Investigating Attachment Behavior in Shelter Dogs

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by

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Abstract

The strength and nature of the social connection between humans and dogs is a product of a long history of domestication. This study, conducted at a municipal shelter in Northern California using a modified Strange Situation Test, investigated the hypothesis that human-dog interactions will improve the quality and quantity of physical contact between dogs and people across an episodic set of trials. A dog either engaged with a person with whom it previously interacted and a stranger (handled condition) or interacted with two strangers (unhandled condition). Because dogs living at a shelter in the United States typically do not have a reliable source of social connection to humans, it was predicted that 1) dogs would have similar rates of physical contact with any individual regardless of condition, 2) handled dogs would exhibit more physical contact during Episode 1 of the original condition compared to the counterbalanced condition and 3) all dogs would maintain proximity to individuals regardless of condition. There were no statistically significant patterns of physical contacts across the episodes or in Episode 1, but there was a tendency towards more consistent use of room location as opposed to individual location. There was large variance in the data set, and thus a study with more subjects and also one that investigates not only the occurrence but also the duration of behaviors, as well as taking into account the background of the dogs, would further our understanding of shelter dog behavior, and their ability to form attachments to caregivers and future adopters.
Investigating Attachment Behavior in shelter dogs

During the 1970’s, there was a rise of academic interest in how attachment forms. Bowlby and Ainsworth hypothesized an ethological theory to attachment (as cited in Rajecki et al., 1978, p 419). They proposed that infants are born biologically predisposed to seek proximity and contact with conspecific adults. Bowlby argued that, at birth, modern-day infants exhibit behavior patterns that developed in man’s evolutionary history to maintain contact with caretakers (Rajecki et al., 1978). Ainsworth noted that qualitative factors would not affect whether an attachment would form but they would influence the security of the resulting relationship (Rajecki et al., 1978).

Ainsworth (1970) defined attachment as an affectional tie that an animal or person forms between them and another person or animal. That tie exists beyond space and also endures over time (Ainsworth & Bell, 1970). For Ainsworth, the behavioral marker for attachment in an animal or person was seeking to gain and maintain a certain level of physical contact under different circumstances; the strength of attachment may be heightened or diminished by various situations. Ainsworth and Bell (1970) argued that attachment is an organization of behavioral systems having an internal structure that is able to endure throughout time when potentially none of the component behaviors are activated.

In the landmark study, 56 one-year old infants and their mothers were recruited. Each trial was divided into eight episodes in a standard order for all 56 subjects. The episodes were designed to be novel enough to elicit certain behaviors but not so strange as evoke fear and overwhelm attachment at the start of the trial. Across the eight episodes, there were a variety of different situations for the infant to experience: mother present, mother and stranger present, etc (Ainsworth & Bell, 1970).
Five main behaviors were scored for each trial: 1) proximity and contact-seeking behavior such as approaching or active gestures like reaching; 2) contact-maintaining behavior like clinging or holding on; 3) proximity and interaction-avoiding behavior such as ignoring an adult; 4) contact and interact-resisting behavior such as attempts to push away an adult; 5) search behavior like following the mother to the door or trying to open the door. (Ainsworth & Bell, 1970).

As a result of their exploratory findings, Ainsworth and Bell offered a few propositions for their concept of attachment. The existence of attachment to an organism and an object of attachment do not need to coincide with the exhibition of attachment behavior. Attachment behavior is heightened in situations where the organism may perceive the situation as threatening. When attachment behavior is strongly activated, exploratory behavior will decrease, whereas if there is no threat to separation, the organism will use the object of attachment as a secure base in which to exploration a space. Finally, while exhibited attachment behavior may decrease, the attachment is not gone and will likely remerge upon reunion to the object of attachment (Ainsworth & Bell, 1970).

In Bowlby’s observations of birds, he noted that birds maintain proximity to another animal and attempt to restore it if the attachment is impaired. He also noted that attachment is not arbitrary but directed towards a specific being, and so relies on an animal’s ability to recognize individuals (as cited in Nagasawa, Mogi & Kikusui, 2009). Dogs have been shown to understand pointing gestures from humans unlike other animals and it is proposed that this cognitive ability developed during their close domestication within human society (Hare & Tomasello, 1999). As Bowlby observed, animals will attach to specific beings; in one study, dogs were able to discriminate between their owner and a stranger. Dogs stared longer at a visual stimulus when
the voice and the face did not match than when they did exhibiting the importance of both visual and auditory cue importance to dogs (Nagasawa et al., 2009).

Based on the close connection between humans and dogs, Topal and colleagues hypothesized that the human-dog bond would fall along similar lines as the mother-infant bond. They recruited 51 owner-dog pairs from local kennel clubs in Europe and ran a modified version of Ainsworth’s Strange Situation Test (Topal, Miklosi, Csanyi & Doka, 1998). Unlike Ainsworth’s original procedure with eight 3-minute long episodes, the modified test was comprised of seven two-minute episodes and a 30-second introduction episode. The role of the stranger was assumed by the same person in all trials and the owners were given no information on the ultimate goal of the study to keep them blinded to the experiment. As in the Ainsworth test, the owner and dogs were placed in a relatively empty room and over the seven episodes the dog was in the room with either the owner, stranger, both together or alone (Topal et al., 1998). Two trained observers analyzed the video and coded for eight different behavioral categories: exploration in the presence of the owner or in the presence of the stranger, playing with the owner or with the stranger, passivity in the presence of the owner or with the stranger, physical contact with the owner or stranger, standing by the door in the presence of the owner or strange and finally greeting behavior during reunion episodes.

