the dog showed no interest, the assessor would allow the dog to continue its behavior for the 3-minute play duration while intermittingly attempting to capture the dog's interest in play by calling to the dog, bouncing the ball, squeaking the stuffy, or gently tossing

the toys. If the dog exhibited increasingly aroused or avoidant behaviors (e.g., constant whining, pacing, and avoidance or uninhibited mouthing or mounting) then playtime ended early, and toys were put away. At the end of playtime, the assessor would pick up toys if not in use or offer a treat for a trade if the toys were in use, then place them out of reach of the dog.

Settle (HAI 3)

The assessor called the dog to get its attention and while the dog was looking in the direction of the human, placed a large size Milkbone on a fabric mat. The assessor then sat down approximately 8 feet from the mat to observe the dog for 2 minutes. During the 2 minutes, the assessor sat calmly and ignored solicitations for attention.

Acoustic startle (HAI 4)

The assessor remained seated and played a loud buzzer noise via a mobile app through a Bluetooth speaker placed on the floor in the center of the assessment area. The assessor observed the behavior of the dog through the duration of the sound and the following 3 seconds after the noise had ceased.

Visual startle (HAI 5)

The assessor attached a leash to the dog's collar or harness and walked the dog over to a tethered rope, where the assessor then secured the leash to the rope. As the assessor bent down to pick up a separate rope attached to a metal folding chair, the assessor offered the dog a treat (Zukes Mini Natural) to orient the dog to the chair. After standing, the assessor tugged the rope so that the chair moved approximately 6 inches and observed the dog for the duration of the chair movement and the following 3 seconds after movement ceased.

Distraction (HAI 6)

The assessor walked the dog to the end of the tethered leash and then continued forward to where a model dog was hidden behind a barrier. The assessor brought the model dog out from behind the visual shield and proceeded to walk the model dog by leash attached to a harness for approximately 8 feet before stopping the model dog at a location out of reach by the real dog. The assessor then walked toward the real dog, past the shoulder and behind, to then call for the dog, offering a treat (Zukes Mini Natural). After 5-10 seconds, the assessor unclipped the leash from the tethered rope and allowed the dog to approach the model dog.

Whether the dog approached the model dog or not, the assessor would then walk the model dog an additional 4 feet, pausing to allow the dog to react while untethered. The assessor then removed the model dog and placed it behind the barrier.

In-kennel: Return (HAI 7)

The assessor led the dog back to its kennel. When within approximately 5 feet of the kennel entry, the assessor observed the manner of return. The assessor would continue walking straight to the kennel and open the gate, verbally encouraging the dog if necessary. Once the dog was inside the kennel, the assessor would place a medium size Milkbone in the kennel while unclipping the leash. Finally, the assessor would close and secure the gate. If the dog resisted entering the kennel, the assessor would use first the Milkbone as a lure and then wet food.

Activity (HAI 8)

'Activity' represents miscellaneous behaviors that can correlate with maladaptive coping. These behaviors are circled if observed either while the dog is in the kennel (during HAI 1 or HAI 7), or while the dog is transitioning to/from the kennel (after HAI 1 or before HAI 7).

2.2.vii: Analysis

Rater reliability was analyzed using R version 4.1.3; indoor and outdoor dogs were analyzed separately. For inter-rater reliability, only dogs scored by rater pair A+B were included in analysis (indoor = 35; outdoor = 37) because of the low number of dogs scored by rater pairs A+C (indoor = 5; outdoor = 8) and A+D (indoor = 3; outdoor = 3). To test for intra-rater reliability, Rater A watched assessment video a minimum of 4 months after the original assessment for 20% of the dogs assessed indoors (n = 10) and outdoors (n = 10). Dogs for intra-rater reliability were randomly selected from the sampled population after excluding assessments that had ≥1 prompt with missing data from the original assessment performed by Rater A (n = 7). Prompt responses from both scored (sc01-sc15) and unscored prompts (usc01-usc07, pilo1-pilo8) were analyzed for agreement with percentage observed total agreement (P_o) and Cohen's kappa (k) which adjusts for chance agreement using the proportion of agreement expected by chance (P_e). Prompt responses from unscored prompts were also analyzed for proportion positive agreement (P_{pos}) and proportion negative agreement (P_{neg}). Agreement analysis can result in

high percent agreement with low kappa values in instances where observed marginal totals are symmetrically imbalanced by affecting the expected percent agreement, i.e., P_e (Feinstein & Cicchetti, 1990). For this reason, it is suggested that P_{pos} and P_{neg} be reported in addition to P_o and k for a comprehensive understanding of the data (Cicchetti & Feinstein, 1990). See Table 2.2 for equations used for reliability analysis.

Unscored prompts are multiple choice (usc01-usc07) or binary present/absent (pilo1-pilo8). One unscored prompt (supp.01) is open-ended, however written response was not included in analysis. Of the seven multiple choice prompts, two are mutually exclusive (usc01 and usc03) and were analyzed using P_o and k while each individual response was additionally analyzed with P_{pos} and P_{neg}. Each response of all unscored prompts, including the two mutually exclusive prompts, were analyzed separately as binary present or absent outcome variables to test for P_o, k, P_{pos}, and P_{neg}. Three prompts (usc05, usc06, usc07) include the response option "Other (write)". The occurrence of response "Other" was included in reliability analysis; however, written responses were not analyzed. Due to the relatedness between body language images (responses for usc02 and usc04), images were grouped according to correlation and analyzed as a group in addition to individually if there was more than one image in the body language group. In total there was eight groups of correlated images, five of which consisted of more than one image; Group 1 (images 1 and 2), Group 2 (images 3, 4, 5, and 6), Group 3 (images 7, 8, 9, and 10), Group 4 (images 11, 12, and 13), Group 5 (image 14), Group 6 (image 15), Group 7 (image 16) and Group 8 (image 17, 18, 19, and 20).

For the 15 scored prompts (sc01-sc15), both responses and scores were analyzed for reliability. Several scored prompts (sc02, sc09, sc10, sc11, sc12, sc13, and sc14) had ≥2 responses that were scored 0 points, leading to the possibility of improved score agreement over response agreement. Responses were analyzed for P_o and k while prompt scores were analyzed using the quadratic weighted kappa (QWK) for consideration of relatedness among ranked integers (Vanbelle, 2016).

In summary, individual prompts were analyzed for reliability using the appropriate test for unranked categorical data, totaling to 77 unscored binary response outcomes, five additional unscored binary outcomes for body language groups with more than one correlated image, and

two mutually exclusive unscored prompts. Further, 15 mutually exclusive scored prompts were analyzed for reliability both as unranked categorical data (response agreement) and as ranked integers (score agreement). For interpretation of coefficient values, categorical descriptors widely accepted as the reference standard (Cohen, 1960) will be referenced (Table 2.2(c)).

Table 2.2. Equations and symbols for reliability analysis. Assessment form data was analyzed for inter- and intra-rater reliability using the appropriate measures of percent agreement, proportion positive agreement, proportion negative agreement, and kappa value to correct for chance. **(a)** Unscored assessment form data (responses for usc01-usc07 and pilo1-pilo8) was rated by two raters for inter-rater reliability and again by a single rater using assessment video for intra-rater reliability. The presence of the behavior in both instances was considered positive agreement, count a, and the absence of the behavior in both instances was considered negative agreement, count d. Total count included in analysis is designated with a capital N. **(b)** Test coefficients used for rater reliability testing, the symbol used, and the equation. P_o and k were calculated for all prompt responses (usc01-usc07, sc01-sc15, and pilo1-pilo8). P_{pos} and P_{neg} were calculated for nonexclusive unscored prompts (usc02, usc04-usc07, and pilo1-pilo8). QWK was calculated for prompt scores (sc01-sc15). **(c)** Descriptive categories used for interpreting test values, P_o, P_{pos}, P_{neg}, k, and QWK (Cohen, 1960).

(a) Contingency key for binary data, agreement on presence or absence of behavior

		Rater A (inter-rater) or time 1 (intra-rater)		
		Present	Absent	Totals
Rater B (inter-rater) or time 2 (intra-rater)	Present	a	b	g_1
	Absent	c	d	g_2
	Totals	f_1	f_2	N

(b) Rater reliability test coefficients and equations

Test Coefficient	**Symbol & Equation**	**Reporting**	**Description**
Percent agreement	$P_o = (a + d) / N$	Unscored prompts (usc01-usc07, pilo1-pilo8) and scored prompt responses (sc01(a), sc01(b), etc.)	where a is the positive agreement count, d is negative agreement count, and N is total observations
Percent agreement expected by chance	$P_e = (f_1g_1 + f_2g_2) / N^2$	Calculated for Cohen's kappa (unreported)	where f_1 is total positive count by rater 1, g_1 is total positive count by rater 2, f_2 is total negative count by rater 1, and g_2 is total negative count by rater 2, and N is total observations
Cohen's kappa	$k = (P_o - P_e) / (1 - P_e)$	Unscored prompts (usc01-usc07, pilo1-pilo8) and scored prompt responses (sc01(a), sc01(b), etc.)	Where P_o is percent agreement and P_e is percent agreement expected by chance

Table 2.2 (cont'd)

Proportion positive agreement	P_{pos} = 2a / (N + (a - d))	Nonexclusive unscored prompts (usc02, usc04-usc07, pilo1-pilo8)	Where a is the positive agreement count, N is total observations, and d is the negative agreement count
Proportion negative agreement	P_{neg} = 2d / (N - (a – d))	Nonexclusive unscored prompts (usc02, usc04-usc07, pilo1-pilo8)	Where d is the negative agreement count, N is the total observations, and a is the positive agreement count
Quadratic weighted kappa	QWK = 1 – [(1 – k) / (1 – kmax)]	Prompt scores (sc01-sc15)	where k is Cohen's kappa and kmax is the maximum possible value of k which represents the agreement expected by chance. In our analysis, kmax was calculated in R through library(irr), using observed scores

(c) Descriptive categories for test values

Test Value	Descriptive Category
0.81-1.00	Near perfect agreement
0.61-0.80	Substantial agreement
0.41-0.60	Moderate agreement
0.21-0.40	Fair agreement
0.0-0.2	Slight agreement
<0.0	Worse than chance agreement

2.3: Results

2.3.i: Inter-rater Reliability, Indoor Assessments

Unscored (Table 2.3) and scored (Table 2.4) responses showed a significant level of agreement between raters, ranging from substantial (n = 8 unscored responses; n = 4 scored responses) to near perfect (n = 73 unscored responses; n = 9 scored responses) percent agreement (Po), with only three instances of moderate agreement (1 unscored response, 2 scored responses). However, when corrected for chance, agreement as measured by kappa values ranged from worse than chance to near perfect agreement for both unscored responses (k) and scored prompts (QWK), which is described in further detail below.

Unscored Prompts (indoor, inter-rater)

To assess agreement between raters A and B, I analyzed inter-rater reliability using percent agreement (P_o), proportion positive agreement (P_{pos}), proportion negative agreement (P_{neg}), and Cohen's kappa (k) to correct for chance agreement for all unscored responses. Both mutually exclusive unscored prompts, location in kennel with closed door (usc01) and open door (usc03), showed near perfect percent agreement (usc01(P_o) = 0.971, usc03(P_o) = 0.912).

However, when Cohen's kappa was calculated to correct for chance agreement, usc01 had substantial agreement (k = 0.657), while usc03 had fair agreement (k = 0.227). To evaluate the agreement for each possible response ('Front', 'Back', 'Middle', or 'Not Stationary' for both prompts) responses were individually assessed for agreement.

For 32 unscored responses, the kappa value (k) could not be determined (k = NA) because the proportion of agreement expected by chance (P_e) was equal to 1, resulting in a denominator of 0 when calculating Cohen's kappa (Table 2.3). This occurred due to a low observed occurrence, with 0 instances of positive agreement and a denominator of 0 for proportion positive agreement (P_{pos} = NA), along with perfect occurrence of proportion negative agreement (P_{neg} = 1) in all instances where k = NA.

Responses with unsatisfactory kappa values ($k \leq 0.60$) had acceptable percent agreement uncorrected for chance ($P_o > 0.60$) in 35 instances and moderate percent agreement in one instance (image 19, usc04(s)). Of the 36 responses that fall into this category, the observed prevalence bias for 30 of them led to poor agreement when corrected for chance (k) despite acceptable values for P_o. There was no observed prevalence bias for the remaining six responses (see “Moderate observed occurrence” in Table 2.3). Five of the responses with moderate observed occurrence and unsatisfactory kappa values were body language images observed during Play (HAI 2) while the remaining response was ‘None’ during miscellaneous behavior in Settle (HAI 3). However, only one of these six responses (image 19, usc04(s)) had a questionable degree of agreement (P_o = 0.514). Image 19 is a dog sniffing with lowered head. The ambiguous reliability results (P_{pos} = 0.370, P_{neg} = 0.605) could reflect confusion as to whether the image pertains to sniffing the toys or the ground when not in proximity to the toys.

The remaining 12 responses had acceptable kappa values ($k > 0.60$) and acceptable percent agreement uncorrected for chance ($P_o > 0.60$). Nine of the responses had low observed occurrence, one had high observed occurrence, and two had moderate observed occurrence (Table 2.3).

Table 2.3. Inter-rater reliability of unscored prompts for indoor dogs (n = 35). Inter-rater reliability analysis (P_o, P_{pos}, P_{neg}, k; see Table 2.2 for abbreviations) of unscored prompts for dogs assessed indoors by rater pair A + B (n = 35). Prompts with missing data were excluded from analysis. Responses are organized by observed prevalence (low, high, and moderate) and listed in ascending order for Cohen's kappa (k). Low observed prevalence for a behavior, i.e., response, occurs when the number of dogs where the raters were in negative agreement (d) exceeds the number of dogs for which either one or both raters recorded the behavior as present (a + b + c). High observed prevalence for a behavior, i.e., response, occurs when the number of dogs where either one or both raters recorded the behavior as present (a + b + c) exceeds the number of dogs where the raters were in negative agreement (d). Responses with low or high observed prevalence indicate a prevalence bias that caused a discrepancy between P_o and k in several instances, illuminated by considering both P_{neg} and P_{pos} in context with P_o and k. For instances where the number of dogs for which either one or both raters recorded a behavior, i.e., response, as present (a + b + c) was within ±50% of the total number of dogs analyzed for that prompt to the negative agreement count (0.50 x N* ± d). Moderately observed behaviors indicate that there was no prevalence bias in the sample population for those responses.

HAI	Prompt	Abbrev.	Response	N*	Pos. Agree. Count (a)	Neg. Agree. Count (d)	Disagree. Count (b + c)	P_o	P_{pos}	P_{neg}	k
Low observed occurrence (a + b + c < d) with high negative agreement (d)											
1	Location after approach	usc01(c)	Middle	35	0	35	0	1	NA	1	NA
1	Location with open door	usc03(c)	Middle	34	0	34	0	1	NA	1	NA
1	Body language	usc02(d)	Image 4	35	0	35	0	1	NA	1	NA
1	Body language	usc02(e)	Image 5	35	0	35	0	1	NA	1	NA
1	Body language	usc02(g)	Image 7	35	0	35	0	1	NA	1	NA
1	Body language	usc02(i)	Image 9	35	0	35	0	1	NA	1	NA
1	Body language	usc02(m)	Image 13	35	0	35	0	1	NA	1	NA
1	Body language	usc02(o)	Image 15	35	0	35	0	1	NA	1	NA

Table 2.3 (cont'd)

1	Body language	usc02(p)	Image 16	35	0	35	0	1	NA	1	NA
1	Body language	usc02(q)	Image 17	35	0	35	0	1	NA	1	NA
1	Body language	usc02(s)	Image 19	35	0	35	0	1	NA	1	NA
1	Body language	usc02(t)	Image 20	35	0	35	0	1	NA	1	NA
2	Body language	usc04(a)	Image 1	35	0	35	0	1	NA	1	NA
2	Body language	usc04(b)	Image 2	35	0	35	0	1	NA	1	NA
2	Body language	usc04(a-b)	Group 1 (1-2)	70	0	70	0	1	NA	1	NA
2	Body language	usc04(c)	Image 3	35	0	35	0	1	NA	1	NA
2	Body language	usc04(m)	Image 13	35	0	35	0	1	NA	1	NA
2	Body language	usc04(o)	Image 15	35	0	35	0	1	NA	1	NA
2	Body language	usc04(p)	Image 16	35	0	35	0	1	NA	1	NA
2	Piloerection	pilo2	Present	35	0	35	0	1	NA	1	NA
3	Misc. behavior	usc05(a)	Pawing at exit	35	0	35	0	1	NA	1	NA
3	Misc. behavior	usc05(d)	Barking	35	0	35	0	1	NA	1	NA
3	Piloerection	pilo3	Present	35	0	35	0	1	NA	1	NA
4	Piloerection	pilo4	Present	35	0	35	0	1	NA	1	NA
5	Piloerection	pilo5	Present	35	0	35	0	1	NA	1	NA
7	Piloerection	pilo7	Present	35	0	35	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(a)	Spinning	35	0	35	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(b)	Excessive jumping	35	0	35	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(e)	Pacing	35	0	35	0	1	NA	1	NA

Table 2.3 (cont'd)

8	In-kennel misc. behavior	usc06(f)	Frantic pawing at door	35	0	35	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(g)	Smeared feces in kennel	35	0	35	0	1	NA	1	NA
8	Out-of-kennel misc. behavior	usc07(a)	Dog directed reactivity	35	0	35	0	1	NA	1	NA
1	Body language	usc02(h)	Image 8	35	0	26	9	0.743	0	0.852	-0.145
1	Body language	usc02(c)	Image 3	35	0	31	4	0.886	0	0.939	-0.061
1	Location with open door	usc03(d)	Not stationary	34	0	32	2	0.941	0	0.970	-0.030
1	Body language	usc02(c-f)	Group 2 (3-6)	140	0	135	5	0.964	0	0.982	-0.017
1	Body language	usc02(a-b)	Group 1 (1-2)	70	0	68	2	0.971	0	0.986	-0.014
1	Location after approach	usc01(d)	Not stationary	35	0	34	1	0.971	0	0.986	0
1	Location with open door	usc03(b)	Back	34	0	32	2	0.941	0	0.970	0
1	Body language	usc02(a)	Image 1	35	0	34	1	0.971	0	0.986	0
1	Body language	usc02(b)	Image 2	35	0	34	1	0.971	0	0.986	0
1	Body language	usc02(f)	Image 6	35	0	34	1	0.971	0	0.986	0
1	Body language	usc02(l)	Image 12	35	0	33	2	0.943	0	0.971	0
2	Body language	usc04(d)	Image 4	35	0	34	1	0.971	0	0.986	0
2	Body language	usc04(e)	Image 5	35	0	34	1	0.971	0	0.986	0
2	Body language	usc04(g)	Image 7	35	0	30	5	0.857	0	0.923	0
2	Body language	usc04(l)	Image 12	35	0	34	1	0.971	0	0.986	0

Table 2.3 (cont'd)

2	Body language	usc04(n)	Image 14	35	0	34	1	0.971	0	0.986	0
2	Body language	usc04(q)	Image 17	35	0	34	1	0.971	0	0.986	0
2	Body language	usc04(r)	Image 18	35	0	34	1	0.971	0	0.986	0
2	Body language	usc04(t)	Image 20	35	0	34	1	0.971	0	0.986	0
8	In-kennel misc. behavior	usc06(d)	Excessive barking	35	0	34	1	0.971	0	0.986	0
8	In-kennel misc. behavior	usc06(h)	Other	35	0	34	1	0.971	0	0.986	0
8	Out-of-kennel misc. behavior	usc07(b)	Other	35	0	33	2	0.943	0	0.971	0
8	Piloerection	pilo8	Present	35	0	31	4	0.886	0	0.939	0
6	Piloerection	pilo6	Present	35	2	24	9	0.743	0.308	0.842	0.203
1	Body language	usc02(g-j)	Group 3 (7-10)	140	2	128	10	0.929	0.286	0.962	0.248
2	Body language	usc04(c-f)	Group 2 (3-6)	140	2	128	10	0.929	0.286	0.962	0.261
2	Body language	usc04(f)	Image 6	35	2	25	8	0.771	0.334	0.862	0.263
2	Body language	usc04(q-t)	Group 8 (17-20)	140	5	115	20	0.857	0.334	0.920	0.263
1	Body language	usc02(r)	Image 18	35	1	33	1	0.971	0.667	0.985	0.653
1	Piloerection	pilo1	Present	35	1	33	1	0.971	0.667	0.985	0.653
8	In-kennel misc. behavior	usc06(c)	Whining	35	1	33	1	0.971	0.667	0.985	0.653
1	Body language	usc02(q-t)	Group 8 (17-20)	140	1	138	1	0.993	0.667	0.996	0.663
1	Body language	usc02(j)	Image 10	35	2	32	1	0.971	0.80	0.985	0.785
3	Misc. behavior	usc05(c)	Whining	35	5	29	1	0.971	0.909	0.983	0.892
1	Body language	usc02(n)	Image 14	35	6	28	1	0.971	0.923	0.982	0.906

Table 2.3 (cont'd)

1	Location after approach	usc01(b)	Back	35	1	34	0	1	1	1	1
3	Misc. behavior	usc05(b)	Pacing	35	2	33	0	1	1	1	1
High observed occurrence (a + b + c > d) with high positive agreement (a)											
1	Body language	usc02(k)	Image 11	35	29	0	6	0.829	0.906	0	-0.050
2	Body language	usc04(k)	Image 11	35	30	1	4	0.886	0.938	0.333	0.278
3	Misc. Behavior	usc05(e)	Other	35	19	5	11	0.686	0.776	0.476	0.306
1	Location with open door	usc03(a)	Front	34	31	1	2	0.941	0.969	0.50	0.477
1	Location after approach	usc01(a)	Front	35	33	1	1	0.971	0.985	0.667	0.653
Moderate observed occurrence (a + b + c is ±50%(N) of d)											
2	Body language	usc04(s)	Image 19	35	5	13	17	0.514	0.370	0.605	0.105
2	Body language	usc04(j)	Image 10	35	7	16	12	0.657	0.538	0.727	0.266
3	Misc. behavior	usc05(f)	None	35	5	20	10	0.714	0.50	0.80	0.342
2	Body language	usc04(h)	Image 8	35	12	12	11	0.686	0.686	0.686	0.428
2	Body Language	usc04(g-j)	Group 3 (7-10)	140	25	81	34	0.757	0.595	0.827	0.429
2	Body Language	usc04(i)	Image 9	35	6	23	6	0.829	0.667	0.885	0.553
1	Body language	usc02(k-m)	Group 4 (11-13)	105	29	68	8	0.924	0.879	0.944	0.823
2	Body language	usc04(k-m)	Group 4 (11-13)	105	30	70	5	0.952	0.923	0.966	0.889

N* = total dogs analyzed per response; prompts with missing data were excluded from analysis

Scored Prompts (indoor, inter-rater)

Scored prompts with unsatisfactory score agreement corrected for chance (QWK ≤ 0.60) had unsatisfactory response agreement corrected for chance (k ≤ 0.60) in seven instances yet acceptable response agreement (k > 0.60) in two instances (Table 2.4). When uncorrected for chance, two of the nine instances were unacceptable (P_o ≤ 0.60), the reaction to the acoustic startle (sc10) and the reaction to the visual startle (sc11), both of which had differing response agreement to score agreement due to three responses leading to an equivalent score of zero (responses (e), (f), and (g) for both sc10 and sc11, see Table 2.1 for abbreviations).

Scored prompts with satisfactory score agreement corrected for chance (QWK > 0.60) also had satisfactory response agreement corrected for chance (k > 0.60) in four instances, yet unsatisfactory (k ≤ 0.60) in two instances, presentation with closed door (sc01) and presentation with open door (sc03). However, when uncorrected for chance, all six scored prompts had satisfactory agreement (P_o > 0.60).

Table 2.4. Inter-rater reliability of scored prompts for indoor dogs (n = 35). Inter-rater reliability analysis (P_o, k, QWK; see Table 2.2 for abbreviations) of scored prompts for dogs assessed indoors by rater pair A + B (n = 35), listed in ascending order for QWK. Prompts with missing data were excluded from analysis. Scored prompts were analyzed for both response agreement (P_o and k) and score agreement (QWK) because seven of the prompts had more than one response that was scored zero. Prompts with differing agreement count (a) between responses and scores are highlighted with bold red font in columns 'a' for both response and score agreement.

				Response Agreement			Score Agreement	
HAI	**Abbrev**	**Prompt**	**N***	**a**	**P_o**	**k**	**a**	**k**
1	sc02	Ability to take treat	32	**28**	0.875	0.739	**30**	-0.026
7	sc14	Approach to kennel entry	34	**24**	0.706	0.473	**26**	0.077
3	sc09	Activity	34	**25**	0.735	0.578	**28**	0.288
6	sc12	Overall body language	34	24	0.706	0.518	24	0.467
4	sc10	Reaction to acoustic startle	35	**16**	0.457	0.278	**19**	0.488
5	sc11	Reaction to visual startle	33	**15**	0.455	0.321	**23**	0.552
2	sc05	Initial reaction to play	34	30	0.882	0.783	30	0.573
7	sc15	In-kennel behavior post-return	35	31	0.886	0.551	31	0.598
1	sc04	Latency to exit	34	26	0.765	0.487	26	0.60
2	sc06	Ease of putting away toys	34	30	0.882	0.770	30	0.636
6	sc13	Can you obtain the dog's attention	28	24	0.857	0.697	24	0.753

Table 2.4 (cont'd)

3	sc08	Response to treat	32	31	0.969	0.951	31	0.979
1	sc01	Presentation with closed door	34	29	0.853	0.320	29	1
1	sc03	Presentation with open door	35	30	0.857	0.481	30	1
2	sc07	Was play ended early	33	33	1	1	33	1

N* = total dogs analyzed per response; prompts with missing data were excluded from analysis

2.3.ii: Inter-rater Reliability, Outdoor Assessments

Unscored (Table 2.5) and scored (Table 2.6) responses showed a significant level of agreement between raters, ranging from substantial (n = 10 unscored responses; n = 4 scored responses) to near perfect (n = 72 unscored responses; n = 9 scored responses) percent agreement (P_o), with only three instances of moderate agreement (1 unscored response, 2 scored responses). However, when corrected for chance, agreement as measured by kappa values ranged from worse than chance to near perfect agreement for both unscored responses (k) and scored prompts (QWK), described in further detail below.

Unscored Prompts (outdoor, inter-rater)

To assess agreement between raters A and B, I analyzed inter-rater reliability using percent agreement (P_o), proportion positive agreement (P_{pos}), proportion negative agreement (P_{neg}), and Cohen's kappa (k) to correct for chance agreement for all unscored responses. Both mutually exclusive unscored prompts, location in kennel with closed door (usc01) and open door (usc03), showed near perfect percent agreement (usc01(P_o) = 0.946, usc03(P_o) = 0.970). However, when Cohen's kappa was calculated to correct for chance agreement, usc01 had moderate agreement (k = 0.486), while usc03 had slight agreement (k = 0). To evaluate the agreement for each possible response ('Front', 'Back', 'Middle', or 'Not Stationary' for both prompts) responses were individually assessed for agreement.

For 35 unscored responses, the kappa value (k) could not be determined (k = NA) because the proportion of agreement expected by chance (P_e) was equal to 1, resulting in a denominator of 0 when calculating Cohen's kappa (Table 2.5). This occurred due to a low observed occurrence, with 0 instances of positive agreement and a denominator of 0 for

proportion positive agreement (P_{pos} = NA), along with perfect occurrence of proportion negative agreement (P_{neg} = 1) in all instances where k = NA.

Responses with unsatisfactory kappa values ($k \leq 0.60$) had acceptable percent agreement uncorrected for chance ($P_o > 0.60$) in 42 instances. Of the 42 responses, the observed prevalence bias for 35 of them led to poor agreement when corrected for chance (k) despite acceptable values for P_o. There was no observed prevalence bias for the remaining seven responses (see “Moderate observed occurrence” in Table 2.5).

The remaining five responses had acceptable kappa values ($k > 0.60$) and acceptable percent agreement uncorrected for chance ($P_o > 0.60$). Three of the responses had low observed occurrence and two had moderate observed occurrence (Table 2.5).

Table 2.5. Inter-rater reliability of unscored prompts for outdoor dogs (n = 37). Inter-rater reliability analysis (P_o, P_{pos}, P_{neg}, k; see Table 2.2 for abbreviations) of unscored prompts for dogs assessed outdoors by rater pair A + B (n = 37). Prompts with missing data were excluded from analysis. Responses are organized by observed prevalence (low, high, and moderate) and listed in ascending order for Cohen's kappa (k). Low observed prevalence for a behavior, i.e., response, occurs when the number of dogs where the raters were in negative agreement (d) exceeds the number of dogs for which either one or both raters recorded the behavior as present (a + b + c). High observed prevalence for a behavior, i.e., response, occurs when the number of dogs where either one or both raters recorded the behavior as present (a + b + c) exceeds the number of dogs where the raters were in negative agreement (d). Responses with low or high observed prevalence indicate a prevalence bias that caused a discrepancy between P_o and k in several instances, illuminated by considering both P_{neg} and P_{pos} in context with P_o and k. For instances where the number of dogs for which either one or both raters recorded a behavior, i.e., response, as present (a + b + c) was within ±50% of the total number of dogs analyzed for that prompt to the negative agreement count (0.50 x N* ± d). Moderately observed behaviors indicate that there was no prevalence bias in the sample population for those responses.

HAI	Prompt	Abbrev.	Response	N*	Pos. Agree. (a)	Neg. Agree. (d)	Disagree. (b + c)	P_o	P_{pos}	P_{neg}	k
Low observed occurrence (a + b + c < d) with high negative agreement (d)											
1	Location with open door	usc03(b)	Back	33	0	33	0	1	NA	1	NA
1	Location with open door	usc03(c)	Middle	33	0	33	0	1	NA	1	NA
1	Body language	usc02(b)	Image 2	37	0	37	0	1	NA	1	NA
1	Body language	usc02(d)	Image 4	37	0	37	0	1	NA	1	NA
1	Body language	usc02(e)	Image 5	37	0	37	0	1	NA	1	NA
1	Body language	usc02(i)	Image 9	37	0	37	0	1	NA	1	NA
1	Body language	usc02(m)	Image 13	37	0	37	0	1	NA	1	NA
1	Body language	usc02(o)	Image 15	37	0	37	0	1	NA	1	NA
1	Body language	usc02(p)	Image 16	37	0	37	0	1	NA	1	NA
1	Body language	usc02(q)	Image 17	37	0	37	0	1	NA	1	NA

Table 2.5 (cont'd)

1	Body language	usc02(s)	Image 19	37	0	37	0	1	NA	1	NA
1	Body language	usc02(t)	Image 20	37	0	37	0	1	NA	1	NA
1	Piloerection during In-kennel: Begin	pilo1	Present	37	0	37	0	1	NA	1	NA
2	Body language	usc04(b)	Image 2	37	0	37	0	1	NA	1	NA
2	Body language	usc04(c)	Image 3	37	0	37	0	1	NA	1	NA
2	Body language	usc04(e)	Image 5	37	0	37	0	1	NA	1	NA
2	Body language	usc04(l)	Image 12	37	0	37	0	1	NA	1	NA
2	Body language	usc04(m)	Image 13	37	0	37	0	1	NA	1	NA
2	Body language	usc04(o)	Image 15	37	0	37	0	1	NA	1	NA
2	Body language	usc04(p)	Image 16	37	0	37	0	1	NA	1	NA
2	Body language	usc04(q)	Image 17	37	0	37	0	1	NA	1	NA
2	Body language	usc04(r)	Image 18	37	0	37	0	1	NA	1	NA
2	Piloerection	pilo2	Present	37	0	37	0	1	NA	1	NA
3	Misc. behavior	usc05(b)	Pacing	37	0	37	0	1	NA	1	NA
3	Misc. behavior	usc05(d)	Barking	37	0	37	0	1	NA	1	NA
3	Piloerection	pilo3	Present	37	0	37	0	1	NA	1	NA
4	Piloerection	pilo4	Present	37	0	37	0	1	NA	1	NA
5	Piloerection	pilo5	Present	37	0	37	0	1	NA	1	NA
7	Piloerection	pilo7	Present	37	0	37	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(a)	Spinning	37	0	37	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(b)	Excessive jumping	37	0	37	0	1	NA	1	NA

Table 2.5 (cont'd)

8	In-kennel misc. behavior	usc06(d)	Excessive barking	37	0	37	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(e)	Pacing	37	0	37	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(f)	Frantic pawing at door	37	0	37	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(g)	Smeared feces in kennel	37	0	37	0	1	NA	1	NA
1	Body language	usc02(f)	Image 6	37	0	31	6	0.838	0	0.912	-0.047
1	Body language	usc02(j)	Image 10	37	0	35	2	0.946	0	0.972	-0.028
2	Body language	usc04(d)	Image 4	37	0	35	2	0.946	0	0.972	-0.028
2	Body language	usc04(t)	Image 20	37	0	35	2	0.946	0	0.972	-0.028
1	Body language	usc02(c-f)	Group 2 (3-6)	148	0	140	8	0.946	0	0.972	-0.012
1	Location after approach	usc01(b)	Back	37	0	36	1	0.973	0	0.986	0
1	Location after approach	usc01(c)	Middle	37	0	36	1	0.973	0	0.986	0
1	Location with open door	usc03(d)	Not Stationary	33	0	32	1	0.970	0	0.985	0
1	Body language	usc02(a)	Image 1	37	0	36	1	0.973	0	0.986	0
1	Body language	usc02(a-b)	Group 1 (1-2)	74	0	73	1	0.986	0	0.993	0
1	Body language	usc02(c)	Image 3	37	0	35	2	0.946	0	0.972	0
1	Body language	usc02(g)	Image 7	37	0	35	2	0.946	0	0.972	0
2	Body language	usc04(a)	Image 1	37	0	36	1	0.973	0	0.986	0
2	Body language	usc04(a-b)	Group 1 (1-2)	74	0	73	1	0.986	0	0.993	0
2	Body language	usc04(g)	Image 7	37	0	28	9	0.757	0	0.862	0
2	Body language	usc04(n)	Image 14	37	0	35	2	0.946	0	0.972	0
3	Misc. behavior	usc05(a)	Pawing at exit	37	0	36	1	0.973	0	0.986	0

Table 2.5 (cont'd)

6	Piloerection	pilo6	Present	37	0	30	7	0.811	0	0.896	0
8	In-kennel misc. behavior	usc06(h)	Other	37	0	36	1	0.973	0	0.986	0
8	Out-of-kennel misc. behavior	usc07(b)	Other	37	0	36	1	0.973	0	0.986	0
8	Piloerection	pilo8	Present	37	0	33	4	0.892	0	0.943	0
2	Body language	usc04(c-f)	Group 2 (3-6)	148	1	135	12	0.919	0.143	0.957	0.123
1	Body language	usc02(l)	Image 12	37	1	31	5	0.865	0.286	0.925	0.213
1	Body language	usc02(g-j)	Group 3 (7-10)	148	1	141	6	0.959	0.250	0.979	0.231
8	In-kennel misc. behavior	usc06(c)	Whining	37	1	32	4	0.892	0.333	0.941	0.275
1	Body language	usc02(r)	Image 18	37	1	33	3	0.919	0.400	0.957	0.373
1	Body language	usc02(q-t)	Group 8 (17-20)	148	1	144	3	0.980	0.400	0.990	0.393
1	Body language	usc02(h)	Image 8	37	1	34	2	0.946	0.500	0.971	0.471
1	Body language	usc02(n)	Image 14	37	4	28	5	0.865	0.615	0.918	0.534
8	Out-of-kennel misc. behavior	usc07(a)	Dog directed reactivity	37	2	32	3	0.919	0.571	0.955	0.536
2	Body language	usc04(q-t)	Group 8 (17-20)	148	11	122	15	0.899	0.595	0.942	0.541
3	Misc. behavior	usc05(c)	Whining	37	2	34	1	0.973	0.800	0.986	0.786
2	Body language	usc04(i)	Image 9	37	6	29	2	0.946	0.857	0.967	0.825
1	Location after approach	usc01(d)	Not Stationary	37	1	36	0	1	1	1	1
High observed occurrence (a + b + c > d) with high positive agreement (a)											
2	Body language	usc04(k)	Image 11	37	29	0	8	0.784	0.879	0	-0.121
1	Location with open door	usc03(a)	Front	33	32	0	1	0.970	0.985	0	0

Table 2.5 (cont'd)

1	Body language	usc02(k)	Image 11	37	29	0	8	0.784	0.879	0	0
1	Location after approach	usc01(a)	Front	37	34	1	2	0.946	0.971	0.500	0.479
Moderate observed occurrence (a + b + c is ±50%(N) of d)											
2	Body language	usc04(f)	Image 6	37	1	26	10	0.730	0.167	0.839	0.123
2	Body language	usc04(s)	Image 19	37	11	13	13	0.649	0.629	0.667	0.335
3	Misc. behavior	usc05(e)	Other	37	15	10	12	0.676	0.714	0.625	0.347
3	Misc. behavior	usc05(f)	None	37	10	15	12	0.676	0.625	0.714	0.347
2	Body language	usc04(j)	Image 10	37	8	18	11	0.703	0.593	0.766	0.359
2	Body language	usc04(h)	Image 8	37	7	20	10	0.730	0.583	0.800	0.415
2	Body language	usc04(g-j)	Group 3 (7-10)	148	21	95	32	0.784	0.568	0.856	0.430
1	Body language	usc02(k-m)	Group 4 (11-13)	111	30	68	13	0.883	0.822	0.913	0.736
2	Body language	usc04(k-m)	Group 4 (11-13)	111	29	74	8	0.928	0.879	0.949	0.828

N* = total dogs analyzed per response; prompts with missing data were excluded from analysis

Scored Prompts (outdoor, inter-rater)

Scored prompts with unsatisfactory score agreement corrected for chance (QWK ≤ 0.60) had unsatisfactory response agreement corrected for chance (k ≤ 0.60) in seven instances yet acceptable response agreement (k > 0.60) in one instance (Table 2.6). When uncorrected for chance, one of the eight instances were unacceptable ($P_o \leq 0.60$), the reaction to the acoustic startle (sc10), which had differing response agreement to score agreement due to three responses leading to an equivalent score of zero (responses (e), (f), and (g), see Table 2.1 for abbreviations).

Scored prompts with satisfactory score agreement corrected for chance (QWK > 0.60) also had satisfactory response agreement corrected for chance (k > 0.60) in three instances, yet unsatisfactory (k ≤ 0.60) in two instances, presentation with open door (sc03), and reaction to visual startle (sc11). However, when uncorrected for chance, only reaction to visual startle (sc11) had unsatisfactory agreement ($P_o < 0.60$). Two prompts, presentation with closed door (sc01) and whether play was ended early (sc07) had incalculable score agreement corrected for chance (QWK = NA). Response agreement was incalculable for sc07 (k = NA) due to perfect agreement yet unacceptable for sc01 (k = 0.358) despite near perfect agreement uncorrected for chance ($P_o = 0.919$).

Table 2.6. Inter-rater reliability of scored prompts for outdoor dogs (n = 37). Inter-rater reliability analysis (P_o, k, QWK; see Table 2.2 for abbreviations) of scored prompts for dogs assessed outdoors by rater pair A + B (n = 37), listed in ascending order for QWK. Prompts with missing data were excluded from analysis. Scored prompts were analyzed for both response agreement (P_o and k) and score agreement (QWK) because seven of the prompts had more than one response that was scored zero. Prompts with differing agreement count (a) between responses and scores are highlighted with bold red font in columns 'a' for both response and score agreement.