From the study observations, the researchers noted that the experimental conditions were effective to activate attachment behavior in the dogs that was once just considered a mark of childhood (Topal et al., 1998). The dogs tended to play more and spend more time exploring in the presence of the owner just as the infants did with their mothers in the Ainsworth test, potentially displaying a secure base effect. During separation, the dogs stood at the door for a considerable length of time and such behavior was not reduced by the stranger’s presence.
The researchers followed up the original study to see if three short interactions with a stranger would lead a dog living in a shelter to develop similar attachment behavior as a dog to its owner. As in the original modified study, the researchers wished to analyze whether the dogs could discriminate and respond differentially to an object of attachment, show preference for the attachment figure and differentially respond to the separation and reunion to the attachment figure (Gasci, Topal, Miklosi, Doka & Csanyi, 2001). Sixty dogs, living in two rescue centers in Europe, were recruited for the study. Unlike shelters in the United States, the dogs were housed in a group environment in yards of 30-100 dogs with limited human interaction, usually just once a day for cleaning and feeding. At each center, 20 dogs were handled where the dogs interacted with an experimenter prior to the trial and 10 were not handled as a control measure. The trial consisted of the same episodes as their original modified Strange Situation Test; dogs in the handled condition would have an experimenter as owner and a stranger whereas dogs in the unhandled condition would interact with two strangers.

Despite only interacting with the experimental owner for 30 minutes (10 minutes over three consecutive days), the rescue dogs exhibited behavior patterns that seem to fulfill the three operational criteria of attachment: using the person as a secure base, reacting differentially to the experimental owner and seeking proximity to the experimental owner (Gasci et al., 2001). Dogs in the handled condition stood by the door less in the presence of the experimental owner than dogs in the unhandled condition and dogs in the handled condition exhibited higher levels of contact seeking behavior towards the experimental owner. There was no difference in contact-seeking and interest towards the stranger for dogs in either condition but handled dogs maintained less physical contact with the stranger than the unhandled dogs. Because of the short interaction time between the rescue dogs and the experimenters, the researchers proposed that
dogs living with low or restricted contact to humans might retain an ability to form new attachments to novel people (Gasci et al., 2001).

After the preliminary study results from Topal and colleagues, other researchers utilized the modified Strange Situation Test to study canine behavior further (Palmer & Custance, 2008; Prato-Previde et al., 2003; Rehn et al., 2013). In 2003, Prato-Previde and colleagues conducted a more detailed modified Strange Situation Test using owner-dog pairs. They argued that in Topal’s original study there was not sufficient evidence to confirm a secure base effect; a dog playing more with its owner could just illustrate preference rather than secure base (Prato-Previde, Custance, Spiezio & Sabatini, 2003). To obtain a wider range of data, the researchers expanded and created more detailed behavioral categories making them more similar to the focus of the Ainsworth test, as well as increasing the episode time from two minutes to the original three minutes as in Ainsworth’s test. They also added in an additional episode where both the owner and stranger left an article of clothing for the dog when it was alone for an additional three minutes hoping to see if the dogs would orient to their owner’s objects and if they would utilize these as a source of comfort (Prato-Previde et al., 2003).

As they hypothesized, the human-dog relationship seemed to provide evidence for a strong affectional bond but was limited in illustrating a true attachment. Unlike what was observed in Ainsworth’s original study, the dogs did not display a sufficient amount of individual play nor did they maintain very close proximity to the owner when the stranger entered the room. In fact, many of the dogs did not seem hesitant towards the stranger, so the stranger’s presence did not seem to activate attachment behavior (Prato-Previde et al., 2003). In the original Topal study, they did not code for vocalization or evidence of distress unlike Ainsworth’s test. In the Prato-Previde study, vocalizations increased as well as engagement in
search behaviors similarly seen in human infants and chimpanzees. Vocalizations were highest when the dog was left completely alone and were still present, though decreased, when left alone with the stranger. As would be proposed from the attachment test, dogs differentially responded to the entrance of the owner than to the stranger and after initial separation, the greeting behavior was different where the dogs showed more intense and longer levels of greetings than previously displayed (Prato-Previde et al., 2003). Finally, as not observed in the previous studies, dogs displayed stronger preference and potentially comfort for the object left behind by the owner than the stranger. Distress behavior decreased and the dogs oriented significantly more towards their owner’s chair when left alone.

While there were some indicators of preferential affection towards the owner over the stranger in the Prato-Previde study, due to the inherent order effects of the Ainsworth test, the evidence for the secure base effect was limited. As a result of this observation, Custance, who was involved in the Prato-Previde study, designed a counterbalanced Stranger Situation Test (Palmer & Custance, 2008). Creating a counterbalanced design would provide researchers the confidence that a dog’s reaction was in response to the person rather than as a result of the appearance in the trial episodes. Thirty-eight owner-dog pairs were recruited for the study and were randomly assigned to Condition A (the original trial order) or Condition B (the counterbalanced trial order). In Condition A, the owner would be present in the first episode of the trial while in Condition B, the stranger would be present in the first episode (Palmer & Custance, 2008). If in Condition A, the owner would fill out a questionnaire with the dog off leash during the introductory period or if in Condition B, the owner would bring the dog to the room and unobtrusively leave the room while the dog remained in the room with the stranger already seated and completing the questionnaire.
Each session was video-recorded and coded at 5-second instantaneous samples for 18 different behavioral categories such as orientation, contact, vocalizing, greeting and play. As observed in Prato-Previde (2003), the researchers observed the same patterns of proximity-seeking, comfort-seeking and search behavior and therefore focused much of their analysis on the potential evidence for a secure base effect (Palmer & Custance, 2008). Dogs in Condition A, Episode 1 explored significantly more than dogs in Condition B, Episode 2 showing some support for an owner acting as a secure-base for the dog. In the original condition, it could be argued that the dogs would explore more not because of the presence of the owner but due to the novelty of the room; however, because in the counterbalanced condition the room was just as novel, the decrease in exploration seen in Condition B could not be due to limited novelty. As might be expected, for dogs in both conditions, exploration levels while they were left alone were generally low. Across both conditions, there were no differences in the number of approaches made by the dog to the owner but it was observed that Condition B dogs approached the stranger significantly less (Palmer & Custance, 2008). Unlike the stranger wariness observed with human infants in Ainsworth’s original study, only 2 of the 38 dogs in both conditions returned to the owner’s side upon the appearance of the stranger. More evidence for the existence of a secure-base effect with owner and dog was observed in play; independent play decreased when dogs were left alone or just with the stranger but would recover upon the appearance of the owner. Dogs in both conditions would play with both the stranger and owner in Episode 2 (both owner and stranger present) but play was not maintained when the dogs in Condition A were left alone with the stranger in Episode 3 (Palmer & Custance, 2008). Unlike what was exhibited in previous studies to confirm a secure base effect, Palmer and Custance (2008) were able to
observe lower levels of exploration, passivity and independent play when the stranger was present.

Another research team conducted a study to test possible order effects that might exist in the Strange Situation Test. Rehn and colleagues recruited 12 female beagles from behavior studies on human-animal interactions for the test. All 12 beagles participated in both treatment conditions to observe within-treatment and between-treatment effects (Rehn, McGowan & Keeling, 2013). In the first treatment condition, the beagles were exposed to a familiar woman who had worked with the dogs for over two years and a stranger. In the second treatment condition, the beagles would be exposed to two strangers: Stranger A was presented sequentially like the familiar role and Stranger B was presented like the stranger. The experimenters were instructed to interact with the dog only when it was within one arm length of them or if the dog initiated physical contact. The goal of the study was to investigate whether a familiar person would affect the dog’s reaction during the test or if it was due to a person’s appearance in the sequence of the trial (Rehn et al., 2013). Two conditions were run for the study; one condition presented a familiar person and a stranger (FS condition) to the dogs and the other condition presented two strangers (SS condition). Similarly to other Strange Situation Tests, the dog was collected from the kennel and walked to the test area. Comparisons within treatment were made between episodes when the familiar person (FS condition) or Stranger A (SS condition) was present and to episodes where the stranger (FS condition) and Stranger B (SS condition) were present. The researchers expected that dogs would exhibit more exploratory and play behavior with the familiar person compared to the stranger but such an effect was not expected in the condition when two strangers would be presented. Between-treatment comparisons were made between episodes when the familiar person or when Stranger A was present and expected that
such comparisons that show dogs exploring and playing more in the presence of the familiar person (Rehn et al., 2013). The researchers discovered that in this version of the Strange Situation Test, order effects were present. Dogs explored similarly in the presence of Stranger A as when in the presence of the familiar person; however, dogs initiated more physical contact with the familiar person (Rehn et al., 2013). While Palmer and Custance discovered that the owner acted as a secure base for a dog in an episode compared to the equivalent episode where the stranger was present, Rehn and colleagues found no such result. Instead, exploration increased when either the familiar person or stranger was present; therefore, they suggested that exploratory behavior recovered due to the presence of a person and not necessarily dependent on a particular person (Rehn et al., 2013). Overall, they concluded on the data they collected, proximity seeking and greeting/reunion behavior were better indicators for attachment behavior as opposed to exploration since exploratory behaviors was affected by order effects. As a result of their study, the researchers proposed that Strange Situation Test should focus more on the behavior sequence during a reunion-like approach and the duration of physical contact (Rehn et al., 2013).

Intrigued by the results observed in the Gasci (2003) study, Barrera and colleagues set to further analyze the responses to shelter dogs to strangers. The researchers recruited 20 dogs from a local shelter and 14 pet dogs (Barrera, Jakovevic, Elgier, Mustaca & Bentosela, 2010). The dogs at the shelter in Argentina were housed in mixed gender groups of 3-4 animals. Unlike shelters in the United States where adoption is a priority and the goal is as short a stay as possible in a shelter, those at the Argentine shelter had lived at the shelter for over 2 years. The shelter dogs were provided the opportunity to play in a recreation yard for 15-20 minutes per day and each animal only averaged 13 minutes of daily human contact (Barrera et al., 2010).
While not following a standard Strange Situation Test protocol, the Barrera study still sought to investigate response behaviors, fear-appeasement and sociability, towards a stranger. Each dog followed the same procedure: two consecutive phases of 3 minutes each following an initial 3-minute familiarization to the experimental room. In Phase 1, the unfamiliar female experimenter behaved passively to the dog, standing in the room with the dog without making movements or speaking. The experimenter would only crouch and interact with the dog if the dog approached it; she would pet it for 3-5 seconds before stopping. If the dog reinitiated contact, the experimenter would behave as previously. In Phase 2, the unfamiliar female behaved actively to the dog, calling the dog by its name to get its attention and interacted with it- inviting it to play with a toy or petting it. If the dog exhibited any fearful behavior, the experimenter was instructed to cease approaching (Barrera et al., 2010).

Unlike previous Stranger Situation Test experiments, which focused primarily on attachment behaviors, the Barrera study sought to investigate displayed fear-appeasement and sociability behaviors. Coded fear-appeasement behaviors included the tail down, ears down or crouching, while sociability behaviors included proximity to the experimenter, proximity to door and initiation of physical contact. Behaviors were scored in both phases, every 5-seconds through instantaneous sampling.

As might have been predicted, the shelter dogs responded differentially to the stranger than pet dogs (Barrera et al., 2010). Fear-appeasement behavior in the shelter dogs appeared at a higher frequency than in the pet dogs. However, while fear-appeasement behavior was displayed more often, the shelter dogs remained near the passive experimenter longer than compared to pet dogs. During the passive phase, pet dogs were more likely to be in proximity to the door. During the active phase, shelter dogs exhibited a higher frequency of fear-appeasement behaviors than in
the passive phase but similarly showed a higher frequency of proximity to the experimenter. The researchers proposed an effect of social isolation on the shelter dogs that increased their need for social contact despite the apparent increase in fear displays (Barrera et al., 2010).