				Response Agreement			Score Agreement	
HAI	**Abbrev**	**Prompt**	**N***	**a**	**P_o**	**k**	**a**	**QWK**
7	sc14	Approach to kennel entry	36	**25**	0.694	0.441	**30**	0
7	sc15	In-kennel behavior post-return	35	30	0.857	0.316	30	0
4	sc10	Reaction to acoustic startle	37	**17**	0.459	0.295	**20**	0.156

Table 2.6 (cont'd)

1	sc04	Latency to exit	36	23	0.639	0.088	23	0.235
3	sc09	Activity	36	**25**	0.694	0.435	**31**	0.262
6	sc13	Can you obtain the dog's attention	34	28	0.824	0.598	28	0.427
2	sc05	Initial reaction to play	36	30	0.833	0.732	30	0.441
6	sc12	Overall body language	37	28	0.757	0.543	28	0.529
1	sc02	Ability to take treat	31	**30**	0.968	0.938	**29**	0.622
5	sc11	Reaction to visual startle	35	**12**	0.343	0.159	**32**	0.682
2	sc06	Ease of putting away toys	33	31	0.939	0.836	31	0.895
3	sc08	Response to treat	33	32	0.970	0.947	32	0.977
1	sc03	Presentation with open door	36	33	0.917	0.538	33	1
1	sc01	Presentation with closed door	37	34	0.919	0.358	34	NA
2	sc07	Was play ended early	37	37	1	NA	37	NA

N* = total dogs analyzed per response; prompts with missing data were excluded from analysis

2.3.iii: Intra-rater Reliability, Indoor Assessments

Unscored (Table 2.7) and scored (Table 2.8) responses showed a significant level of agreement between repeat assessment by rater A, using assessment video, ranging from substantial (n = 7 unscored responses; n = 4 scored responses) to near perfect (n = 62 unscored responses; n = 10 scored responses) percent agreement (P_o), with only three instances of moderate agreement (n = 2 unscored responses, n = 1 scored response) and one instance of fair agreement (n = 1 unscored response). However, when corrected for chance, agreement as measured by kappa values ranged from worse than chance to near perfect agreement for both unscored responses (k) and scored prompts (QWK), described in further detail below.

Unscored Prompts (indoor, intra-rater)

To assess agreement within rater A, I analyzed intra-rater reliability using percent agreement (P_o), proportion positive agreement (P_{pos}), proportion negative agreement (P_{neg}), and

Cohen's kappa (k) to correct for chance agreement for all unscored responses. Both mutually exclusive unscored prompts, location in kennel with closed door (usc01) and open door (usc03), had perfect percent agreement (usc01(P_o) = 1.0, usc03(P_o) = 1.0). However, when Cohen's kappa was calculated to correct for chance agreement, usc01 was incalculable (k = NA), while usc03 was perfect (k = 1.0). To evaluate the agreement for each response ('Front', 'Back', 'Middle', or 'Not Stationary' for both prompts) responses were individually assessed for agreement.

For 46 unscored responses, the kappa value (k) could not be determined (k = NA) because the proportion of agreement expected by chance (P_e) was equal to 1, resulting in a denominator of 0 when calculating Cohen's kappa (Table 2.7). This occurred due to a low observed occurrence, with 0 instances of positive agreement and a denominator of 0 for proportion positive agreement (P_{pos} = NA), along with perfect occurrence of proportion negative agreement (P_{neg} = 1) for 45 of the instances where k = NA. The remaining response, conversely, had perfect positive agreement (P_{pos} = 1.0) and zero instances of negative agreement (P_{neg} = NA).

Responses with unsatisfactory kappa values ($k \leq 0.60$) had acceptable percent agreement uncorrected for chance ($P_o > 0.60$) in 18 instances but unacceptable percent agreement in three instances, image 18 (usc02(r)) and image 11 (usc04(k)) which had moderate percent agreement (P_o = 0.60) and image 19 (usc04(s)) which had fair agreement (P_o = 0.30). Of the 18 instances of acceptable percent agreement, the observed prevalence bias for 15 of them led to poor agreement when corrected for chance (k) despite acceptable values for P_o. There was no observed prevalence bias for the remaining three which had substantial to near perfect percent agreement ($P_o \geq 0.80$) (see "Moderate observed occurrence" in Table 2.7).

The remaining 12 responses had acceptable kappa values ($k > 0.60$) and acceptable percent agreement uncorrected for chance ($P_o > 0.60$). Seven of the responses had low observed occurrence, three had high observed occurrence, and two had moderate observed occurrence (Table 2.7).

Table 2.7. Intra-rater reliability of unscored prompts for indoor dogs (n = 10). Intra-rater reliability analysis (P_o, P_{pos}, P_{neg}, k; see Table 2.2 for abbreviations) of unscored prompts for dogs assessed indoors by rater A (n = 10). Prompts with missing data were excluded from analysis. Responses are organized by observed prevalence (low, high, and moderate) and listed in ascending order for Cohen's kappa (k). Low observed prevalence for a behavior, i.e., response, occurs when the number of dogs where the raters were in negative agreement (d) exceeds the number of dogs for which either one or both raters recorded the behavior as present (a + b + c). High observed prevalence for a behavior, i.e., response, occurs when the number of dogs where either one or both raters recorded the behavior as present (a + b + c) exceeds the number of dogs where the raters were in negative agreement (d). Responses with low or high observed prevalence indicate a prevalence bias that caused a discrepancy between P_o and k in several instances, illuminated by considering both P_{neg} and P_{pos} in context with P_o and k. For instances where the number of dogs for which either one or both raters recorded a behavior, i.e., response, as present (a + b + c) was within ±50% of the total number of dogs analyzed for that prompt to the negative agreement count (0.50 x N* ± d). Moderately observed behaviors indicate that there was no prevalence bias in the sample population for those responses.

HAI	Prompt	Abbrev.	Response	Pos. Agree. (a)	Neg. Agree. (d)	Disagree. (b + c)	P_o	P_{pos}	P_{neg}	k
Low observed occurrence (a + b + c < d) with high negative agreement (d)										
1	Location with open door	usc01(b)	Back	0	10	0	1	NA	1	NA
1	Location with open door	usc01(c)	Middle	0	10	0	1	NA	1	NA
1	Location with open door	usc01(d)	Not Stationary	0	10	0	1	NA	1	NA
1	Location with open door	usc03(b)	Back	0	10	0	1	NA	1	NA
1	Location with open door	usc03(c)	Middle	0	10	0	1	NA	1	NA
1	Body language	usc02(b)	Image 2	0	10	0	1	NA	1	NA
1	Body language	usc02(d)	Image 4	0	10	0	1	NA	1	NA
1	Body language	usc02(e)	Image 5	0	10	0	1	NA	1	NA
1	Body language	usc02(f)	Image 6	0	10	0	1	NA	1	NA
1	Body language	usc02(g)	Image 7	0	10	0	1	NA	1	NA
1	Body language	usc02(i)	Image 9	0	10	0	1	NA	1	NA

Table 2.7 (cont'd)

1	Body language	usc02(l)	Image 12	0	10	0	1	NA	1	NA
1	Body language	usc02(m)	Image 13	0	10	0	1	NA	1	NA
1	Body language	usc02(o)	Image 15	0	10	0	1	NA	1	NA
1	Body language	usc02(p)	Image 16	0	10	0	1	NA	1	NA
1	Body language	usc02(q)	Image 17	0	10	0	1	NA	1	NA
1	Body language	usc02(s)	Image 19	0	10	0	1	NA	1	NA
1	Body language	usc02(t)	Image 20	0	10	0	1	NA	1	NA
1	Piloerection	pilo1	Present	0	10	0	1	NA	1	NA
2	Body language	usc04(a)	Image 1	0	10	0	1	NA	1	NA
2	Body language	usc04(b)	Image 2	0	10	0	1	NA	1	NA
2	Body language	usc04(a-b)	Group 1 (1-2)	0	10	0	1	NA	1	NA
2	Body language	usc04(c)	Image 3	0	10	0	1	NA	1	NA
2	Body language	usc04(e)	Image 5	0	10	0	1	NA	1	NA
2	Body language	usc04(g)	Image 7	0	10	0	1	NA	1	NA
2	Body language	usc04(l)	Image 12	0	10	0	1	NA	1	NA
2	Body language	usc04(m)	Image 13	0	10	0	1	NA	1	NA
2	Body language	usc04(n)	Image 14	0	10	0	1	NA	1	NA
2	Body language	usc04(o)	Image 15	0	10	0	1	NA	1	NA
2	Body language	usc04(p)	Image 16	0	10	0	1	NA	1	NA
2	Body language	usc04(q)	Image 17	0	10	0	1	NA	1	NA
2	Piloerection	pilo2	Present	0	10	0	1	NA	1	NA
3	Misc. behavior	usc05(a)	Pawing at exit	0	10	0	1	NA	1	NA
3	Misc. behavior	usc05(e)	Pacing	0	10	0	1	NA	1	NA
3	Misc. behavior	usc05(d)	Barking	0	10	0	1	NA	1	NA

Table 2.7 (cont'd)

3	Piloerection	pilo3	Present	0	10	0	1	NA	1	NA
4	Piloerection	pilo4	Present	0	10	0	1	NA	1	NA
5	Piloerection	pilo5	Present	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	pilo8	Spinning	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(b)	Excessive jumping	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(d)	Excessive barking	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(e)	Pacing	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(f)	Frantic pawing at door	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(g)	Smeared feces in kennel	0	10	0	1	NA	1	NA
8	Out-of-kennel misc. behavior	usc07(a)	Dog directed reactivity	0	10	0	1	NA	1	NA
1	Body language	usc02(h)	Image 8	0	8	2	0.80	0	0.889	-0.111
1	Body language	usc02(a)	Image 1	0	9	1	0.90	0	0.947	0
1	Body language	usc02(a-b)	Group 1 (1-2)	0	19	1	0.950	0	0.974	0
2	Body language	usc04(d)	Image 4	0	9	1	0.90	0	0.947	0
2	Body language	usc04(r)	Image 18	0	9	1	0.90	0	0.947	0
2	Body language	usc04(t)	Image 20	0	9	1	0.90	0	0.947	0
3	Misc. behavior	usc05(c)	Whining	0	8	2	0.80	0	0.889	0
7	Piloerection	pilo7	Present	0	9	1	0.90	0	0.947	0
8	In-kennel misc. behavior	usc06(c)	Whining	0	9	1	0.90	0	0.947	0
8	In-kennel misc. behavior	usc06(h)	Other	0	9	1	0.90	0	0.947	0
8	Out-of-kennel misc. behavior	usc07(b)	Other	0	9	1	0.90	0	0.947	0
8	Piloerection	pilo8	Present	0	8	2	0.80	0	0.889	0

Table 2.7 (cont'd)

1	Body language	usc02(r)	Image 18	0	5	4	0.60	0.333	0.714	0.20
2	Body language	usc04(q-t)	Group 8 (17-20)	3	28	9	0.775	0.40	0.862	0.262
1	Body language	usc02(q-t)	Group 8 (17-20)	1	35	4	0.90	0.333	0.946	0.304
1	Body language	usc02(g-j)	Group 3 (7-10)	1	36	3	0.925	0.40	0.960	0.362
1	Body language	usc02(j)	Image 10	1	8	1	0.90	0.667	0.941	0.615
2	Body language	usc04(j)	Image 10	1	8	1	0.90	0.667	0.941	0.615
3	Misc. behavior	usc05(f)	None	1	8	1	0.90	0.667	0.941	0.615
2	Body language	usc04(c-f)	Group 2 (3-6)	2	36	2	0.950	0.667	0.973	0.643
1	Location with open door	usc03(d)	Not Stationary	1	9	0	1	1	1	1
1	Body language	usc02(c)	Image 3	1	9	0	1	1	1	1
1	Body language	usc02(c-f)	Group 2 (3-6)	1	39	0	1	1	1	1
High observed occurrence (a + b + c > d) with moderate to perfect proportion positive agreement (P_{pos})										
1	Location after approach	usc01(a)	Front	10	0	0	1	1	NA	NA
2	Body language	usc04(s)	Image 19	3	0	7	0.30	0.462	0	-0.40
2	Body language	usc04(k)	Image 11	6	0	4	0.60	0.750	0	-0.176
3	Misc. behavior	usc05(e)	Other	8	1	1	0.90	0.941	0.667	0.615
1	Body language	usc02(k)	Image 11	7	2	1	0.90	0.933	0.80	0.737
1	Location with open door	usc03(a)	Front	9	1	0	1	1	1	1
Moderate observed occurrence (a + b + c is ±50%(N) of d)										
2	Body language	usc04(h)	Image 8	1	7	2	0.80	0.50	0.875	0.412
6	Piloerection	pilo6	Present	1	7	2	0.80	0.50	0.875	0.412
2	Body language	usc04(g-j)	Group 3 (7-10)	5	30	5	0.875	0.667	0.923	0.590

Table 2.7 (cont'd)

2	Body language	usc04(i)	Image 9	3	5	2	0.800	0.750	0.833	0.60
1	Body language	usc02(k-m)	Group 4 (11-13)	7	22	1	0.967	0.933	0.978	0.911

N* = total dogs analyzed per response; prompts with missing data were excluded from analysis

Scored Prompts (indoor, intra-rater)

Scored prompts with unsatisfactory score agreement corrected for chance (QWK ≤ 0.60) had unsatisfactory response agreement corrected for chance (k ≤ 0.60) in two instances yet acceptable response agreement (k > 0.60) in one instance (Table 2.8). When uncorrected for chance, all three instances had acceptable response agreement (P_o > 0.60).

Scored prompts with satisfactory score agreement corrected for chance (QWK > 0.60) also had satisfactory response agreement corrected for chance (k > 0.60) in six instances, yet unsatisfactory (k ≤ 0.60) in one instance, 'Activity' during HAI 3 (sc09), which had unacceptable agreement when uncorrected for chance (P_o = 0.60).

Five prompts had incalculable score agreement corrected for chance (QWK = NA). Response agreement was incalculable (k = NA) for whether play was ended early (sc07) due to perfect agreement yet unacceptable (k ≤ 0.60) for 'Presentation with closed door' (sc01) and 'Ability to take treat' (sc02). 'Presentation with open door' (sc03) and 'Approach to kennel entry' (sc14) had acceptable response agreement (k > 0.60). However, when uncorrected for chance, all five prompts had substantial to near perfect percent agreement (P_o ≥ 0.80).

Table 2.8. Intra-rater reliability of scored prompts for indoor dogs (n = 10). Intra-rater reliability analysis (P_o, k, QWK; see Table 2.2 for abbreviations) of scored prompts for dogs assessed indoors by rater A (n = 10), listed in ascending order for QWK. Prompts with missing data were excluded from analysis. Scored prompts were analyzed for both response agreement (P_o and k) and score agreement (QWK) because seven of the prompts had more than one response that was scored zero. Prompts with differing agreement count (a) between responses and scores are highlighted with bold red font in columns 'a' for both response and score agreement.

			Response Agreement			Score Agreement	
HAI	**Abbrev**	**Prompt**	**a**	**P_o**	**k**	**a**	**QWK**
7	sc15	In-kennel behavior post-return	9	0.9	0	9	0
5	sc11	Reaction to visual startle	7	0.70	0.50	7	0.455
4	sc10	Reaction to acoustic startle	8	0.80	0.697	8	0.524
6	sc13	Can you obtain the dog's attention	8	0.80	0.636	8	0.714
6	sc12	Overall body language	9	0.90	0.737	9	0.737
1	sc04	Latency to exit	9	0.90	0.80	9	0.80
3	sc09	Activity	**6**	0.60	0.452	**9**	0.857

Table 2.8 (cont'd)

2	sc05	Initial reaction to play	10	1	1	10	1
2	sc06	Ease of putting away toys	10	1	1	10	1
3	sc08	Response to treat	10	1	1	10	1
1	sc01	Presentation with closed door	9	0.90	0	9	NA
1	sc02	Ability to take treat	**8**	0.80	0.524	**10**	NA
1	sc03	Presentation with open door	9	0.90	0.615	9	NA
2	sc07	Was play ended early	10	1	NA	10	NA
7	sc14	Approach to kennel entry	**9**	0.90	0.804	**10**	NA

2.3.iv: Intra-rater Reliability, Outdoor Assessments

Unscored (Table 2.9) and scored (Table 2.10) responses showed a significant level of agreement between repeat assessment by rater A, using assessment video, ranging from substantial (n = 6 unscored responses; n = 2 scored responses) to near perfect (n = 63 unscored responses; n = 10 scored responses) percent agreement (P_o), with only six instances of moderate agreement (n = 3 unscored responses, n = 3 scored response). However, when corrected for chance, agreement as measured by kappa values ranged from worse than chance to near perfect agreement for both unscored responses (k) and scored prompts (QWK), described in further detail below.

Unscored Prompts (outdoor, intra-rater)

To assess agreement within rater A, I analyzed inter-rater reliability using percent agreement (P_o), proportion positive agreement (P_{pos}), proportion negative agreement (P_{neg}), and Cohen's kappa (k) to correct for chance agreement for all unscored responses. Both mutually exclusive unscored prompts, location in kennel with closed door (usc01) and open door (usc03), had near perfect percent agreement (usc01(P_o) = 0.90, usc03(P_o) = 1.0). However, when Cohen's kappa was calculated to correct for chance agreement, usc01 had substantial agreement (k = 0.615), while usc03 was incalculable (k = NA). To evaluate the agreement for each possible response ('Front', 'Back', 'Middle', or 'Not Stationary' for both prompts) responses were individually assessed for agreement.

For 50 unscored responses, the kappa value (k) could not be determined (k = NA) because the proportion of agreement expected by chance (P_e) was equal to 1, resulting in a denominator of 0 when calculating Cohen's kappa (Table 2.9). This occurred due to a low observed occurrence, with 0 instances of positive agreement and a denominator of 0 for proportion positive agreement (P_{pos} = NA), along with perfect occurrence of proportion negative agreement (P_{neg} = 1).

Responses with unsatisfactory kappa values ($k \leq 0.60$) had acceptable percent agreement uncorrected for chance ($P_o > 0.60$) in 16 instances but unacceptable percent agreement in three instances, image 11 (usc04(k)), image 9 (usc04(i)), and 'Other' (usc05(e)) which all had moderate percent agreement (P_o = 0.50, 0.60, and 0.60 respectively). and image 19 (usc04(s)) which had fair agreement (P_o = 0.30). For usc04(k), the observed prevalence bias led to poor agreement when corrected for chance (k); however, there was no observed prevalence bias for the latter two responses (see "Moderate observed occurrence" in Table 2.9).

The remaining 12 responses had acceptable kappa values ($k > 0.60$) and acceptable percent agreement uncorrected for chance ($P_o > 0.60$). Seven of the responses had low observed occurrence, one had high observed occurrence, and four had moderate observed occurrence (Table 2.9).

Table 2.9. Intra-rater reliability of unscored prompts for outdoor dogs (n=10). Intra-rater reliability (P_o, P_{pos}, P_{neg}, k; see Table 2.2 for abbreviations) of unscored prompts for dogs assessed outdoors by rater A (n = 10). Prompts with missing data were excluded from analysis. Responses are organized by observed prevalence (low, high, and moderate) and listed in ascending order for Cohen's kappa (k). Low observed prevalence for a behavior, i.e., response, occurs when the number of dogs where the raters were in negative agreement (d) exceeds the number of dogs for which either one or both raters recorded the behavior as present (a + b + c). High observed prevalence for a behavior, i.e., response, occurs when the number of dogs where either one or both raters recorded the behavior as present (a + b + c) exceeds the number of dogs where the raters were in negative agreement (d). Responses with low or high observed prevalence indicate a prevalence bias that caused a discrepancy between P_o and k in several instances, illuminated by considering both P_{neg} and P_{pos} in context with P_o and k. For instances where the number of dogs for which either one or both raters recorded a behavior, i.e., response, as present (a + b + c) was within ±50% of the total number of dogs analyzed for that prompt to the negative agreement count (0.50 x N* ± d). Moderately observed behaviors indicate that there was no prevalence bias in the sample population for those responses.

HAI	Prompt	Abbrev.	Response	Pos. Agree. (a)	Neg. Agree. (d)	Disagree. (b + c)	P_o	P_{pos}	P_{neg}	k
Low observed occurrence (a + b + c < d) with high negative agreement (d)										
1	Location with open door	usc01(c)	Middle	0	10	0	1	NA	1	NA
1	Location with open door	usc01(d)	Not Stationary	0	10	0	1	NA	1	NA
1	Location with open door	usc03(b)	Back	0	10	0	1	NA	1	NA
1	Location with open door	usc03(c)	Middle	0	10	0	1	NA	1	NA
1	Location with open door	usc03(d)	Not Stationary	0	10	0	1	NA	1	NA
1	Body language	usc02(a)	Image 1	0	10	0	1	NA	1	NA
1	Body language	usc02(b)	Image 2	0	10	0	1	NA	1	NA
1	Body language	usc02(a-b)	Group 1 (1-2)	0	20	0	1	NA	1	NA
1	Body language	usc02(c)	Image 3	0	10	0	1	NA	1	NA
1	Body language	usc02(d)	Image 4	0	10	0	1	NA	1	NA
1	Body language	usc02(e)	Image 5	0	10	0	1	NA	1	NA

Table 2.9 (cont'd)

1	Body language	usc02(g)	Image 7	0	10	0	1	NA	1	NA
1	Body language	usc02(i)	Image 9	0	10	0	1	NA	1	NA
1	Body language	usc02(j)	Image 10	0	10	0	1	NA	1	NA
1	Body language	usc02(m)	Image 13	0	10	0	1	NA	1	NA
1	Body language	usc02(o)	Image 15	0	10	0	1	NA	1	NA
1	Body language	usc02(p)	Image 16	0	10	0	1	NA	1	NA
1	Body language	usc02(s)	Image 19	0	10	0	1	NA	1	NA
1	Body language	usc02(t)	Image 20	0	10	0	1	NA	1	NA
1	Piloerection	pilo1	Present	0	10	0	1	NA	1	NA
2	Body language	usc04(a)	Image 1	0	10	0	1	NA	1	NA
2	Body language	usc04(b)	Image 2	0	10	0	1	NA	1	NA
2	Body language	usc04(a-b)	Group 1 (1-2)	0	20	0	1	NA	1	NA
2	Body language	usc04(c)	Image 3	0	10	0	1	NA	1	NA
2	Body language	usc04(d)	Image 4	0	10	0	1	NA	1	NA
2	Body language	usc04(e)	Image 5	0	10	0	1	NA	1	NA
2	Body language	usc04(g)	Image 7	0	10	0	1	NA	1	NA
2	Body language	usc04(m)	Image 13	0	10	0	1	NA	1	NA
2	Body language	usc04(n)	Image 14	0	10	0	1	NA	1	NA
2	Body language	usc04(o)	Image 15	0	10	0	1	NA	1	NA
2	Body language	usc04(p)	Image 16	0	10	0	1	NA	1	NA
2	Body language	usc04(q)	Image 17	0	10	0	1	NA	1	NA
2	Body language	usc04(r)	Image 18	0	10	0	1	NA	1	NA
2	Body language	usc04(t)	Image 20	0	10	0	1	NA	1	NA
2	Piloerection	pilo2	Present	0	10	0	1	NA	1	NA

Table 2.9 (cont'd)

3	Misc. behavior	usc05(a)	Pawing at exit	0	10	0	1	NA	1	NA
3	Misc. behavior	usc05(b)	Pacing	0	10	0	1	NA	1	NA
3	Misc. behavior	usc05(c)	Whining	0	10	0	1	NA	1	NA
3	Piloerection	pilo3	Present	0	10	0	1	NA	1	NA
4	Piloerection	pilo4	Present	0	10	0	1	NA	1	NA
5	Piloerection	pilo5	Present	0	10	0	1	NA	1	NA
7	Piloerection	pilo7	Present	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(a)	Spinning	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(b)	Excessive jumping	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(e)	Pacing	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(f)	Frantic pawing at door	0	10	0	1	NA	1	NA
8	In-kennel misc. behavior	usc06(g)	Smeared feces in kennel	0	10	0	1	NA	1	NA
8	Out-of-kennel misc. behavior	usc07(a)	Dog directed reactivity	0	10	0	1	NA	1	NA
8	Out-of-kennel misc. behavior	usc07(b)	Other	0	10	0	1	NA	1	NA
8	Piloerection	pilo8	Present	0	10	0	1	NA	1	NA
1	Body language	usc02(h)	Image 8	0	8	2	0.80	0	0.889	-0.111
1	Body language	usc02(g-j)	Group 3 (7-10)	0	38	2	0.950	0	0.974	-0.026
1	Body language	usc02(l)	Image 12	0	9	1	0.90	0	0.947	0
1	Body language	usc02(q)	Image 17	0	9	1	0.90	0	0.947	0
2	Body language	usc04(l)	Image 12	0	9	1	0.90	0	0.947	0
3	Misc. behavior	usc05(d)	Barking	0	9	1	0.90	0	0.947	0
8	In-kennel misc. behavior	usc06(c)	Whining	0	9	1	0.90	0	0.947	0

Table 2.9 (cont'd)

8	In-kennel misc. behavior	usc06(d)	Excessive barking	0	9	1	0.90	0	0.947	0
8	In-kennel misc. behavior	usc06(h)	Other	0	9	1	0.90	0	0.947	0
2	Body language	usc04(g-j)	Group 3 (7-10)	3	30	7	0.825	0.462	0.896	0.358
2	Body language	usc04(k-m)	Group 4 (11-13)	4	20	6	0.80	0.571	0.870	0.444
1	Body language	usc02(q-t)	Group 8 (17-20)	1	37	2	0.950	0.50	0.974	0.481
1	Location after approach	usc01(b)	Back	1	8	1	0.90	0.667	0.941	0.615
1	Body language	usc02(f)	Image 6	1	8	1	0.90	0.667	0.941	0.615
1	Body language	usc02(r)	Image 18	1	8	1	0.90	0.667	0.941	0.615
1	Body language	usc02(c-f)	Group 2 (3-6)	1	38	1	0.975	0.667	0.987	0.655
2	Body language	usc04(q-t)	Group 8 (17-20)	6	33	1	0.975	0.923	0.985	0.908
2	Body language	usc04(f)	Image 6	1	9	0	1	1	1	1
2	Body language	usc04(c-f)	Group 2 (3-6)	1	39	0	1	1	1	1
High observed occurrence (a + b + c > d) with substantial to near perfect proportion positive agreement (P_{pos})										
1	Body language	usc02(k)	Image 11	8	0	2	0.80	0.889	0	-0.111
2	Body language	usc04(k)	Image 11	4	1	5	0.50	0.615	0.286	0
1	Location with open door	usc01(a)	Front	8	1	1	0.90	0.941	0.667	0.615
Moderate observed occurrence (a + b + c is ±50%(N) of d)										
2	Body language	usc04(i)	Image 9	0	6	4	0.60	0	0.750	-0.250
6	Piloerection	pilo6	Present	0	7	3	0.70	0	0.824	-0.154
3	Misc. behavior	usc05(e)	Other	3	3	4	0.60	0.60	0.60	0.231
3	Misc. behavior	usc05(f)	None	3	4	3	0.70	0.667	0.727	0.40
2	Body language	usc04(h)	Image 8	1	7	2	0.80	0.50	0.875	0.412

Table 2.9 (cont'd)

2	Body language	usc04(j)	Image 10	2	7	1	0.90	0.80	0.933	0.737
1	Body language	usc02(k-m)	Group 4 (11-13)	8	19	3	0.90	0.842	0.927	0.769
2	Body language	usc04(s)	Image 19	6	3	1	0.90	0.923	0.857	0.783
1	Body language	usc02(n)	Image 14	3	7	0	1	1	1	1

Scored Prompts (outdoor, intra-rater)

Scored prompts with unsatisfactory score agreement corrected for chance (QWK ≤ 0.60) had unsatisfactory response agreement corrected for chance (k ≤ 0.60) in three instances (Table 2.10). When uncorrected for chance, one instance had acceptable response agreement (P_o > 0.60) while the remaining two, 'Activity' during HAI 3 (sc09) and 'Overall body language' during HAI 6 (sc12) was unacceptable (P_o = 0.60).

Scored prompts with satisfactory score agreement corrected for chance (QWK > 0.60) also had satisfactory response agreement corrected for chance (k > 0.60) in all five instances. The remaining seven prompts had incalculable score agreement corrected for chance (QWK = NA). Response agreement was incalculable (k = NA) for three of the seven instances due to perfect response agreement (P_o = 1.0). For the other four instances, corrected for chance, response agreement was acceptable in one instance, 'Presentation with closed door' (sc01) but unacceptable for 'Reaction to acoustic startle' (sc10), 'Reaction to visual startle' (sc11), and 'Approach to kennel entry' (sc14). However, for two of these (sc11 and sc14), percent agreement was acceptable when uncorrected for chance (P_o = 0.80).

Table 2.10. Intra-rater reliability of scored prompts for outdoor dogs (n = 10). Intra-rater reliability analysis (P_o, k, QWK; see Table 2.2 for abbreviations) of scored prompts for dogs assessed outdoors by rater A (n = 10), listed in ascending order for QWK. Prompts with missing data were excluded from analysis. Scored prompts were analyzed for both response agreement (P_o and k) and score agreement (QWK) because seven of the prompts had more than one response that was scored zero. Prompts with differing agreement count (a) between responses and scores are highlighted with bold red font in columns 'a' for both response and score agreement.

			Response Agreement			Score Agreement	
HAI	**Abbrev**	**Prompt**	**a**	**P_o**	**k**	**a**	**QWK**
3	sc09	Activity	**6**	0.60	0.333	**8**	0
7	sc15	In-kennel behavior post-return	8	0.80	0.412	8	0.118
6	sc12	Overall body language	6	0.60	0.310	6	0.375
2	sc06	Ease of putting away toys	9	0.90	0.615	9	0.615
1	sc02	Ability to take treat	10	1	1	10	1
2	sc05	Initial reaction to play	10	1	1	10	1
3	sc08	Response to treat	10	1	1	10	1

Table 2.10 (cont'd)

6	sc13	Can you obtain the dog's attention	10	1	1	10	1
1	sc01	Presentation with closed door	10	1	1	10	NA
1	sc03	Presentation with open door	10	1	NA	10	NA
1	sc04	Latency to exit	10	1	NA	10	NA
2	sc07	Was play ended early	10	1	NA	10	NA
4	sc10	Reaction to acoustic startle	6	0.60	0.50	6	NA
5	sc11	Reaction to visual startle	**8**	0.80	0.583	**10**	NA
7	sc14	Approach to kennel entry	**8**	0.80	0	**10**	NA

2.4: Discussion

To support shelter dog welfare, a practical and reliable behavior assessment that quantifies coping behavior would provide shelter staff with a tool that can communicate clinical need for anxiolytic medication to veterinarians, streamlining individualized behavioral intervention plans for dogs that are struggling to cope in the shelter environment. This novel assessment can be performed in its entirety by a single handler with low-cost materials that shelters are likely to have on hand. The most expensive item used for the assessment was the model, stuffed dog which retails around $75.00 (US). The average length of time to complete the assessment was 20 ± 4 minutes with a range of 10-42 minutes. Of the assessments that took an excess of one standard deviation, 13 assessments lasted between 25 to 30 minutes. One single assessment took 42 minutes because the dog was highly resistant to entering the kennel. The assessment ended early before 'In-kennel behavior post-return' (sc15) could be scored. Shelter dog behavior varies across individuals and therefore variation in assessment duration can be expected. However, considering cooperative dogs as the baseline, an excess of 10 minutes may inhibit staff's ability to routinely perform the assessment when time is a concern. However, with further refinement based on validity analysis in Chapter 3, the assessment duration could decrease, leading to improved practicality for staff use.

2.4.i: Inter-rater Reliability

For both indoor and outdoor dogs, unscored responses had acceptable levels of inter-rater reliability demonstrated by near perfect negative agreement for responses with low

prevalence, substantial to near perfect positive agreement for responses with high prevalence, and moderate to near perfect percent agreement for responses with moderate observed occurrence. Kappa values were highly variable, reflecting the observed prevalence bias of several of the responses. Prevalence may be specific to the sample population and Chapter 3 validity analysis will provide insight on which unscored prompts contribute clinically relevant information on coping ability.

For both indoor and outdoor dogs, two scored prompts (sc10 and sc11) had fair to moderate percent agreement. Acoustic Startle, HAI 4 and Visual Startle, HAI 5 consisted of sc10 and sc11, respectively. Additional training may improve inter-rater reliability; however, because startle tests are contrary to the enriching purpose of the assessment, these prompts are candidates for removal pending validity analysis in Chapter 3. For the remaining 13 scored prompts, percent agreement on response was acceptable (substantial to near perfect) although kappa values on score agreement varied significantly.

Discrepancies between response agreement and score agreement could occur for prompts that had multiple responses that would result in zero (n = 7). Two of these, sc10 and sc11, are candidates for removal as discussed. For the remaining five, one (sc02) had improved score agreement from response agreement for dogs assessed indoors but worse score agreement for dogs assessed outdoors, two (sc09 and sc14) had improved score agreement in both assessment locations, and two (sc12 and sc13) had equivalent response to score agreement in both locations. When score agreement improves, responses within a single prompt that are scored zero could be combined while maintaining score integrity if the behaviors are also found to be clinically equivalent. Alternatively, additional training may improve response agreement. However, when score agreement worsens, as happened for sc02 during outdoor assessments, reliability performance is unsatisfactory. Further refinement or elimination of sc02 could be warranted pending validity analysis.

2.4.ii: Intra-rater Reliability

For both indoor and outdoor dogs, unscored responses had acceptable levels of intra-rater reliability demonstrated by substantial to near perfect negative agreement for responses with low prevalence, moderate to near perfect positive agreement for responses with high

prevalence, and moderate to near perfect percent agreement for responses with moderate prevalence. Here kappa values reflected prevalence biases and varied significantly as was the case for inter-rater reliability.

All fifteen scored prompts had acceptable intra-rater reliability ranging from moderate to near perfect response agreement, although kappa values reflected prevalence biases and varied significantly. Twelve (sc01, sc02, sc03, sc04, sc05, sc06, sc07, sc08, sc11, sc13, sc14, and sc15) had substantial to near perfect response agreement in both assessment locations while three (sc09, sc10, and sc12) had moderate response agreement in at least one of the locations. For the three prompts with the lowest response agreement (moderate), the disagreements are characterized by a shift to a more neutral response. For 'Activity, HAI 3' (sc09), the rating changed from 'Stressed - active' to either 'Neutral - stationary' or 'Neutral - active' (n = 3) or there was a shift between 'Neutral - active' and 'Neutral - stationary' (n = 4). For 'Reaction to acoustic startle, HAI 4' (sc10), the rating changed from either 'Flinches/startles' or 'Stops briefly/orients' to 'Immediate approach' (n = 4). Finally, for 'Overall body language, HAI 6' (sc12), the rating shifted from either Image 2 (lowered, forward lean) or Image 5 (alert, forward motion) to Image 4 (neutral) (n = 7). The disagreements could in part be due to perception since video recordings were used for the second rating and subtle behavioral cues may not translate from live observation to observation of recordings.

Improved score agreement over response agreement occurred for four scored prompts (sc02, sc09, sc11, and sc14). For sc02 and sc14, response disagreements did not result in a score change, implying that the disagreement occurred between responses that were scored zero. For sc09 and sc11, some disagreements resulted in a score change while others did not. Thus, for sc02 and sc14, score integrity is maintained during disagreements, but this was not always the case for the response disagreements observed for sc09 and sc11. As previously discussed, response disagreements for sc09 could be due to the differences between real-life and video observation and sc11 has been identified as a candidate for removal.

2.4.iii: Limitations

Assessment scores on the extreme ends of total coping score (scores near –45 or +45) were not observed. The observed score range was relatively moderate (indoor range –18 to

+10; outdoor range –9 to +11.5) and is reflective of the prevalence imbalance for several behavioral responses. Consequently, several behaviors were never observed and therefore conclusions regarding rater agreement are limited. Distribution of total score is discussed further in Chapter 3. Four dogs were excluded from enrollment because they were designated 'Staff only' due to high levels of aggression. It is possible that had these dogs been assessed, they would have had high positive assessment scores. Six dogs were excluded for refusal to exit the kennel. It is likely that these dogs were on the extreme end of the anxious-avoidant spectrum but were not included in analysis due to the truncated assessment score.

Several assessments had at least one prompt that was left blank (rater A = 7 of 91 assessments; rater B = 36 of 72 assessments; rater C = 2 of 13 assessments; rater D = 0 of 6 assessments). Some instances may be attributed to perspective, as raters were instructed to leave prompts blank if they were unable to see the dog's response. However, most of the missing data is likely due to human error. There has been extensive research on survey design to maximize data quality with emphasis on tailored design methods and fitness of use (Biemer, 2010; Dillman, 2011). While the tool is not a survey in the traditional sense, it does require citizen participation for completion. Since shelter staff would be motivated to comply, fitness of use must consider ease of response. Design based on accessibility principles may improve compliance by reducing participant burden (Lazar et al., 2004). Future integration into an app could also encourage compliance by requiring input for each prompt before opening the next question. Web survey research suggests that careful design consideration can decrease missing data (Couper et al., 2001). The format of the tool used to record assessment results should be further evaluated to maximize data quality.

The tool is intended for use throughout shelters in the United States. However, the ability to extrapolate results may be circumscribed by the sample population. All assessments took place at a single non-profit humane society in the Midwest; intake population may not be representative of the national shelter dog population discussed in Chapter 3. Furthermore, dogs that were unhealthy were excluded from enrollment as health influence on behavior would be confounded with coping behavior. Further methodological and environmental limitations are discussed in Chapter 3 during discussion on validity.

2.5: Conclusion

Several behavioral responses had low or high prevalence which created a wide range of variability among agreement when corrected for chance (kappa values). For this reason, percent agreement, proportion positive agreement, and proportion negative agreement were reported for a comprehensive investigation into rater reliability. Overall, the tool was reliable for dogs assessed either indoors or outdoors with acceptable measures of agreement other than two prompts that had unsatisfactory measures of inter-rater reliability, 'Reaction to acoustic startle, HAI 4' (sc10) and 'Reaction to visual startle, HAI 5' (sc11). Sc10 and sc11 are candidates for removal pending validity analysis. Subsequent analysis on criterion validity will provide insight on clinical value by comparing assessment results to blinded veterinarian diagnoses and comparison between total scores and prompt scores of dogs assessed indoors to those assessed outdoors, to be discussed in Chapter 3. Based on analysis of reliability and validity, the tool will be further refined to improve practicality while maintaining validity. The refined tool should undergo additional reliability and validity studies across shelters and users to ensure accuracy and replicability.

CHAPTER 3: VALIDITY OF A BEHAVIOR ASSESSMENT TO MEASURE COPING BEHAVIOR OF SHELTER DOGS

3.1: Introduction

An estimated 3.1 to 5 million dogs enter shelters nationwide each year (*Pet statistics*, ASPCA; Rowan & Kartel, 2018; Woodruff & Smith, 2020). Shelters play a crucial role in providing health, safety, and welfare services for homeless animals. However, environmental stressors like novelty, sensory overload, limited opportunity to socialize, and spatial restriction negatively impact shelter dog welfare (Hennessy, 2013; Marston & Bennett, 2003; Protopopova, 2016). Extensive research on this topic has informed management practices including environmental modifications, enrichment strategies, and behavioral intervention programs (for review see Taylor & Mills, 2007; Wells, 2004). Behavioral intervention programs may include a combination of any one or more of the following strategies: operant conditioning, environmental enrichment, or anxiolytic medication prescribed by veterinarians (Abrams et al., 2020; Corsetti et al., 2021; Protopopova & Wynne, 2015; Protopopova et al., 2018; Tod et al., 2005).