The aim of this study was to observe whether a modified Strange Situation Test conducted with shelter dogs in an United States shelter would illicit attachment behavior as similarly observed in previous studies. This study utilized a number of different aspects from these previous studies in order to provide a more developed test. In order to also control for any potential order effects, a counterbalanced Strange Situation Test as in Palmer & Custance (2008) was implemented in addition to the original modified Strange Situation Test (Gasci et al., 2001, Prato-Previde et al., 2003). Shelters in the United States individually house adoptable dogs while dogs in the Gasci (2003) and Barrera (2010) were group-housed which may affect motivation. Because of sparse housing conditions with limited conspecific and human interaction, I predicted that 1) frequency of physical contact between both the handled and unhandled conditions would be similar 2) handled dogs will exhibit greater physical contact in Episode 1 of the original condition compared to Episode 1 of the counterbalanced condition and 3) all dogs will maintain proximity to an individual regardless of condition.

**Materials and Methods**

**Dates and Location for the Study**

The study took place from March 21-25, 2016 at Yolo County Animal Services (YCAS) shelter located in Woodland, California.

**Shelter Protocol and Housing**

Dogs arrive at the shelter one of two main ways: as a stray brought in by a field officer or a member of the public or as an owner surrender- an animal whose owner(s) can no longer care for it. The majority of the dogs in the study came to the shelter as strays. If an animal comes in as a stray, the dog remains in the stray kennel, unavailable for adoption, for three days to allow for
the opportunity for a potential owner to come forward to claim the dog. After three days, the dog is evaluated for its behavior; if the dog passes the evaluation it is moved to the adoption kennels.

For dogs that come into the shelter as owner surrenders, they are given 24 hours to habituate to the shelter environment and then are similarly behaviorally evaluated and if they pass, are moved to the adoption floor. All dogs in the study passed their behavioral evaluation and were available for adoption.

The adoption section of the shelter has two rows of kennels. Each row has a lane of kennels on the right and left side with an aisle down the middle for adopters and staff to walk through. Each individual kennel is staggered from the other across from it to minimize dogs staring at each other, but dogs are still able to see other dogs across from their kennel.

The standard kennel has a concrete floor to allow for easier cleaning and a wire fence front (see Figure 1). Unless noted by staff due to a particular reason like destructive tendencies or lack of use, each kennel is equipped with a Kuranda bed (Kuranda USA, 2016), toys, and a water bowl.

Figure 1: Yolo County Animal Services Adoption Kennel
Wayne Tilcock/ Davis Enterprise photo
Exposure and Experience with People

Dogs living in the adoption kennel are constantly exposed to a range of different people. Kennels are cleaned every morning by a different person and each dog is moved from its “home” kennel to a temporary one for cleaning by one of these individuals before moving back to its original kennel. From 8am to 10am, prior to when the shelter is open to the public and while cleaning may be occurring, volunteers arrive to specifically provide enrichment for the dogs. Depending on the number of volunteers available per day, the majority or all dogs will be given the opportunity for one-on-one socialization enrichment and time outside in the outdoor kennels to run around and play with toys.

On days when the shelter is closed to the public and staffing is limited, at a minimum, dogs will be provided morning enrichment. When the shelter is open to the public until 6pm, volunteers arrive for 2-hour shifts after the morning enrichment volunteers to offer dogs the opportunity for walks and play as needed as well as to assist the public who may be interested in adoption.

All dogs on the adoption floor have the opportunity at any point to be taken out to interact with the public. Dogs are brought out to outdoor kennels by a volunteer and are given the opportunity to interact with the potential adopters. Dogs available for adoption may also be brought to offsite adoption events in the area like pet stores or community events where they are exposed to a range of different people and situations.

Experiment Subjects

Sixteen dogs, eight males and eight females were recruited for the study on the first day at the site. Males and females were then distributed into different conditions, handled or unhandled and in the original or counterbalanced condition through random sampling (see Figure 2). Over the course of the 5 days at the shelter, additional animals were added when possible to
accommodate some of the initially recruited animals lost to adoption, foster homes or illness. At the end of the five days, data was only able to be fully collected from 12 subjects: 3 subjects were either adopted, placed in foster or had fallen ill and one trial was rejected due to errors during the experiment. Table 1 provides a breakdown of the 12 completed trials and the conditions for each animal.

![Figure 2: Structure of subjects and how distributed](image)

H=Handled; UnH= Unhandled; Orig= Original; Cbal=Counterbalanced

<table>
<thead>
<tr>
<th>Dog Number</th>
<th>Name</th>
<th>Gender</th>
<th>Breed</th>
<th>Est Age</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Hulk</td>
<td>Male</td>
<td>Pit Bull</td>
<td>5 years</td>
<td>Handled Counter</td>
</tr>
<tr>
<td>3</td>
<td>Minor</td>
<td>Male</td>
<td>Pit Bull</td>
<td>---</td>
<td>Unhandled Original</td>
</tr>
<tr>
<td>5</td>
<td>Finn</td>
<td>Male</td>
<td>Boxer/Golden Retriever</td>
<td>4 years</td>
<td>Unhandled Original</td>
</tr>
<tr>
<td>6</td>
<td>Bandit</td>
<td>Male</td>
<td>Chihuahua Shorthair Mix</td>
<td>4 years</td>
<td>Unhandled Counter</td>
</tr>
<tr>
<td>7</td>
<td>Captain America</td>
<td>Male</td>
<td>Pit Bull</td>
<td>1 year</td>
<td>Unhandled Counter</td>
</tr>
<tr>
<td>8</td>
<td>Raider</td>
<td>Male</td>
<td>Terrier Mix</td>
<td>5 years</td>
<td>Handled Original</td>
</tr>
<tr>
<td>10</td>
<td>Alyssa</td>
<td>Female</td>
<td>Pit Bull</td>
<td>2.5 years</td>
<td>Handled Counter</td>
</tr>
</tbody>
</table>
Table 1: Subjects in trial and the conditions distributed