Once behavior issues are identified, appropriate intervention plans, e.g., positive reinforcement training, desensitization, and counterconditioning techniques, can be implemented (for review see Protopopova & Gunter, 2017). However, some dogs continue to struggle and could benefit from pharmaceutical treatment that would manage underlying anxiety or physiological factors (Abrams et al., 2020; Ballantyne, 2018; Corsetti et al., 2021; Gilbert-Gregory et al., 2016; Gruen & Sherman, 2008; Tod et al., 2005).

Shelter veterinarians typically rely on reports from staff and volunteers to assess and monitor the behavioral health of shelter animals. While communication from caregivers to shelter veterinarians is crucial, a validated behavior assessment specifically designed to identify dogs struggling to cope in the shelter environment does not currently exist. While diagnosis and prescription are within the professional capacity of all practicing veterinarians, the level of comfort in addressing behavioral issues is variable (Stelow, 2018), further demonstrating the need for a diagnostic tool that would quantify coping state. Scientific validation of behavior assessments requires reporting on the tool's ability to measure the intended outcome (McCall, 1984). Principle components of establishing criterion validity include sensitivity (percentage of population that is positive and identified as positive), specificity (percentage of the population

that is negative and identified as negative), and a clear criterion of the identified behavior (Akobeng, 2007a; Akobeng, 2007b; Akobeng, 2007c; Patronek & Bradley, 2016). To characterize sensitivity and specificity, a reference standard, i.e., gold-standard, is required for confirmatory diagnostics. Current accepted diagnostics for identifying dogs that could benefit from anxiolytic treatment is veterinarian evaluation. A complete plan for diagnosis includes review of medical and behavioral history and direct observation (Stelow, 2018). However, shelters frequently do not have the medical nor behavioral history of the dog, or it is very sparse. Therefore, shelter veterinarians rely on physical examinations performed upon intake and direct observation of shelter dogs to diagnose behavior problems. Identification of true positive dogs for maladaptive coping can thus be established through professional diagnosis by a veterinarian behaviorist.

To define diagnoses, maladaptive coping is descriptive of dogs whose behavioral symptoms would warrant intervention, whereas adaptive coping categorizes dogs that are at a low risk for mental deterioration while in-shelter. Adaptive responses to stress encompass a variety of behavioral responses evolved to effectively increase fitness of the individual while in the presence of a real or perceived threat. These behaviors have been studied in several species under the dichotomy of reactive and proactive coping styles which are characterized by physiological and behavioral differences in response to stressors (Koolhaas et al., 1999). An individual's coping style is dependent on several factors such as genetics, past experiences, and situational context. Dogs that acclimate to the shelter environment habituate to stressful stimuli and adjust behavior accordingly. However, for the shelter dogs that remain in a state of stress, behavioral responses fail to eliminate the perception of danger, resulting in a maladaptive coping response. Within maladaptive coping, dogs may either be diagnosed as anxious-avoidant or excessive-aroused, which are defined in the following paragraph.

Anxious-avoidant diagnosis encompasses behaviors that correlate with a reactive coping style often recognized by decreased physical activity. Anxious-avoidant dogs may benefit from anti-depressant pharmaceutical therapies such as buspirone which attenuates fear and worry through enhancing serotonin activity in areas of the brain (Stahl, 2021). On the other end of the spectrum, increased physical activity is correlated with proactive coping styles, which manifests as excessive arousal under chronic stress. Excessive-aroused dogs may benefit from serotonin

antagonist/reuptake inhibitor (SARI) pharmaceutical therapies such as trazodone hydrochloride by decreasing arousal through antihistamine activity and antagonism of alpha-1 adrenergic receptors (Abrams et al., 2020; Gilbert-Gregory et al., 2016; Gruen & Sherman, 2008; Gruen et al., 2014; Kim et al., 2022).

Shelters need to rely on staff to communicate maladaptive coping and behavioral intervention to administration and veterinarians for timely treatment. However, a validated behavior assessment specifically designed to identify dogs struggling to cope in the shelter environment does not currently exist. Therefore, the aim of this study was to evaluate the criterion validity of a novel diagnostic tool developed to quantify shelter dog coping behavior.

3.1.i: Development of the behavioral assessment tool

The tool consists of a battery of behavioral assessments and was previously analyzed for inter- and intra-rater reliability in Chapter 2. Criterion validity was based on expert observation and assessment by a board-certified veterinary behaviorist, which is the industry standard for behavioral diagnostics in dogs. I hypothesized that low negative scores would correlate with maladaptive coping-anxious-avoidant dogs (MC-AA), high positive scores with maladaptive coping-excessive-aroused dogs (MC-EA) and near 0 scores with adaptive coping dogs (AC). Furthermore, analysis of individual tool components for clinical value will inform refinement of the assessment for further reliability and validity testing.

3.2: Materials and Methods

3.2.i: Ethical Approval

This study was approved by the Institutional Animal Care and Use Committee of Michigan State University (IACUC AMEND202100602 / PROTO202100191). Permission for subject participation was granted by the shelter President/CEO as the legal owner of the dogs while in shelter using the organization consent form provided by IACUC.

3.2.ii: Inclusion Criteria

Healthy dogs, 12 weeks or older, housed in solitary kennels at Capital Area Humane Society (Lansing, MI), were eligible for assessment. Dogs were excluded for health reasons (obesity, cancer, broken bones), if they were younger than 12 weeks of age, if they were group-housed, if they refused to exit the kennel, or if they were designated to be handled only by staff

due to severe aggression. Shelter housing and care was previously described in Chapter 2. A total of 91 dogs were assessed, 44 of which were female (33 spayed, 11 intact) and 47 of which were male (29 neutered, 18 intact). There is no evidence that sex is correlated with increased risk of relinquishment (Patronek et al., 1996) and our sample population generally aligns with the sex distribution of previous domestic (Arhant & Troxler, 2014; Brown et al., 2013; Salman et al., 1998) and international shelter studies (Diesel et al., 2010; Shih et al., 2021). It was the shelter's policy to spay/neuter all adoptable dogs; however, surgeries were performed on select days of the week which resulted in 31.87% of subjects intact at time of assessment.

Breed history was largely unknown (described in detail in Chapter 2) with a mean weight of 42.07 ± 18.08 lbs. Age of the dogs, as estimated by shelter clinicians, ranged from 0y 3m 9d to 10y 9m 1d with a mean age of 2.32 ± 2.41 years.

3.2.iii: Behavior Assessment

Behavioral assessments took place from June 2022 through October 2022, a minimum of 20 hours after intake. Eligible dogs were assessed once (n = 91). Enrollment protocol was previously described in Chapter 2. Assessments were recorded using GoPro Hero7 Black video recording devices from two perspectives for intra-rater reliability and validity testing. In brief, the behavior assessment consisted of eight categories, i.e., human-animal interactions (HAI's). All assessments were performed by the same handler in the following order, In-Kennel: Begin (HAI 1), Play (HAI 2), Settle (HAI 3), Acoustic Startle (HAI 4), Visual Startle (HAI 5), Distraction (HAI 6), and In-Kennel: Return (HAI 7). The final category, Activity (HAI 8), was assessed during transitions between the kennel and assessment area. Assessment protocol was described in detail in Chapter 2.

To determine whether the area for assessment had an impact on behavioral scores, eligible dogs were randomly assigned to either an indoor (n = 43) or outdoor (n = 48) assessment. Indoor assessments took place in the shelter's educational room (594 S.F.) while outdoor assessments occurred in a fenced enclosure (545 S.F.) on the back area of the shelter property. Assessment location was kept consistent through the day but varied per day of the week based on room availability and inclement weather. The diagnostic criterion standard was established by identification of the dogs as either adaptive coping (AC), maladaptive coping

anxious-avoidant (MC-AA) or maladaptive coping excessive-aroused (MC-EA) by a board-certified veterinarian behaviorist. This individual was blinded to assessment results and performed diagnoses retrospectively using the assessment video recordings. In addition, dogs that were diagnosed as maladaptive coping were further rated by the board-certified veterinarian behaviorist as mild, moderate, or severe based on the observed severity of behavioral symptoms.

3.2.ii: Sample Population

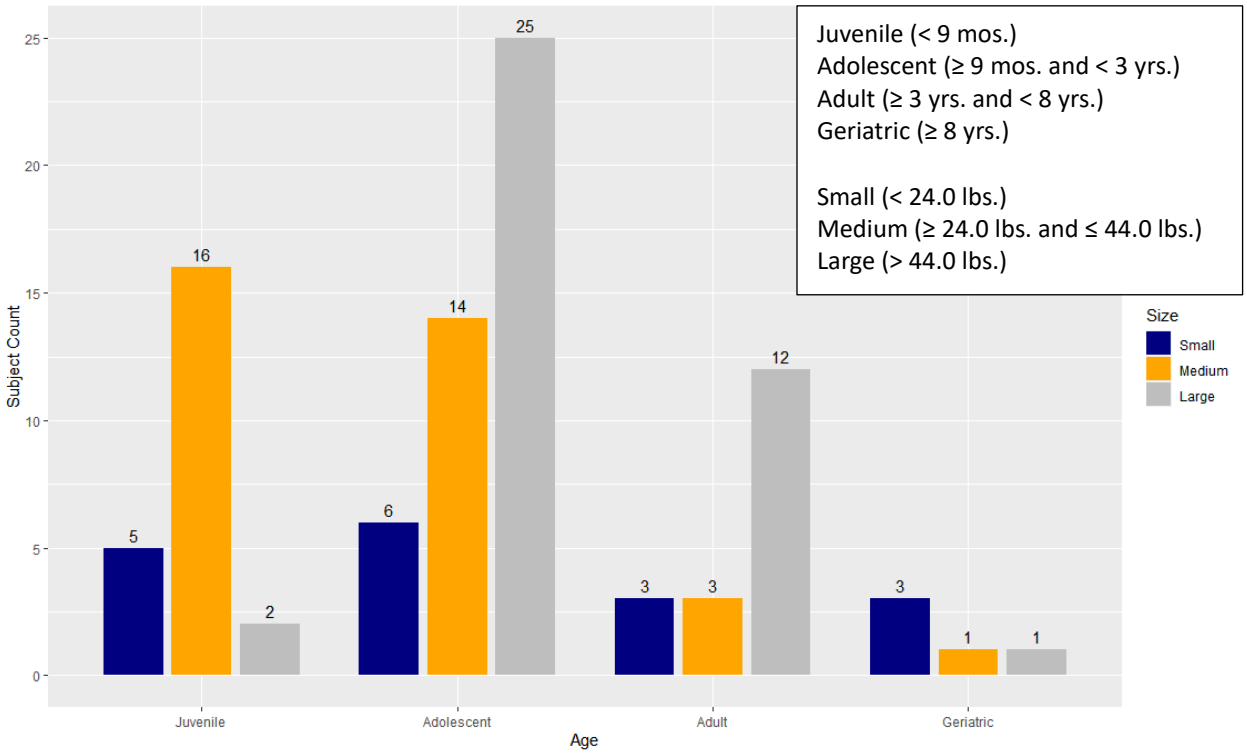
Power analysis was performed for each goal: a) assessing the ability of coping score to differentiate between diagnoses and b) determining whether assessment area impacted score. Target enrollment was established from the higher required subject enrollment for a minimum of 80% power with an estimated standard deviation of 0.50. Based on the expected ratio of observed diagnoses by a board-certified veterinarian behaviorist knowledgeable in shelter medicine of 40% AC / 40% MC-EA / 20% MC-AA, to assess score validity across diagnoses, nine subjects were required (SAS PROC POWER for one-way ANOVA with three sample populations, i.e., diagnoses). To determine if the assessment area impacts score, 46 dogs per assessment area would be required (SAS GLIMMIX using hypothetical data for two treatments, i.e., indoor or outdoor assessment). Therefore, the target enrollment was set at 92 dogs and duration of the study was influenced by number of dogs assessed in addition to the researchers' schedules.

Age, sex, and size were categorized for reporting on the characteristics of the sample population (Table 3.1 and Figure 3.1). Age categories were adapted from the AAHA guidelines for canine life stages based on the approximation of when dogs experience cessation of rapid growth (9 months), social and physical maturation (3 years), and the last 25% of estimated lifespan (8 years) (*Canine Life Stage Definitions*, AAHA). Dogs younger than 3 months were excluded from the study so therefore dogs less than 9 months were labeled as juveniles, dogs from 9 months up to 3 years as adolescents, dogs from 3 years up to 8 years as adults, and dogs 8 years or older as geriatric. Size categories, small (less than 24.0 lbs.), medium (24.0 lbs. to 44.0 lbs.), and large (more than 44.0 lbs.) were based on the shelter's standards; however, juveniles were categorized by their current weight and not that of adult size.

Table 3.1. Characteristics of sample population (n = 91). Sample population by characteristics age, sex, and size (n = 91). Dogs were categorized based on their age as juvenile, adolescent, adult, or geriatric. Dogs less than 3 months were ineligible for assessment. The sex of the dogs was either female-spayed (F-S), female-intact (F-I), male-neutered (M-N), or male-intact (M-I). Size was based on current weight and categorized as small, medium, or large.

Characteristic	Number	%
Age		
Juvenile (< 9 mos.)	23	25.27
Adolescent (≥ 9 mos. and < 3 yrs.)	45	49.45
Adult (≥ 3 yrs. and < 8 yrs.)	18	19.78
Geriatric (≥ 8 yrs.)	5	5.49
Sex		
Female-Spayed	33	36.26
Female-Intact	11	12.09
Total Female	*44*	*48.35*
Male-Neutered	29	31.87
Male-Intact	18	19.78
Total Male	*47*	*51.65*
Size		
Small (< 24.0 lbs.)	17	18.68
Medium (≥ 24.0 lbs. and ≤ 44.0 lbs.)	34	37.36
Large (> 44.0 lbs.)	40	43.96

Figure 3.1. Sample population characteristics clustered by age and size (n = 91). Sample population characteristics for factors age and size (n = 91). Bars show the number of dogs in each size category, small, medium, and large, clustered by age, juvenile, adolescent, adult, and geriatric. The number of dogs per descriptive combination of age and size (n) is shown above bars.



3.2.iii: Validity Analysis

For validity testing, assessment results from Rater A (first author) were compared to blinded veterinarian diagnoses and statistical analyses were calculated in R version 4.1.3. Total coping score and prompt scores (sc01-sc15) were individually analyzed for validity. Dogs with missing prompt scores were excluded from total score analyses. For analysis of each prompt score, all assessments with complete data were included for that prompt score (Table 3.2). Total coping score was assumed normally distributed by comparison of the histogram, residual plot, and Q-Q plot of standardized residuals. However, individual prompt scores appeared non-normally distributed and validity tests for prompt scores were selected based on robustness to non-normality.

Table 3.2. Total dogs used for validity analysis. Number of dogs included in validity analysis for indoor, outdoor, and pooled indoor + outdoor models for each factor (individual scored prompts, unscored prompts, and total coping score). See Table 2.1 for abbreviations. Total coping score was analyzed for four models (Full Model, Reduced Model, Refined Model A, and Refined Model B; described in results), of which only the Full Model was analyzed for both indoor and outdoor assessments in addition to pooled assessments (indoor + outdoor). All assessments used for validity analysis were from Rater A and dogs with one or more missing scored prompt were excluded from total coping score analysis. Therefore, of the 91 dogs that were assessed, 84 were analyzed for the Full Model and Reduced Model while 86 were included in the Refined Model A and Refined Model B. Indoor and outdoor assessments were pooled for validity analysis on unscored prompts.

Factor	Indoor (n)	Outdoor (n)	Indoor + Outdoor (n)
Scored prompts			
sc01	43	48	91
sc02	43	48	91
sc03	43	47	90
sc04	43	47	90
sc05	43	48	91
sc06	43	47	90
sc07	43	48	91
sc08	42	47	89
sc09	43	48	91
sc10	43	48	91
sc11	42	48	90
sc12	43	48	91
sc13	43	48	91
sc14	43	47	90
sc15	43	46	89
Total coping score			
Full Model (sc01-sc15)	41	43	84
Reduced Model (sc01-sc09, sc11-sc15)	.	.	84
Refined Model A (sc04-sc06, sc08, sc09, sc13, sc14)	.	.	86
Refined Model B (sc01, sc03-sc06, sc08, sc09, sc13, sc14)	.	.	86
Unscored prompts			
usc01 – usc07	.	.	91
pilo1 – pilo8	.	.	91

To test our prediction that score correlates with diagnosis, we used a linear mixed model (ANOVA) with a Tukey adjustment for multiple comparisons, 95% confidence interval, and significance of $\alpha \leq 0.05$, to consider the total score as predicted by diagnosis using all 15 prompt scores as the full model. Significant p-values indicate the tool can identify a difference in total score between the diagnostic categories (R code: emmeans). Significant p-values on contrasts AC:MC-AA, MC-EA:MC-AA, or MC-EA:AC would indicate the tool is able to identify a difference in total score range between the respective diagnostic categories. The decision to pool indoor and outdoor assessments was based on either linear regression (R code: lm) if the factor was assumed normally distributed (total coping score) or the Wilcoxon rank sum test with a continuity correction (R code: wilcox.test) if the factor was non-normally distributed (sc01-sc15). Assessments were pooled for additional statistical testing (indoor + outdoor) if $p > 0.05$, indicating that assessment area had no effect on factor results.

To propose ways in which the tool could be refined to improve practicality while maintaining validity, I performed cumulative regression analysis using each prompt score as a predictor of diagnosis for indoor and outdoor dogs until all coefficients had a p-value ≤ 0.25 (R code: clm + stepAIC). The refined model was then analyzed for validity using the same strategy as with the full model. Additionally, to analyze the clinical value of unscored prompts, we performed a Chi-squared test on unscored responses (usc01-usc05 and pilo1-pilo8) with diagnostic category (AC, MC-AA, or MC-EA) as the outcome variable (R code: chisq.test). To correct for multiple comparisons, a Bonferroni correction for three variables was applied ($\alpha = 0.05 / 3$) so that p-values ≤ 0.0167 indicate a statistically significant correlation between the behavior and diagnostic outcome. However, because the tool is intended to capture behavioral nuances, to avoid becoming overly constrictive, prompts with p-values ≤ 0.10 are considered clinically relevant. For two unscored prompts (usc01 and usc03), the assumption of reasonably large, expected cell count (≥ 5) was violated which would cause inaccurate chi square approximations. Consequently, for 'Location after approach, HAI 1' and 'Location with open door, HAI 1', clinical relevance was analyzed using Fisher's exact test. Unscored prompts that were not clinically relevant were candidates for removal.

3.3: Results

3.3.i: Diagnosis Distribution

Of all dogs (n = 91), 40.66% were diagnosed MC-AA (n = 37), 21.98% MC-EA (n = 20), and 37.36% AC (n = 34). Further diagnostics of mild, moderate, or severe for maladaptive coping are delineated in Table 3.3 and Figure 3.2. Assessments with more than one missing prompt score were excluded from total score analyses (n = 7). Those excluded from total score analyses consisted of the following diagnoses: MC-AA mild (outdoors = 1), MC-AA moderate (outdoors = 1), MC-AA severe (outdoors = 1), AC (indoors = 1; outdoors = 1), MC-EA mild (outdoors = 1), and MC-EA moderate (indoors = 1).

Table 3.3. Diagnosis distribution. Dogs were diagnosed by a veterinarian behaviorist blinded to assessment scores as one of three possible outcomes, Maladaptive Coping-Anxious-Avoidant (MC-AA), Maladaptive Coping-Excessive-Aroused (MC-EA) or Adaptive Coping (AC). **(a)** Distribution of diagnoses for total sample population (n = 91). MC-AA and MC-EA dogs were further categorized by severity of behavioral symptoms (mild, moderate, severe). **(b)** Severity distribution of dogs diagnosed as maladaptive coping (MC-AA + MC-EA) (n = 57).

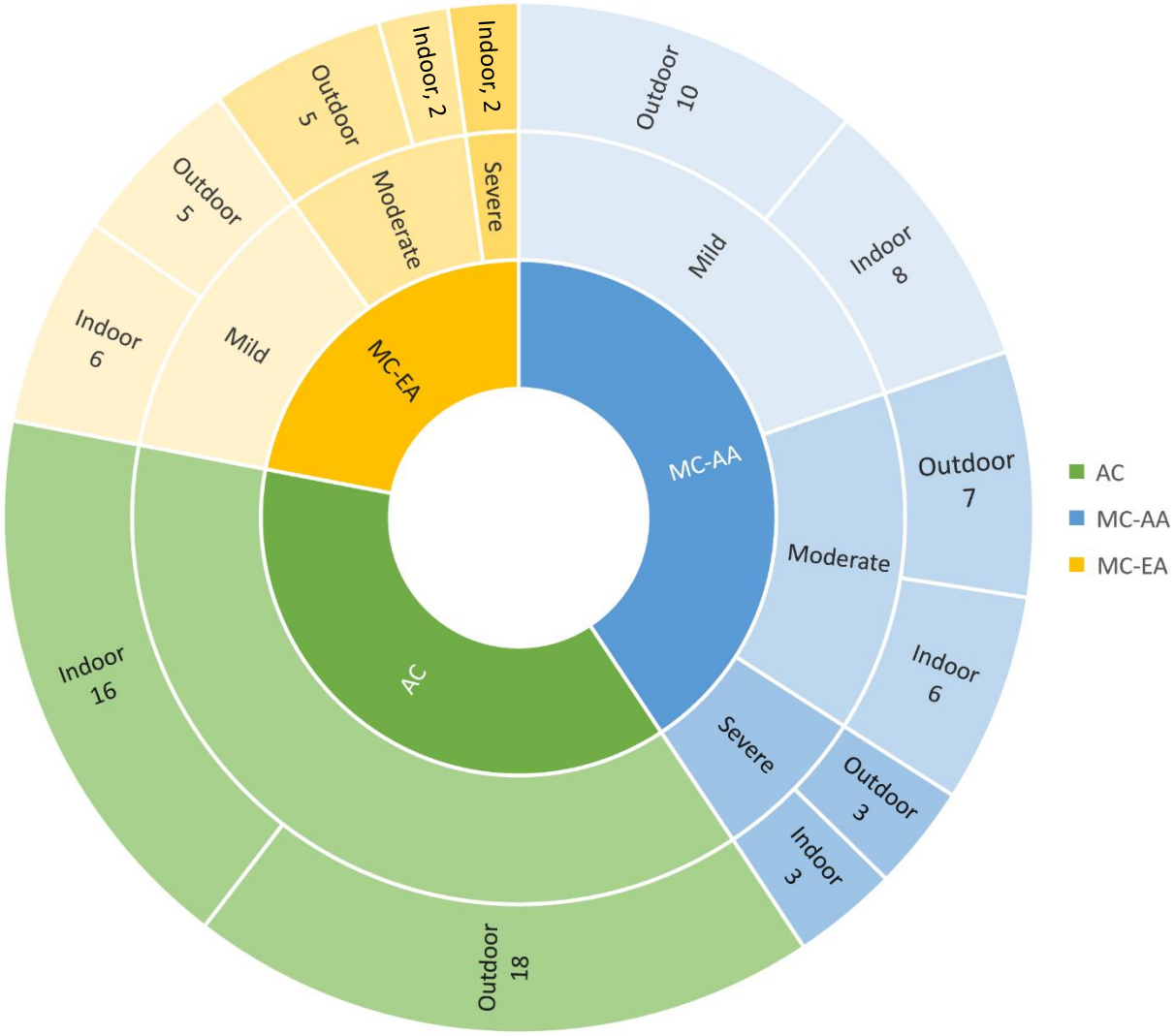
(a) Diagnosis distribution of sample population (n = 91)

Diagnosis		**n**	**%**
MC-AA			
	mild	18	19.78
	moderate	13	14.29
	severe	6	06.59
Total MC-AA		***37***	***40.66***
MC-EA			
	mild	11	12.09
	moderate	7	7.69
	severe	2	2.20
Total MC-EA		***20***	***21.98***
Total AC		***34***	***37.36***

(b) Distribution of severity across maladaptive coping diagnoses (n = 57)

Diagnosis		**n**	**%**
MC (AA + EA)			
	mild	29	50.877
	moderate	20	35.088
	severe	8	14.035
Total MC (AA+EA)		***57***	***100.0***

Figure 3.2. Diagnosis distribution across all dogs (n = 91). Diagnoses distribution across sample population (n = 91) by diagnosis (inner ring), severity (middle ring) and assessment area (outer ring). Dogs were diagnosed by a board-certified veterinarian behaviorist blinded to assessment scores using assessment videos as adaptive coping (AC) or maladaptive coping (MC) anxious-avoidant (AA) or excessive-aroused (EA). One full circle along the perimeter of each ring represents the sample population (n = 91) with factors shown proportionate to number of dogs. For example, three dogs assessed indoors (outer ring), had severe symptoms (middle ring) for MC-AA (inner ring). AC dogs were not rated for severity. Number of dogs (n) in each category is shown in the outer ring. 37.36% were AC, 40.66% were MC-AA, 21.98% were MC-EA, with 50.877% of MC dogs exhibiting mild symptoms, 35.088% moderate, and 14.035% severe. MC-EA/severe was not diagnosed for any of the dogs assessed outdoors.



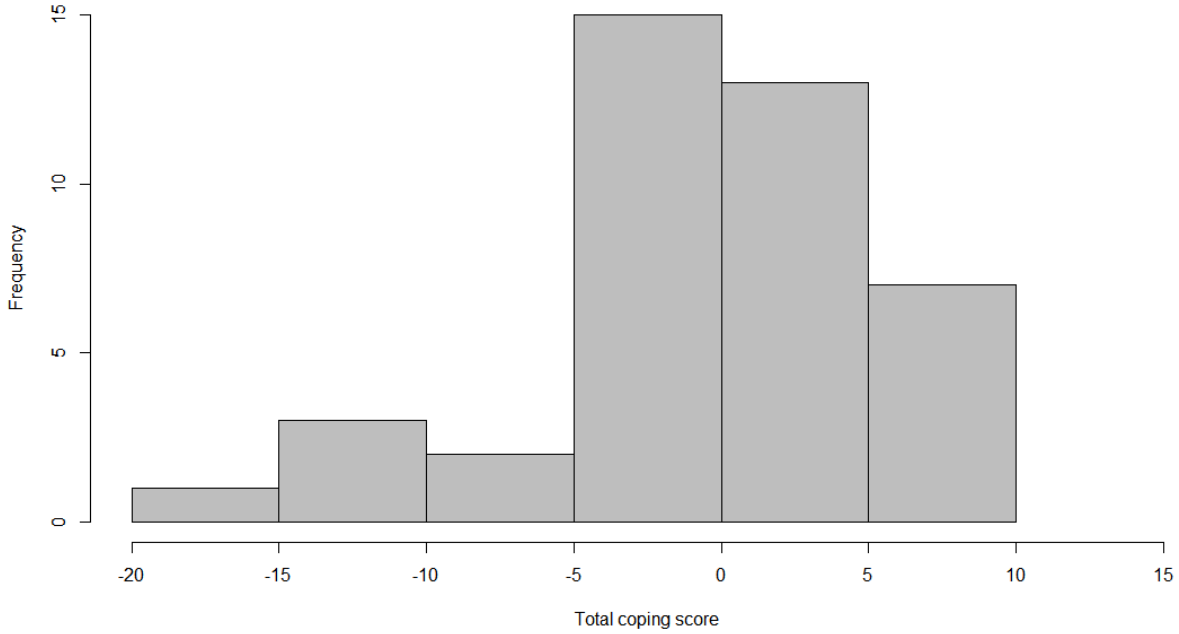
To evaluate if canine characteristics affect diagnosis, the variables sex, size, and age, were fitted to a multivariate ANOVA model (R code: clm). Since not all factor combinations were represented in our sample population, neither 3-way nor 2-way interactions could be calculated. Therefore, the model does not account for interactions. Diagnosis outcome (MC-AA, AC, MC-EA) and individual factors (sex, size, age) were categorical. Sex consisted of female-spayed (F-S), female-intact (F-I), male-neutered (M-N), male-intact (M-I); size consisted of small (< 24.0 lbs.), medium (≥ 24.0 lbs. & ≤ 44.0 lbs.), large (> 44.0 lbs.); and age consisted of juvenile (< 9 mos.), adolescent (≥ 9 mos. & < 3 yrs.), adult (≥ 3 yrs. & < 8 yrs.), geriatric (≥ 8 yrs.). No significant differences were found in diagnoses across groups (sex $p = 0.129$; size $p = 0.178$; age $p = 0.408$), indicating individual characteristics had no effect on diagnosis. However, there was a significant difference found in the individual sex coefficient for F-S ($p = 0.039$) and a near significant difference for the individual sex coefficient M-N ($p = 0.054$). Further pairwise comparison on sex failed to find evidence of a significant difference between contrasts averaged over the levels of age and size with a C.I. = 0.95 and a Tukey adjustment for comparing a family of four estimates (F-S, F-I, M-N, and M-I), leading to the conclusion that dog characteristics did not impact diagnoses.

3.3.ii: Total Score Distribution

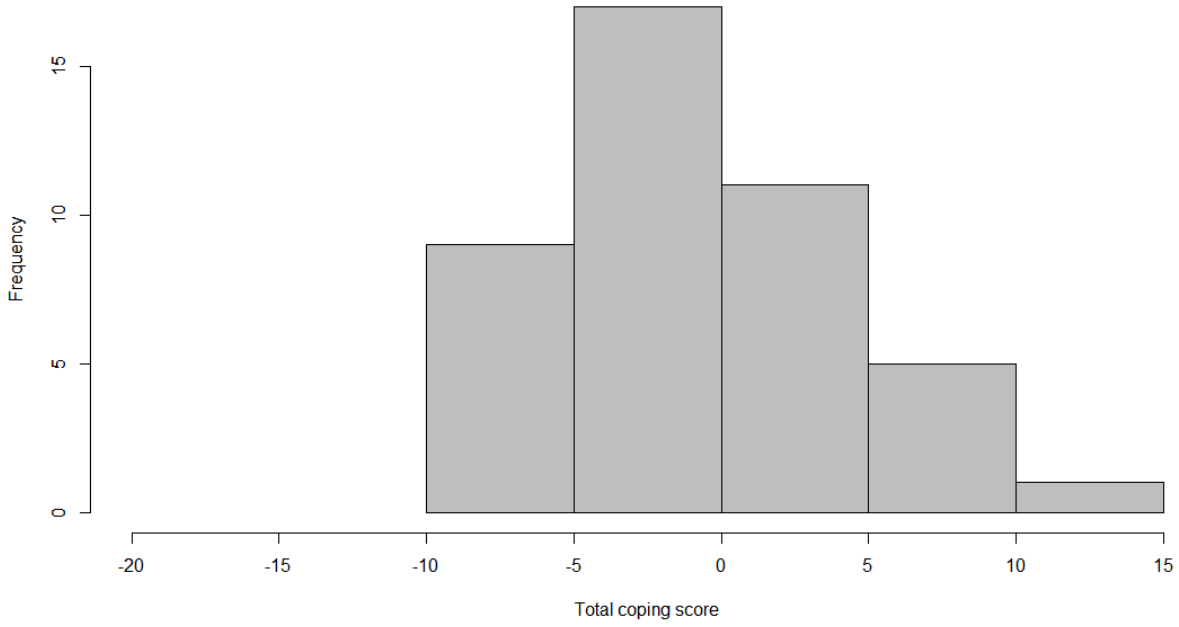
Observed total scores (Figure 3.3) ranged from –18 to +10 for dogs assessed indoors (n = 41) and –9 to +11.5 for dogs assessed outdoors (n = 43). The median score was zero for indoor assessments and –0.5 for outdoor assessments. The scores shared by most dogs (mode) were –3, 0, and +1 for indoor assessments (5 dogs each) and +4 for outdoor assessments (5 dogs).

Figure 3.3. Histogram of total coping score for sample population. The histogram of total coping score for the sample population excluding dogs with at least one missing prompt score (n = 84). Total coping score was assumed normally distributed. **(a)** The frequency (number of dogs) for total coping score for dogs assessed indoors (n = 41). The observed score range was -18 to +10, median score was 0, and mode was shared between -3, 0, and +1 with five dogs each. **(b)** The frequency (number of dogs) of total coping score for dogs assessed outdoors (n = 43). The observed score range was -9 to +11.5, median score was -0.5, and mode was +4 with five dogs.

(a) Frequency of total scores for dogs assessed indoors (n = 41)



(b) Frequency of total scores for dogs assessed outdoors (n = 43)



3.3.iii: Impact of Assessment Area on Total Score

There was no significant difference in total scores when comparing indoor assessments versus outdoors (p = 0.842). However, there was a notable distinction for sc10 (Reaction to acoustic startle, HAI 4), which was significantly different between indoor and outdoor dogs (W = 1243, p = 0.025) (Table 3.4). Therefore, total score was analyzed both with and without sc10 for pooled data (indoor + outdoor), as well as analyzing indoor and outdoor datasets separately using all 15 scored prompts, allowing us to compare validity across scenarios.

Table 3.4. Prompt score comparison of indoor to outdoor assessments. Scored prompts were analyzed to compare indoor to outdoor assessments using the Wilcoxon-rank sum test. 'Reaction to acoustic startle' (sc10) was statistically significant, indicating that assessment area may impact dog behavior for sc10. There was no evidence that any of the remaining prompt scores were affected by the area.

Abbrev.	Scored prompt	W	p
sc01	Presentation with closed door, HAI 1	1091	0.411
sc02	Ability to take treat, HAI 1	1069	0.410
sc03	Presentation with open door, HAI 1	10004.5	0.935
sc04	Latency to exit, HAI 1	898	0.260
sc05	Initial reaction to play, HAI 2	946	0.442
sc06	Ease of putting away toys, HAI 2	1126	0.252
sc07	Was play ended early, HAI 2	984	0.137
sc08	Response to treat, HAI 3	1111.5	0.258
sc09	Activity, HAI 3	981.5	0.558
sc10	Reaction to acoustic startle, HAI 4	1243	0.025*
sc11	Reaction to visual startle, HAI 5	930	0.431
sc12	Overall body language, HAI 6	942.5	0.431
sc13	Can you obtain the dog's attention, HAI 6	1023.5	0.937
sc14	Approach to kennel entry, HAI 7	991	0.843
sc15	In-kennel behavior post-return, HAI 7	969	0.780

*Significant at $\alpha \leq 0.05$

3.3.iv: Validity

Indoor assessments

For the full model consisting of all 15 scored prompts (Figure 3.4), the estimated marginal mean total score for dogs assessed indoors (n = 41) was -3.00 ± 1.280 for MC-AA dogs (n = 17), 1.367 ± 1.362 for AC dogs (n = 15), and 1.444 ± 1.759 for MC-EA dogs (n = 9). There was a numeric difference between groups with negative scores correlated with MC-AA and positive scores correlated with AC and MC-EA; however, there was no statistically significant difference between marginal means. In contrasting estimated range of diagnostic groups, there was a trend suggesting total score range of MC-AA dogs differed from AC dogs (p = 0.063) but no significant difference from MC-EA dogs (p = 0.116) nor AC from MC-EA (p = 0.999). Three dogs (MC-AA/severe = 1, AC = 1, MC-EA/mild = 1) were identified as potential influential outliers based on a Cook's distance greater than 0.098 (4/n). Further, the only two MC-EA/severe dogs assessed were observationally close to the 0.098 cutoff, each rated with a negative total coping score (-6 and –3.5). Despite being statistical outliers, from a biological perspective each diagnosis and score is relevant since variability in shelter dog behavior is expected. Therefore, the outliers were not excluded from the model and results reflect their inclusion.

Figure 3.4. Full Model (15 scored prompts) for indoor assessments (n = 41). Estimated marginal mean of total coping score ±SE for each diagnosis using the Full Model (sum of sc01 through sc15) for dogs assessed indoors (n = 41). At statistical significance ($p \leq 0.05$), there was no evidence of a difference between total coping score of diagnoses. **(a)** There is a numerical difference of total coping score between diagnoses, with -3.00 ± 1.280 estimated for MC-AA dogs, 1.367 ± 1.362 for AC dogs, and 1.444 ± 1.759 for MC-EA dogs. **(b)** By severity, total coping score increases as expected from MC-AA/severe on the left to MC-EA/moderate on the right. However, the negative score estimated for MC-EA/severe was unexpected. The dogs that were diagnosed MC-EA/severe (n = 2), were statistical outliers (Cook's distance greater than 4/n) but remained in the model as biologically relevant since variability in shelter dog behavior is expected.