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Gender</th>
<th>Breed</th>
<th>Age</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Rosey</td>
<td>Female</td>
<td>Pit Bull</td>
<td>2 years</td>
<td>Unhandled Counter</td>
</tr>
<tr>
<td>12</td>
<td>Ivy</td>
<td>Female</td>
<td>Basenji/Sharpei</td>
<td>1 year 4 months</td>
<td>Unhandled Original</td>
</tr>
<tr>
<td>13</td>
<td>Aubrey</td>
<td>Female</td>
<td>Yorkshire Terrier mix</td>
<td>7 months</td>
<td>Unhandled Counter</td>
</tr>
<tr>
<td>14</td>
<td>Tuscon</td>
<td>Female</td>
<td>Pit Bull Mix</td>
<td>6 years</td>
<td>Handled Original</td>
</tr>
<tr>
<td>16</td>
<td>Maui</td>
<td>Female</td>
<td>Pit Bull Mix</td>
<td>---</td>
<td>Unhandled Original</td>
</tr>
</tbody>
</table>

The majority of the animals recruited in the study and living at the shelter are Pit Bull mixes. In an ASPCA study looking at data collected from 30 national shelters, Pit Bull mixes were ranked number 1 in dog’s intake at shelters, number one in euthanasia but ranked three in type of dog adopted (Weiss, 2014). Chihuahua mixes were the second most likely dog to be intaked at a shelter but were number one in popularity for adoption. These rankings might help explain the imbalance of breeds of animal recruited for this study.

**Experimental Room**

The experiment was conducted in a 20 ft (6 m) by 9 ft (2.7 m) wide room. This room is the main entry point to the adoption kennel. One door opens to an open walkway that visitors pass through from the main office to this entry room. A door on the opposite wall opens to the adoption kennel. It is noted that this room was not an ideal location for a controlled experiment as people could walk through but signs were placed on both doors during the experiment notifying visitors that a trial was in progress and nearly every trial was run prior to the shelter being open to the public so foot traffic into the adoption kennel was minimal.

For most of the dogs this entry room is not a regular location for them to visit unlike the outdoor kennels so any previous associations with the space were very minimal. To allow the
shelter to have access a portion for the space for their use, the trial was run in a 14.5 ft (4.4 m) x 9 ft (2.7 m) area; a gated, smaller area was left for shelter use.

The center of the room was measured and marked at 7.6 ft (2.3 m) and 4.5 ft (1.4 m). The chairs for each experimenter were placed at the 7.6 feet (2.3m), with a .5 m radius around each chair. From the center of the door, a .5 m radius was measured as well (see Figure 3).

Dogs were brought into the experiment room by the door to the adoption kennel by the primary experimenter. The experimenters in the role of either stranger or owner would leave or enter the room via the door to the open walkway.

Figure 3: Experimental Room at Yolo County Animal Services

**Handling Procedure**

Due to the limited space availability for the experiment’s use, handling sessions could only occur either in the outdoor kennels where most dogs interact with volunteers or interested adopters or inside their kennels. The week of the experiment, weather conditions were variable;
some days had rain or were predicted for rain. As a result, handling sessions occurred within each dog’s kennel. If handling sessions were held outside, the only individual entering the adoption kennel would have been the primary experimenter, thus eliminating any potential interaction between the two female experimenters and the subjects. However, because handling sessions were held inside the adoption kennel, it is possible that potential visual interaction may have occur between the two experimenters and dogs later utilized for the unhandled condition portions of the study.

Each handling session was 10 minutes long and occurred twice over two different days for a total of twenty minutes of handling and socialization time prior to the dog’s trial. The two experimenters would sit inside the kennel and interact based on the dog’s engagement; many of the dogs chose to sit next to the experimenter or on the experimenter’s lap they were petted. The experimenter who interacted with the dog for the handling sessions assumed the role of “owner” in the trials.

**Experimental Procedure**

The experimental procedure was modified from the Gasci shelter study (2001), the Prato-Previde (2003) study and the counterbalanced procedure from the Palmer study (2010). The Gasci study developed the Ainsworth procedure for use with dogs but used two-minute episodes instead of Ainsworth original three-minute procedure. The Prato-Previde study was run more similarly to the Ainsworth study model with three-minute episodes as well as the use of a more detailed ethogram to code behavior. Both the Gasci and Prato-Previde study ran the trials in one direction (begin with owner, end with owner); however, Palmer noted the possible confounds this procedure may create and also utilized a counterbalanced trial which was implemented in this study as well.
This study operated a two-by-two factorial design. Dogs were randomly assigned to either the handled or unhandled condition as in Gasci (2003) and then assigned to either the original procedure or the counterbalanced procedure as in Palmer and Custance (2010). Because handling sessions needed to be for ten-minute sessions over two days prior to the trial, unhandled dog trials were run first.

Each trial consisted of seven episodes running three minutes each for a total trial time of twenty-one minutes. As seen in Tables 2-5, each trial across the conditions provided the dog interaction with either one or both experimenters. Table 2 presents the sequence of each episode of a handled dog in an original condition - the experimenter in the assumed role of owner was the first and last person to be present to the dog in the trial. In the counterbalanced condition for a handled dog (see Table 3), the second experimenter, assuming the role of the “stranger,” was the first and last person to be present in the trial. For the unhandled trials, the two experimenters were both strangers to the subject. To maintain consistency throughout the trials, one experimenter was assigned the role of Stranger 1 and the other was Stranger 2. Stranger 1 was present in the first and last episode of the unhandled, original condition (see Table 4) while Stranger 2 was present in the first and last episode of the unhandled, counterbalanced condition (Table 5).