(a) Estimated marginal mean total coping score per diagnosis

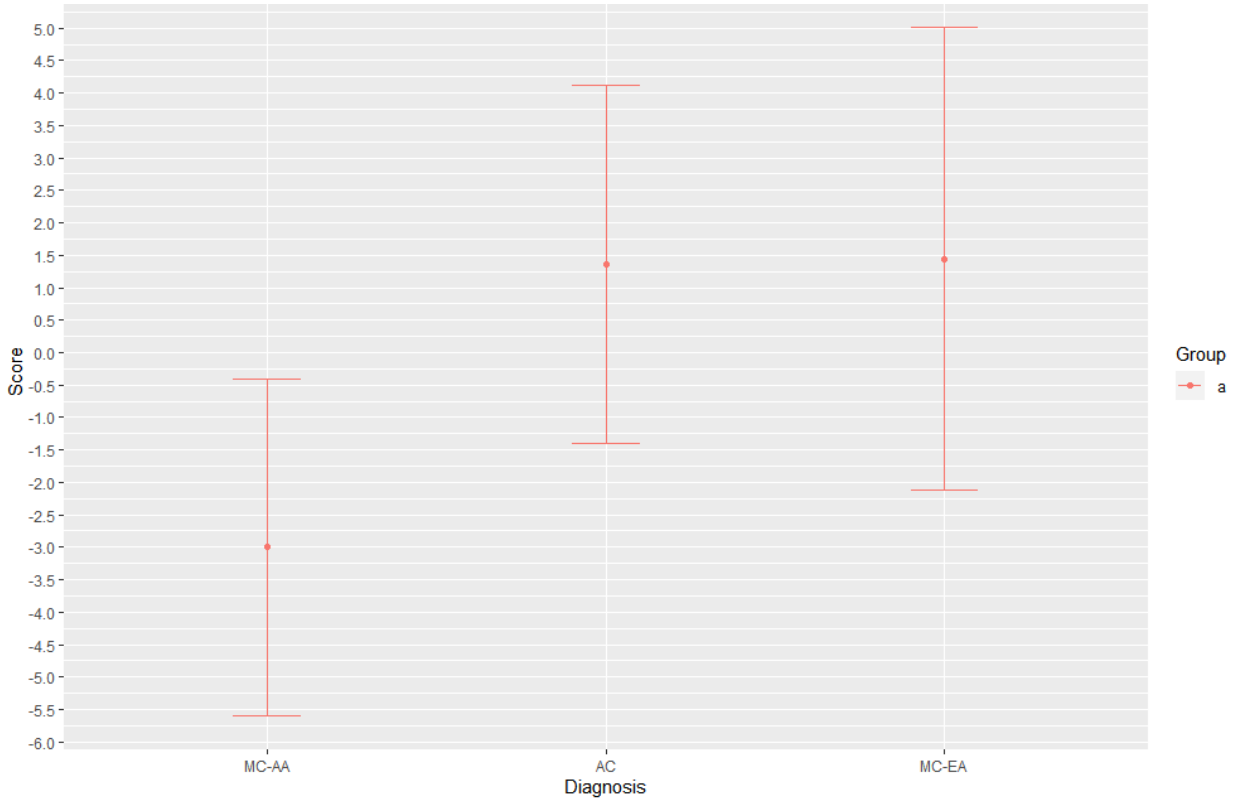
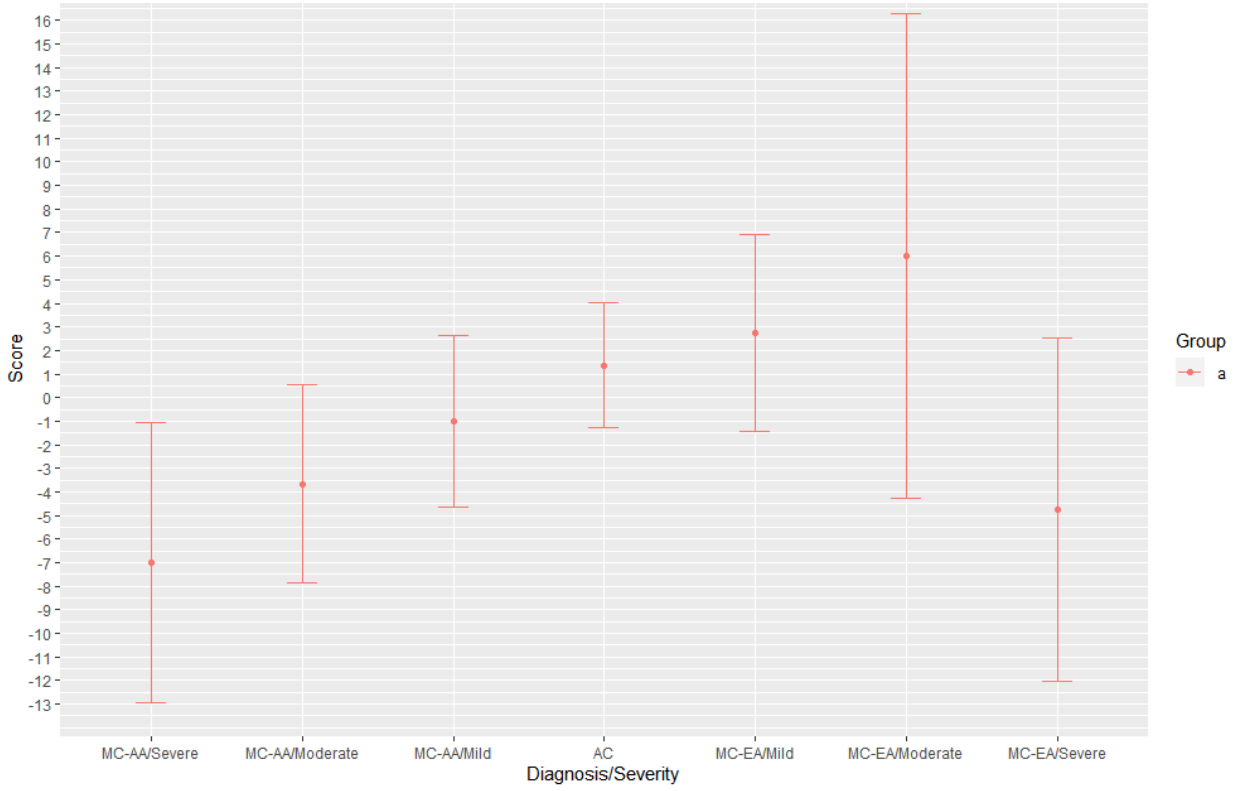


Figure 3.4 (cont'd)

(b) Estimated marginal mean total coping score per severity of symptoms



Outdoor assessments

For the full model consisting of all 15 scored prompts (Figure 3.5), the estimated marginal mean total score for dogs assessed outdoors (n = 43) was -4.176 ± 0.898 for MC-AA dogs (n = 17), 1.647 ± 0.898 for AC dogs (n = 17), and 3.833 ± 1.234 for MC-EA dogs (n = 9). Here there is a statistically significant difference of MC-AA marginal mean total score from AC and MC-EA ($p \leq 0.05$). Statistical results on marginal mean differences are reflected in the significant difference in total score range of MC-AA dogs to AC ($p = 0.0001$) and MC-EA ($p < 0.0001$). There was no significant difference in range from AC dogs to MC-EA ($p = 0.334$), but numerically MC-EA dogs have a higher marginal mean total score compared to AC dogs.

Figure 3.5. Full Model (15 scored prompts) for outdoor assessments (n = 43). Estimated marginal mean of total coping score ±SE for each diagnosis using the Full Model (sum of sc01 through sc15) for dogs assessed outdoors (n = 43). Pairwise significant differences ($p \leq 0.05$) between the groups are shown by color. **(a)** The est. mean for MC-AA dogs is different than that of AC and MC-EA dogs at statistical significance. There is a numerical difference of total coping score between diagnoses, with -4.176 ± 0.898 estimated for MC-AA dogs, 1.647 ± 0.898 for AC dogs, and 3.833 ± 1.234 for MC-EA dogs. **(b)** By severity, total coping score increases as expected from MC-AA/severe on the left to MC-EA/moderate on the right. While est. mean drops slightly from MC-AA/moderate to MC-AA/mild and from MC-EA/mild to MC-EA/moderate, variability in shelter dog behavior is expected and results are biologically relevant. There were no dogs assessed outdoors that were diagnosed MC-EA/severe.

(a) Estimated marginal mean total coping score per diagnosis

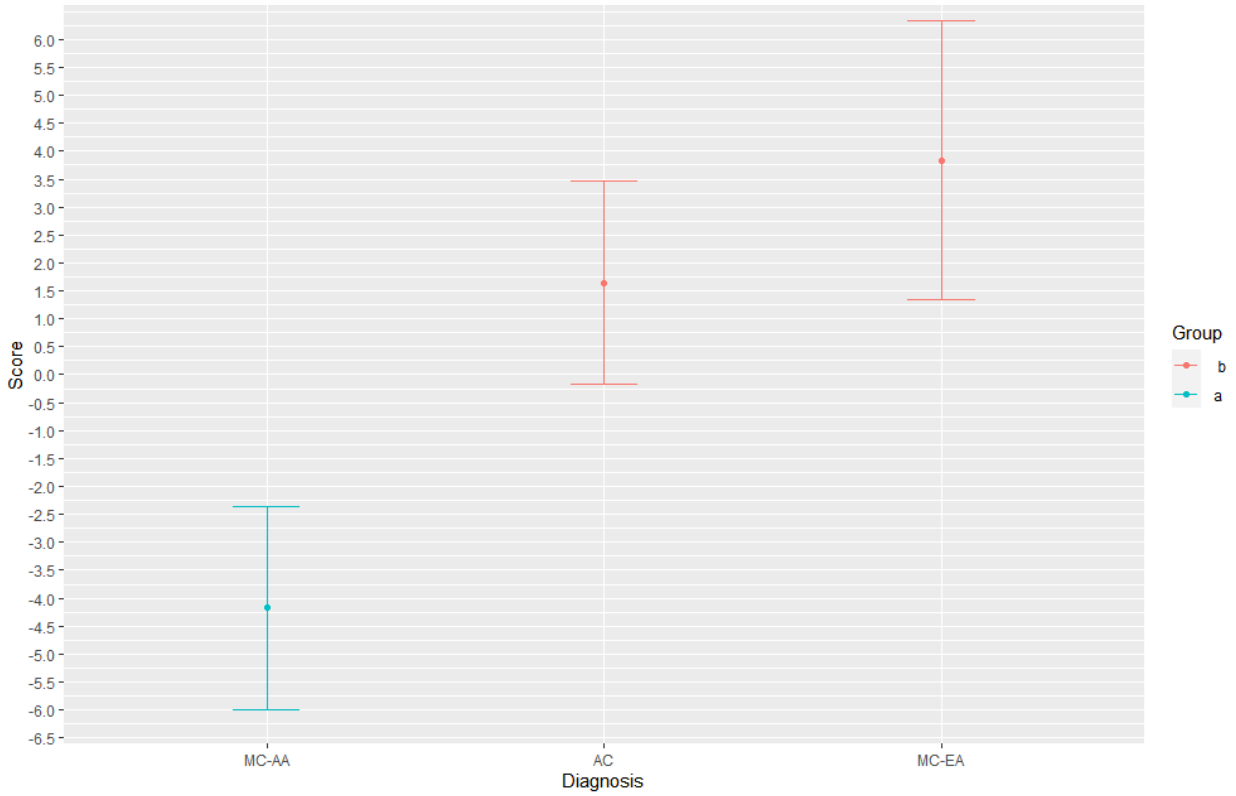
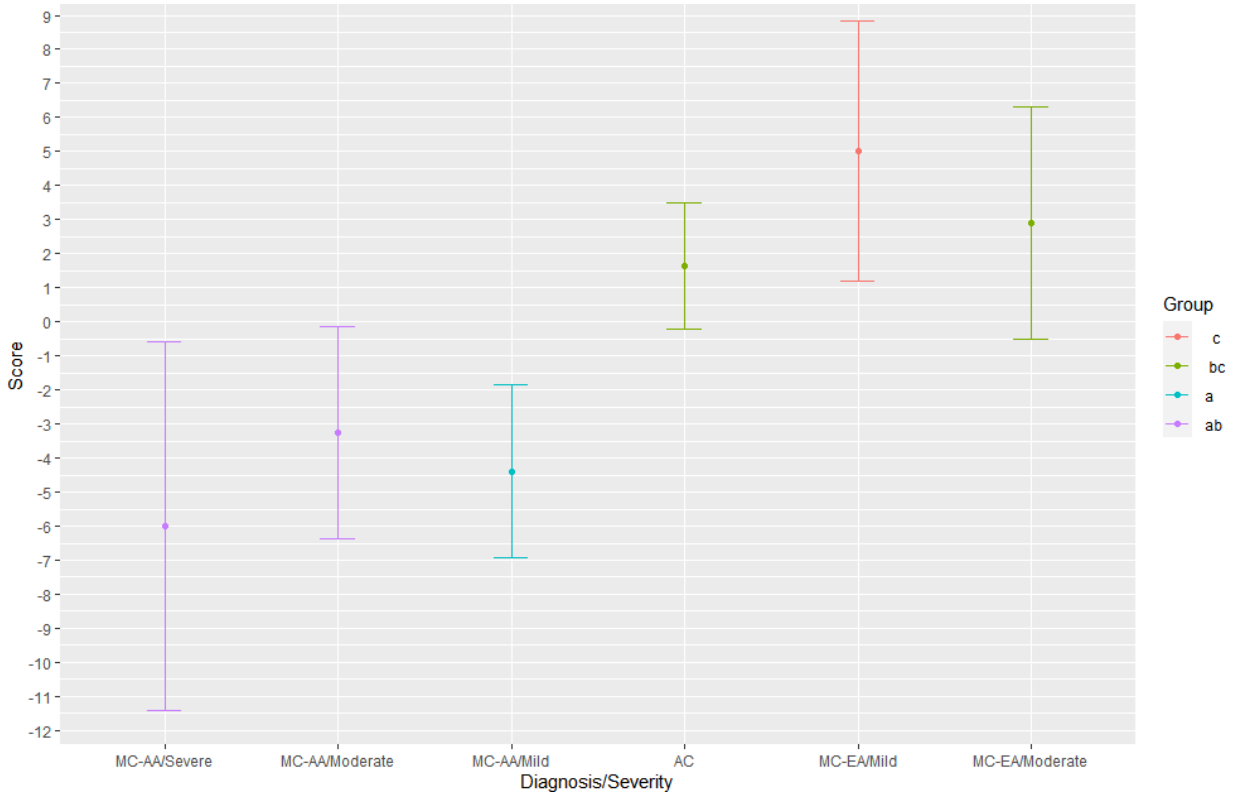


Figure 3.5 (cont'd)

(b) Estimated marginal mean total coping score per severity of symptoms



Indoor + outdoor assessments (pooled)

When pooling both indoor and outdoor assessments (n = 84), for the full model consisting of all 15 scored prompts (Figure 3.6), the estimated marginal mean total score was -3.588 ± 0.773 for MC-AA dogs (n = 34), 1.516 ± 0.796 for AC dogs (n = 32) and 2.639 ± 1.062 for MC-EA dogs (n = 18). In agreement with the results from the outdoor assessments, there was a significant difference in marginal mean total score for MC-AA dogs from AC and MC-EA ($p \leq 0.05$) and a significant difference in score range of MC-AA dogs to AC ($p < 0.0001$) and MC-EA ($p < 0.0001$).

Figure 3.6. Full Model (15 scored prompts) for indoor + outdoor assessments (n = 84). Estimated marginal mean of total coping score ±SE for each diagnosis using the Full Model (sum of sc01 through sc15) for dogs assessed indoors and outdoors (n = 84). Pairwise significant differences ($p \leq 0.05$) between the groups are shown by color. **(a)** The est. mean for MC-AA dogs is different than that of AC and MC-EA dogs at statistical significance. There is a numerical difference of total coping score between diagnoses, with -3.588 ± 0.773 estimated for MC-AA dogs, 1.516 ± 0.796 for AC dogs, and 2.639 ± 1.062 for MC-EA dogs. **(b)** By severity, total coping score increases as expected from MC-AA/severe on the left to MC-EA/moderate on the right, with a slight drop from MC-EA/mild to MC-EA/severe; variability in shelter dog behavior is expected and results are biologically relevant. Estimated mean for MC-EA/severe is unexpectedly low, which is reflective of the statistical outliers diagnosed MC-EA/severe (n = 2).

(a) Estimated marginal mean total coping score per diagnosis

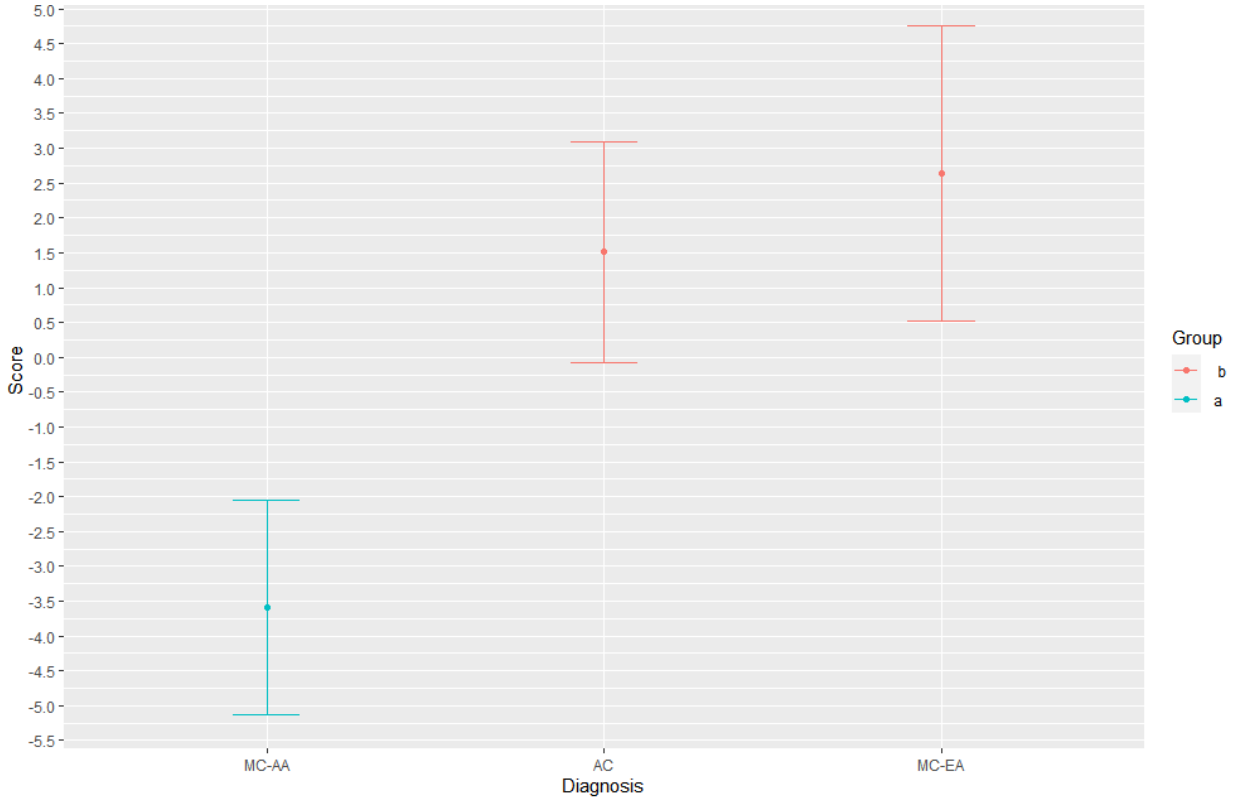
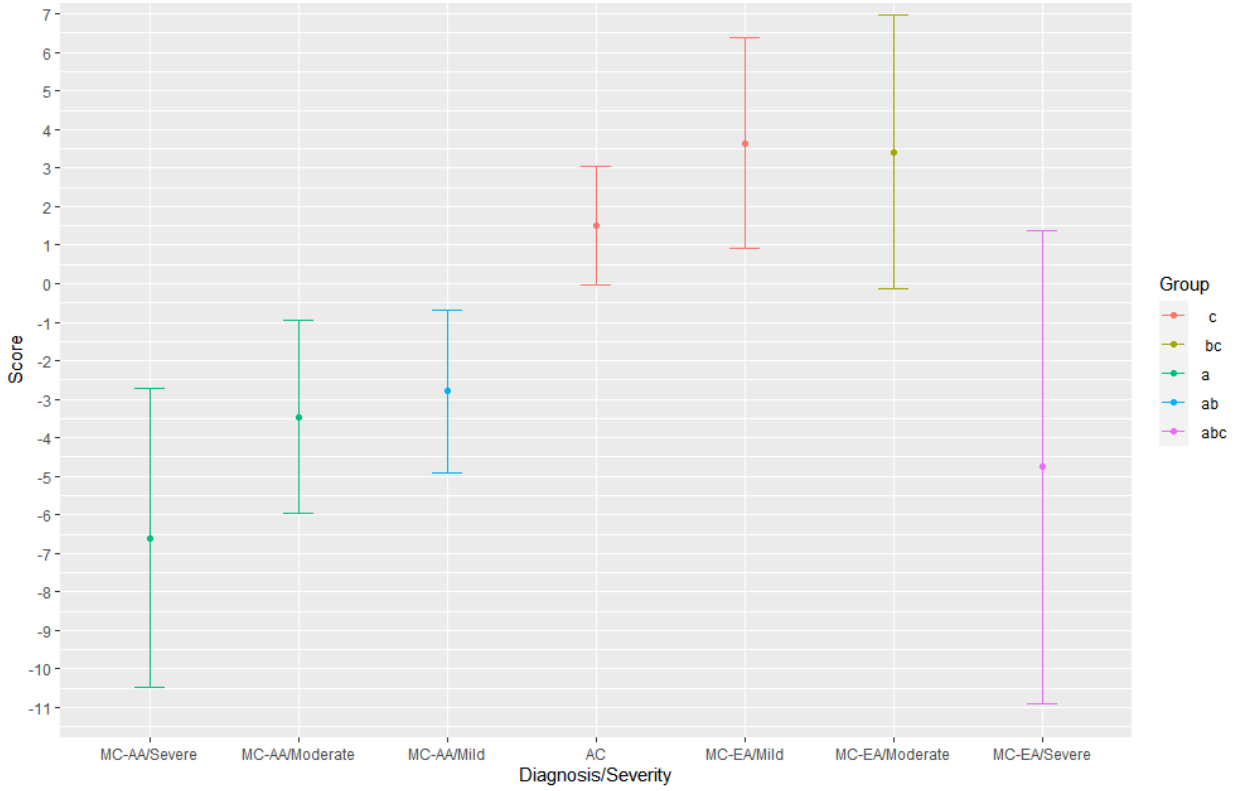


Figure 3.6 (cont'd)

(b) Estimated marginal mean total coping score per severity of symptoms



To account for the difference in scores across assessment areas for sc10, a reduced model consisting of 14 scored prompts with the elimination of the acoustic startle was analyzed (Figure 3.7). Assuming normal based on the histogram of total score, residual plot, and Q-Q plot of standardized residuals, the reduced model's ability to predict diagnosis was analyzed using a linear mixed model (ANOVA) with a Tukey adjustment. Statistical results agreed with the findings from the full model, corroborating validity. MC-AA dogs had a significantly different marginal mean total score (-4.43 ± 0.751) from AC (1.23 ± 0.774) and MC-EA (1.97 ± 1.032). A significant range difference was seen in MC-AA dogs from AC ($p < 0.0001$) and MC-EA ($p < 0.001$) with no significant difference between AC and MC-EA ($p = 0.8354$).

Figure 3.7. Reduced Model (14 scored prompts) for indoor + outdoor assessments (n = 84). Estimated marginal mean of total coping score ±SE for each diagnosis using the Reduced Model (sum of sc01 through sc15, excluding sc10) for dogs assessed indoors and outdoors (n = 84). Pairwise significant differences ($p \leq 0.05$) between the groups are shown by color. **(a)** The est. mean for MC-AA dogs is different than that of AC and MC-EA dogs at statistical significance. There is a numerical difference of total coping score between diagnoses, with -4.43 ± 0.751 estimated for MC-AA dogs, 1.23 ± 0.774 for AC dogs, and 1.97 ± 1.032 for MC-EA dogs. **(b)** By severity, total coping score increases as expected from MC-AA/severe on the left to MC-EA/moderate on the right. Estimated mean for MC-EA/severe is unexpectedly low, which is reflective of the statistical outliers diagnosed MC-EA/severe (n = 2).

(a) Estimated marginal mean total coping score per diagnosis

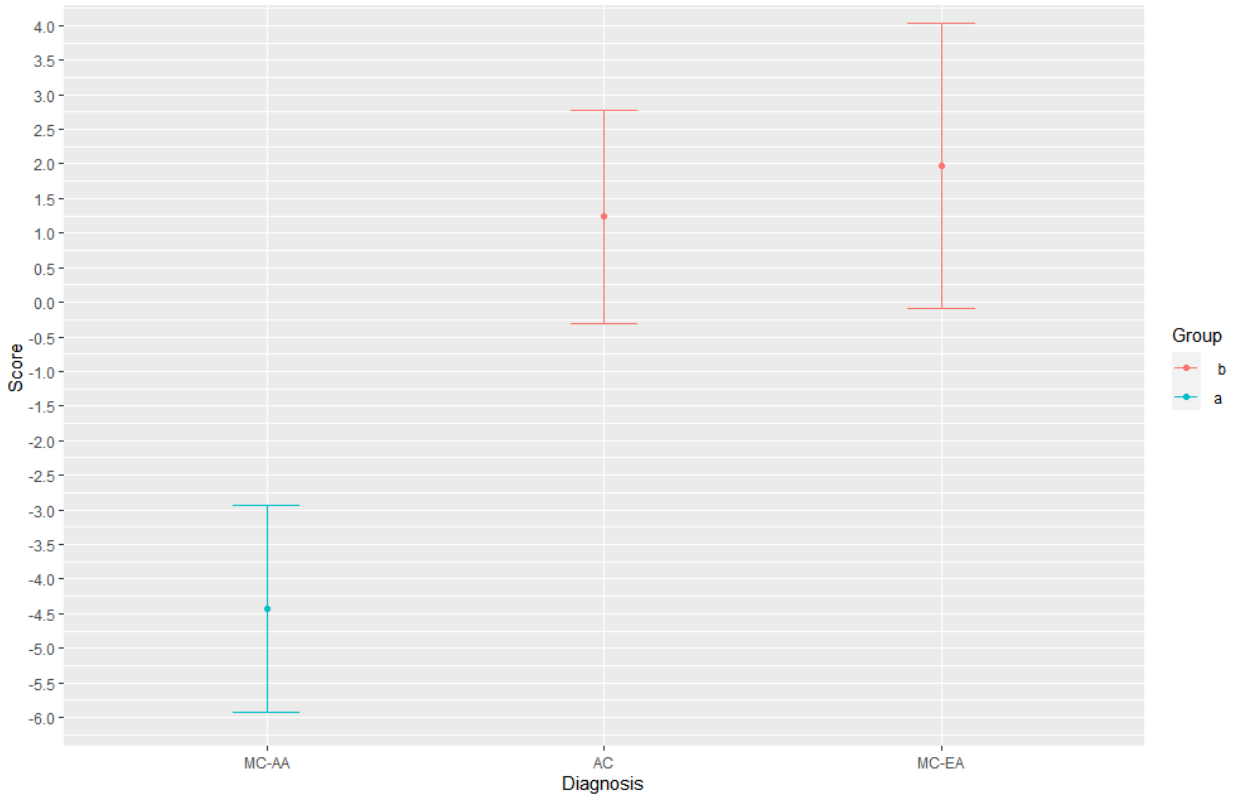
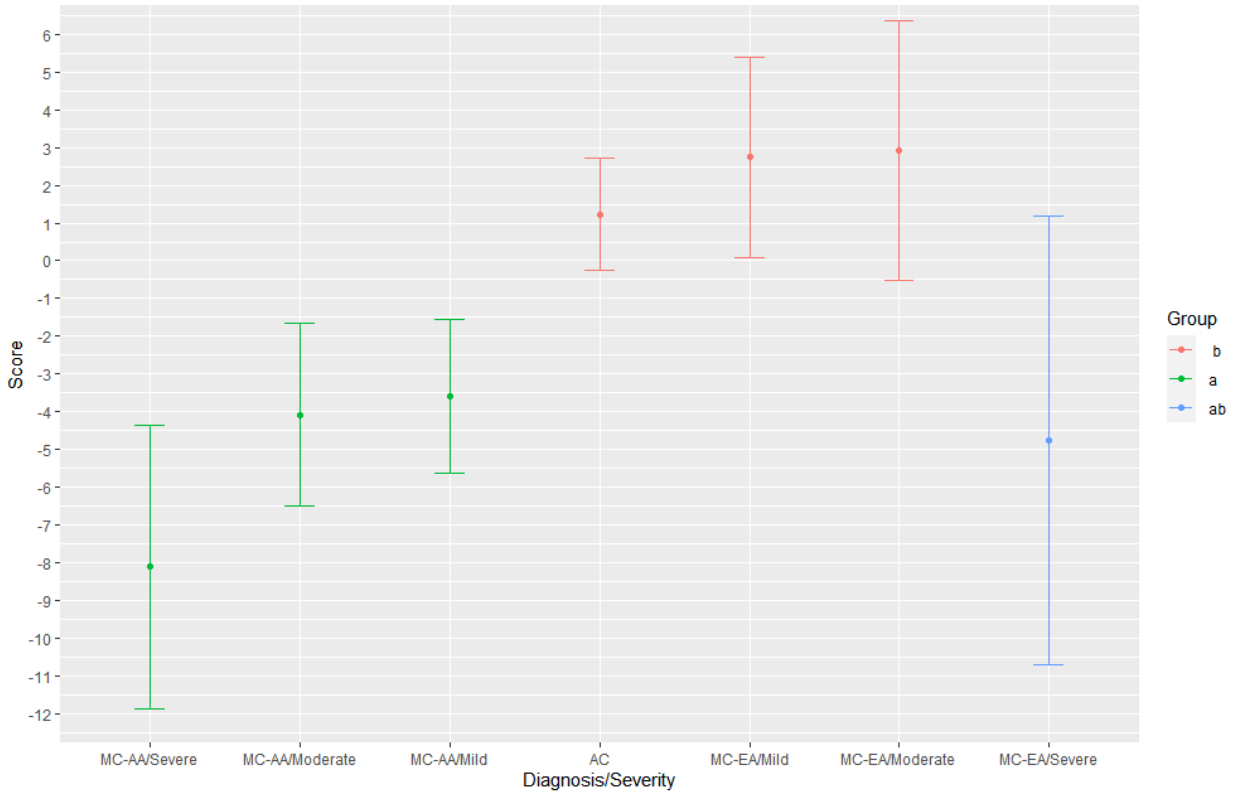


Figure 3.7 (cont'd)

(b) Estimated marginal mean total coping score per severity of symptoms



The statistical difference between estimated marginal mean total score of MC-AA dogs to AC and MC-EA across the full model (outdoor + indoor) as well as the reduced model corroborates validity results for total coping score.

3.3.v: Refinement

During the refinement process, our goal was to reduce the number of components within the tool while also maintaining validity. Candidates for removal were identified through cumulative regression analysis on total score for all dogs (indoor + outdoor assessments) until all scored prompts that remained in the model had a p-value ≤ 0.25. This resulted in a drastically reduced number of scored prompts from 15 to three (sc04, sc08, and sc14). However, a tool used for behavioral diagnostics based on three scores would not provide enough context for clinical interpretation of the behaviors, rendering the model clinically irrelevant. Therefore, analysis was performed for indoor and outdoor assessments separately. This reduced indoor

scores to sc04, sc05, sc08, sc13, and sc14 while outdoor scores were reduced to sc04, sc06, sc08, sc09, and sc14. After accounting for duplicates, the refined version of the tool based on statistical significance (Model A) consisted of 'Latency to exit, HAI 1' (sc04), 'Initial reaction to play, HAI 2' (sc05), 'Ease of putting away toys, HAI 2' (sc06), 'Response to treat, HAI 3' (sc08), 'Activity, HAI 3' (sc09), 'Ability to obtain the dog's attention, HAI 6' (sc13) and 'Approach to kennel entry, HAI 7' (sc14).

Upon discussion with the veterinarian behaviorist that blindly diagnosed the dogs, two scored prompts that were eliminated from Model A were clinically valuable, 'Presentation with closed door, HAI 1' (sc01) and 'Presentation with open door, HAI 1' (sc03). Therefore, two refined models were analyzed for validity, Model A and Model B, which in addition to sc04, sc05, sc06, sc08, sc09, sc13, and sc14 included sc01 and sc03, and results were compared to the full and reduced models. Both Model A and Model B were assumed normal based on histograms of total score, residual plots, and Q-Q plots of standardized residuals.

Results for Model A (Figure 3.8) and Model B (Figure 3.9) were in concordance with the Full and Reduced Models (indoor + outdoor), indicating that validity was maintained during proposed refinement (Table 3.5). There was a statistically significant difference of MC-AA marginal mean total score from AC and MC-EA ($p \leq 0.05$) in Model A and Model B with a significant difference in total score range of MC-AA dogs to AC (Model A, $p = 0.0015$; Model B, $p = 0.004$) and MC-EA (Model A, $p = 0.0001$; Model B, $p < 0.0001$). However, there was no significant difference in range from AC dogs to MC-EA (Model A, $p = 0.3341$; Model B, $p < 0.325$), but numerically there was a higher marginal mean total score for MC-EA dogs compared to AC dogs. Validity remained consistent across Model A and B, justifying the professional decision to include sc01 and sc03 in the assessment in addition to the statistically significant scores.

Figure 3.8. Refined Model A (7 scored prompts) for indoor + outdoor assessments (n = 86). Estimated marginal mean of total coping score ±SE for each diagnosis using the Refined Model A (sum of sc04, sc05, sc06, sc08, sc09, sc13, sc14) for dogs assessed indoors and outdoors (n = 86). Pairwise significant differences ($p \leq 0.05$) between the groups are shown by color. **(a)** The est. mean for MC-AA dogs is different than that of AC and MC-EA dogs at statistical significance. There is a numerical difference of total coping score between diagnoses, with -2.89 ± 0.685 estimated for MC-AA dogs, 0.727 ± 0.706 for AC dogs, and 2.417 ± 0.955 for MC-EA dogs. **(b)** By severity, total coping score increases as expected from MC-AA/severe on the left to MC-EA/moderate on the right. Estimated mean for MC-EA/severe is unexpectedly low, which is reflective of the statistical outliers diagnosed MC-EA/severe (n = 2).

(a) Estimated marginal mean total coping score per diagnosis

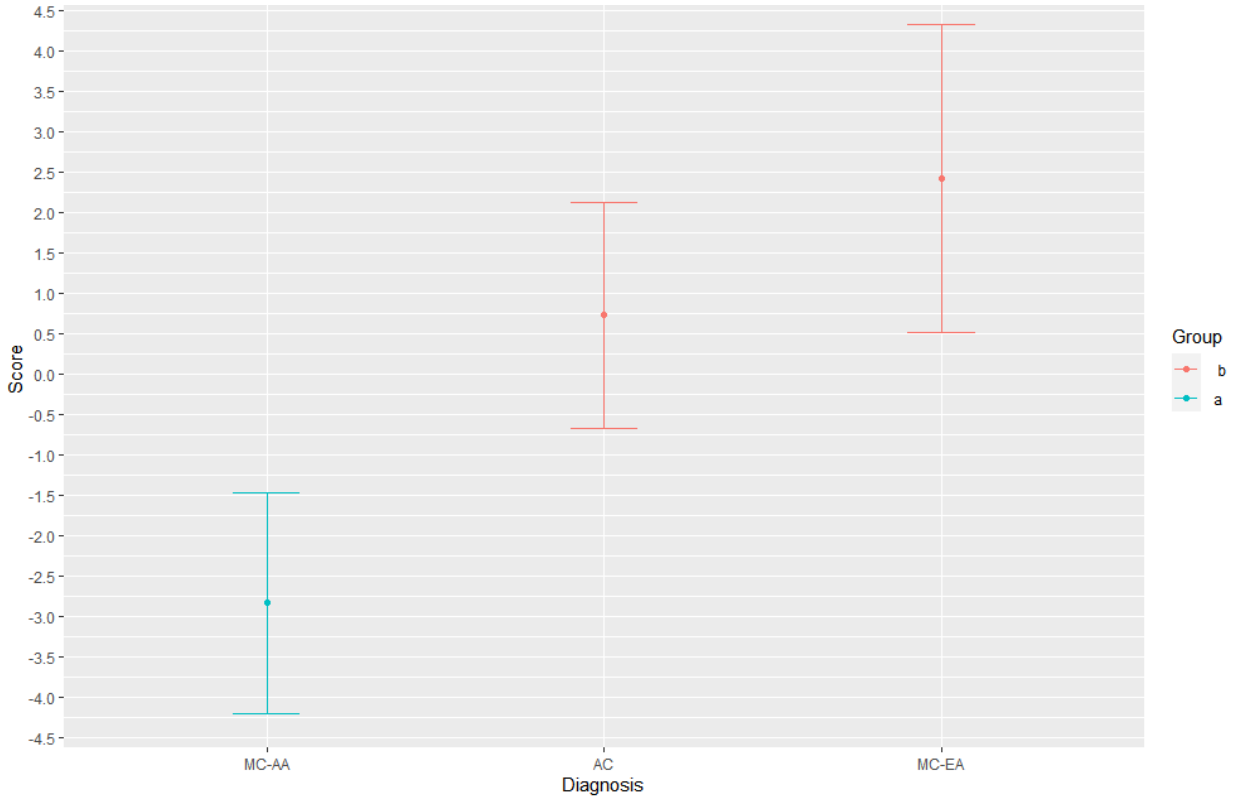


Figure 3.8 (cont'd)

(b) Estimated marginal mean total coping score per severity of symptoms

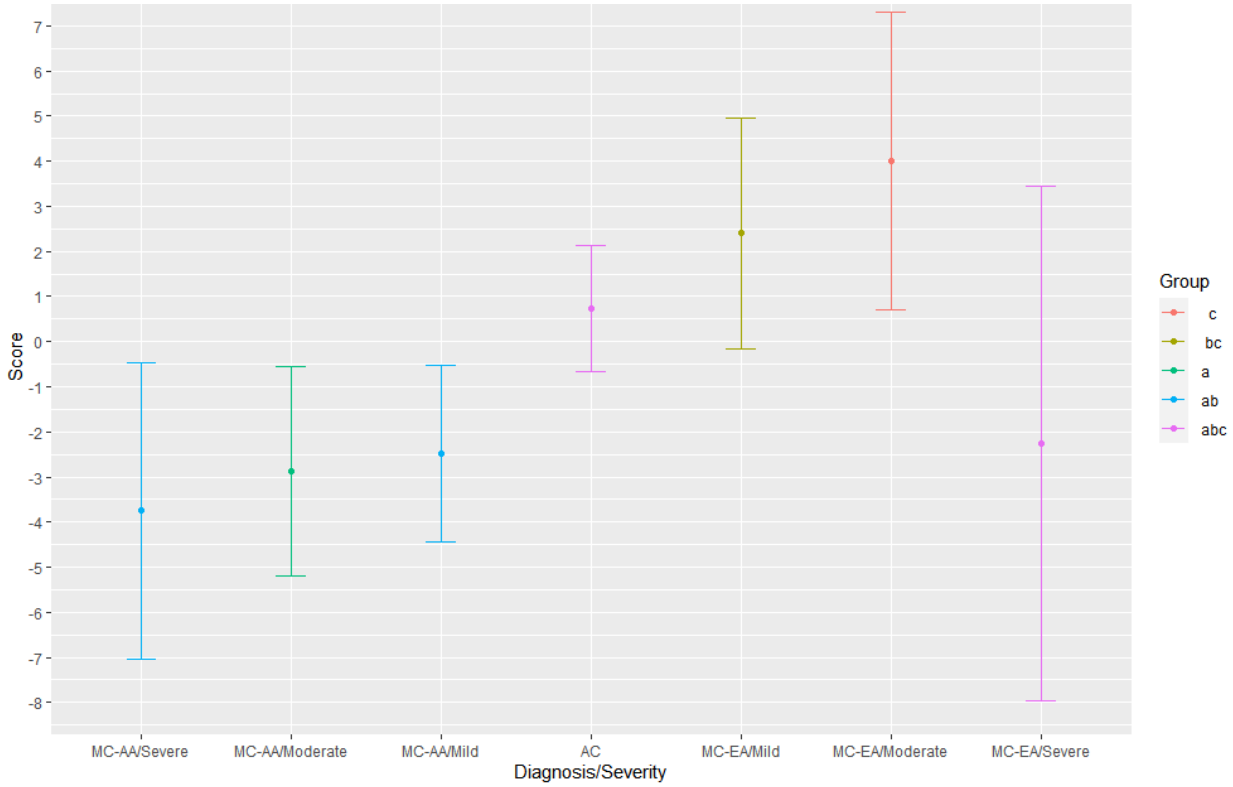


Figure 3.9. Refined Model B (9 scored prompts) for indoor + outdoor assessments. Estimated marginal mean of total coping score ±SE for each diagnosis using the Refined Model B (sum of sc01, sc03, sc04, sc05, sc06, sc08, sc09, sc13, sc14) for dogs assessed indoors and outdoors (n = 86). Pairwise significant differences ($p \leq 0.05$) between the groups are shown by color. **(a)** The est. mean for MC-AA dogs is different than that of AC and MC-EA dogs at statistical significance. There is a numerical difference of total coping score between diagnoses, with -3.34 ± 0.710 estimated for MC-AA dogs, 0.727 ± 0.731 for AC dogs, and 2.500 ± 0.990 for MC-EA dogs. **(b)** By severity, total coping score increases as expected from MC-AA/severe on the left to MC-EA/moderate on the right. Estimated mean for MC-EA/severe is unexpectedly low, which is reflective of the statistical outliers diagnosed MC-EA/severe (n = 2).

(a) Estimated marginal mean total coping score per diagnoses (n = 86)

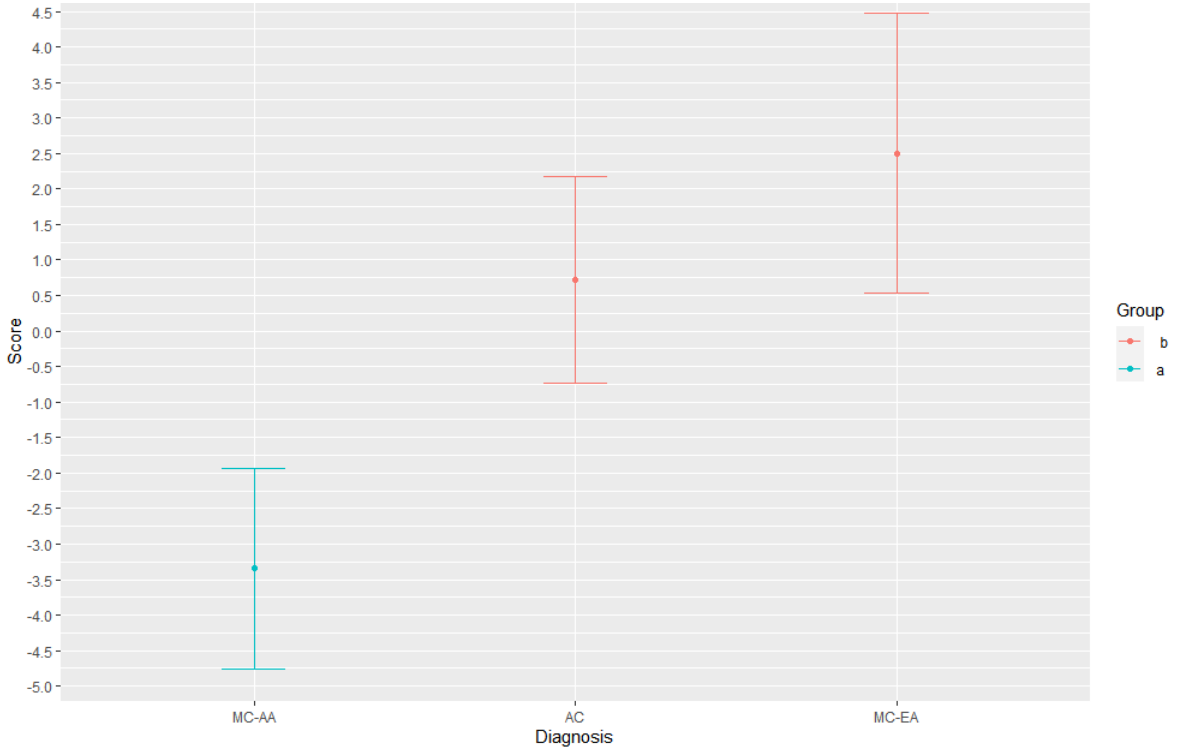


Figure 3.9 (cont'd)

(b) Estimated marginal mean total coping score per severity of symptoms (n = 86)

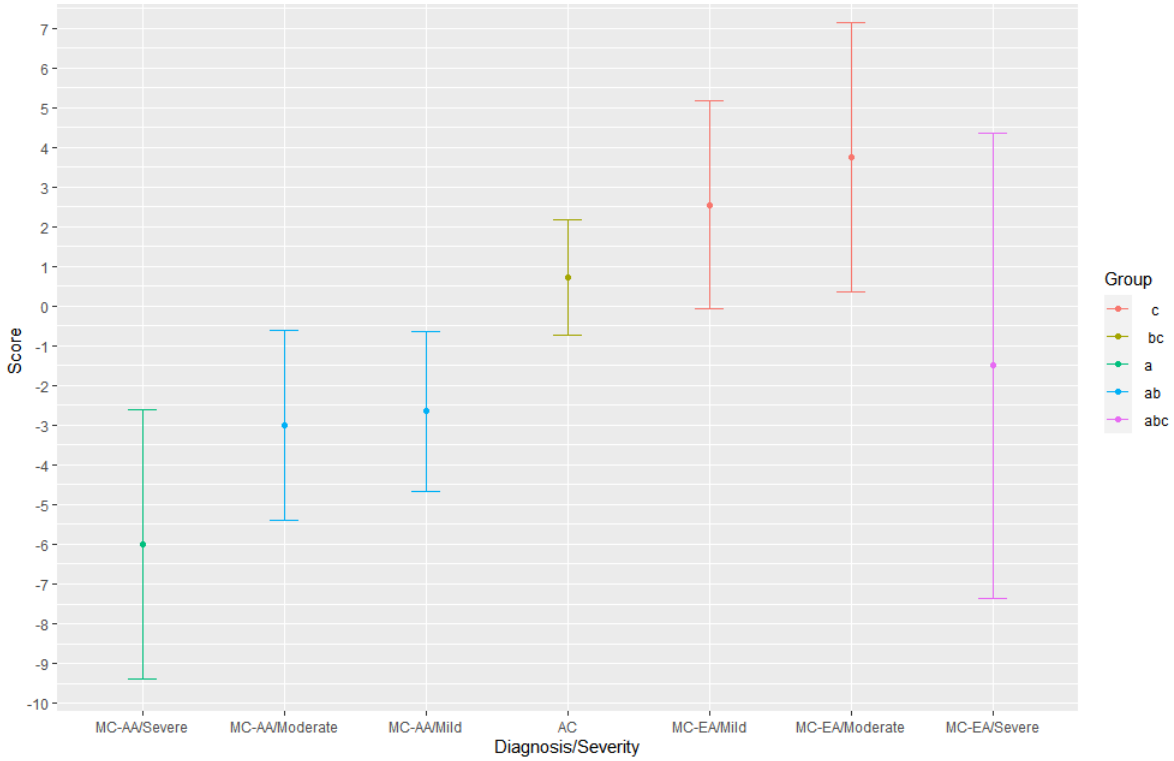


Table 3.5. Total score as predicted by diagnosis, linear mixed model. Total coping score was analyzed for validity using a linear mixed model to determine the total score as predicted by diagnosis (diag.) for four models (Full Model, Reduced Model, Refined Model A, Refined Model B) for pooled indoor + outdoor assessments. Additionally, the Full Model was analyzed for indoor and outdoor assessments separately. Pairwise significant differences ($p \leq 0.05$) between estimated marginal means (emmeans) are designated within each model by superscripts. For all models, the emmean for MC-AA is significantly different than those for AC and MC-EA dogs except for the indoor assessments using the Full Model. Across all models, there is a numeric difference between negative emmeans for MC-AA dogs and positive emmeans for MC-EA dogs with the emmeans for AC dogs falling between the two. There is evidence that the score range for MC-AA dogs is significantly different than that of MC-EA and AC dogs (contrast $p \leq 0.05$) for all models except indoor assessments using the Full Model.

	Full Model (15 scored prompts)			**Reduced Model (14 scored prompts)**	**Refined Model A (7 scored prompts)**	**Refined Model B (9 scored prompts)**
	Indoor (n=41)	Outdoor (n=43)	Pooled (n=84)	Pooled (n=84)	Pooled (n=86)	Pooled (n=86)
Diag.	**Estimated marginal mean ±SE**					
MC-AA	-3.00[a] ±1.280	-4.176[a] ±0.898	-3.588[a] ±0.773	-4.43[a] ±0.751	-2.89[a] ±0.685	-3.34[a] ±0.710
AC	1.367[a] ±1.362	1.647[b] ±0.898	1.516[b] ±0.796	1.23[b] ±0.774	0.727[b] ±0.706	0.727[b] ±0.731
MC-EA	1.444[a] ±1.759	3.833[b] ±1.234	2.639[b] ±1.062	1.97[b] ±1.032	2.417[b] ±0.955	2.500[b] ±0.990
	***p*-value for contrasts**					
AC : MC-AA	0.063	0.0001*	<0.0001*	<0.0001*	0.0015*	0.004*
MC-EA : MC-AA	0.116	<0.0001*	<0.0001*	<0.0001*	0.0001*	<0.0001*
MC-EA : AC	0.999	0.334	0.676	0.8354	0.3341	0.325

*Significant at α = 0.05

Superscripts denote statistically significant differences between marginal means within each model

Among the scored prompts included in the Refined Model B, several responses were not observed (n = 9) (Table 3.6). Of the nine responses that were never observed, two would have caused the analysis to end (sc04(d) and sc04€) and therefore would have zero dogs included in the analysis. The observed mode matched the predicted response for 20 responses, while 10 responses had the most dogs diagnosed in a category other than expected.

Table 3.6. Contingency table for Refined Model B (n = 86). The response contingency table for all scored prompts included in the Refined Model B shows the number of dogs per diagnosis that received each score. The highest proportion of dogs per response (row) is illustrated with bold font. Positive values are predicted to have the largest proportion of MC-EA dogs, negative values are predicted to have the highest proportion of MC-AA dogs, and zero values are predicted to have the highest proportion of AC dogs. Responses with the highest proportion of dogs other than what was expected are shown by bold red font for diagnoses columns (n).

Prompt	Abbrev.	Response	*Score*	MC-AA (n)	AC (n)	MC- EA (n)
Presentation	sc01(a)	Friendly/Attentive/Neutral	*0*	29	**34**	17
with closed	sc01(b)	Dissociated (fearful/stressed)	*-3*	0	0	0
door,	sc01(c)	Aware (fearful/stressed)	*-1.5*	**7**	0	1
HAI 1	sc01(d)	Hyper-active	*1.5*	0	0	**2**
	sc01(e)	Aggression	*3*	**1**	0	0
	sc01(f)	Hidden from view	*NULL*	0	0	0
Presentation	sc03(a)	Friendly/Attentive/Neutral	*0*	29	**31**	20
with open	sc03(b)	Dissociated (fearful/stressed)	*-3*	0	0	0
door,	sc03(c)	Aware (fearful/stressed)	*-1.5*	**8**	1	0
HAI 1	sc03(d)	Hyper-active	*1.5*	0	**1**	0
	sc03(e)	Aggression	*3*	0	0	0
	sc03(f)	Hidden from view	*NULL*	0	0	0
Latency to	sc04(a)	Bolts	*3*	0	2	**4**
exit,	sc04(b)	Efficient	*0*	22	**26**	15
HAI 1	sc04(c)	Delayed	*-3*	**15**	5	1
	sc04(d)	Refuses to exit	*END*	0	0	0
	sc04(e)	Unsafe to allow exit	*END*	0	0	0
Initial	sc05(a)	Engages in play	*0*	5	**21**	12
reaction to	sc05(b)	Approach - does not engage	*3*	**28**	12	8
play,	sc05(c)	No approach - does not engage	*-3*	**4**	1	0
HAI 2						

Table 3.6 (cont'd)

Ease of putting away toys, HAI 2	sc06(a)	Easy - not engaged with toy	*-3*	**31**	20	10
	sc06(b)	Easy with trade for treat	*0*	5	**13**	8
	sc06(c)	Difficult - multiple trades required	*3*	0	1	**2**
Response to treat, HAI 3	sc08(a)	Consumes while standing or moving	*3*	3	**12**	5
	sc08(b)	Consumes while lying/sitting or plays with treat	*0*	5	**12**	3
	sc08(c)	Ignores treat/brief interest or holds treat in mouth without consuming	*-3*	**29**	10	10
Activity, HAI 3	sc09(a)	Neutral - stationary	*0*	**13**	6	5
	sc09(b)	Neutral - active	*0*	16	**24**	10
	sc09(c)	Stressed - stationary	*-3*	**3**	1	1
	sc09(d)	Stressed - active	*3*	**5**	3	4
Ability to obtain dog's attention, HAI 6	sc03(a)	No - oriented toward stimulus	*3*	9	**10**	5
	sc03(b)	No - retreat from stimulus	*-3*	1	1	**2**
	sc03(c)	No - uninterested	*0*	0	0	0
	sc13(d)	Yes	*0*	**27**	23	13
Approach to kennel entry, HAI 7	sc14(a)	Actively pulling towards entry	*-3*	0	0	0
	sc14(b)	Actively pulling away from entry	*1.5*	4	0	**5**
	sc14(c)	Actively pulling/darting in multiple directions	*3*	3	4	**8**
	sc14(d)	Requires encouragement	*0*	**11**	4	4
	sc14(e)	Cooperative	*0*	18	**26**	3

Several prompts were unscored (usc01-usc07, pilo1-pilo8) and used to gather exploratory data in anticipation that the information may prove beneficial in maladaptive coping diagnosis (Table 3.7). Many of the behavioral responses (n = 28) were never observed and excluded from analysis (X^2 = N/A). Responses from three of the five non-mutually exclusive prompts (Overall body language, HAI 1 (usc02), Overall body language, HAI 2 (usc04), and

Miscellaneous behavior, HAI 3 (usc05)) were found to be correlated with at least one of the three diagnoses at a clinically relevant level ($p \leq 0.10$). Three of the responses for these prompts were statistically significant: Image 14, Overall body language, HAI 1 (usc02(n) $p = 9.16 \times 10^{-5}$), Image 6, Overall body language, HAI 2 (usc04(f) $p = 8.92 \times 10^{-3}$), and Image 8, Overall body language, HAI 2 (usc04(h) $p = 4.68 \times 10^{-3}$). An additional five unscored responses were above statistical significance but within clinical value ($0.0167 < p \leq 0.10$): Image 11, Overall body language, HAI 1 (usc02(k) $p = 0.467$), Image 18, Overall body language, HAI 1 (usc02(r) $p = 0.033$), Image 10, Overall body language, HAI 2 (usc04(j) $p = 0.020$), Image 11, Overall body language, HAI 2 (usc04(k) $p = 0.089$), and None, Miscellaneous behavior, HAI 3 (usc05(f) $p = 0.066$). There was no evidence at either a statistical significance or clinical relevance the following prompts are biologically relevant: In-kennel miscellaneous behavior, HAI 8 (usc06), Out-of-kennel miscellaneous behavior (usc07), Location after approach, HAI 1 (usc01), Location with open door, HAI 1 (usc03), and Piloerection, HAI 1-8 (pilo1-pilo8).

Table 3.7. Unscored response correlation to diagnosis. Unscored prompts were analyzed for correlation to diagnosis using a Chi-squared (X^2) test or Fisher's exact test. A clinically meaningful *p*-value ($p \leq 0.10$) indicates a relationship between diagnosis and behavior, i.e., response. Unscored prompts where there is no evidence of a relationship between all possible responses and diagnosis were candidates for removal during refinement. **(a)** Responses for unscored prompts usc02, usc04-usc07, and pilo1-pilo8 that are correlated to diagnosis at a clinically meaningful level ($p \leq 0.10$) are considered biologically relevant to coping ability. **(b)** Because the assumption of large cell count was violated for usc01 and usc03, correlation to diagnosis was analyzed using the Fisher's exact test (R code: fisher.test). There was no evidence of a relationship between in-kennel location (usc01 and usc03) and diagnosis.

(a) Responses tested with the Chi-squared test

Abbrev.	Unscored Prompt	Response	X^2	*p*
usc02(a)	Overall body language, HAI 1	Image 1	2.985	0.225
usc02(b)	Overall body language, HAI 1	Image 2	N/A	.
usc02(c)	Overall body language, HAI 1	Image 3	4.000	0.135
usc02(d)	Overall body language, HAI 1	Image 4	N/A	.
usc02(e)	Overall body language, HAI 1	Image 5	N/A	.
usc02(f)	Overall body language, HAI 1	Image 6	1.738	0.419
usc02(g)	Overall body language, HAI 1	Image 7	1.695	0.429
usc02(h)	Overall body language, HAI 1	Image 8	1.561	0.458

Table 3.7 (cont'd)

usc02(i)	Overall body language, HAI 1	Image 9	N/A	.
usc02(j)	Overall body language, HAI 1	Image 10	0.449	0.799
usc02(k)	Overall body language, HAI 1	Image 11	6.129	0.0467*
usc02(l)	Overall body language, HAI 1	Image 12	2.235	0.327
usc02(m)	Overall body language, HAI 1	Image 13	N/A	.
usc02(n)	Overall body language, HAI 1	Image 14	18.596	$9.16x10^{-05}$**
usc02(o)	Overall body language, HAI 1	Image 15	N/A	.
usc02(p)	Overall body language, HAI 1	Image 16	N/A	.
usc02(q)	Overall body language, HAI 1	Image 17	N/A	.
usc02(r)	Overall body language, HAI 1	Image 18	6.824	0.033*
usc02(s)	Overall body language, HAI 1	Image 19	N/A	.
usc02(t)	Overall body language, HAI 1	Image 20	N/A	.
pilo1	Piloerection, HAI 1	Present	2.985	0.225
usc04(a)	Overall body language, HAI 2	Image 1	1.476	0.478
usc04(b)	Overall body language, HAI 2	Image 2	N/A	.
usc04(c)	Overall body language, HAI 2	Image 3	N/A	.
usc04(d)	Overall body language, HAI 2	Image 4	2.985	0.225
usc04(e)	Overall body language, HAI 2	Image 5	N/A	.
usc04(f)	Overall body language, HAI 2	Image 6	9.438	0.0089**
usc04(g)	Overall body language, HAI 2	Image 7	3.589	0.166
usc04(h)	Overall body language, HAI 2	Image 8	10.730	0.0047**
usc04(i)	Overall body language, HAI 2	Image 9	2.746	0.253
usc04(j)	Overall body language, HAI 2	Image 10	7.790	0.020*
usc04(k)	Overall body language, HAI 2	Image 11	4.831	0.089*
usc04(l)	Overall body language, HAI 2	Image 12	1.695	0.429
usc04(m)	Overall body language, HAI 2	Image 13	N/A	.
usc04(n)	Overall body language, HAI 2	Image 14	3.589	0.166
usc04(o)	Overall body language, HAI 2	Image 15	N/A	.
usc04(p)	Overall body language, HAI 2	Image 16	N/A	.
usc04(q)	Overall body language, HAI 2	Image 17	N/A	.
usc04(r)	Overall body language, HAI 2	Image 18	N/A	.
usc04(s)	Overall body language, HAI 2	Image 19	0.652	0.721
usc04(t)	Overall body language, HAI 2	Image 20	3.589	0.166
pilo2	Piloerection, HAI 2	Present	N/A	.

Table 3.7 (cont'd)

usc05(a)	Miscellaneous behavior, HAI 3	Pawing at exit	1.476	0.478
usc05(b)	Miscellaneous behavior, HAI 3	Pacing	2.985	0.225
usc05(c)	Miscellaneous behavior, HAI 3	Whining	3.504	0.173
usc05(d)	Miscellaneous behavior, HAI 3	Barking	N/A	.
usc05(e)	Miscellaneous behavior, HAI 3	Other	3.754	0.153
usc05(f)	Miscellaneous behavior, HAI 3	None	5.446	0.066*
pilo3	Piloerection, HAI 3	Present	3.589	0.166
pilo4	Piloerection, HAI 4	Present	N/A	.
pilo5	Piloerection, HAI 5	Present	N/A	.
pilo6	Piloerection, HAI 6	Present	1.308	0.520
pilo7	Piloerection, HAI 7	Present	N/A	.
usc06(a)	In-kennel misc. behavior, HAI 8	Spinning	N/A	.
usc06(b)	In-kennel misc. behavior, HAI 8	Excessive jumping	N/A	.
usc06(c)	In-kennel misc. behavior, HAI 8	Whining	0.020	0.990
usc06(d)	In-kennel misc. behavior, HAI 8	Excessive barking	1.539	0.463
usc06(e)	In-kennel misc. behavior, HAI 8	Pacing	N/A	.
usc06(f)	In-kennel misc. behavior, HAI 8	Frantic pawing at door	N/A	.
usc06(g)	In-kennel misc. behavior, HAI 8	Smeared feces in kennel	N/A	.
usc06(h)	In-kennel misc. behavior, HAI 8	Other	4.000	0.135
usc07(a)	Out-of-kennel misc. behavior, HAI 8	Dog directed reactivity	4.022	0.134
usc07(b)	Out-of-kennel misc. behavior, HAI 8	Other	2.304	0.316
pilo8	Piloerection, HAI 8	Present	3.038	0.219

**Statistically significant at $\alpha \leq 0.0167$
*Clinically meaningful at $\alpha \leq 0.10$

(b) Unscored prompts tested with Fisher's exact test

Abbrev.	**Unscored Prompt**	***p***
usc01	Location after approach, HAI 1	0.810
usc03	Location with open door, HAI 1	0.280

3.4: Discussion

The novel tool developed for measuring coping behavior can differentiate MC-AA dogs from AC and MC-EA dogs in shelters at a statistically significant level. It was piloted at a single

humane society located in the Midwest (USA); however, based on previous shelter studies, the sample population was similarly sized to that of dogs observed in shelters (Brown et al., 2013; Shih et al., 2021). Furthermore, the age distribution was representative of the typical US shelter. According to the US national shelter database, 30% of incoming shelter dogs in 2022 were less than 5 months of age, with the remainder 70% of incoming dogs 5 months or older (*Data Detail 2022*, Shelter Animals Count). Previous studies on shelter dogs have reported a range of ages; however, we see a trend across studies demonstrating most shelter dogs are juveniles to adults, with proportionately fewer geriatric residents (Arhant & Troxler, 2014; Brown et al., 2013; Patronek et al., 1996; Salman et al., 1998).

While the tool was unable to differentiate MC-EA dogs from AC dogs at a statistically significant level, numerically MC-EA dogs had higher marginal mean total scores than AC dogs across all models apart from the Full Model for Indoor Assessments, in which there was a numerical difference between means with no evidence of statistical significance. The failure to detect a statistical difference in total scores from indoor assessments is likely due to the influential impact of the two MC-EA/severe dogs that both scored negative total coping scores. No dogs had extreme negative or positive coping scores. Therefore, our hypotheses were partially supported in that we saw negative scores for MC-AA dogs and positive scores for MC-EA dogs while scores for AC dogs fell between the two, although the range was more moderate than predicted. There was an unexpectedly low proportion of MC-EA dogs compared to AC and MC-AA dogs in our sample population in comparison to the focal sample from the pilot study. When considering severity, there were only two dogs diagnosed with MC-EA severe. It is possible that our study did not have enough power to detect a statistically significant difference between MC-EA and AC dogs. Additionally, the median total score was not as expected considering the diagnosis distribution of the sample population. This suggests that the scale of the scoring rubric may have been too narrow to capture the variation among dogs. The score values assigned to each prompt should be reassessed in future studies.

The effectiveness of a behavior assessment for shelter use depends not only on reliability and validity, but also on practicality. The tool must be easy to implement and efficient. Therefore, several components of the tool are candidates for removal based on validity analysis.

Removal of clinically irrelevant components will improve the efficiency of the behavior assessment for practical use. While initial refinement was based on statistical methods (Model A), clinical expertise informed the additional inclusion of sc01 and sc03 (Model B). Within the industry, kennel presentation is weighed considerably in staff's evaluation of shelter dogs. The removal of kennel presentation may decrease user support, rendering the tool impractical. The final iteration of the tool, therefore, consists of nine scored prompts (sc01, sc03-sc06, sc08, sc09, sc13, sc14) and three unscored prompts (usc02, usc04, usc05) observed across five HAI's (see Appendix E).

Areas of concern that need further evaluation and critique include the statistically insignificant findings of sc01 and sc03, and the incongruent distribution of diagnoses for sc01, sc05, sc09, and sc13. There was no statistical evidence that sc01 and sc03, which score in-kennel presentation, were significantly correlated with diagnosis. However, indirect evidence indicates that in-kennel presentation may be clinically relevant; body language images 11, 14, and 18 (usc02(k), usc02(n), usc02(r)) were correlated with diagnosis. Within the shelter industry, in-kennel presentation is heavily considered during formal and informal assessments. Disregard for in-kennel presentation may decrease professional support in implementing the tool. It is possible that the response options for in-kennel presentation ('Friendly/attentive/neutral', 'Dissociated (fearful/stressed)', 'Aware (fearful/stressed)', 'Hyper-active', 'Aggression', or 'Hidden from view') are not fully representative of the behavioral responses of shelter dogs. Assessment videos should be coded for in-kennel behavior to further evaluate the format and terminology of in-kennel presentation.

Of the statistically significant scored prompts, there were four prompts (sc01, sc05, sc09, sc13) with incongruent proportion of MC-AA to MC-EA dogs receiving either positive or negative scores for that prompt. For scored prompts that correlate with diagnosis, it was expected that MC-AA dogs would have negative scores and MC-EA dogs would have positive scores with some variation. Therefore, the proportion of dogs receiving positive scores should predominately be MC-EA dogs while negative scores should predominately be MC-AA dogs. 'Activity, HAI 3' (sc09) had five MC-AA dogs score +3 while four MC-EA dogs scored +3. 'Ability to obtain the dog's attention, HAI 6' (sc13) had two MC-EA dogs score –3 while one MC-AA dog scored –3. These

results could be explained by low occurrence and consequently low power. Further validity testing using a larger sample population could better reveal the relationship of these two prompts to diagnosis. However, the remaining prompt, 'Initial reaction to play, HAI 2' (sc05) had 28 MC-AA dogs score +3 while only eight MC-EA dogs scored +3. This is likely due to an error in score value assignment. 'Approach - does not engage' (sc05(b) was assigned a score value of +3. Upon re-evaluation by a board-certified veterinarian behaviorist, we believe this value should be negative. There is evidence that sc05(b) is significantly correlated with diagnosis which is reflected in the variation across diagnostic groups; however, we would propose restructuring the prompt to better represent MC-AA and MC-EA behaviors. Allotting –3 points to sc05(b) would better represent validity results, but video analysis and behavior coding of the assessment videos can further inform appropriate revisions.

The scored prompt 'Presentation with closed door, HAI 1' (sc01) which was included in Refined Model B, had one MC-AA dog score +3 for 'Aggression' (sc01(e)). This was the only instance of 'Aggression' for in-kennel presentation. 'Aggression' was defined in the ethogram as the presence of any one of the following behaviors: growling, snarling, snapping, lunging with lips drawn away from teeth, hard stare with freeze. Dogs may exhibit aggression due to various motivational states including both fear and excitement (Leuscher & Reisner, 2008). By ascribing +3 points to 'Aggression', valence is assumed to be excessive arousal, which may not always be the case. Furthermore, dogs that posed a safety risk due to aggression (i.e., bite history) were excluded from enrollment. 'Aggression' may be an inappropriate category for evaluating in-kennel behavior and instead more nuanced behaviors such as specific body language signals should be considered. Tool revision should include re-evaluation of in-kennel presentation response categories based on the behavioral coding of assessment videos.

There was evidence that three of the unscored prompts were clinically relevant (usc02, usc04, usc05). Overall Body Language, HAI 1 (usc02) and Overall Body Language, HAI 2 (usc04) prompts the assessor to circle all that apply from a collection of 20 images. While only six images were found to be clinically or statistically significant, results could be influenced by the presence of all 20 images and therefore none of the responses should be eliminated during refinement. However, for Miscellaneous behavior, HAI 3 (usc05), the response options should be

revised to better reflect the clinical findings. Assessors were instructed to circle all that apply from a selection of six responses; however, the only response that was clinically significant was 'None' (usc05(f)). Despite the nonexclusive nature of the prompt, if 'None' was selected, the assessor would not have selected any of the other options. This implies that it is the absence of behaviors that correlates with at least one diagnosis. To improve usability, usc05 was revised to capture the presence or absence of each behavior for the refined assessment (Appendix E). Responses were restructured based on relatedness and integration of the predominant behaviors written for response 'Other (write)' (usc05(e)). Therefore, the revised prompt became 'Are the following behaviors observed (Yes or No), HAI 3' with the responses 'Attention seeking through close proximity/touch', 'Vigilance to environment', 'Vocalizing', and 'Pacing and/or pawing at exit' for inclusion in the refined assessment form (Appendix E).

Upon evaluation post-analysis, the tool was found to lack the ability to quantify solicitation of human touch. Anecdotally, there was variation among individuals during acclimation and Play (HAI 2) in desire to interact with the human through proximity. Several dogs that were not interested in play were content to receive petting and scratching from the assessor instead. Additionally, during Settle (HAI 3), assessors were instructed to ignore the dog and observe behavior independent from human cues. However, several dogs would solicit attention during this time, illustrated by the inclusion of 'Attention seeking through close proximity/touch' in the refined assessment form. HAI 3 was predominately inspired by the collection of studies that investigate activity as it correlates with shelter dog welfare (for review see Protopopova, 2016). Monitoring activities like eating, resting, or drinking in the presence of a human is common practice in shelters as a measure of positive welfare (Bauer et al., 2017). Therefore, HAI 3 included the opportunity for independent activity with the availability of a food reward. A water dish located in the assessment area was available throughout the assessment. Incorporating a measurement for solicitation of touch in either HAI 2 or HAI 3 may improve the tool's ability to differentiate between diagnostic groups.

During HAI 6, the dog is allowed to interact with the model dog off-leash, of which the behavior of the dog was clinically relevant to diagnostic outcome. The version of the tool analyzed for reliability and validity included the unscored, open-response prompt 'Note

behavior after the dog is let off-leash' (supp.01). Written responses were not analyzed in this study; however, future evaluation of behavior using video coding can inform the addition of a score for interaction with the model dog while off-leash.

3.4.i: Limitations

The histories of shelter dogs are largely unknown, confounding the ability to comment on behavioral influences from past experiences. There is the potential that prior experiences may influence behavior during certain human-animal interactions, as familiar scenarios may cause a conditioned response in lieu of a coping response. However, it is unlikely that the assessed dogs would have experienced similar interactions unless they have previously been housed at a shelter that performs temperament testing. Future goals include validation of the refined tool to track behavioral changes in shelter over time. Habituation to the assessment can be expected, however sensitization may indicate poor coping ability. Therefore, it is possible that prior experience with behavior testing does not limit the ability of the tool to quantify coping ability. Longitudinal studies that follow individuals across time are needed to validate repeat performance.

Factors that may have affected behavior during assessment include the presence of an additional human (the second rater) and the presence of the GoPro cameras. For reliability testing (discussed in Chapter 2), there were two raters present during assessments. One rater handled the dog and performed the assessment while the second rater observed without interacting with the dog. Initial reaction to the observer and cameras ranged from avoidance, absence of acknowledgement, or exploratory approach. Most dogs reacted with approach, and it is unlikely behavior was significantly affected as all dogs assumed neutral behavior toward the observer and cameras after acclimation.

Criterion validity was established by a single veterinarian. While the gold-standard for psychological diagnosis in dogs is the evaluation by a veterinarian behaviorist, it is possible that factors such as video perspective and unknown medical history may have affected diagnostics. Evaluation of the assessment videos by additional veterinarian behaviorists and subsequent reliability analysis could reduce the margin of error. Validation of the tool is statistically limited to differentiating MC-AA dogs from AC and MC-EA dogs. The inability of the tool to identify MC-

EA may have been a consequence of low power or the influence of the two identified influential outliers that were diagnosed MC-EA/severe, both of which scored a negative value for total coping score.

3.4.ii: Future goals

Additional studies examining reliability and validity in various shelters would provide a more comprehensive understanding of coping behavior in relation to tool use. Future goals should be to a) validate the refined tool's ability to differentiate between MC-EA and AC dogs and b) establish score values that communicate pharmaceutical need using the receiver operating characteristic (ROC) curve to establish optimal cut-off points (Akobeng, 2007c). Once threshold values are established for diagnosis of MC-AA and MC-EA dogs, specificity (proportion of true AC dogs that score AC) and sensitivity (proportion of true MC dogs that score MC) can be determined to calculate likelihood ratios (the ratio between the probability of observing the score in MC dogs to the probability of observing the same result in AC dogs), commonly reported as a measure for the usefulness of diagnostic tests (Akobeng, 2007a; Akobeng, 2007b). Finally, the refined tool can be used in future studies to track behavioral changes over time and in response to behavioral interventions. Long-term, the assessment could be distributed externally and formatted for a mobile app that automatically logs behavior into a shared database accessible by shelter staff and veterinarians to facilitate fluid partnerships. Such a database could be utilized to deepen our understanding of species-specific needs and coping strategies on a multicentric level and inform the care and welfare of shelter dogs nationally or even internationally.

3.5: Conclusion

A novel tool was developed to assess and quantify coping behavior of shelter dogs. The tool was able to statistically differentiate MC-AA dogs and numerically differentiate MC-EA dogs from AC dogs based on total coping score. Six of the original 15 scored prompts and four of the original seven unscored prompts can be eliminated while maintaining validity, resulting in a refined version of the tool that consists of five HAI's: Approach (formerly In-Kennel: Begin, HAI 1), Play (formerly Play, HAI 2), Settle (formerly Settle, HAI 3), Model Dog (formerly Distraction, HAI 6), and Return (formerly In-Kennel: Return, HAI 7). The refined tool will be further edited

based on behavioral coding of assessment videos before use in future studies to validate the refined version of the assessment and to track behavioral changes in shelter dogs over time and in response to pharmaceutical interventions.

BIBLIOGRAPHY

Abrams, J., Brennen, R., & Byosiere, S.E. (2020). Trazodone as a mediator of transitional stress in a shelter: Effects on illness, length of stay, and outcome. *Journal of Veterinary Behavior*, *36*, 13–18.

Ader, R., & Cohen, N. (1993). Psychoneuroimmunology: Conditioning and stress. *Annual Review of Psychology*, *44*, 53–85.

Akobeng, A. K. (2007a). Understanding diagnostic tests 1: Sensitivity, specificity and predictive values. *Acta Paediatrica*, *96*(3), 338–341.

Akobeng, A. K. (2007b). Understanding diagnostic tests 2: Likelihood ratios, pre- and post-test probabilities and their use in clinical practice. *Acta Paediatrica*, *96*(4), 487–491.

Akobeng, A. K. (2007c). Understanding diagnostic tests 3: Receiver operating characteristic curves. *Acta Paediatrica*, *96*(5), 644–647.

Albuquerque, N., & Resende, B. (2023). Dogs functionally respond to and use emotional information from human expressions. *Evolutionary Human Sciences*, *5*, e2.

Appleby, D. L., Bradshaw, J. W., & Casey, R. A. (2002). Relationship between aggressive and avoidance behaviour by dogs and their experience in the first six months of life. *The Veterinary Record*, *150*(14), 434–438.

Arena, L., Berteselli, G. V., Lombardo, F., Candeloro, L., Dalla Villa, P., & De Massis, F. (2019a). Application of a welfare assessment tool (Shelter Quality Protocol) in 64 Italian long-term dogs' shelters: Welfare hazard analysis. *Animal Welfare* , *28*(3), 353–363.

Arena, L., Wemelsfelder, F., Messori, S., Ferri, N., & Barnard, S. (2017). Application of Free Choice Profiling to assess the emotional state of dogs housed in shelter environments. *Applied Animal Behaviour Science*, *195*, 72–79.

Arena, L., Wemelsfelder, F., Messori, S., Ferri, N., & Barnard, S. (2019b). Development of a fixed list of terms for the Qualitative Behavioural Assessment of shelter dogs. *PloS One*, *14*(10), e0212652.

Arhant, C., & Troxler, J. (2014). Approach behaviour of shelter dogs and its relationships with the attitudes of shelter staff to dogs. *Applied Animal Behaviour Science*, *160*, 116–126.

Ballantyne, K. C. (2018). Separation, confinement, or noises: What is scaring that dog? *The Veterinary Clinics of North America. Small Animal Practice*, *48*(3), 367–386.

Barnard, S., Pedernera, C., Candeloro, L., Ferri, N., Velarde, A., & Dalla Villa, P. (2016). Development of a new welfare assessment protocol for practical application in long-term dog shelters. *The Veterinary Record*, *178*(1), 18.

Barnard, S., Siracusa, C., Reisner, I., Valsecchi, P., & Serpell, J. A. (2012). Validity of model devices used to assess canine temperament in behavioral tests. *Applied Animal Behaviour Science*, *138*(1), 79–87.

Barnard, S., Wells, D. L., & Hepper, P. G. (2018). Laterality as a Predictor of Coping Strategies in Dogs Entering a Rescue Shelter. *Symmetry*, *10*(11), 538.

Bartlett, P. C., Bartlett, A., Walshaw, S., & Halstead, S. (2005). Rates of euthanasia and adoption for dogs and cats in Michigan animal shelters. *Journal of Applied Animal Welfare Science: JAAWS*, *8*(2), 97–104.

Bateson, P. (2014). Play, Playfulness, Creativity and Innovation. *Animal Behavior and Cognition*, *1*(2), 99–112.

Bauer, A. E., Jordan, M., Colon, M., Shreyer, T., & Croney, C. C. (2017). Evaluating FIDO: Developing and pilot testing the Field Instantaneous Dog Observation tool. *Pet Behaviour Science*, *4*, 1–15.

Beerda, B., Schilder, M. B., Bernadina, W., van Hooff, J. A., de Vries, H. W., & Mol, J. A. (1999b). Chronic stress in dogs subjected to social and spatial restriction. II. Hormonal and immunological responses. *Physiology & Behavior*, *66*(2), 243–254.

Beerda, B., Schilder, M. B., van Hooff, J. A., & de Vries, H. W. (1997). Manifestations of chronic and acute stress in dogs. *Applied Animal Behaviour Science*, *52*(3), 307–319.

Beerda, B., Schilder, M. B., van Hooff, J. A., de Vries, H. W., & Mol, J. A. (1999a). Chronic stress in dogs subjected to social and spatial restriction. I. Behavioral responses. *Physiology & Behavior*, *66*(2), 233–242.

Bennett, S. L., Litster, A., Weng, H.Y., Walker, S. L., & Luescher, A. U. (2012). Investigating behavior assessment instruments to predict aggression in dogs. *Applied Animal Behaviour Science*, *141*(3), 139–148.

Benus, R. F., Bohus, B., Koolhaas, J. M., & van Oortmerssen, G. A. (1989). Behavioural strategies of aggressive and non-aggressive male mice in active shock avoidance. *Behavioural Processes*, *20*(1-3), 1–12.

Berteselli, G. V., Arena, L., Candeloro, L., Dalla Villa, P., & De Massis, F. (2019). Interobserver agreement and sensitivity to climatic conditions in sheltered dogs' welfare evaluation

performed with welfare assessment protocol (Shelter Quality protocol). *Journal of Veterinary Behavior*, *29*, 45–52.

Biemer, P. P. (2010). Total survey error: Design, implementation, and evaluation. *Public Opinion Quarterly, 74*(5), 817–848.

Bollen, K. S., & Horowitz, J. (2008). Behavioral evaluation and demographic information in the assessment of aggressiveness in shelter dogs. *Applied Animal Behaviour Science*, *112*(1), 120–135.

Boxall, J., Heath, S., Bate, S., & Brautigam, J. (2004). Modern concepts of socialisation for dogs: Implications for their behaviour, welfare and use in scientific procedures. *Alternatives to Laboratory Animals: ATLA*, *32* (sup2), 81–93.

Bradley, J., & Rajendran, S. (2021). Increasing adoption rates at animal shelters: A two-phase approach to predict length of stay and optimal shelter allocation. *BMC Veterinary Research*, *17*, 70.

Bray, E. E., Sammel, M. D., Seyfarth, R. M., Serpell, J. A., & Cheney, D. L. (2017). Temperament and problem solving in a population of adolescent guide dogs. *Animal Cognition*, *20*(5), 923–939.

Broom, D. M. (1991). Animal welfare: Concepts and measurement. *Journal of Animal Science*, *69*(10), 4167–4175.

Broom, D. M. (2019). Welfare concepts. In J.C. Choe (Ed.), *Encyclopedia of animal behavior (second edition)* (Vol. 1, pp. 80–83). Academic Press.

Brown, W. P., Davidson, J. P., & Zuefle, M. E. (2013). Effects of phenotypic characteristics on the length of stay of dogs at two no kill animal shelters. *Journal of Applied Animal Welfare Science: JAAWS*, *16*(1), 2–18.