<table>
<thead>
<tr>
<th>Episode 1 (owner and dog)</th>
<th>OW enters room with the dog and sits down and ignores the dog. Only interact with dog if dog seeks attention. Dog is still on leash but is able to move about the room.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episode 2 (owner, dog, stranger)</td>
<td>The UP enters the room and sits down on the other chair in the room. After one minute UP will begin talking to the owner and after the second minute the UP will try to engage the dog in play. OW will unobtrusively leave the room.</td>
</tr>
<tr>
<td>Episode 3 (UP and dog)</td>
<td>UP will continue to try and play with the dog if it is willing.</td>
</tr>
<tr>
<td>Episode 4 (OW and dog)</td>
<td>1st reunion episode. OW enters the room and allows about 5 seconds for the dog to respond and sits down. UP then leaves room at unobtrusively as possible. OW will play with dog if</td>
</tr>
</tbody>
</table>
willing and pet the dog if close enough. At the end of the three minutes, will stop petting the dog and tell the dog “goodbye” and exit the room.

**Episode 5 (dog alone)**
Dog is left alone in the room for 3 minutes

**Episode 6 (UP and dog)**
UP enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, goes sit down. If the dog is willing, UP will start playing or pet the dog if willing.

**Episode 7 (OW and dog)**
OW enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, sits down. UP leave rooms as in episode 4. OW will begin playing or petting dog if willing.

**Table 2: Condition 1: Handled Dog, Original Condition**

<table>
<thead>
<tr>
<th>Episode 1 (stranger 1 and dog)</th>
<th>S1 enters room with the dog and sits down and ignores the dog. Only interact with dog if dog seeks attention. Dog is still on leash but is able to move about the room.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episode 2 (stranger 1, dog, stranger 2)</td>
<td>The S2 enters the room and sits down on the other chair in the room. After one minute S2 will begin talking to the owner and after the second minute the UP will try to engage the dog in play. S1 will unobtrusively leave the room.</td>
</tr>
<tr>
<td>Episode 3 (stranger 2 and dog)</td>
<td>S2 will continue to try and play with the dog if it is willing.</td>
</tr>
<tr>
<td>Episode 4 (stranger 1 and dog)</td>
<td>1st reunion episode. S1 enters the room and allows about 5 seconds for the dog to respond and sits down. S2 then leaves room as unobtrusively as possible. S1 will play with dog if willing and pet the dog if close enough. At the end of the three minutes, will stop petting the dog and tell the dog “goodbye” and exit the room.</td>
</tr>
<tr>
<td>Episode 5 (dog alone)</td>
<td>Dog is left alone in the room for 3 minutes</td>
</tr>
<tr>
<td>Episode 6 (stranger 2 and dog)</td>
<td>S2 enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, goes sit down. If the dog is willing, S2 will start playing or pet the dog if willing.</td>
</tr>
<tr>
<td>Episode 7 (stranger 1 and dog)</td>
<td>S1 enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, sits down. S2 leave rooms as in episode 4. S1 will begin playing or petting dog if willing.</td>
</tr>
</tbody>
</table>

**Table 3: Condition 2: Unhandled Dog, Original Condition**

<table>
<thead>
<tr>
<th>Episode 1 (UP and dog)</th>
<th>UP enters room with the dog and sits down and ignores the dog. Only interact with dog if dog seeks attention. Dog is still on leash but is able to move about the room.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episode 2 (owner, dog, stranger)</td>
<td>The OW enters the room and sits down on the other chair in the room. After one minute OW will begin talking to the owner and after the second minute the second person will try to engage...</td>
</tr>
<tr>
<td>Episode 3 (OW and dog)</td>
<td>OW will continue to try and play with the dog if it is willing.</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Episode 4 (UP and dog)</td>
<td>1st reunion episode. UP enters the room and allows about 5 seconds for the dog to respond, sits down OW then leaves room at unobtrusively as possible. UP will play with dog or pet the dog if close enough. At the end of the three minutes, will stop petting the dog and tell the dog “goodbye” and exit the room.</td>
</tr>
<tr>
<td>Episode 5 (dog alone)</td>
<td>Dog is left alone in the room for 3 minutes</td>
</tr>
<tr>
<td>Episode 6 (OW and dog)</td>
<td>OW enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, sits down. If the dog is willing, OW will start playing or petting dog if willing.</td>
</tr>
<tr>
<td>Episode 7 (UP and dog)</td>
<td>UP enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, sits down. OW leave rooms as in episode 4. UP will begin playing with the dog or petting the dog if willing.</td>
</tr>
</tbody>
</table>

Table 4: Condition 3: Handled Dog, Counterbalanced Condition

<table>
<thead>
<tr>
<th>Episode 1 (Stranger 2 and dog)</th>
<th>S2 enters room with the dog and sits down and ignores the dog. Only interact with dog if dog seeks attention. Dog is still on leash but is able to move about the room.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Episode 2 (Stranger 2, dog, Stranger 1)</td>
<td>The S1 enters the room and sits down on the other chair in the room. After one minute S1 will begin talking to the S2 and after the second minute S1 will try to engage the dog in play. S2 will unobtrusively leave the room.</td>
</tr>
<tr>
<td>Episode 3 (Stranger 1 and dog)</td>
<td>S1 will continue to try and play with the dog if it is willing.</td>
</tr>
<tr>
<td>Episode 4 (Stranger 2 and dog)</td>
<td>1st reunion episode. S2 enters the room and allows about 5 seconds for the dog to respond, sits down S1 then leaves room at unobtrusively as possible. S2 will play with dog or pet the dog if close enough. At the end of the three minutes, will stop petting the dog and tell the dog “goodbye” and exit the room</td>
</tr>
<tr>
<td>Episode 5 (dog alone)</td>
<td>Dog is left alone in the room for 3 minutes</td>
</tr>
<tr>
<td>Episode 6 (S1 and dog)</td>
<td>S1 enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, sits down. If the dog is willing, S1 will start playing or petting dog if willing.</td>
</tr>
<tr>
<td>Episode 7 (S2 and dog)</td>
<td>S2 enters the room and pauses for 5 seconds to allow the dog to respond and initiate interaction, sits down. S1 leave rooms as in episode 4. S2 will begin playing with the dog or petting the dog if willing.</td>
</tr>
</tbody>
</table>
Table 5: Unhandled Dog, Counterbalanced Condition

At the beginning of each trial, both experimenters stood outside the door to the walkway and the primary experimenter walked through the adoption kennel to retrieve the trial subject. Dogs were brought to and from the experimental room by a collar and a leash and kept the leash on, dragging, throughout the session for safety.

The dog was left alone at the very beginning of the trial for a brief few seconds between the primary experimenter leaving and one of the trial experimenters entering the room. For consistency and to decrease the possible confounding variable of side preference, each experimenter was assigned the right or the left chair in the room that they sat in whether they entered first or second in a trial.

The primary experimenter communicated to the two experimenters throughout the trial via earphones and a conference call. The primary experimenter kept a stopwatch to time each three-minute episode and would cue when each experimenter should enter or leave the experiment room. At the end of the trial, the primary experimenter would cue the end of the trial and would have the experimenter leave the room while the primary experimenter would enter and walk the dog back to its kennel.

**Video Recording Procedure and Analysis**

Footage for each trial was obtained using a GoPro HERO3 Black camera (GoPro, 2016). To get the widest view of the experiment room, the GoPro was attached to the ceiling above the center of the room in between the two experimenter’s seats. Footage was shot at 5-second intervals; for a 21-minute trial, on average 250 images were obtained. The camera was wirelessly connected via Wi-Fi from the GoPro to the primary experimenter’s phone. The primary experimenter activated the GoPro before entering the adoption kennel to ensure that filming was occurring as soon as the trial started. Spare, extraneous images prior to the trial beginning were
edited out before video analysis was completed. Video analysis was completed by two coders blind to the experiment. Neither coder knew the conditions the dog was assigned nor which trial experimenter was assigned the role of stranger or owner.

**Coding Procedure**

The coding procedure was initially modeled on the behavioral operational definitions from Prato-Previde (2003) and Barrera (2010) observing proximity to owners and strangers as well as fear appeasement and sociability behaviors. When initially analyzing the footage, the previous planned coding definitions (Table 6) were not suitable so a modified coding scheme was devised. The modified behavioral operational scale (Table 7) looked at location of person right or left, the location of the dog in the image frame and the behavior of the dog.

<table>
<thead>
<tr>
<th>Sociability Behavior</th>
<th>Proximity to person</th>
<th>Dog within half meter to person, either stranger or owner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physical contact with person</td>
<td>Being in physical contact with either owner or stranger</td>
</tr>
<tr>
<td></td>
<td>Greeting behavior</td>
<td>Greeting behavior towards entering owner or stranger, approaching, tail-wagging, jumping, any other physical contact</td>
</tr>
<tr>
<td></td>
<td>Proximity to door</td>
<td>Dog within distance of half meter from door</td>
</tr>
<tr>
<td></td>
<td>Approach</td>
<td>Approaching while clearly visually oriented towards a person</td>
</tr>
<tr>
<td>Fear Appeasement</td>
<td>Withdraw</td>
<td>Avoiding interaction with</td>
</tr>
<tr>
<td>Behavior</td>
<td>owner or stranger by moving away, looking away or turning away</td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Tail Down</td>
<td>Tail tucked to hind legs, no movement</td>
<td></td>
</tr>
<tr>
<td>Ears down</td>
<td>Ears low and down against top of head</td>
<td></td>
</tr>
</tbody>
</table>

**Secure Base/Other**

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Activity directed toward physical aspects of the environment: sniffing, visual inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td></td>
</tr>
<tr>
<td>Passive behavior</td>
<td>Sitting, standing or lying down without obvious orientation to person or door</td>
</tr>
<tr>
<td>Locomotion</td>
<td>Walking, pacing or running without exploring or playing</td>
</tr>
<tr>
<td>Social play</td>
<td>Any active behavior when interacting with owner or stranger, includes running, jumping</td>
</tr>
<tr>
<td>Vocalizing</td>
<td>Any vocalization exhibited: barking, growling, howling, whining</td>
</tr>
</tbody>
</table>

Table 6: Behavioral Categories recorded in shelter Strange Situation Test Procedure, adapted from Prato-Previde 2003 and Barrera 2010

<table>
<thead>
<tr>
<th>Left Person Present</th>
<th>person present in left chair/left frame</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right Person Present</td>
<td>person present in right chair/right frame</td>
</tr>
<tr>
<td>In contact with left</td>
<td>Yes</td>
</tr>
<tr>
<td>person</td>
<td>Active Behavior</td>
</tr>
<tr>
<td>-----------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Active Behavior</td>
<td>leaning body or muzzle against person, jumping onto person</td>
</tr>
<tr>
<td>Passive Behavior</td>
<td>in contact but not leaning against person, no apparent solicitation</td>
</tr>
<tr>
<td>In contact with right person</td>
<td>Yes</td>
</tr>
<tr>
<td>Active Behavior</td>
<td>leaning body or muzzle against person, jumping onto person</td>
</tr>
<tr>
<td>Passive Behavior</td>
<td>in contact but not leaning against person, no apparent solicitation</td>
</tr>
<tr>
<td>Location of Dog</td>
<td>At left Door dog is standing in .5 m² around left door</td>
</tr>
<tr>
<td></td>
<td>Left Square dog located in .5 m² around left located chair</td>
</tr>
<tr>
<td></td>
<td>Lower Frame dog located in square on lower frame of screen</td>
</tr>
<tr>
<td></td>
<td>Out of Frame dog not visible</td>
</tr>
<tr>
<td>Behavior</td>
<td>Greeting dog at door when person entering the room</td>
</tr>
<tr>
<td></td>
<td>Sitting dog is sitting on ground, not in person's lap</td>
</tr>
<tr>
<td></td>
<td>Laying Down dog lying down, paws beneath body</td>
</tr>
</tbody>
</table>