Buff, P. R., Carter, R. A., Bauer, J. E., & Kersey, J. H. (2014). Natural pet food: a review of natural diets and their impact on canine and feline physiology. *Journal of Animal Science*, *92*(9), 3781–3791.

Burghardt, G. M. (2005). *The genesis of animal play: Testing the limits*. MIT Press.

Burghardt, G. M., Bartmess-LeVasseur, J. N., Browning, S. A., Morrison, K. E., Stec, C. L., Zachau, C. E., & Freeberg, T. M. (2012). Perspectives - minimizing observer bias in behavioral studies: A review and recommendations. *Ethology: Formerly Zeitschrift Fur Tierpsychologie*, *118*(6), 511–517.

Canine Life Stage Definitions. (n.d.). Retrieved August 17, 2023, from https://www.aaha.org/aaha-guidelines/life-stage-canine-2019/canine-life-stage-definitions/

Cannon, W. B. (1915). *Bodily changes in pain, hunger, fear, and rage: An account of recent researches into the function of emotional excitement*. New York: D. Appleton.

Carenzi, C., & Verga, M. (2009). Animal welfare: Review of the scientific concept and definition. *Italian Journal of Animal Science*, *8*(sup1), 21–30.

Cicchetti, D. V., & Feinstein, A. R. (1990). High agreement but low kappa: II. Resolving the paradoxes. *Journal of Clinical Epidemiology*, *43*(6), 551–558.

Clay, L., Paterson, M. B., Bennett, P., Perry, G., & Phillips, C. C. (2020). Do behaviour assessments in a shelter predict the behaviour of dogs post-adoption? *Animals*, *10*(7), 1225.

Cohen, J. (1960). Kappa: Coefficient of concordance. *Educational and Psychological Measurement*.

Cohen, S. E., & Todd, P. M. (2019). Stated and revealed preferences in companion animal choice. *Behavior Research Methods*, *51*(4), 1498–1509.

Coppola, C. L., Enns, R. M., & Grandin, T. (2006a). Noise in the animal shelter environment: Building design and the effects of daily noise exposure. *Journal of Applied Animal Welfare Science: JAAWS*, *9*(1), 1–7.

Coppola, C. L., Grandin, T., & Enns, R. M. (2006b). Human interaction and cortisol: Can human contact reduce stress for shelter dogs? *Physiology & Behavior*, *87*(3), 537–541.

Corsetti, S., Borruso, S., Malandrucco, L., Spallucci, V., Maragliano, L., Perino, R., D'Agostino, P., & Natoli, E. (2021). *Cannabis sativa* L. may reduce aggressive behaviour towards humans in shelter dogs. *Scientific Reports*, *11*(1), 2773.

Corson, S. A., & O'Leary Corson, E. (1976). Constitutional differences in physiologic adaptation to stress and distress. In G. Serban (Ed.), *Psychopathology of Human Adaptation* (pp. 77–94). Springer US.

Couper, M. P. (2001). Web survey design and administration. *Public Opinion Quarterly, 65*(2), 230–253.

Data Detail 2022. (n.d.). Shelter Animals Count. Retrieved August, 17 2023, from https://www.shelteranimalscount.org/intake-and-outcome-database-iod/

Dawkins, M. S. (1998). Evolution and animal welfare. *The Quarterly Review of Biology*, *73*(3), 305–328.

De Boer, S. F., Slangen, J. L., & Van der Gugten, J. (1990). Plasma catecholamine and corticosterone levels during active and passive shock-prod avoidance behavior in rats: Effects of chlordiazepoxide. *Physiology & Behavior*, *47*(6), 1089–1098.

De Palma, C., Viggiano, E., Barillari, E., Palme, R., Dufour, A. B., Fantin, C., & Natoli, E. (2005). Evaluating the temperament in shelter dogs. *Behaviour*, *142*(9), 1307–1328.

Diederich, C., & Giffroy, J.-M. (2006). Behavioural testing in dogs: A review of methodology in search for standardisation. *Applied Animal Behaviour Science*, *97*(1), 51–72.

Diesel, G., Brodbelt, D., & Pfeiffer, D. U. (2008). Reliability of assessment of dogs' behavioural responses by staff working at a welfare charity in the UK. *Applied Animal Behaviour Science*, *115*(3-4), 171–181.

Diesel, G., Brodbelt, D., & Pfeiffer, D. U. (2010). Characteristics of relinquished dogs and their owners at 14 rehoming centers in the United Kingdom. *Journal of Applied Animal Welfare Science: JAAWS*, *13*(1), 15–30.

Dillman, D. A. (2011). *Mail and Internet Surveys: The Tailored Design Method – 2007 Update with New Internet, Visual, and Mixed-Mode Guide*. John Wiley & Sons.

Dowling-Guyer, S., Marder, A., & D'Arpino, S. (2011). Behavioral traits detected in shelter dogs by a behavior evaluation. *Applied Animal Behaviour Science*, *130*(3), 107–114.

Downes, M. J., Dean, R. S., Stavisky, J. H., Adams, V. J., Grindlay, D. J. C., & Brennan, M. L. (2013). Methods used to estimate the size of the owned cat and dog population: A systematic review. *BMC Veterinary Research*, *9*, 121.

Engel, G. L., & Schmale, A. H. (1972). Conservation-withdrawal: A primary regulatory process for organismic homeostasis. In R. Porter & J. Knight (Eds.), *Physiology, emotion, & psychosomatic illness* (pp. 57–85). Associated Scientific Publishers.

Feigenson, K. A., Kusnecov, A. W., & Silverstein, S. M. (2014). Inflammation and the two-hit hypothesis of schizophrenia. *Neuroscience and Biobehavioral Reviews*, *38*, 72–93.

Feinstein, A. R., & Cicchetti, D. V. (1990). High agreement but low kappa: I. The problems of two paradoxes. *Journal of Clinical Epidemiology*, *43*(6), 543–549.

Fidler, M., Light, P., & Costall, A. (1996). Describing dog behavior psychologically: Pet owners versus non-owners. *Anthrozoös*, *9*(4), 196–200.

Foyer, P., Svedberg, A.M., Nilsson, E., Wilsson, E., Faresjö, Å., & Jensen, P. (2016). Behavior and cortisol responses of dogs evaluated in a standardized temperament test for military working dogs. *Journal of Veterinary Behavior*, *11*, 7–12.

Fraser, D., & Duncan, I. J. (1998). 'Pleasures', 'pains' and animal welfare: Toward a natural history of affect. *Animal Welfare*, *7*(4), 383–396.

Gee, N. R., Rodriguez, K. E., Fine, A. H., & Trammell, J. P. (2021). Dogs supporting human health and well-being: A biopsychosocial approach. *Frontiers in Veterinary Science*, *8*, 630465.

Gilbert-Gregory, S. E., Stull, J. W., Rice, M. R., & Herron, M. E. (2016). Effects of trazodone on behavioral signs of stress in hospitalized dogs. *Journal of the American Veterinary Medical Association: JAVMA*, *249*(11), 1281–1291.

Goddard, M. E., & Beilharz, R. G. (1984). A factor analysis of fearfulness in potential guide dogs. *Applied Animal Behaviour Science*, *12*(3), 253–265.

Goddard, M. E., & Beilharz, R. G. (1985). A multivariate analysis of the genetics of fearfulness in potential guide dogs. *Behavior Genetics*, *15*(1), 69–89.

Gold, P., Goodwin, F., & Chrousos, G. (1988). Clinical and biochemical manifestations of depression. *The New England Journal of Medicine*, *319*(7), 413–420.

Gruen, M. E., Roe, S. C., Griffith, E., Hamilton, A., & Sherman, B. L. (2014). Use of trazodone to facilitate postsurgical confinement in dogs. *Journal of the American Veterinary Medical Association*, *245*(3), 296–301.

Gruen, M. E., & Sherman, B. L. (2008). Use of trazodone as an adjunctive agent in the treatment of canine anxiety disorders: 56 cases (1995-2007). *Journal of the American Veterinary Medical Association*, *233*(12), 1902–1907.

Gunter, L. M., Feuerbacher, E. N., Gilchrist, R. J., & Wynne, C. D. (2019). Evaluating the effects of a temporary fostering program on shelter dog welfare. *PeerJ*, *7*, e6620.

Harvey, N. D. (2021). *A Simple Guide to Inter-rater, Intra-rater and Test-retest Reliability for Animal Behaviour Studies*. School of Veterinary Medicine and Science, University of Nottingham.

Haverbeke, A., Diederich, C., Depiereux, E., & Giffroy, J. M. (2008). Cortisol and behavioral responses of working dogs to environmental challenges. *Physiology & Behavior*, *93*, 59–67.

Hawes, S. M., Camacho, B. A., Tedeschi, P., & Morris, K. N. (2019). Temporal trends in intake and outcome data for animal shelter and rescue facilities in Colorado from 2000 through 2015. *Journal of the American Veterinary Medical Association: JAVMA*, *254*(3), 363–372.

Hawes, S. M., Hupe, T. M., Gandenberger, J., & Morris, K. N. (2021). Temporal trends in intake category data for animal shelter and rescue organizations in Colorado from 2008 to 2018. *Journal of the American Veterinary Medical Association: JAVMA*, *260*(3), 311–319.

Hennessy, M. B. (2013). Using hypothalamic–pituitary–adrenal measures for assessing and reducing the stress of dogs in shelters: A review. *Applied Animal Behaviour Science*, *149*(1), 1–12.

Hennessy, M. B., Davis, H. N., Williams, M. T., Mellott, C., & Douglas, C. W. (1997). Plasma cortisol levels of dogs at a county animal shelter. *Physiology & Behavior*, *62*(3), 485–490.

Hennessy, M. B., Morris, A., & Linden, F. (2006). Evaluation of the effects of a socialization program in a prison on behavior and pituitary–adrenal hormone levels of shelter dogs. *Applied Animal Behaviour Science*, *99*(1), 157–171.

Hennessy, M. B., Voith, V. L., Hawke, J. L., Young, T. L., Centrone, J., McDowell, A. L., Linden, F., & Davenport, G. M. (2002). Effects of a program of human interaction and alteration in diet composition on activity of the hypothalamic-pituitary-adrenal axis in dogs housed in a public animal shelter. *Journal of the American Veterinary Medical Association: JAVMA*, *221*(1), 65–71.

Hennessy, M. B., Williams, M. T., Miller, D. D., Douglas, C. W., & Voith, V. L. (1998). Influence of male and female petters on plasma cortisol and behaviour: Can human interaction reduce the stress of dogs in a public animal shelter? *Applied Animal Behaviour Science*, *61*(1), 63–77.

Hennessy, M. B., Willen, R. M., & Schiml, P. A. (2020). Psychological Stress, Its Reduction, and Long-Term Consequences: What Studies with Laboratory Animals Might Teach Us about Life in the Dog Shelter. *Animals*, *10*(11), 2061.

Henry, J. P., & Stephens, P. M. (1977). *Stress, health, and the social environment: A sociobiologic approach to medicine* (K. E. Schaefer, Ed.). Springer-Verlag New York Inc.

Herron, M. E., Lord, L. K., & Husseini, S. E. (2014). Effects of preadoption counseling on the prevention of separation anxiety in newly adopted shelter dogs. *Journal of Veterinary Behavior*, *9*(1), 13–21.

Hessing, M. J., Hagelsø, A. M., Schouten, W. G., Wiepkema, P. R., & Van Beek, J. A. (1994). Individual behavioral and physiological strategies in pigs. *Physiology & Behavior*, *55*(1), 39–46.

Hetts, S., Derrell Clark, J., Calpin, J. P., Arnold, C. E., & Mateo, J. M. (1992). Influence of housing conditions on beagle behaviour. *Applied Animal Behaviour Science*, *34*(1), 137–155.

Hiby, E. F., Rooney, N. J., & Bradshaw, J. W. (2006). Behavioural and physiological responses of dogs entering re-homing kennels. *Physiology & Behavior*, *89*(3), 385–391.

Horowitz, A. (2009). Attention to attention in domestic dog (*Canis familiaris*) dyadic play. *Animal Cognition*, *12*(1), 107–118.

Horváth, Z., Dóka, A., & Miklósi, A. (2008). Affiliative and disciplinary behavior of human handlers during play with their dog affects cortisol concentrations in opposite directions. *Hormones and Behavior*, *54*(1), 107–114.

Horváth, Z., Igyártó, B.-Z., Magyar, A., & Miklósi, A. (2007). Three different coping styles in police dogs exposed to a short-term challenge. *Hormones and Behavior*, *52*(5), 621–630.

Hubrecht, R. C., Serpell, J. A., & Poole, T. B. (1992). Correlates of pen size and housing conditions on the behaviour of kennelled dogs. *Applied Animal Behaviour Science,34*(4), 365-383.

Hubrecht, R. C., Wickens, S., & Kirkwood, J. (2017). The welfare of dogs in human care. In J. A. Serpell (Ed.), *The domestic dog: Its evolution, behavior and interactions with people* (second, pp. 271–299). Cambridge University Press.

Jones, A. C., & Gosling, S. D. (2005). Temperament and personality in dogs (*Canis familiaris*): A review and evaluation of past research. *Applied Animal Behaviour Science*, *95*(1), 1–53.

Jones, B., & Boissy, A. (2011). Fear and other negative emotions. In M. C. Appleby, J. A. Mench, I. A. Olsson, & B. O. Hughes (Eds.), *Animal welfare* (pp. 78–98). CAB International.

Kartashova, I. A., Ganina, K. K., Karelina, E. A., & Tarasov, S. A. (2021). How to evaluate and manage stress in dogs – A guide for veterinary specialist. *Applied Animal Behaviour Science*, *243*, 105458.

Kiddie, J. L., & Collins, L. M. (2014). Development and validation of a quality of life assessment tool for use in kennelled dogs (*Canis familiaris*). *Applied Animal Behaviour Science*, *158*, 57–68.

Kim, S. A., Borchardt, M. R., Lee, K., Stelow, E. A., & Bain, M. J. (2022). Effects of trazodone on behavioral and physiological signs of stress in dogs during veterinary visits: A randomized double-blind placebo-controlled crossover clinical trial. *Journal of the American Veterinary Medical Association: JAVMA, 260*(8), 876–883.

King, T., Hemsworth, P. H., & Coleman, G. J. (2003). Fear of novel and startling stimuli in domestic dogs. *Applied Animal Behaviour Science*, *82*(1), 45–64.

Knudson, A. G., Jr. (1971). Mutation and cancer: Statistical study of retinoblastoma. *Proceedings of the National Academy of Sciences of the United States of America*, *68*(4), 820–823.

Koolhaas, J. M., Korte, S. M., De Boer, S. F., Van Der Vegt, B. J., Van Reenen, C. G., Hopster, H., De Jong, I. C., Ruis, M. A., & Blokhuis, H. J. (1999). Coping styles in animals: Current status in behavior and stress-physiology. *Neuroscience and Biobehavioral Reviews*, *23*(7), 925–935.

Korte, S. M., Buwalda, B., Bouws, G. A., Koolhaas, J. M., Maes, F. W., & Bohus, B. (1992). Conditioned neuroendocrine and cardiovascular stress responsiveness accompanying behavioral passivity and activity in aged and in young rats. *Physiology & Behavior*, *51*(4), 815–822.

Korte, S. M., Ruesink, W., & Blokhuis, H. J. (1999). Heart rate variability during manual restraint in chicks from high- and low-feather pecking lines of laying hens. *Physiology & Behavior*, *65*(4-5), 649–652.

Kuhne, F., Hößler, J. C., & Struwe, R. (2014). Emotions in dogs being petted by a familiar or unfamiliar person: Validating behavioural indicators of emotional states using heart rate variability. *Applied Animal Behaviour Science*, *161*, 113–120.

Lamon, T. K., Slater, M. R., Moberly, H. K., & Budke, C. M. (2021). Welfare and quality of life assessments for shelter dogs: A scoping review. *Applied Animal Behaviour Science*, *244*, 105490.

Lazar, J., Dudley-Sponaugle, A., & Greenidge, K.-D. (2004). Improving web accessibility: A study of webmaster perceptions. *Computers in Human Behavior, 20*(2), 269–288.

Lazzaroni, M., Range, F., Backes, J., Portele, K., Scheck, K., & Marshall-Pescini, S. (2020). The effect of domestication and experience on the social interaction of dogs and wolves with a human companion. *Frontiers in Psychology*, *11*, 785.

Ley, J., Coleman, G. J., Holmes, R., & Hemsworth, P. H. (2007). Assessing fear of novel and startling stimuli in domestic dogs. *Applied Animal Behaviour Science*, *104*, 71–84.

Lindsay, S. R. (2005). *Handbook of applied dog behavior and training: Procedures and protocols* (S. R. Lindsay (Ed.)) [PDF]. Iowa State University Press.

Lucidi, P., Bernabò, N., Panunzi, M., Villa, P. D., & Mattioli, M. (2005). Ethotest: A new model to identify (shelter) dogs' skills as service animals or adoptable pets. *Applied Animal Behaviour Science*, *95*(1), 103–122.

Luescher, A. U., & Reisner, I. R. (2008). Canine aggression toward familiar people: A new look at an old problem. *The Veterinary Clinics of North America. Small Animal Practice*, *38*(5), 1107–1130.

Luescher, A. U., & Medlock, R. T. (2009). The effects of training and environmental alterations on adoption success of shelter dogs. *Applied Animal Behaviour Science*, *117*(1), 63–68.

Maestripieri, D., Schino, G., Aureli, F., & Troisi, A. (1992). A modest proposal: Displacement activities as an indicator of emotions in primates. *Animal Behaviour*, *44*(5), 967–979.

Maier, S. F. (1984). Learned helplessness and animal models of depression. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, *8*(3), 435–446.

Manteca, X., Villalba, J. J., Atwood, S. B., Dziba, L., & Provenza, F. D. (2008). Is dietary choice important to animal welfare? *Journal of Veterinary Behavior*, *3*(5), 229–239.

Marsh, D. M., & Hanlon, T. J. (2007). Seeing what we want to see: Confirmation bias in animal behavior research. *Ethology*, *113*(11), 1089–1098.

Marston, L. C., & Bennett, P. C. (2003). Reforging the bond—Towards successful canine adoption. *Applied Animal Behaviour Science*, *83*(3), 227–245.

Martin, P., & Caro, T. M. (1985). On the functions of play and its role in behavioral development. In J. S. Rosenblatt, C. Beer, M. C. Busnel, & P. J. B. Slater (Eds.), *Advances in the study of behavior* (Vol. 15, pp. 59–103). Academic Press.

McCall, G. J. (1984). Systematic Field Observation. *Annual Review of Sociology*, *10*, 263–282.

McNicholas, J., Gilbey, A., Rennie, A., Ahmedzai, S., Dono, J. A., & Ormerod, E. (2005). Pet ownership and human health: A brief review of evidence and issues. *British Medical Journal: BMJ* , *331*(7527), 1252–1254.

Menchetti, L., Righi, C., Guelfi, G., Enas, C., Moscati, L., Mancini, S., & Diverio, S. (2019). Multi-Operator Qualitative Behavioural Assessment for dogs entering the shelter. *Applied Animal Behaviour Science*, *213*, 107–116.

Menor-Campos, D. J., Molleda-Carbonell, J. M., & López-Rodríguez, R. (2011). Effects of exercise and human contact on animal welfare in a dog shelter. *The Veterinary Record*, *169*(15), 388.

Mertens, P. A., & Unshelm, J. (1996). Effects of group and individual housing on the behaviour of kennelled dogs in animal shelters. *Anthrozoos*, *9*(1), 40–51.

Meyer, I., Forkman, B., & Paul, E. S. (2014). Factors affecting the human interpretation of dog behavior. *Anthrozoös*, *27*(1), 127–140.

Mornement, K. M., Coleman, G. J., Toukhsati, S., & Bennett, P. C. (2014). Development of the behavioural assessment for re-homing K9's (B.A.R.K.) protocol. *Applied Animal Behaviour Science*, *151*, 75–83.

Mornement, K. M., Coleman, G. J., Toukhsati, S. R., & Bennett, P. C. (2015). Evaluation of the predictive validity of the Behavioural Assessment for Re-homing K9's (B.A.R.K.) protocol and owner satisfaction with adopted dogs. *Applied Animal Behaviour Science*, *167*, 35–42.

Morris, E. M., Kitts-Morgan, S. E., Spangler, D. M., McLeod, K. R., Costa, J. H., & Harmon, D. L. (2020). The impact of feeding cannabidiol (CBD) containing treats on canine response to a noise-induced fear response test. *Frontiers in Veterinary Science*, *7*, 569565.

Mugenda, L., Shreyer, T., & Croney, C. (2019). Refining canine welfare assessment in kennels: Evaluating the reliability of Field Instantaneous Dog Observation (FIDO) scoring. *Applied Animal Behaviour Science*, *221*, 104874.

Murphy, J. A. (1998). Describing categories of temperament in potential guide dogs for the blind. *Applied Animal Behaviour Science*, *58*(1), 163–178.

Netto, W. J., & Planta, D. J. (1997). Behavioural testing for aggression in the domestic dog. *Applied Animal Behaviour Science*, *52*(3), 243–263.

Normando, S., Stefanini, C., Meers, L., Adamelli, S., Coultis, D., & Bono, G. (2006). Some factors influencing adoption of sheltered dogs. *Anthrozoös*, *19*(3), 211–224.

Overall, K. L. (2017). Appeasement, calming signals, and information capture: How do our subjects tell us what matters to them? *Journal of Veterinary Behavior*, *19*, v – viii.

Part, C. E., Kiddie, J. L., Hayes, W. A., Mills, D. S., Neville, R. F., Morton, D. B., & Collins, L. M. (2014). Physiological, physical and behavioural changes in dogs (*Canis familiaris*) when kennelled: Testing the validity of stress parameters. *Physiology & Behavior*, *133*, 260–271.

Pastore, C., Pirrone, F., Balzarotti, F., Faustini, M., Pierantoni, L., & Albertini, M. (2011). Evaluation of physiological and behavioral stress-dependent parameters in agility dogs. *Journal of Veterinary Behavior*, *6*(3), 188–194.

Patronek, G. J., & Bradley, J. (2016). No better than flipping a coin: Reconsidering canine behavior evaluations in animal shelters. *Journal of Veterinary Behavior*, *15*, 66–77.

Patronek, G. J., Bradley, J., & Arps, E. (2019). What is the evidence for reliability and validity of behavior evaluations for shelter dogs? A prequel to “No better than flipping a coin.” *Journal of Veterinary Behavior*, *31*, 43–58.

Patronek, G. J., & Glickman, L. T. (1994). Development of a model for estimating the size and dynamics of the pet dog population. *Anthrozoos*, *7*(1), 25–42.

Patronek, G. J., Glickman, L. T., Beck, A. M., McCabe, G. P., & Ecker, C. (1996). Risk factors for relinquishment of dogs to an animal shelter. *Journal of the American Veterinary Medical Association: JAVMA*, *209*(3), 572–581.

Pedretti, G., Canori, C., Biffi, E., Marshall-Pescini, S., & Valsecchi, P. (2023). Appeasement function of displacement behaviours? Dogs’ behavioural displays exhibited towards threatening and neutral humans. *Animal Cognition*, *26*(3), 943–952.

Pet Statistics. (n.d.). ASPCA. Retrieved August 2, 2023, from https://www.aspca.org/helping-people-pets/shelter-intake-and-surrender/pet-statistics

Polgár, Z., Blackwell, E. J., & Rooney, N. J. (2019). Assessing the welfare of kennelled dogs-A review of animal-based measures. *Applied Animal Behaviour Science*, *213*, 1–13.

Popescu, S., Borda, C., El Mahdy, C., Lazar, E. A., Blaga Petrean, A., Campean, I. D., & Spinu, M. (2018). The effect of a social enrichment programme on the behaviour of dogs from a private shelter. *Bulletin UASVM Veterinary Medicine*, *75*(2), 222–230.

Powell, L., Houlihan, C., Stone, M., Gitlin, I., Ji, X., Reinhard, C. L., & Watson, B. (2021). Animal shelters’ response to the COVID-19 pandemic: A pilot survey of 14 shelters in the northeastern United States. *Animals*, *11*(9), 2669.

Prato-Previde, E., Custance, D. M., Spiezio, C., & Sabatini, F. (2003). Is the dog-human relationship an attachment bond? An observational study using Ainsworth’s strange situation. *Behaviour*, *140*(2), 225–254.

Previde, E. P., & Valsechhi, P. (2007). Effects of abandonment on attachment behavior of adult pet dogs. *Journal of Veterinary Behavior: Clinical Applications and Research*, *2*(3), 87–88.

Protopopova, A. (2016). Effects of sheltering on physiology, immune function, behavior, and the welfare of dogs. *Physiology & Behavior*, *159*, 95–103.

Protopopova, A., & Gunter, L. M. (2017). Adoption and relinquishment interventions at the animal shelter: A review. *Animal Welfare* , *26*(1), 35–48.

Protopopova, A., Hauser, H., Goldman, K. J., & Wynne, C. D. (2018). The effects of exercise and calm interactions on in-kennel behavior of shelter dogs. *Behavioural Processes*, *146*, 54–60.

Protopopova, A., Mehrkam, L. R., Boggess, M. M., & Wynne, C. D. (2014). In-kennel behavior predicts length of stay in shelter dogs. *PloS One*, *9*(12), e114319.

Protopopova, A., & Wynne, C. D. (2014). Adopter-dog interactions at the shelter: Behavioral and contextual predictors of adoption. *Applied Animal Behaviour Science*, *157*, 109–116.

Protopopova, A., & Wynne, C. D. (2015). Improving in-kennel presentation of shelter dogs through response-dependent and response-independent treat delivery. *Journal of Applied Behavior Analysis*, *48*(3), 590–601.

Pullen, A. J., Merrill, R. J., & Bradshaw, J. W. (2010). Preferences for toy types and presentations in kennel housed dogs. *Applied Animal Behaviour Science*, *125*(3), 151–156.

Q2 2023 Analysis. (2023). Shelter Animals Count. https://www.shelteranimalscount.org/wp-content/uploads/2023/07/Q2-Report.pdf

Reid, P., & Collins, K. (2012). Assessing conspecific aggression in fighting dogs. *Proceedings of the AVSAB/ACVB Meeting*, 37–39.

Řezáč, P., Viziová, P., Dobešová, M., Havlíček, Z., & Pospíšilová, D. (2011). Factors affecting dog–dog interactions on walks with their owners. *Applied Animal Behaviour Science*, *134*(3), 170–176.

Rodriguez, J. R., Davis, J., Hill, S., Wolf, P. J., Hawes, S. M., & Morris, K. N. (2022). Trends in intake and outcome data from U.S. animal shelters from 2016 to 2020. *Frontiers in Veterinary Science*, *9*, 863990.

Rooney, N. J., Bradshaw, J. W., & Robinson, I. H. (2000). A comparison of dog–dog and dog–human play behaviour. *Applied Animal Behaviour Science*, *66*(3), 235–248.

Rooney, N. J., Gaines, S. A., & Bradshaw, J. W. (2007). Behavioural and glucocorticoid responses of dogs (*Canis familiaris*) to kennelling: Investigating mitigation of stress by prior habituation. *Physiology & Behavior*, *92*(5), 847–854.

Rowan, A., & Kartal, T. (2018). Dog Population & Dog Sheltering Trends in the United States of America. *Animals*, *8*(5), 0068.

Ruis, M. A., te Brake, J. H., van de Burgwal, J. A., de Jong, I. C., Blokhuis, H. J., & Koolhaas, J. M. (2000). Personalities in female domesticated pigs: Behavioural and physiological indications. *Applied Animal Behaviour Science*, *66*(1), 31–47.

Russo, A., Dowling-Guyer, S., & McCobb, E. (2021). Community programming for companion dog retention: A survey of animal welfare organizations. *Journal of Applied Animal Welfare Science: JAAWS*, 1–15.

Sales, G., Hubrecht, R., Peyvandi, A., Milligan, S., & Shield, B. (1997). Noise in dog kennelling: Is barking a welfare problem for dogs? *Applied Animal Behaviour Science*, *52*(3), 321–329.

Salman, M. D., New, J. G., Jr, Scarlett, J. M., Kass, P. H., Ruch-Gallie, R., & Hetts, S. (1998). Human and animal factors related to relinquishment of dogs and cats in 12 selected animal shelters in the United States. *Journal of Applied Animal Welfare Science: JAAWS*, *1*(3), 207–226.

Scheifele, P., Martin, D., Clark, J. G., Kemper, D., & Wells, J. (2012). Effect of kennel noise on hearing in dogs. *American Journal of Veterinary Research*, *73*(4), 482–489.

Schouten, W. G., & Wiegant, V. M. (1997). Individual responses to acute and chronic stress in pigs. *Acta Physiologica Scandinavica. Supplementum*, *640*, 88–91.

Serpell, J. A. (1996). Evidence for an association between pet behavior and owner attachment levels. *Applied Animal Behaviour Science*, *47*(1), 49–60.

Serpell, J. A. (2019). How happy is your pet? The Problem of subjectivity in the assessment of companion animal welfare. *Animal Welfare* , *28*(1), 57–66.

Shabelansky, A., Dowling-Guyer, S., Quist, H., D'Arpino, S. S., & McCobb, E. (2015). Consistency of shelter dogs' behavior toward a fake versus real stimulus dog during a behavior evaluation. *Applied Animal Behaviour Science*, *163*, 158–166.

Sherman, B. L., Gruen, M. E., Case, B. C., Foster, M. L., Fish, R. E., Lazarowski, L., DePuy, V., & Dorman, D. C. (2015). A test for the evaluation of emotional reactivity in Labrador retrievers used for explosives detection. *Journal of Veterinary Behavior*, *10*(2), 94–102.

Shih, H. Y., Paterson, M. B., Georgiou, F., & Phillips, C. J. (2021). Do canine behavioural assessments and characteristics predict the human-dog interaction when walking on a leash in a shelter setting? *Animals*, *11*(1), 0026.

Shiverdecker, M. D., Schiml, P. A., & Hennessy, M. B. (2013). Human interaction moderates plasma cortisol and behavioral responses of dogs to shelter housing. *Physiology & Behavior*, *109*, 75–79.

Sloan Wilson, D., Clark, A. B., Coleman, K., & Dearstyne, T. (1994). Shyness and boldness in humans and other animals. *Trends in Ecology & Evolution*, *9*(11), 442–446.

Smaldino, P. E., Palagi, E., Burghardt, G. M., & Pellis, S. M. (2019). The evolution of two types of play. *Behavioral Ecology*, *30*(5), 1388–1397.

Smith, S. M., & Vale, W. W. (2006). The role of the hypothalamic-pituitary-adrenal axis in neuroendocrine responses to stress. *Dialogues in Clinical Neuroscience*, *8*(4), 383–395.

Sommerville, R., O'Connor, E. A., & Asher, L. (2017). Why do dogs play? Function and welfare implications of play in the domestic dog. *Applied Animal Behaviour Science*, *197*, 1–8.

Stahl, S. M. (2021). *Stahl's essential psychopharmacology: Neuroscientific basis and practical applications*. Cambridge University Press.

Stelow, E. (2018). Diagnosing Behavior Problems: A Guide for Practitioners. *The Veterinary Clinics of North America. Small Animal Practice*, *48*(3), 339–350.

Stone, H. R., McGreevy, P. D., Starling, M. J., & Forkman, B. (2016). Associations between Domestic-Dog Morphology and Behaviour Scores in the Dog Mentality Assessment. *PloS One*, *11*(2), e0149403.

Sundman, A. S., Johnsson, M., Wright, D., & Jensen, P. (2016). Similar recent selection criteria associated with different behavioural effects in two dog breeds. *Genes, Brain, and Behavior*, *15*(8), 750–756.

Svartberg, K., & Forkman, B. (2002). Personality traits in the domestic dog (*Canis familiaris*). *Applied Animal Behaviour Science*, *79*(2), 133–155.

Svartberg, K., Tapper, I., Temrin, H., Radesäter, T., & Thorman, S. (2005). Consistency of personality traits in dogs. *Animal Behaviour*, *69*(2), 283–291.

Szydlowski, M., & Gragg, C. (2020). An overview of the current and potential effects of COVID-19 on US Animal Shelters. In *AIJR Preprints* (157, version 1). University of Exeter. https://preprints.aijr.org/index.php/ap/preprint/view/157

Tami, G., & Gallagher, A. (2009). Description of the behaviour of domestic dog (*Canis familiaris*) by experienced and inexperienced people. *Applied Animal Behaviour Science*, *120*, 159–169.

Taylor, K. D., & Mills, D. S. (2006). The development and assessment of temperament tests for adult companion dogs. *Journal of Veterinary Behavior*, *1*(3), 94–108.

Taylor, K. D., & Mills, D. S. (2007). The effect of the kennel environment on canine welfare: A critical review of experimental studies. *Animal Welfare*, *16*, 435–447.

Titulaer, M., Blackwell, E. J., Mendl, M., & Casey, R. A. (2013). Cross sectional study comparing behavioural, cognitive and physiological indicators of welfare between short and long term kennelled domestic dogs. *Applied Animal Behaviour Science*, *147*(1), 149–158.

Tod, E., Brander, D., & Waran, N. (2005). Efficacy of dog appeasing pheromone in reducing stress and fear related behaviour in shelter dogs. *Applied Animal Behaviour Science*, *93*(3), 295–308.

Tuber, D. S., Sanders, S., Hennessy, M. B., & Miller, J. A. (1996). Behavioral and glucocorticoid responses of adult domestic dogs (*Canis familiaris*) to companionship and social separation. *Journal of Comparative Psychology*, *110*(1), 103–108.

Tuyttens, F. A., de Graaf, S., Heerkens, J. L., Jacobs, L., Nalon, E., Ott, S., Stadig, L., Van Laer, E., & Ampe, B. (2014). Observer bias in animal behaviour research: Can we believe what we score, if we score what we believe? *Animal Behaviour*, *90*, 273–280.

van Oortmerssen, G. A., & Bakker, T. C. (1981). Artificial selection for short and long attack latencies in wild *Mus musculus domesticus*. *Behavior Genetics*, *11*(2), 115–126.

van Rooij, S. J., Stevens, J. S., Ely, T. D., Hinrichs, R., Michopoulos, V., Winters, S. J., Ogbonmwan, Y. E., Shin, J., Nugent, N. R., Hudak, L. A., Rothbaum, B. O., Ressler, K. J., & Jovanovic, T. (2018). The role of the hippocampus in predicting future posttraumatic stress disorder symptoms in recently traumatized civilians. *Biological Psychiatry*, *84*(2), 106–115.

Vanbelle, S. (2016). A New Interpretation of the Weighted Kappa Coefficients. *Psychometrika*, *81*(2), 399–410.

vonHoldt, B. M., & Driscoll, C. A. (2017). Origins of the dog: Genetic insights into dog domestication. In J. A. Serpell (Ed.), *The domestic dog: Its evolution, behavior and interactions with people* (second, pp. 22–41). Cambridge University Press.

Walker, J. K., Dale, A. R., D'Eath, R. B., & Wemelsfelder, F. (2016). Qualitative Behaviour Assessment of dogs in the shelter and home environment and relationship with quantitative behaviour assessment and physiological responses. *Applied Animal Behaviour Science*, *184*, 97–108.

Walker, J. K., Waran, N. K., & Phillips, C. J. (2014). The effect of conspecific removal on the behaviour and physiology of pair-housed shelter dogs. *Applied Animal Behaviour Science*, *158*, 46–56.

Wechsler, B. (1995). Coping and coping strategies: A behavioural view. *Applied Animal Behaviour Science*, *43*(2), 123–134.

Weiss, E. (2007). *SAFER Guide and Forms* [pdf file]. American Society for the Prevention of Cruelty to Animals: ASPCA. Retrieved from https://aspcapro.org/sites/default/files/safer-guide-and-forms.pdf

Wells, D. L. (2004). A review of environmental enrichment for kennelled dogs, *Canis familiaris*. *Applied Animal Behaviour Science*, *85*(3), 307–317.

Wells, D. L. (2009). Sensory stimulation as environmental enrichment for captive animals: A review. *Applied Animal Behaviour Science*, *118*(1), 1–11.

Wells, D. L., Graham, L., & Hepper, P. G. (2002). The influence of auditory stimulation on the behaviour of dogs housed in a rescue shelter. *Animal Welfare*, *11*, 385–393.

Wells, D. L., & Hepper, P. G. (2000). The influence of environmental change on the behaviour of sheltered dogs. *Applied Animal Behaviour Science*, *68*(2), 151–162.

Wenstrup, J., & Dowidchuk, A. (1999). Pet overpopulation: Data and measurement issues in shelters. *Journal of Applied Animal Welfare Science: JAAWS*, *2*(4), 303–319.

Wilsson, E., & Sinn, D. L. (2012). Are there differences between behavioral measurement methods? A comparison of the predictive validity of two ratings methods in a working dog program. *Applied Animal Behaviour Science*, *141*(3), 158–172.

Woodruff, K., & Smith, D. R. (2020). An estimate of the number of dogs in US shelters in 2015 and the factors affecting their fate. *Journal of Applied Animal Welfare Science: JAAWS*, *23*(3), 302–314.

Zeigler, H. P. (1964). Displacement activity and motivational theory: A case study in the history of ethology. *Psychological Bulletin*, *61*(5), 362–376.

APPENDIX A: ASSESSMENT FORM DRAFTS

A.1: Draft 1

Date Start/End time / Dog name Actigraph

A) Kennel Location
   1) Front
   2) Ambivalent (approach/retreat)
   3) Back

B) Kennel Presentation
   1) Reactive
   2) Hyper / Frantic
   3) Fearful
   4) Ambivalent
   5) Friendly

C) In-kennel body language[1]
   1) 
   2) 
   3) 
   4) 
   5) 

D) Eating meals
   1) Consumed all
   2) Consumed a portion
   3) Consumed very little or none

E) Ability to take treats
   1) Won't take treat from hand but will consume if tossed on ground
   2) Consumes treat from hand
   3) Takes treat from hand but does not consume
   4) No interest in treat

F) Latency to Exit Kennel
   1) Immediate/lacks self-regulation
   2) Efficient
   3) Hesitant
   4) Resisting
   5) Unable to exit

G) Ability to Walk on Leash
   1) Behavioral issues (e.g. mouthing, jumping)
   2) Hard pulling
   3) Loose leash mostly
   4) Lagging
   5) Unable to walk on leash

H) Engagement with toy
   1) Uninterested
   2) Brief interest
   3) Playful
   4) Obsessive

I) Response to human walking dog

Ia) Latency to respond
   1) Avoidant/never
   2) Delayed
   3) Immediate

Ib) Ability to Redirect
   4) Impossible
   5) Difficult
   6) Acceptable
   7) Easy
   8) N/A - no response to stimuli

Ic) Signs of offensive aggression?
   1) Yes
   2) No

J) Engagement with person
   1) Avoidant
   2) Attentive/engaged
   3) Hyper-aroused

K) Latency to engage in chew treat
   1) Immediate
   2) Delayed
   3) Never

L) Ability to settle in presence of human with chew treat
   1) Remains standing to chew
   2) Paces with treat in mouth
   3) Lies down to chew

M) Out-of-kennel body language[1]
   1) 
   2) 
   3) 
   4) 
   5) 
   6) 

N) Activity Level
   1) Very High
   2) High
   3) Moderate
   4) Low
   5) Very Low / Inactive

O) Latency to Enter Kennel
   1) Immediate/lacks self-regulation
   2) Efficient
   3) Hesitant
   4) Resisting
   5) Unable to exit

P) Latency to engage in food enrichment
   1) Immediate
   2) Delayed
   3) No interest

Q) Elimination
   1) DEFAULT - Eliminating normally
   2) Not eliminating and/or constipation
   3) Overly eliminating and/or soft stool
   4) Smearing feces in kennel

R) Additional comments
   1) Spinning? Yes / No
   2) Excessive jumping in-kennel? Yes / No
   3) Other:_____

[1] Artist Lili Chen, "Doggie Language" doggiedrawings.net

A.2: Draft 2

Dog name:_____ Date:_____ Start/End Time: _____ / _____

IN-KENNEL: BEGIN

A) Location after approach
- 1) Front
- 3) Back
- 4) Ambivalent (approach/retreat)

B) Presentation
- 1) Friendly / Attentive
- 2) Ambivalent
- 3) Fearful
- 4) Hyper / Frantic
- 5) Reactive

C) Body language* (circle all that apply)

D) Ability to take treat
- 1) Consumes treat from hand
- 2) Takes treat from hand but does not consume
- 3) Consumes if tossed on floor
- 4) No interest in treat

E) Latency to exit kennel
- 1) Immediate / lacks self-regulation
- 2) Efficient
- 3) Hesitant
- 5) Unable to exit

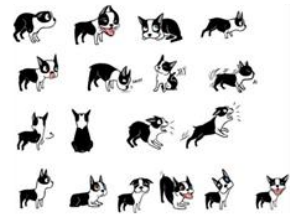
LEASH WALK

A) Ability to walk on leash
- 1) Behavioral issues (e.g. mouthing, jumping)
- 2) Hard pulling
- 3) Moderate pulling
- 4) Loose leash mostly
- 5) Lagging / hesitant
- 6) Unable to walk on leash

PLAY

A) Engagement with toy
- 1) Avoidant
- 2) Uninterested
- 3) Brief interest
- 4) Playful
- 5) Obsessive

B) Body language* (circle all that apply)



C) Activity level
- 1) Hyper / Frantic
- 2) High
- 3) Moderate
- 4) Low
- 5) Lethargic / Inactive

DISTRACTION

A) Latency to respond
- 1) Avoidant / never
- 2) Delayed
- 3) Immediate

B) Ability to redirect
- 1) Impossible
- 2) Difficult
- 3) Acceptable
- 4) N/A (no response to stimuli)

C) Body language* (circle all that apply)

AROUSAL

A) Engagement with person
- 1) Avoidant
- 2) Attentive / engaged
- 3) Ambivalent (approach/retreat)
- 4) Hyper-aroused

SETTLE IN YARD

A) Latency to approach treat
- 1) Immediate
- 2) Delayed
- 3) Never

B) Response to treat
- 1) Ignores treat
- 2) Brief interest / quick sniffs
- 3) Plays with treat but does not consume
- 4) Paces with treat in mouth
- 5) Remains standing to eat treat
- 6) Lies down to eat

C) Additional comments (circle if observed)
- 1) Pawing at exit
- 2) Pacing
- 3) Vocalizing
- 4) Other:_____

IN-KENNEL: RETURN

A) Latency to enter kennel
- 1) Immediate / lacks self-regulation
- 2) Efficient
- 3) Delayed
- 4) Resisting

B) Latency to engage in food enrichment
- 1) Immediate
- 2) Delayed
- 3) No interest

C) Presentation
- 1) Friendly / Attentive
- 2) Ambivalent
- 3) Fearful
- 4) Hyper / Frantic
- 5) Pacing
- 6) Reactive

ADDITIONAL COMMENTS

A) **"IN-KENNEL"** assessments, begin and return (circle if observed)
- 1) Spinning
- 2) Excessive jumping
- 3) Vocalizing (i.e. whine, bark)
- 4) Pacing
- 5) Pawing at door
- 6) Other:_____

B) Dog-directed reactivity (circle if observed)
- 1) Barrier aggression (e.g. fence-fighting)

GASTRO

A) Eating meals
- 1) Consumed all
- 2) Consumed a portion
- 3) Consumed very little or none

B) Elimination (circle if observed during assessments)
- 2) Constipation
- 3) Soft stool
- 4) Smeared feces in kennel
- 5) Vomiting

*Artist Lili Chen, "Doggie Language" doggiedrawings.net

A.3: Draft 3

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.
If more than one response is selected in single response questions, note the reason.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

0. ELIMINATION - circle if observed at any time
   1) Soft stool
   2) Vomiting

1. IN-KENNEL: BEGIN
A) Location after approach
   1) Front
   2) Back
   3) Middle
   4) Conflicted (approach/retreat)
B) Presentation with closed door
   1) Friendly / Attentive
   2) Lethargic
   3) Fearful
   4) Frantic
   5) Reactive
C) Activity - see category 8
D) Overall body language*
   (circle one or more)
E) Ability to take treat
   1) Consumes treat from hand
   2) Takes treat from hand but does not consume
   3) Consumes if tossed on floor
   4) No interest in treat
F) Presentation with open door
   1) No change
   2) Different than with closed door
   If (2) selected, write presentation here:
G) Latency to exit kennel
   1) Lacks self-regulation
   2) Efficient
   3) Delayed
   4) Hesitant
   5) Unable to exit

2. LEASH WALK (designated path only)
A) Ability to walk on leash
   1) Behavioral issues (e.g. mouthing, jumping)
   2) Hard pulling
   3) Moderate pulling
   4) Loose leash mostly
   5) Lagging / hesitant
   6) Unable to walk on leash

3. PLAY (3 min.)
A) Engagement in play
   1) Avoidant
   2) Uninterested
   3) Brief interest
   4) Playful
   5) Obsessive
B) Overall body language*
   (circle one or more)
C) Energy level
   1) Frantic
   2) High
   3) Moderate
   4) Low
   5) Lethargic / Inactive
D) Was assessment ended early due to behavior?
   1) Yes
   2) No

4. SETTLE IN YARD (2 min.)
A) Latency to approach treat
   1) Immediate
   2) Delayed
   3) Never
B) Response to treat
   1) Ignores treat
   2) Brief interest / quick sniffs
   3) Plays with treat but does not consume
   4) Paces with treat in mouth
   5) Remains standing to chew
   6) Lies down to chew
C) Circle if observed
   1) Pawing at exit
   2) Pacing
   3) Vocalizing (e.g. whine, bark)
   4) Other:

5. DISTRACTION
A) Overall body language* (circle one or more)
B) Circle if observed (one or more)
   1) Vocalizing (e.g. whine, bark)
   2) Signs of aggression
   3) Signs of frusteration
   4) Avoidance
   5) None
C) Ability to redirect
   1) Impossible
   2) Difficult
   3) Acceptable

6. AROUSAL (1 min. 40 sec.)
A) Engagement with person
   1) Avoidant
   2) Attentive / engaged
   3) Conflicted (approach/retreat)
   4) Hyper-aroused
D) Was assessment ended early due to behavior?
   1) Yes
   2) No

7. IN-KENNEL: RETURN
A) Latency to enter kennel
   1) Lacks self-regulation
   2) Efficient
   3) Delayed
   4) Resisting
B) Initial interest in treat
   1) Consumes
   2) Does not consume
C) Presentation in passing (after 1 min.)
   1) Attentive
   2) Engaged in enrichment
   3) Relaxed
   4) Lethargic
   5) Fearful
   6) Frantic
   7) Reactive
   8) Hidden from view
D) Activity - see category 8

8. ACTIVITY - circle if observed during in-kennel assessments
A) In-kennel
   1) Spinning
   2) Excessive jumping
   3) Vocalizing (e.g. whine, bark)
   4) Pacing
   5) Frantic pawing at door
   6) Smeared feces in kennel
   7) Other:
B) Out-of-kennel (transitory time entering/exiting)
   1) Dog directed reactivity (e.g. fence-fighting)
   2) Other:

A.4: Draft 4

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.
If more than one response is selected in single response questions, note the reason.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

0. ELIMINATION - circle if observed at any time
   1) Soft stool
   2) Vomiting

1. IN-KENNEL: BEGIN
A) Location after approach
   1) Front
   2) Back
   3) Middle
   4) Conflicted (approach/retreat)
B) Presentation with closed door
   1) Friendly / Attentive
   2) Lethargic
   3) Fearful / Stressed
   4) Frantic
   5) Reactive
C) Activity - see category 8
D) Overall body language* (circle one or more)
E) Ability to take treat
   1) Consumes treat from hand
   2) Takes treat from hand but does not consume
   3) Consumes if tossed on floor
   4) No interest in treat
F) Presentation with open door
   1) No change
   2) Different than with closed door
   If (2) selected, write presentation here:
G) Latency to exit kennel
   1) Lacks self-regulation
   2) Efficient
   3) Delayed
   4) Hesitant
   5) Unable to exit

2. LEASH WALK (designated path only)
A) Ability to walk on leash
   1) Behavioral issues (e.g. mouthing, jumping)
   2) Hard pulling
   3) Moderate pulling
   4) Loose leash mostly
   5) Lagging / Hesitant
   6) Unable to walk on leash

5. DISTRACTION (stimulus present to 20 sec. after gone)
A) Overall body language* (circle one or more)
B) Circle if observed (one or more)
   1) Vocalizing (e.g. whine, bark)
   2) Aggression
   3) Frusteration
   4) Avoidance
   5) None
C) Ability to redirect
   1) Impossible
   2) Difficult
   3) Acceptable

3. PLAY (3 min.)
A) Engagement in play
   1) Avoidant
   2) Uninterested
   3) Sporadic / Conflicted
   4) Playful
   5) Obsessive
CONTINUED ON NEXT COLUMN

3. PLAY (CONTINUED FROM PREVIOUS COLUMN)
B) Overall body language* (circle one or more)
C) Energy level
   1) Frantic
   2) High
   3) Moderate
   4) Low
   5) Lethargic / Inactive
D) Was assessment ended early due to behavior?
   1) Yes
   2) No

4. SETTLE IN YARD (2 min.)
A) Response to treat
   1) Ignores treat
   2) Brief interest / quick sniffs
   3) Plays with treat but does not consume
   4) Holds treat in mouth but does not consume
   5) Remains standing to chew
   6) Lies down to chew
B) Circle if observed
   1) Pawing at exit
   2) Pacing
   3) Vocalizing (e.g. whine, bark)
   4) Other:
C) Energy level (after 1 minute)
   1) Frantic
   2) High
   3) Moderate
   4) Low
   5) Lethargic / Inactive

6. AROUSAL (1 min. 40 sec.)
A) Engagement with person
   1) Avoidant
   2) Attentive / engaged
   3) Conflicted
   4) Hyper-aroused
D) Was assessment ended early due to behavior?
   1) Yes
   2) No

7. IN-KENNEL: RETURN
A) Latency to enter kennel
   1) Lacks self-regulation
   2) Efficient
   3) Delayed
   4) Resisting
B) Initial interest in treat
   1) Consumes
   2) Does not consume
C) Presentation in passing (after 1 min.)
   1) Attentive
   2) Engaged in environment
   3) Relaxed
   4) Lethargic
   5) Fearful / Stressed
   6) Frantic
   7) Reactive
   8) Hidden from view
D) Activity - see category 8

8. ACTIVITY - circle if observed during in-kennel assessments
A) In-kennel
   1) Spinning
   2) Excessive jumping
   3) Vocalizing (e.g. whine, bark)
   4) Pacing
   5) Frantic pawing at door
   6) Smeared feces in kennel
   7) Other:
B) Out-of-kennel (transitory time entering/exiting)
   1) Dog directed reactivity (e.g. fence-fighting)
   2) Other:

A.5: Draft 5

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted. If more than one response is selected in single response questions, note the reason.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

1. IN-KENNEL: BEGIN

A) Location after approach
- 1) Front
- 2) Back
- 3) Middle
- 4) Conflicted (approach/retreat)

B) Presentation with closed door
- 1) Friendly / Attentive
- 2) Lethargic
- 3) Fearful / Stressed
- 4) Frantic
- 5) Reactive

C) Activity - see category 8

D) Overall body language* (circle one or more)

E) Ability to take treat
- 1) Consumes treat from hand
- 2) Takes treat from hand but does not consume
- 3) Consumes if tossed on floor
- 4) No interest in treat

F) Presentation with open door
- 1) No change
- 2) Different than with closed door

If (2) selected, write presentation here:

G) Latency to exit kennel
- 1) Lacks self-regulation
- 2) Efficient
- 3) Delayed
- 4) Hesitant
- 5) Unable to exit

2. LEASH WALK (designated path only)

A) Ability to walk on leash
- 1) Behavioral issues (e.g. mouthing, jumping)
- 2) Hard pulling
- 3) Moderate pulling
- 4) Loose leash mostly
- 5) Lagging / Hesitant
- 6) Unable to walk on leash

3. PLAY (3 min.)

A) Engagement in play
- 1) Avoidant
- 2) Uninterested
- 3) Sporadic / Conflicted
- 4) Playful
- 5) Obsessive

B) Overall body language* (circle one or more)

C) Energy level
- 1) Frantic
- 2) High
- 3) Moderate
- 4) Low
- 5) Lethargic / Inactive

D) Was assessment ended early due to behavior?
- 1) Yes
- 2) No

4. SETTLE IN YARD (2 min.)

A) Response to treat
- 1) Ignores treat
- 2) Brief interest / quick sniffs
- 3) Plays with treat but does not consume
- 4) Holds treat in mouth but does not consume
- 5) Remains standing to chew
- 6) Lies down to chew

B) Circle if observed
- 1) Pawing at exit
- 2) Pacing
- 3) Vocalizing (e.g. whine, bark)
- 4) Other:

C) Energy level (after 1 minute)
- 1) Frantic
- 2) High
- 3) Moderate
- 4) Low
- 5) Lethargic / Inactive

5. AROUSAL (1 min. 40 sec.)

A) Engagement with person
- 1) Avoidant
- 2) Attentive / engaged
- 3) Conflicted
- 4) Hyper-aroused

D) Was assessment ended early due to behavior?
- 1) Yes
- 2) No

6. DISTRACTION

A) Overall body language* (while stimulus is moving) (circle one or more)

B) Ability to redirect (while stimulus is stationary, 10 sec.)
- 1) Impossible (aroused) - ignores assessor
- 2) Impossible (avoidant) - ignores assessor
- 3) Difficult (aroused) - only acknowledges assessor
- 4) Difficult (avoidant) - only acknowledges assessor
- 5) Acceptable - orients attention toward assessor

C) Manner of approach to stimulus (after dog is released for 10 sec.)
- 1) Aggressive
- 2) Aroused
- 3) Playful / Explorative / Neutral
- 4) Hesitant approach
- 5) Avoidant - does not approach

7. IN-KENNEL: RETURN

A) Latency to enter kennel
- 1) Lacks self-regulation
- 2) Efficient
- 3) Delayed
- 4) Resisting

B) Initial interest in treat
- 1) Consumes
- 2) Does not consume

C) Presentation in passing (after 1 min.)
- 1) Attentive
- 2) Engaged in environment
- 3) Relaxed
- 4) Lethargic
- 5) Fearful / Stressed
- 6) Frantic
- 7) Reactive
- 8) Hidden from view

D) Activity - see category 8

8. ACTIVITY - circle if observed during Assessments 1 & 7

A) In-kennel
- 1) Spinning
- 2) Excessive jumping
- 3) Vocalizing (e.g. whine, bark)
- 4) Pacing
- 5) Frantic pawing at door
- 6) Smeared feces in kennel
- 7) Other:

B) Out-of-kennel (transitory time entering/exiting)
- 1) Dog directed reactivity (e.g. fence-fighting)
- 2) Other:

A.6: Draft 6

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted. If more than one response is selected in single response questions, note the reason.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

1. IN-KENNEL: BEGIN
A) Location after approach
1) Front
2) Back
3) Middle
4) Not stationary
B) Presentation with closed door
1) Friendly / Attentive / Neutral
2) Dissociated (fearful/stressed)
3) Aware (fearful/stressed)
4) Hyper-active
5) Aggression
6) Hidden from view
C) Activity - see category 8
D) Overall body language*
(circle one or more)
E) Ability to take treat
1) Consumes treat from hand
2) Takes treat from hand but does not consume
3) Consumes if tossed on floor
4) No interest in treat
F) Location/presentation with open door -
Write-in answer using terms from A) and B)
1) Location:
2) Presentation:
G) Latency to exit kennel
1) Rapid
2) Efficient
3) Delayed
4) Unable to exit
5) Unsafe to allow exit

2. LEASH WALK (designated path only)
A) Ability to walk on leash
1) Mouthing (person or leash) / jumping / spinning
2) Hard pulling
3) Moderate pulling
4) Loose leash mostly
5) Lagging (fearful/stressed)
6) Unable to walk on leash

3. PLAY (3 min.)
A) Initial reaction to play (30 sec.)
1) Engages in play
2) Approach - does not engage
3) No approach - does not engage
B) Engagement in play (2.5 min.)
1) Avoidant
2) Uninterested in play
3) Sporadic play signals but no engagement
4) Playful
5) Obsessive
C) Overall body language*
(circle one or more)
D) Was play ended early?
1) Yes - over-stimulated
2) Yes - fearful
3) No

8. ACTIVITY - circle if observed during Assessments 1 & 7
A) In-kennel
1) Spinning
2) Excessive jumping
3) Whining
4) Excessive barking
5) Pacing
6) Frantic pawing at door
7) Smeared feces in kennel
8) Other:
B) Out-of-kennel (transitory time entering/exiting)
1) Dog directed reactivity (e.g. fence-fighting)
2) Other:

4. SETTLING IN PRESENCE OF HUMAN (2 min.)
A) Response to treat
1) Ignores treat
2) Brief interest / quick sniffs
3) Plays with treat but does not consume
4) Holds treat in mouth but does not consume
5) Remains standing to chew
6) Lies or sits to chew
B) Circle if observed
1) Pawing at exit
2) Pacing
3) Whining
4) Barking
5) Other:
C) Activity (after 1 minute)
1) Relaxed
2) Explorative
3) Active - stressed
4) Stationary - stressed

5. AROUSAL (1 min. 40 sec.)
A) Engagement with person
1) Avoidant
2) Attentive / engaged
3) Uninterested
4) Conflicted
5) Hyper-aroused
B) Manner of treat consumption
1) Does not consume
2) Consumes
3) Chomps
C) Was assessment ended early due to behavior?
1) Yes - over-stimulated
2) Yes - fearful
3) No

6. DISTRACTION
A) Overall body language* (while stimulus is moving)
(circle one or more)
B) Can you obtain the dog's attention?
(while stimulus is stationary, 10 sec.)
1) No - oriented toward stimulus
2) No - retreat from stimulus
3) Yes
C) Manner of approach to stimulus
(after dog is released for 10 sec.)
1) Aggression
2) Mounting
3) Initiates play
4) Social greeting
5) Uninterested (no approach)
6) Mouthing fake dog
7) Hesitant approach
8) Fearful/stressed (no approach)

7. IN-KENNEL: RETURN
A) Manner of return to kennel
1) Pulling away from entry
2) Requires encouragment to enter
3) Calmly enters
4) High energy entry
B) Initial interest in treat
1) Consumes
2) Does not consume
C) Presentation in passing (after 1 min.)
1) Friendly / Attentive / Neutral
2) Dissociated (fearful/stressed)
3) Aware (fearful/stressed)
4) Hyper-active
5) Aggression
6) Hidden from view
D) Activity - see category 8

A.7: Draft 7

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

1. IN-KENNEL: BEGIN

A) Location after approach
1) Front
2) Back
3) Middle
4) Not stationary

B) Presentation with closed door
1) Friendly / Attentive / Neutral
2) Dissociated (fearful/stressed)
3) Aware (fearful/stressed)
4) Hyper-active
5) Aggression
6) Hidden from view

C) Overall body language*
(circle one or more)

D) Ability to take treat
1) Consumes treat from hand
2) Takes treat from hand but does not consume
3) Consumes if tossed on floor
4) No interest in treat

E) Location/presentation with open door -
Write-in answer using terms from A) and B)
1) Location:
2) Presentation:

F) Manner of exit
1) High energy/lots of movement
2) High energy prior to opening door but calm exit
3) Calmly-quickly
4) Calmly-slowly
5) Delayed
6) Requires alternate method of exit
7) Unable to exit
8) Unsafe to allow exit

SEE 8. ACTIVITY (circle if observed)

2. PLAY (3 min.)

A) Initial reaction to play (first 30 sec.)
1) Engages in play
2) Approach - does not engage
3) No approach - does not engage

B) Overall body language* (first 30 sec.)
(circle one or more)

C) Was play ended early?
1) Yes - over-stimulated
2) Yes - fearful
3) No

3. SETTLE (2 min.)

A) Response to treat.
1) Ignores treat
2) Brief interest / quick sniffs
3) Plays with treat but does not consume
4) Holds treat in mouth but does not consume
5) Remains standing to chew
6) Lies or sits to chew

B) Misc. behavior (circle all observed)
1) Pawing at exit
2) Pacing
3) Whining
4) Barking
5) Other:
6) None

C) Activity (last 15 sec.)
1) Relaxed
2) Explorative
3) Active - stressed
4) Stationary - stressed

4. AROUSAL (45 sec.)

A) Manner of treat consumption (30 sec.)
1) Does not consume
2) Consumes some
3) Consumes all
4) Chomps

B) Behavior after cessation of treats (15 sec.)
1) Fearful
2) Attentive
3) Uninterested
4) Hyper-aroused

5. STARTLE

A) Response
1) Fearful
2) Attentive
3) Aggression

6. DISTRACTION

A) Overall body language* (while stimulus is moving)
(circle one)

B) Can you obtain the dog's attention?
(while stimulus is stationary, 5 sec.)
1) No - oriented toward stimulus
2) No - retreat from stimulus
3) Yes

C) Manner of approach to stimulus
(after dog is released for 10 sec.)
1) Aggression
2) Mounting
3) Initiates play
4) Social greeting
5) Uninterested (no approach)
6) Mouthing fake dog (note where and if shakes)
7) Hesitant approach
8) Fearful/stressed (no approach)

7. IN-KENNEL: RETURN

A) Manner of return
1) High energy/movement
2) Calmly-quickly
3) Calmly-slowly
4) Requires coaxing
5) Pulling away from entry

SEE 8. ACTIVITY (circle if observed)

8. ACTIVITY - circle all observed during sub-tests 1 or 8 (In-Kennel tests)

A) In-kennel misc. behavior
1) Spinning
2) Excessive jumping
3) Whining
4) Excessive barking
5) Pacing
6) Frantic pawing at door
7) Smeared feces in kennel
8) Other:

B) Out-of-kennel (while transitioning through shelter)
1) Dog directed reactivity
(e.g. barrier aggression)
2) Other:

A.8: Draft 8

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

1. IN-KENNEL: BEGIN

A) Location after approach
- 1) Front
- 2) Back
- 3) Middle
- 4) Not stationary

B) Presentation with closed door
- 1) Friendly / Attentive / Neutral
- 2) Dissociated (fearful/stressed)
- 3) Aware (fearful/stressed)
- 4) Hyper-active
- 5) Aggression
- 6) Hidden from view

C) Overall body language*
(circle one or more)

D) Ability to take treat
- 1) Consumes treat from hand
- 2) Takes treat from hand but does not consume
- 3) Consumes if tossed on floor
- 4) No interest in treat

E) Location/presentation with open door -
Write-in answer using terms from A) and B)
- 1) Location:
- 2) Presentation:

F) Manner of exit
- 1) High energy/lots of movement
- 2) High energy prior to opening door but calm exit
- 3) Calmly - quickly or slowly
- 6) Delayed
- 7) Requires alternate method of exit
- 8) Unable to exit
- 9) Unsafe to allow exit

SEE 8. ACTIVITY (circle if observed)

2. PLAY (3 min.)

A) Initial reaction to play (first 30 sec.)
- 1) Engages in play
- 2) Approach - does not engage
- 3) No approach - does not engage

B) Overall body language* (first 30 sec.)
(circle one or more)

C) Was play ended early?
- 1) Yes - over-stimulated
- 2) Yes - fearful
- 3) No

3. SETTLE (2 min.)

A) Response to treat.
- 1) Ignores treat
- 2) Brief interest / quick sniffs
- 3) Plays with treat but does not consume
- 4) Holds treat in mouth but does not consume
- 5) Remains standing to chew
- 6) Lies or sits to chew

B) Misc. behavior (circle all observed)
- 1) Pawing at exit
- 2) Pacing
- 3) Whining
- 4) Barking
- 5) Other:
- 6) None

C) Activity (last 15 sec.)
- 1) Relaxed - stationary
- 2) Relaxed - active
- 3) Stressed - stationary
- 4) Stressed - active

4. AROUSAL (45 sec.)

A) Manner of treat consumption (30 sec.)
- 1) Does not consume
- 2) Consumes some
- 3) Consumes all
- 4) Chomps

B) Behavior after cessation of treats (15 sec.)
- 1) Fearful
- 2) Attentive
- 3) Uninterested
- 4) Hyper-aroused

5. STARTLE

A) Reaction
- 1) Retreat
- 2) Startle (pronounced movement)
- 3) Freeze - upright
- 4) Freeze - cower
- 5) Stops briefly or flinches
- 6) No reaction

B) Approach to object
- 1) No approach - uninterested
- 2) No approach - fearful/stressed
- 3) Hesitant approach
- 4) Immediate approach

6. DISTRACTION

Check box next to category letters if piloerection is observed during the observation interval

☐A) Overall body language* (while stimulus is moving)
(circle one)

☐B) Can you obtain the dog's attention while on-leash?
(while stimulus is stationary, 5-10 sec.)
- 1) No - oriented toward stimulus
- 2) No - retreat from stimulus
- 3) Yes

☐C) Manner of approach to stationary stimulus (10 sec.)

☐D) Manner of approach to moving stimulus while off-leash

C	D	select one for C & D by checking box
		1) Aggression
		2) Mounting
		3) Initiates play
		4) Social greeting
		4a) Loose body
		4b) Stiff body
		5) Mouthing fake dog
		5a) Note where on stimulus
Y/N	Y/N	5b) Does the dog shake the stimulus?
		6) Hesitant approach
		7) No approach
		7a) Uninterested
		7b) Fearful/stressed
For C) & D) answer question below:		
Y/N	Y/N	Is the stimulus dislodged by the dog?

☐E) Can you obtain the dog's attention while off-leash? (5-10 sec.)
- 1) No - oriented toward stimulus
- 2) No - retreat from stimulus
- 3) Yes

7. IN-KENNEL: RETURN

A) Manner of return
- 1) High energy/movement
- 2) Calmly - quickly or slowly
- 3) Requires coaxing
- 4) Pulling away from entry

SEE 8. ACTIVITY (circle if observed)

8. ACTIVITY - circle all observed during sub-tests 1 or 8 (In-Kennel tests)

A) In-kennel misc. behavior
- 1) Spinning
- 2) Excessive jumping
- 3) Whining
- 4) Excessive barking
- 5) Pacing
- 6) Frantic pawing at door
- 7) Smeared feces in kennel
- 8) Other:

B) Out-of-kennel (while transitioning through shelter)
- 1) Dog directed reactivity (e.g. barrier aggression)
- 2) Other:

A.9: Draft 9

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.

Check box next to category letters if piloerection is observed during the score interval.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

PILOERECTION

1. IN-KENNEL: BEGIN

A) Location after approach
1) Front
2) Back
3) Middle
4) Not stationary

B) Presentation with closed door
1) Friendly / Attentive / Neutral
2) Dissociated (fearful/stressed)
3) Aware (fearful/stressed)
4) Hyper-active
5) Aggression
6) Hidden from view

C) Overall body language* (circle one or more)

D) Ability to take treat
1) Consumes treat from hand
2) Takes treat from hand but does not consume
3) Consumes if tossed on floor
4) No interest in treat

E) Location/presentation with open door - Write-in answer using terms from A) and B)
1) Location:
2) Presentation:

F) Manner of exit
1) High energy/movement
2) High energy prior to opening door but calm exit
3) Calmly - quickly or slowly
4) Delayed/requires coaxing
5) Requires alternate method of exit
6) Unable to exit
7) Unsafe to allow exit

SEE 10. ACTIVITY (circle if observed)

2. ACCLIMATION (2 min.)

A) Anxiety Score
1) None; No anxiety behaviors
2) Occassional and mild
3) Some of the time and mild/ occassional and moderate
4) Most of the time and mild/some of the time and moderate/ occassional and severe
5) Some of the time and severe/ most of the time and moderate
6) Most of the time and severe

3. PLAY (3 min.)

A) Initial reaction to play (first 30 sec.)
1) Engages in play
2) Approach - does not engage
3) No approach - does not engage

B) Overall body language* (first 30 sec.) (circle one or more)

C) Ease of putting away toys
1) Easy - not engaged with toy
2) Easy with trade for treat
3) Difficult - multiple trades required

D) Was play ended early?
1) Yes - over-stimulated
2) Yes - fearful
3) No

PILOERECTION

4. SETTLE (2 min.)

A) Response to treat.
1) Ignores treat
2) Brief interest / quick sniffs
3) Plays with treat but does not consume
4) Holds treat in mouth but does not consume
5) Remains standing to chew
6) Lies or sits to chew

B) Misc. behavior (circle all observed)
1) Pawing at exit
2) Pacing
3) Whining
4) Barking
5) Other:
6) None

C) Activity (last 15 sec.)
1) Relaxed - stationary
2) Relaxed - active
3) Stressed - stationary
4) Stressed - active

5. ACOUSTIC STARTLE

A) Reaction to dogs barking
1) Retreat
2) Startle (pronounced movement)
3) Freeze - upright
4) Freeze - cower
5) Stops briefly or flinches
6) No reaction

B) Reaction to knocking
1) Retreat
2) Startle (pronounced movement)
3) Freeze - upright
4) Freeze - cower
5) Stops briefly or flinches
6) No reaction

6. AROUSAL

A) Manner of treat consumption (10 treats/30 sec.)
1) Does not consume
2) Consumes some
3) Consumes all

B) Behavior after cessation of treats (10 sec.)
1) Attentive to human
a) fearful/stressed
b) calm
c) hyper-active
2) Attentive to environment
a) fearful/stressed
b) calm
c) hyper-active

7. VISUAL STARTLE

A) Reaction
1) Retreat
2) Startle (pronounced movement)
3) Freeze - upright
4) Freeze - cower
5) Stops briefly or flinches
6) No reaction

B) Approach to object
1) No approach - uninterested
2) No approach - fearful/stressed
3) Hesitant approach
4) Immediate approach

PILOERECTION

8. DISTRACTION

A) Overall body language* (while stimulus is moving) - circle one

B) Can you obtain the dog's attention while on-leash? (stimulus is stationary, 5-10 sec.)
1) No - oriented toward stimulus
2) No - retreat from stimulus
3) Yes

C) Manner of approach to stationary stimulus (10 sec.) - use table below

D) Manner of approach to moving stimulus while off-leash - use table below

C	D	Select one for C & D by checking box
		1) Aggression
		2) Mounting
		3) Initiates play
		4) Social greeting - loose body
		5) Social greeting - stiff body
		6) Mouthing fake dog
		6a) Note where on stimulus
Y/N	Y/N	6b) Does the dog shake the stimulus?
		7) Hesitant approach
		8) No approach - uninterested
		9) No approach - fearful/stressed
For C) & D) answer question below:		
Y/N	Y/N	Is the stimulus dislodged by the dog?

E) Can you obtain the dog's attention while off-leash? (5-10 sec.)
1) No - oriented toward stimulus
2) No - retreat from stimulus
3) No - uninterested
4) Yes

9. IN-KENNEL: RETURN

A) Manner of return
1) High energy/movement
2) Calm entry but high energy after release
3) Calmly - quickly or slowly
4) Delayed/requires coaxing
5) Fearful/stressed - quickly or slowly
6) Pulling away from entry
7) Aggression

SEE 10. ACTIVITY (circle if observed)

10. ACTIVITY - circle all observed during sub-tests #1 or #9 (In-Kennel tests)

A) In-kennel misc. behavior
1) Spinning
2) Excessive jumping
3) Whining
4) Excessive barking
5) Pacing
6) Frantic pawing at door
7) Smeared feces in kennel
8) Other:

B) Out-of-kennel (while transitioning through shelter)
1) Dog directed reactivity (e.g. barrier aggression)
2) Other:

A.10: Draft 10

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.

Check box next to category letters if piloerection is observed during the score interval.

PILOERECTION

1. IN-KENNEL: BEGIN

A) Location after approach
1) Front
2) Back
3) Middle
4) Not stationary

B) Presentation with closed door
1) Friendly/Attentive/Neutral
2) Dissociated (fearful/stressed)
3) Aware (fearful/stressed)
4) Hyper-active
5) Aggression
6) Hidden from view

C) Overall body language*
(circle one or more)

D) Ability to take treat
1) Consumes treat from hand
2) Takes treat from hand but does not consume
3) Consumes treat from floor
4) No interest in treat

E) Location/presentation with open door - Write-in answer using terms from A) and B)
1) Location:
2) Presentation:

F) Manner of exit
1) Hyper-active
2) Hyper-active while door is opening but calm exit
3) Calmly (quickly or slowly)
4) Hesitant with calm exit
5) Fearful/stressed (delayed or not)
6) Refuses to exit
7) Unsafe to allow exit

SEE 9. ACTIVITY (circle if observed)

2. PLAY (3 min.)

A) Initial reaction to play (first 30 sec.)
1) Engages in play
2) Approach - does not engage
3) No approach - does not engage

B) Overall body language* (first 30 sec.)
(circle one or more)

C) Ease of putting away toys
1) Easy - not engaged with toy
2) Easy with trade for treat
3) Difficult - multiple trades required

D) Was play ended early?
1) Yes - over-stimulated
2) Yes - fearful
3) No

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

PILOERECTION

3. SETTLE (2 min.)

A) Response to treat.
1) Ignores treat
2) Brief interest/quick sniffs
3) Plays with treat but does not consume
4) Holds treat in mouth but does not consume
5) Remains standing to chew
6) Lies or sits to chew

B) Misc. behavior (circle all observed)
1) Pawing at exit
2) Pacing
3) Whining
4) Barking
5) Other:
6) None

C) Activity (last 15 sec.)
1) Neutral - stationary
2) Neutral - active
3) Stressed - stationary
4) Stressed - active

4. ACOUSTIC STARTLE

A) Reaction to sound 1
1) Retreat
2) Immediate approach
3) Freeze - upright
4) Freeze - cower
5) Stops briefly/orients/flinches/ startles
6) No reaction

B) Reaction to sound 2
1) Retreat
2) Immediate approach
3) Freeze - upright
4) Freeze - cower
5) Stops briefly/orients/flinches/ startles
6) No reaction

5. AROUSAL

A) Manner of treat consumption (10 treats/30 sec.)
1) Does not consume
2) Consumes some
3) Consumes all

B) Orientation after cessation of treats (10 sec.)
1) Human
2) Environment
3) Alternates between human and environment

C) Behavior after cessation of treats (same time as B)
1) Fearful/stressed
2) Calm
3) Hyper-active

6. VISUAL STARTLE

A) Reaction
1) Retreat
2) Immediate approach
3) Freeze - upright
4) Freeze - cower
5) Stops briefly/orients/flinches/ startles
6) No reaction

B) Approach to object
1) No approach - uninterested
2) No approach - fearful/stressed
3) Hesitant approach
4) Immediate approach

PILOERECTION

7. DISTRACTION

A) Overall body language* (while stimulus is moving) - circle one

B) Can you obtain the dog's attention while on-leash? (stimulus is stationary, 5-10 sec.)
1) No - oriented toward stimulus
2) No - retreat from stimulus
3) No - uninterested
4) Yes

C) Manner of approach to stationary stimulus (10 sec.) - use table below

D) Manner of approach to moving stimulus while off-leash - use table below

C	D	Select one for C & D by checking box
		1) Aggression
		2) Mounting
		3) Initiates play
		4) Social greeting - loose body
		5) Social greeting - stiff body
		6) Mouthing fake dog
		6a) Note where on stimulus
Y/N	Y/N	6b) Does the dog shake the stimulus?
		7) Hesitant approach
		8) No approach - uninterested
		9) No approach - fearful/stressed
For C) & D) answer question below:		
Y/N	Y/N	Is the stimulus dislodged by the dog?

E) Can you obtain the dog's attention while off-leash? (5-10 sec.)
1) No - oriented toward stimulus
2) No - retreat from stimulus
3) No - uninterested
4) Yes

8. IN-KENNEL: RETURN

A) Manner of return
1) Hyper-active
2) Calm entry but hyper-active once in kennel
3) Calmly (quickly or slowly)
4) Hesitant with calm entry
5) Fearful/stressed (delayed or not)
6) Pulling away from entry
7) Aggression

SEE 9. ACTIVITY (circle if observed)

9. ACTIVITY - circle all observed during sub-tests #1 or #9 (In-Kennel tests)

A) In-kennel misc. behavior
1) Spinning
2) Excessive jumping
3) Whining
4) Excessive barking
5) Pacing
6) Frantic pawing at door
7) Smeared feces in kennel
8) Other:

B) Out-of-kennel (while transitioning through shelter)
1) Dog directed reactivity (e.g. barrier aggression)
2) Other:

A.11: Draft 11

Dog name:

Date:

Start/End Time: /

Assessor's Initials:

Circle one response per question unless noted.

Check box next to category letters if piloerection is observed during the score interval.

*Illustrations by Lili Chen, "Doggie Language" doggiedrawings.net

1. IN-KENNEL: BEGIN

PILOERECTION

- A) Location after approach
  1) Front
  2) Back
  3) Middle
  4) Not stationary
- B) Presentation with closed door
  1) Friendly/Attentive/Neutral
  2) Dissociated (fearful/stressed)
  3) Aware (fearful/stressed)
  4) Hyper-active
  5) Aggression
  6) Hidden from view
- C) Overall body language* (circle one or more)

- D) Ability to take treat
  1) Consumes treat from hand
  2) Takes treat from hand but does not consume
  3) Consumes treat from floor
  4) No interest in treat
- E) Location with open door
  1) Front
  2) Back
  3) Middle
  4) Not stationary
- F) Presentation with open door
  1) Friendly/Attentive/Neutral
  2) Dissociated (fearful/stressed)
  3) Aware (fearful/stressed)
  4) Hyper-active
  5) Aggression
  6) Hidden from view
- G) Latency to exit
  1) Bolts
  2) Efficient
  3) Delayed
  4) Refuses to exit
  5) Unsafe to allow exit

SEE 8. ACTIVITY (circle if observed)

2. PLAY (3 min.)

- A) Initial reaction to play (first 30 sec.)
  1) Engages in play
  2) Approach - does not engage
  3) No approach - does not engage
- B) Overall body language* (first 30 sec.) (circle one or more)

- C) Ease of putting away toys
  1) Easy - not engaged with toy
  2) Easy with trade for treat
  3) Difficult - multiple trades required
- D) Was play ended early?
  1) Yes - over-stimulated
  2) Yes - fearful
  3) No

PILOERECTION

3. SETTLE (2 min.)

- A) Response to treat.
  1) Consumes while standing or moving
  2) Consumes while lying/sitting or plays with treat
  3) Ignores treat/brief interest or holds treat in mouth without consuming
- B) Misc. behavior (circle all observed)
  1) Pawing at exit
  2) Pacing
  3) Whining
  4) Barking
  5) Other (write):
  6) None
- C) Activity (last 15 sec.)
  1) Neutral - stationary
  2) Neutral - active
  3) Stressed - stationary
  4) Stressed - active

4. ACOUSTIC STARTLE (BUZZER)

- A) Reaction (start of sound + 3 sec. after noise ends)
  1) Retreat
  2) Immediate approach
  3) Freeze - upright
  4) Freeze - cower
  5) Flinches/Startles
  6) Stops briefly/Orients
  7) No reaction

5. VISUAL STARTLE (MOVING CHAIR)

- A) Reaction (start of movement + 3 sec. after chair is stationary)
  1) Retreat
  2) Immediate approach
  3) Freeze - upright
  4) Freeze - cower
  5) Flinches/Startles
  6) Stops briefly/Orients
  7) No reaction

PILOERECTION

6. DISTRACTION

- A) Overall body language* (while stimulus is moving) - circle one

- B) Can you obtain the dog's attention while on-leash? (stimulus is stationary, 5-10 sec.)
  1) No - oriented toward stimulus
  2) No - retreat from stimulus
  3) No - uninterested
  4) Yes
- C) Note behavior after dog is let off-leash:

7. IN-KENNEL: RETURN

- A) Approach to kennel entry (when within approx. 5'-0" from entry)
  1) Actively pulling towards entry
  2) Actively pulling away from entry
  3) Actively pulling/darting in multiple directions
  4) Requires encouragement
  5) Cooperative
- B) In-kennel behavior post-return (from leash unclipping to door closed)
  1) Hyper-active
  2) Fearful
  3) Calm

SEE 8. ACTIVITY (circle if observed)

8. ACTIVITY - circle all observed during sub-tests #1 or #9 (In-Kennel tests)

- A) In-kennel misc. behavior
  1) Spinning
  2) Excessive jumping
  3) Whining
  4) Excessive barking
  5) Pacing
  6) Frantic pawing at door
  7) Smeared feces in kennel
  8) Other (write):
- B) Out-of-kennel (while transitioning through shelter)
  1) Dog directed reactivity (e.g. barrier aggression)
  2) Other (write):

APPENDIX B: PILOT DOCUMENTS

B.1: Anxiety Score

Ethogram of anxiety-associated behaviors (1). The Anxiety Score, observed during the 2-minute acclimation in Draft 9 of the assessment form, is calculated based on the frequency and intensity of observed anxiety-associated behaviors.

Anxiety Score

1. None; No anxiety behaviors
2. Occasional and mild
3. Some of the time and mild/ occasional and moderate
4. Most of the time and mild/some of the time and moderate/ occasional and severe
5. Some of the time and severe/ most of the time and moderate
6. Most of the time and severe

Anxiety Score Ethogram (1)

Active anxiety-associated behaviors	
Active responses	Startling, bolting, vigilance, scanning, pacing, aimless activity, stereotypic circling, retreat/escape attempts, digging, climbing
Inactive anxiety-associated behaviors	
Decreased activity	Freezing, positioning in corners/against wall/at door
Lowered body postures	Crouching, tail tucking, ears back
Autonomic/conflict behaviors	Panting, shaking, salivating, yawning, lip licking, elimination

(1) Sherman, B. L., Gruen, M. E., Case, B. C., Foster, M. L., Fish, R. E., Lazarowski, L., DePuy, V., & Dorman, D. C. (2015). A test for the evaluation of emotional reactivity in Labrador retrievers used for explosives detection. *Journal of Veterinary Behavior*, *10*(2), 94–102.

B.2: Kennel Cards

BEHAVIOR LOG – MSU IN-SHELTER BEHAVIOR ASSESSMENT STUDY

DOG NAME: _____ **A#:** _____

DATE	APPETITE (CIRCLE ONE)	EXCESSIVE JUMPING &/OR SPINNING	VOMITING	DEFECATION IN-KENNEL	PURINA FECAL SCORE		OTHER BEHAVIORS (NOTE)
					Score	Specimen	
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	1		
AM	NONE	YES, OUTSIDE		☐ SMEARED			
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	2		
PM	NONE	YES, OUTSIDE		☐ SMEARED			
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	3		
AM	NONE	YES, OUTSIDE		☐ SMEARED			
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	4		
PM	NONE	YES, OUTSIDE		☐ SMEARED			
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	5		
AM	NONE	YES, OUTSIDE		☐ SMEARED			
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	6		
PM	NONE	YES, OUTSIDE		☐ SMEARED			
	ALL	NO	NO	NO			
	SOME	YES, IN KENNEL	YES	YES: SCORE____	7		
PM	NONE	YES, OUTSIDE		☐ SMEARED			

Purina fecal scoring chart. (2021). Purina Institute. https://www.purinainstitute.com/sites/default/files/2021-04/fecal-chart.pdf

APPENDIX C: TRAINING DOCUMENTS

C.1: Protocol

Inclusion:

- Healthy dogs 12 weeks or older maintained in solitary housing at Capital Area Humane Society (Lansing, MI) overnight for at least one night prior to assessment.
- This includes but is not limited to strays, owner-surrenders, transfers, returns, and heartworm positive dogs.

Exclusion:

- Dogs group housed
- Dogs less than 12 weeks of age
- Dogs that appear ill (e.g., vomiting, diarrhea, difficulty breathing, extreme lethargy, difficulty locomoting)
- Dogs that are removed from home by authorities (i.e., cruelty cases)

Data collection:

- Video assessments
- Assessment forms filled out in-field by assessor and observer
- For a sub-population of enrolled dogs, accelerometer data
- Pet Point records

Assessment Schedule:

- Assessments will take place Mon, Tues, Thurs, Fri from 1pm-4pm.
    - Assessor will contact intake staff for a list of eligible dogs by 10am the day of assessments.
    - A maximum of five dogs will be assessed daily.
        - If there are more than five dogs that are eligible, 5 will be randomly chosen. Those that are not assessed are eligible on the following assessment date.
    - Enrolled dogs will be assessed once.
- Assessments will take place in the education room.
    - If the room is unavailable, assessments will take place outside in the fenced yard by shelter intake entry.
- For 80% power, we would like to assess 46 dogs inside and 46 dogs outside. This would equate to a minimum of 10 assessment days inside and 10 outside (5 weeks total).

Assessment Protocol:

- The assessor will conduct the assessment and handle the dog. The assessor will always be the same female person.
    - The assessor will record the assessment using a GoPro camera attached to a Chesty mount.
    - The assessor will rate the dog using the assessment form.

- The observer will witness the assessment and attempt to remain “invisible” to the dog during sub-tests (minimize noise and movement, ignore the dog). The observer will always be female.
    - The observer will record the assessment using a GoPro camera attached to a clip mount.
    - The observer will rate the dog using the assessment form.
        - If the observer cannot see the dog’s response, she will leave the category blank.
    - Observer will be as consistent as possible with her location during tests.
        - During In-Kennel: Exit, observer will follow the assessor, stopping approximately 4’-0” away from the kennel door on the far side of the walkway. The aim is to maintain a good sightline to observe the dog while also standing as far away as possible to minimize influence on the dog’s behavior.
        - During In-Kennel: Return, observer will proceed ahead of assessor to position herself approximately 4’-0” away from the kennel door at the opposite side of the assessor's approach. The aim is to position oneself for a good view of the return while distancing as much as possible to minimize influence on the dog’s behavior.
            - While the goal is to remain at a distance during the time intervals that are scored, the observer will not go so far ahead as to lose sight of the assessor. If the assessor is having a difficult time returning the dog to the kennel, she may ask for the observer's assistance. Observer will not intervene unless asked.
- Assessments will consist of several sub-tests, each with a unique set of categories.
- Sub-tests will be conducted by the assessor in sequence except for ‘Activity’ which is scored during sub-tests ‘In-Kennel: Begin’ and ‘In-Kennel: Return’.
- Room Setup:
    - Cloth mat for Settle
    - Water bowl
    - Bluetooth speaker positioned in the middle of the room under a plastic crate
    - Comfy chair for observer
    - Low camp chair for assessor
    - Metal folding chair with attached rope near tethered leash that is secured in door jamb
    - Rubber floor dots to mark location of fake dog, and location of assessor during distraction test
    - Toys located where dog cannot reach (tennis ball, rope, stuffless soft toy)
    - Fake dog behind cardboard visual barrier
- Dog will have 1 minute of acclimation in room off-leash. Assessor and Observer will sit in a relaxed fashion and encourage interaction with the dog if the dog approaches either human. Assessor will sit in the center of the room during acclimation. During acclimation, A will connect her phone to the Bluetooth speaker.

Sub-Tests:

1. In-Kennel: Begin
    a. Assessor (A) and observer (O) will start their cameras and A will say the time using a wristwatch. Before beginning approach, A and O will show the form header to the camera lens to identify the dog, date, and time of the assessment.
    b. A will approach the dog's kennel door and pin the "Research in Progress" sign to the kennel door.
    c. Immediately after A calls the dog in a friendly manner, location after approach, presentation with closed door, and overall body language is observed.
    d. A will offer the dog a treat through the kennel door for scoring of ability to take treat. If the dog does not take the treat, A will toss the treat into the kennel.
    e. A will then open the kennel door (observing presentation with open door) and use a slip lead to guide the dog out of the kennel. Latency to exit is scored from when the door is open until the dog has all four paws past the door threshold.
        i. If the dog does not exit from the front of the kennel after 90 sec., A will attempt to guide the dog out of the kennel through the back door. If after 90 sec. trying at the other door the dog is still unable to exit, the assessment will end.
2. Play
    a. A will grab toys (a rope, a ball, and a stuffing-free soft toy) and toss one at time slightly out in front of her then start the timer. A will use the toys to encourage the dog to play. Approach and overall body language are scored within the first 30 sec.
    b. A will continue to encourage play for the following 2.5 min. If A ends play early, she will verbally cue O.
    c. After a total of 3 min of play time has passed, A will pick up the toys to observe ease of putting the toys away. If the dog is engaged with a toy, A will offer a trade for a treat.
3. Settle
    a. A will show the dog a large Milkbone and then place it on a floor mat. Time starts once the treat is on the ground. A will then sit down in the low camp chair. A will ignore the dog for the duration of the settle test even if the dog solicits attention.
    b. Response to treat will be observed for the 2 min. duration, as well as miscellaneous behaviors.
    c. At 1:45, activity will be observed and scored until 2:00 min have passed.
4. Acoustic Startle
    a. Without getting up from the chair, A will use a phone app to play a loud buzzer noise.
    b. The immediate response of the dog will be observed from the instant the noise begins to 3 seconds after the noise has ended.
5. Visual Startle
    a. A will clip the dog's collar to a leash and walk the dog over to the tethered leash, connecting the dog's leash to the tethered leash at the loose end. A will then pull

the rope attached to the metal folding chair so that the chair scoots toward her location by the dog approximately 6". Reaction will be scored while the chair is moving up to 3 seconds after it has stopped.

6. Distraction
    a. A will leave the dog tethered and remove the fake dog from behind a visual barrier, walking it to the center of the puzzle floor mat, keeping the fake dog between herself and the dog. Overall body language is scored while the fake dog stimulus is moving.
    b. Once the fake dog is positioned on the dot, A will walk to the location where the dog's leash is attached to the tethered leash and call to the dog, offering a treat. A will attempt to obtain the dog's attention for 5-10 sec after which she will unclip the leash at the handle, leaving it attached to the dog's collar.
    c. A will remain where she is, and observe the dog's behavior for 5-10 seconds, after which she will walk the fake dog for an additional 6'-0". Behavior while the dog is off leash is not scored but written down anecdotally.
7. In-Kennel: Return
    a. A will return the dog to its kennel using the clipped leash (not the slip lead).
    b. Once A is approximately 5'-0" from the dog's kennel entry, approach to kennel entry is observed.
    c. Once the dog is in the kennel, A will give the dog a medium size Milkbone while removing the leash followed by closing the kennel door.
        i. If the dog has not entered the kennel 10 sec. after the door has opened, the Milkbone can be used as a lure.
8. Activity
    a. The activity category represents miscellaneous behaviors that can correlate with maladaptive coping. These behaviors are circled if observed during either the In-Kennel: Begin or In-Kennel: Return tests.

C.2: Picto-ethogram

Images adapted from “Doggie Language” by Lili Chen (doggiedrawings.net/freeposters); Downloaded under Creative Commons License (CC BY-NC-ND 3.0 DEED)

Image 1 	Lowered head and body, backward lean, tail tuck, flattened ears
Image 2 	Lying down/ lowered head/unresponsive
Image 3 	Forward lean with lowered head and body, outstretched neck, possible tail tuck
Image 4 	Avoidant, standing (with or without paw lift)
Image 5 	Avoidant, sitting
Image 6 	Exaggerated yawn or panting with facial muscle tension
Image 7 	Relaxed (no muscle tension in body or face)
Image 8 	Loose/wriggly body, no muscle tension in body

Image 9 	Bow
Image 10 	Panting with no facial muscle tension
Image 11 	Alert (some muscle tension), leash tension may be present
Image 12 	Head tilt
Image 13 	Alert (some muscle tension), lying or sitting
Image 14 	Front paws leave ground at same time/jumping or hard pulling with skittering of paws for multiple steps
Image 15 	Extreme tension/showing teeth/backward lean/ cowering

Image 16		Extreme tension/showing teeth/forward movement
Image 17		Shake-off
Image 18		Lip lick
Image 19		Sniffing
Image 20		Scratching

C.3: Ethogram

Images adapted from “Doggie Language” by Lili Chen (doggiedrawings.net/freeposters); Downloaded under Creative Commons License (CC BY-NC-ND 3.0 DEED)

HAI	PROMPT	OBSERVATION PERIOD	
		RESPONSE	**RESPONSE DESCRIPTION**
HAI 1	Location after approach	Assessor approaches the front of the kennel and calls to the dog; observe the predominant behavior after the dog has noticed the assessor up until assessor offers treat	
		Front	Dog remains near the front of the kennel
		Back	Dog remains in the far back of the kennel
		Middle	Dog remains in the middle third of the kennel
		Not stationary	Dog moves from front to back or vice versa more than once
HAI 1	Presentation with closed door	Observe the dog while assessor is directing attention toward the dog after approach up until assessor offers treat	
		Friendly/ attentive/ neutral	Dog remains at the front of the run; orients gaze toward assessor; may be standing, sitting, or lying; moderate to no muscle tension in the body and face; tail base and ears in neutral to moderately perked position; dog may put paws on front door or make short duration vocalizations; dog may shift weight around with loose wriggly body motions; dog may move around and vocalize but does not repeatedly exhibit these behaviors for the duration of the observation
		Dissociated (fearful/ stressed)	Dog makes no attempt to move or moves very slowly, requiring a lot of encouragement from the assessor; dog may be lying or sitting with head up or down, eyes open
		Aware (fearful/ stressed)	Dog may be cowering with tucked tail or leaning forward with head kept low; dog may or may not retreat to the back of the kennel; dog may be panting with tense facial muscles and wide open eyes; dog may keep head low and turn head to the side to look at environment/human; dog may flatten ears down and look down, moving the head lower; dog may lift front paw or show belly/chest to assessor
		Hyper-active	Dog may be jumping, pacing, or spinning; dog may or may not be vocalizing; dog might paw repeatedly in quick movements at the floor or door of the kennel; dog may remain with front paws on door while continuously vocalizing; dog may make tight back and forth locomotion

		Aggression	Dog might lunge forward with teeth bared; dog might snap jaws or growl; high muscle tension in body and face; dog might freeze with stiff body and whale eye (wide open eyes with whites showing)
		Hidden from view	Not enough of the dog is visible to be able to interpret the body language
HAI 1	Overall body language	Circle one or more images that represent the overall body language observed with kennel door closed	
			See document: Body Language Picto-ethogram
HAI 1	Ability to take treat	Observe dog's reaction to treat ending when the assessor moves to open the door	
		Consumes treat from hand	Takes treat through kennel door from hand and consumes
		Takes treat from hand but does not consume	Takes treat through kennel door from hand and drops it to the floor but does not consume
		Consumes treat from floor	Eats treat from the floor after assessor has dropped or tossed it into the kennel or after the dog has dropped it to the floor
		No interest in treat	Does not take the treat from the hand nor consumes it from the ground
HAI 1	Location with open door	Observe the dog's location while opening the kennel door until the lead is attached to the dog	
		Front	See 'Location with closed door, HAI 1'
		Back	
		Middle	
		Not stationary	
HAI 1	Presentation with open door	Observe the dog's behavior while opening the kennel door until the lead is attached to the dog	
		Friendly/ attentive/ neutral	See 'Presentation with closed door, HAI 1'
		Dissociated (fearful/ stressed)	
		Aware (fearful/ stressed)	

		Hyper-active	
		Aggression	
		Hidden from view	
HAI 1	Latency to exit	Observe the dog from when attaching the lead until all four paws are past the kennel door threshold. Front/primary kennel exit is attempted for 90 sec. followed by a 90 sec. attempt at back/alternate exit if needed.	
		Bolts	Dog might move excitably to the extent that the assessor has difficulty securing the dog; dog may burst from the kennel with sufficient speed and/or strength to cause assessor to counterbalance against the force of the dog; dog may push nose through door opening as assessor is trying to secure the dog; dog may jump with front paws leaving the ground while assessor is trying to secure the dog; dog may leap past door threshold before assessor has moved out of the way; dog may immediately react to neighbor dog in the instant that they are passing through threshold; dog may push into assessor or jump into/over assessor; dog may lower head to push forward before assessor is out of the way
		Efficient	Assessor is easily able to secure dog and dog exits with neutral body in a timely manner
		Delayed	Dog may pull back from the lead; dog may sit in kennel after being secured with lead; dog may require treats to accept lead or exit kennel
		Refuses to exit	Dog won't leave the kennel from neither the front nor the back
		Unsafe to allow exit	Dog exhibits severe aggressive behaviors that cause the assessor to make a judgement call to leave the dog in the kennel and end the assessment
HAI 2	Initial reaction to play	The dog's reaction during the first 30 sec. of play-time is observed.	
		Engages in play	Dog approaches human or toys and engages in play behavior. Play behavior could include bowing, grabbing toys in mouth with loose/wiggly body, chasing, engaging in fetch, tug, or keep-away; dog may or may not shake the toys; dog may individually play or socially play with the assessor
		Approach - does not engage	Dog approaches human or toys but does not engage in play behavior. Dog may sniff the toys or grab the toys with the mouth but does not engage with play behavior; dog may solicit attention from the human with the

			motivation for interaction that does not involve play (e.g., petting)
		No approach - does not engage	Dog does not approach human or toys. Approach is defined as the dog coming close enough to smell or touch object of attention
HAI 2	Overall body language	Circle one or more images that represent the overall body language observed during the first 30 sec. of play time	
			See document: Body Language Picto-ethogram
HAI 2	Ease of putting away toys	How much effort is required to redirect the dog away from the toys when play-time is over?	
		Easy - not engaged with toy	Dog has no interest in the toys and assessor is able to pick them up and put them away with no effort required
		Easy with trade for treat	Dog is interested in the toys but will calmly allow assessor to pick them up and put them away in exchange for a treat
		Difficult - multiple trades required	Dog does not stop playing with the toys and may repeatedly grab at the toys or assessor as they are getting picked up. Assessor requires multiple distractions (scattered treats) to successfully put away the toys
HAI 2	Was play ended early?	Were the toys put away before 3 min. had passed?	
		Yes - over-stimulated	Assessor makes a judgment call to end play before the 3 min. have passed due to the dog's high level of arousal; dog may be hard mouthing the assessor, humping, or tugging at clothing
		Yes - fearful	Assessor makes the judgment call to end play before the 3 min. have passed due to severe and sustained anxiety-associated behaviors such as escape behaviors
		No	Assessor does not put the toys away until 3 min. have passed

HAI 3	Response to treat	Observe response to treat beginning immediately after treat is placed on ground for the duration of 2 minutes. Select predominant response to treat or the most progressive behavior in terms of consumption (consuming while sitting/lying being the most progressive followed by consuming while standing with the least progressive being no consumption)	
		Consumes while standing or moving	Dog will break the treat apart with teeth and swallow but remains standing; dog may or may not eat all of the treat; dog may break pieces of treat while locomoting and consume
		Consumes while lying/sitting or plays with treat	Dog will lie down or sit to bite the treat and swallow; dog may grip treat between the front paws; dog may or may not eat all of the treat; Dog engages with the treat as if it were a toy but does not chew or swallow; dog may consume while in a bowed position
		Ignores treat/brief interest or holds treat in mouth without consuming	Dog never approaches treat during the assessment; dog might follow assessor to the treat location but does not orient toward the treat after it is placed on the ground; Dog will approach and sniff the treat at least once during the assessment; dog might approach and sniff treat multiple times with or without briefly picking it up and putting it back down without carrying it to another location; Dog will pick up the treat in mouth but does not consume any portion of it; dog may pace with treat in mouth; dog may pick up treat in mouth and put it back down; dog does not play with the treat
HAI 3	Misc. behavior	Over the course of 2 min., does the dog display specific behaviors that may be indicative of a negative emotional state?	
		Pawing at exit	Dog will stand at exit (door, gate) and use one or both paws to scratch at the door or ground
		Pacing	Walks back and forth or along perimeter of yard at a brisk pace with or without treat in mouth
		Whining	High pitch, long vocalization with closed mouth
		Barking	Loud, short vocalizations with open mouth
		Other (write)	Note any observations of interest
		None	No behavior outside of what is already captured in the form is of interest
HAI 3	Activity (last 15 sec.)	Observe the activity and manner of the dog for the last 15 sec. of the 2 min. settle test	
		Neutral - stationary	Dog remains in one spot engaging in dog-typical activities

		Neutral - active	Dog is locomoting calmly and engaging in dog-typical activities
		Stressed - stationary	Dog remains in one spot and exhibits anxiety-associated behaviors
		Stressed - active	Dog is locomoting and exhibiting anxiety-associated behaviors
HAI 4	Reaction to acoustic startle	Observe the reaction of the dog while a buzzer noise is played up until 3 sec. after the sound has ceased.	
		Retreat	Dog takes multiple steps backward or quickly turns and rapidly moves away from stimulus; dog may show escape behaviors by hiding or rapidly moving toward an exit
		Immediate approach	Dog reacts automatically to stimulus with full body movement
		Freeze - upright	Dog immediately stops what he/she is doing and does not move, holding the body and head still in an upright posture for the duration of the noise and the subsequent 3 sec.; see also 'anxiety-associated behaviors, freeze'
		Freeze - cower	Dog immediately stops what he/she is doing and does not move, holding the body and head still in a lowered posture for the duration of the noise and the subsequent 3 sec.; see also 'anxiety-associated behaviors, freeze'
		Flinches/startles	Dog alters activity in acknowledgement of the stimulus by flinching (dog reacts automatically to stimulus with tense facial muscles, lowering ears, and/or stepping backward) or by startling (automatic full body reaction such as jumping, or lowering body) with quick recovery to movement; dog may show additional anxiety-associated behaviors after immediate reaction
		Stops briefly/orients	Dog alters activity in acknowledgement of the stimulus by momentarily pausing with rapid recovery to movement, by turning head toward stimulus, by perking ears, or by turning head or body toward stimulus; dog will have neutral to attentive body language
		No reaction	Dog does not acknowledge the stimulus
HAI 5	Reaction to visual startle	Observe the immediate reaction of the dog to a sudden moving chair up until 3 sec. after the chair has stopped moving	
		Retreat	See 'Reaction to acoustic startle, HAI 4'
		Immediate approach	

		Freeze - upright	
		Freeze - cower	
		Flinches/startles	
		Stops briefly/orients	
		No reaction	
HAI 6	Overall body language (while stimulus is moving)	Select the most predominant body language of the dog while the dog is tethered and the fake dog is moving. End observation when fake dog stops moving.	
		Image A 	Lowered head and body, backward lean, tail tuck, flattened ears
		Image B 	Forward lean with lowered head and body, outstretched neck, possible tail tuck
		Image C 	Relaxed (no muscle tension in body or face)
		Image D 	Alert (some muscle tension), leash tension may be present
		Image E 	Front paws leave ground at same time/jumping or hard pulling with skittering of paws for multiple steps
		Image F 	Extreme tension/showing teeth/backward lean/ cowering

		Image G	Extreme tension/showing teeth/forward movement
			
HAI 6	Can you obtain the dog's attention while stimulus is stationary (5-10 sec.)	Once assessor is positioned near the dog and calls to it, offering a treat, is the assessor able to obtain the dog's attention within 10 sec.?	
		No - oriented toward stimulus	Dog remains oriented toward fake dog and does not approach the assessor or approaches briefly after which the dog immediately goes back toward the fake dog; dog may look at assessor briefly but not approach assessor; dog may run to the assessor and quickly consume treat but immediately move toward the fake dog
		No - retreat from stimulus	Dog keeps distance between him/herself and the fake dog and does not approach the assessor or will stand near the assessor but ignore the treat and remain looking at the fake dog while exhibiting anxiety-associated behaviors
		No - uninterested	Dog does not approach the fake dog nor the assessor and performs dog-typical activities with a neutral body language
		Yes	Dog approaches assessor and orients toward assessor; dog may or may not consume treat; dog shows neutral or attentive body language toward assessor; dog may look back at the fake dog or move toward the fake dog after giving attention to the assessor in a calm manner
HAI 6	Note behavior after let off-leash	After dog is untethered observe approach behavior; observe the dog's behavior while walking the fake dog when dog is untethered	
		Write-in response	Write-in observed approach behaviors and interactions with the fake dog
HAI 7	Approach to kennel entry	Observer behavior of dog when within approximately 5'-0" of the kennel entry up until all four paws have passed the entry threshold	
		Actively pulling towards entry	Dog enters kennel with hard pulling on the lead and does not pause to allow assessor to remove lead but continues to pull causing difficulty in detaching the lead
		Actively pulling away from entry	Dog pulls past entry on either side of the door; Dog might back-up resulting in a pull backward on the leash; dog may require high reward treat to be coaxed into kennel

		Actively pulling/darting in multiple directions	Dog moves rapidly to end of leash and abruptly changes direction, repeating this movement pattern in multiple directions (toward or away from kennel entry); dog may enter kennel efficiently after darting in the vicinity of the entry
		Requires encouragement	Dog may divert from crossing the kennel threshold or pause outside the kennel until lured in with treat
		Cooperative	Dog enters the kennel in a timely manner
HAI 7	In-kennel behavior post-return	Observe the behavior of the dog from when it is fully in the kennel to when the door is closed and latched	
		Hyper-active	Dog exhibits high energy movement as assessor attempts to close the door; dog may vocalize while assessor closes the door; dog may paw repeatedly at the door or floor; dog may dart back and forth in kennel; dog may excessively jump or spin in kennel
		Fearful	Dog has lowered body posture; dog may have tucked tail and/or flattened ears; dog may quickly move to the back of the kennel and remain; dog may appear despondent
		Calm	Dog exhibits neutral or attentive body language and engages in dog-typical activities
HAI 8	In-kennel misc. behavior	While observing the dog when it is in the kennel, select behaviors if observed	
		Spinning	Dog turns multiple quick, tight circles
		Excessive jumping	Dog repeatedly jumps, frequently having all four paws off the ground
		Whining	High pitch, long vocalization with closed mouth
		Excessive barking	Multiple loud, short vocalizations with open mouth
		Pacing	Walks back and forth along kennel run at a brisk pace
		Frantic pawing at door	Dog paws at door or ground with both front paws as if digging
		Smeared feces in kennel	Dog has defecated in kennel and the fecal matter has been disturbed from its original shape
		Other (write)	Note any observations of interest
HAI 8	Out-of-kennel misc. behavior	While moving the dog through the shelter, select behaviors if observed	
		Dog directed reactivity (e.g., barrier aggression)	Dog bares teeth toward another dog and lunges toward the dog; dog may growl or bark; dog may bite at the fencing of another dog's kennel
		Other (write)	Note any observations of interest

C.4: Glossary

Aggression	Growling, snarling, snapping, lunging with lips drawn away from teeth, hard stare with freeze
	Fight: body stiffens, facial tension, eyes stare, may struggle, may growl and bare teeth, tail suddenly stops moving, mouth closes, lips tense, begins to growl, lunge forward, bite or snap (1)
Anxiety-associated behaviors	Flight: body stiffens, facial tension, eyes wide, avoids eye contact, turns head away, turns whole body away, creeping, crouching, tail tucked, moves away, tries to escape, retreats as far as possible, roll over to evade contact (1)
	Fret/fidget: restless, eyes wide, lip licking, looking around, scanning, pacing, pawing, sniffing, blinking, shaking off (1)
	Freeze: body stiffens, facial tension, freezes in place, may tremble, eyes wide, mouth closed, bark, whine, or scream, shut down, refuses treats, may appear to be "sleeping", helpless (1)
	Includes active and inactive anxiety-associated behaviors (2)
Anxiety-associated behaviors, active	startling, bolting, vigilance, scanning, pacing, aimless activity, stereotypic circling, retreat/escape attempts, digging, climbing (2)
Anxiety-associated behaviors, inactive	decreased activity: freezing, positioning in corners/against wall/at door (2)
	lowered body postures: crouching, tail tucking, ears back (2)
	autonomic/conflict behaviors: panting, shaking, salivating, yawning, lip licking, elimination (2)
Approach	Dog moves toward the object of interest
Approach, during play	Dog moves toward toys or humans and gets close enough to sniff or touch
Attention, obtain	Dog approaches human and remains near the human while leash is removed (dog may or may not eat the treat that is offered)
Attentive	Orients to human or environment with alert gaze and neutral body language
Aware (fearful/stressed)	Dog is primarily exhibiting anxiety-associated behaviors
Barrier aggression	Aggression directed at dogs while separated by a physical barrier
Calm	Dog is friendly, attentive, or neutral
Dissociated (fearful/stressed)	Dog is lethargic and appears apathetic
Dog-typical activities	Grooming, eating, drinking, exploring using smell, sight, sound, touch, and taste, playing, resting, sleeping, socializing
Dog-directed reactivity	Aggression directed at dogs

Engage, during play	Dog exhibits a sequence of play behaviors
Fearful	See Dissociated and Aware (fearful/stressed)
Flinches	Dog reacts automatically to stimulus with tense muscle movement in face, head, or shoulders
Freeze	Dog immediately stops what he/she is doing and does not move, holding the body and head still. See also 'anxiety-associated behaviors, freeze' with slow recovery to movement
Friendly	Orients to human with soft gaze no muscle tension in body and face; body may be neutral or loose and wiggly
Frustration	Dog is obsessively directing energy into vocalizing, mouthing, jumping, digging and/or humping
Hyper-active	Dog is expending high levels of energy and/or exhibiting severe frustration
Mounting	Dog leans chest into object or human and grips with the front legs
Neutral	Dog is engaging in dog-typical activities with neutral body language
Neutral body language	Overall posture is relaxed or loose, no tension in the mouth and lips, hair coat lies flat, tail base is neither overtly raised or tucked, eyelids are soft, stance is balanced on all four paws, ears are held in natural position
Over-stimulated	Dog is aroused beyond his/her ability to appropriately engage with the human or environment; exhibiting frustration
Piloerection	The hair along the back of the dog is raised in comparison to the natural hairline of the dog (i.e., raised hackles)
Play behaviors	Bowing, prancing with toy in mouth, chasing toys with loose movement, hip bumps (side approach hip sway against human or dog) with loose body and relaxed jaw
Posturing	Dog holds head high and over object with hard staring at object, oriented so that the chest directly faces the direction of the gaze
Retreat	Dog takes multiple steps backward or quickly turns and rapidly moves away from stimulus
Startle	Dog reacts automatically to stimulus with full body movement (e.g., jump, crouch, step backward)
Stressed	See Dissociated and Aware (fearful/stressed)
Uninterested	Dog ignores human or stimulus and engages in dog-typical activities with neutral body language

(1) Fear Free shelter course, module 2c. (n.d.). Retrieved 2022, from https://fearfreeshelters.com/program/
(2) Sherman, B. L., Gruen, M. E., Case, B. C., Foster, M. L., Fish, R. E., Lazarowski, L., DePuy, V., & Dorman, D. C. (2015). A test for the evaluation of emotional reactivity in Labrador retrievers used for explosives detection. Journal of Veterinary Behavior, 10(2), 94–102.

APPENDIX D: ASSESSMENT SCORE RUBRIC

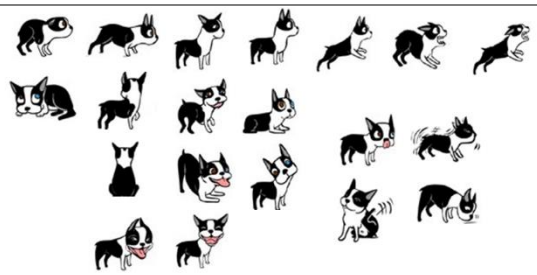
HAI	PROMPT	RESPONSE	PROMPT SCORE		
HAI 1 In-Kennel: Begin	Presentation with closed door (sc01)	Friendly/attentive/neutral	0		
		Dissociated (fearful/stressed)	-3		
		Aware (fearful/stressed)	-1.5		
		Hyper-active	1.5		
		Aggression	3		
		Hidden from view	null		
	Ability to take treat (sc02)	*Score dependent on response to 'Presentation with closed door, HAI 1 (sc01)'*	If Q1=0 pts	If Q1<0 pts	If Q1>0 pts
		Consumes treat from hand	0	0	0
		Takes treat from hand but does not consume	0	-1	1
		Consumes treat from floor	0	-2	2
		No interest in treat	0	-3	3
	Presentation with open door (sc03)	Friendly/attentive/neutral	0		
		Dissociated (fearful/stressed)	-3		
		Aware (fearful/stressed)	-1.5		
		Hyper-active	1.5		
		Aggression	3		
		Hidden from view	null		
	Latency to exit (sc04)	Bolts	3		
		Efficient	0		
		Delayed	-3		
		Refuses to exit	null*	*Assessment ends	
		Unsafe to allow exit	null*		
			-12 TO +12	HAI 1 SCORE RANGE	
HAI 2 Play	Initial reaction to play (sc05)	Engages in play	0		
		Approach - does not engage	3		
		No approach - does not engage	-3		
	Ease of putting away toys (sc06)	Easy - not engaged with toy	-3		
		Easy with trade for treat	0		
		Difficult - multiple trades required	3		
	Was play ended early? (sc07)	Yes - over-stimulated	3		
		Yes - fearful	-3		
		No	0		
			-9 TO +9	HAI 2 SCORE RANGE	

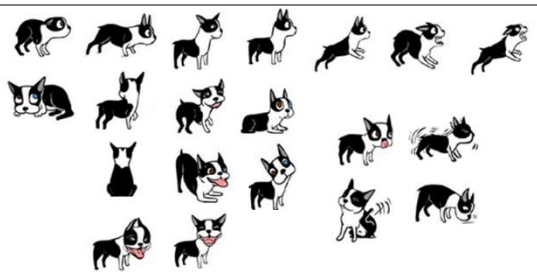
HAI 3 Settle	Response to treat (sc08)	Consumes while standing or moving	3	
		Consumes while lying/sitting or plays with treat	0	
		Ignores treat/brief interest or holds treat in mouth without consuming	-3	
	Activity (last 15 sec.) (sc09)	Neutral - stationary	0	
		Neutral - active	0	
		Stressed - stationary	-3	
		Stressed - active	3	
			-6 TO +6	HAI 3 SCORE RANGE
HAI 4 Acoustic Startle	Reaction to acoustic startle (sc10)	Retreat	-3	
		Immediate approach	1.5	
		Freeze - upright	3	
		Freeze - cower	-1.5	
		Flinches/startles	0	
		Stops briefly/orients	0	
		No reaction	0	
			-3 TO +3	HAI 4 SCORE RANGE
HAI 5 Visual Startle	Reaction to visual startle (sc11)	Retreat	-3	
		Immediate approach	1.5	
		Freeze - upright	3	
		Freeze - cower	-1.5	
		Flinches/startles	0	
		Stops briefly/orients	0	
		No reaction	0	
			-3 TO +3	HAI 5 SCORE RANGE
HAI 6 Distraction	Overall body language (while stimulus is moving) (sc12)	Image A 	-2	Images adapted from "Doggie Language" by Lili Chen (doggiedrawings.net/freeposters); Downloaded under Creative Commons License (CC BY-NC-ND 3.0 DEED)
		Image B 	-1	
		Image C 	0	
		Image D 	0	
		Image E 	1	

		Image F 	-3	
		Image G 	3	
	Can you obtain the dog's attention while on-leash? (stimulus is stationary, 5-10 sec.) (sc13)	No - oriented toward stimulus	3	
		No - retreat from stimulus	-3	
		No - uninterested	0	
		Yes	0	
			-6 TO +6	HAI 6 SCORE RANGE
HAI 7 In-Kennel: Return	Approach to kennel entry (behavior when within 5'-0" of kennel door) (sc14)	Actively pulling towards entry	-3	
		Actively pulling away from entry	1.5	
		Actively pulling/darting in multiple directions	3	
		Requires encouragement	0	
		Cooperative	0	
	In-kennel behavior post-return (behavior while unclipping the leash to closing of door) (sc15)	Hyper-active	3	
		Fearful	-3	
		Calm	0	
			-6 TO 6	HAI 7 SCORE RANGE
			-45 TO 45	TOTAL SCORE RANGE

APPENDIX E: REFINED ASSESSMENT FORM

Overall body language images adapted from "Doggie Language" by Lili Chen (doggiedrawings.net/freeposters); Downloaded under Creative Commons License (CC BY-NC-ND 3.0 DEED)

Dog:			
Date:			
Time:			
Assessor:			
HAI	**PROMPT**	**RESPONSE**	**PROMPT SCORE**
HAI 1: Approach	Presentation with closed door	Friendly/attentive/neutral	0
		Dissociated (fearful/stressed)	-3
		Aware (fearful/stressed)	-1.5
		Hyper-active	1.5
		Aggression	3
		Hidden from view	NULL
	Overall body language (during initial approach to kennel) – circle all that apply		N/A
	Presentation with open door	Friendly/attentive/neutral	0
		Dissociated (fearful/stressed)	-3
		Aware (fearful/stressed)	-1.5
		Hyper-active	1.5
		Aggression	3
		Hidden from view	NULL
	Latency to exit	Bolts	3
		Efficient	0
		Delayed	-3
		Refuses to exit	END
		Unsafe to allow exit	END
Acclimation off-leash (1-2 min.)			
HAI 2: Play (3 min.)	Initial reaction to play (first 30 sec.)	Engages in play	0
		Approach - does not engage	TBD

		No approach - does not engage	TBD
	Overall body language (first 30 sec.) – circle all that apply		N/A
	Ease of putting away toys	Easy - not engaged with toy	-3
		Easy with trade for treat	0
		Difficult - multiple trades required	3
HAI 3: Settle with treat (2 min.)	Response to treat	Consumes while standing or moving	3
		Consumes while lying/sitting or plays with treat	0
		Ignores treat/brief interest or holds treat in mouth without consuming	-3
	Circle Y (yes) if behavior is present or N (no) if absent	Attention seeking through close proximity/touch	Y / N
		Vigilance to environment	Y / N
		Vocalizing	Y / N
		Pacing and/or pawing at exit	Y / N
	Activity (last 15 sec.)	Neutral - stationary	0
		Neutral - active	0
		Stressed - stationary	-3
		Stressed - active	3
HAI 4: Model dog	Can you obtain the dog's attention while on-leash? (model dog is stationary, 5-10 sec.)	No - oriented toward stimulus	3
		No - retreat from stimulus	-3
		No - uninterested	0
		Yes	0
HAI 5: Return	Approach to kennel entry (within 5 ft. of kennel)	Actively pulling towards entry	-3
		Actively pulling away from entry	1.5
		Actively pulling/darting in multiple directions	3
		Requires encouragement	0
		Cooperative	0