Table 7: Behavioral Operations Used in Current Study

Coders analyzed the data in an almost hierarchical manner; they would code for whether a person was present in the right or left square, then whether the dog was in physical contact with the person. If the dog was in physical contact with the person then it was likely in either right or left frame but if not in contact, coders analyzed for its location throughout the room. For whatever the dog’s position and proximity to a person, they coded its behavior at that time point.

By coding for whether a person was present, the primary experimenter would be able to determine if there was a difference between having a person present or not in the dog’s behavior and coding for whether the person was sitting in the right or left chair would aid the primary experimenter in data analysis as to whether the dog was interacting with the owner or stranger and at what points during the trial. As similarly analyzed by Prato-Previde (2003) and Barrera
(2010), the coding for dog location, as in right or left square, would help indicate sociability towards either the right or left person. To flesh out the level of sociability, coders were asked to code for the dog’s physical contact with either the right or left person and whether the dog displayed active or passive behavior. Active behavior was defined as leaning body or muzzle against the person or jumping onto the person, while passive behavior was defined as the dog being in physical contact with the person but with no apparent solicitation - as if the dog was standing next to the person and the person had a hand on the dog to pet but the dog did not appear to have solicited it.

The two coders also coded for the dog’s location in relation to either door in the room. Since the experimenters entered and exited from the same door throughout the experiment, the dog’s location to that door throughout the trial potentially could indicate sociability to one experimenter or to another as well as proximity to the non-used door could indicate some non-social behaviors.

Overall, a dog’s behavior fell into a few discrete categories. The dog greeting an individual at the door was only coded for the entrance of a person. The other behaviors were standard: in lap, standing, sitting or lying down.

While the goal had been to analyze and code for fear-appeasement behaviors, as the Barrera study was able to do, the use of the still images made it too difficult for the coders to tease out for these behaviors.

**Interrater Reliability**

To ensure consistency between the two independent coders, each coder coded the same initial video (Dog 2) before continuing to code the other eleven videos. Once they both completed coding the first video, their results were submitted back to the primary experimenter who compared their results and analyzed using Cohen’s Kappa coefficient ($K=\frac{P_0 - P_e}{1-P_e}$).
Reliability was obtained for all coded items and both coders were allowed to proceed with the rest of the videos. After coding for all 12 videos was complete, the primary experimenter confirmed continued reliability for the videos (Table 8)

<table>
<thead>
<tr>
<th>Dog</th>
<th>Interrater Reliability Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog 2</td>
<td>.772-994</td>
</tr>
<tr>
<td>Dog 3</td>
<td>.706-1</td>
</tr>
<tr>
<td>Dog 5</td>
<td>.642-1</td>
</tr>
<tr>
<td>Dog 6</td>
<td>.746-1</td>
</tr>
<tr>
<td>Dog 7</td>
<td>.764-1</td>
</tr>
<tr>
<td>Dog 8</td>
<td>.769-1</td>
</tr>
<tr>
<td>Dog 10</td>
<td>.768-1</td>
</tr>
<tr>
<td>Dog 11</td>
<td>.708-1</td>
</tr>
<tr>
<td>Dog 12</td>
<td>.770-1</td>
</tr>
<tr>
<td>Dog 13</td>
<td>.598-1</td>
</tr>
<tr>
<td>Dog 14</td>
<td>.742-1</td>
</tr>
<tr>
<td>Dog 16</td>
<td>.798-1</td>
</tr>
</tbody>
</table>

Table 8: Interrater Reliability Range

**Statistical Analysis**

Every video was analyzed at 5-second intervals with the coders imputing a “1” into the data sheet to indicate the presence of a coded behavior or location. These indications for the occurrence of an event were then compiled to form a total number of events for every coded item for each episode, as well as a total number of the coded events over the entire trial. The totaled events for every coded item for each episode for both coders were then averaged to create one total amount of time each coded behavior or location occurred during an episode for one trial.

Due the small sample size (n=12) and uneven sampling between handled and unhandled dogs, non-parametric statistics were utilized for analysis, primarily, the Mann-Whitney test. All statistics and graphs were run using GraphPad Prism. Statistical comparisons were conducted on dogs in the handled and unhandled conditions to assess if there was a difference in frequency of
physical contact across the episodes, if there was a difference in rate of physical contact to the individual present in Episode 1 of the handled condition and to assess if dogs proximity and location changed based on the individual present.

**Results**

Of the analyses run, only one analysis was statistically significant (see Table 9). Due to the small sample size, non-parametric statistics were used for analysis. A Mann-Whitney U test, a non-parametric test, utilized in previous modified Strange Situation Test studies, was used for comparison analysis of physical contact, location and proximity. These statistical comparisons provided some insight into wider group comparisons, but the large degree of variance between the subjects could skew the group statistics. In order to gain a better understanding of individual variation, graphs (Appendix A, Figures 19-30) were produced to investigate any potential trends in variation among the dogs.

<table>
<thead>
<tr>
<th>Situation or Behavior</th>
<th>Comparison</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Contact</td>
<td>HO: O vs S (episode 2)</td>
<td>Mann-Whitney: p &gt; .9999 NS</td>
</tr>
<tr>
<td></td>
<td>HC: O vs S (episode 2)</td>
<td>Mann-Whitney: p &gt; .9999 NS</td>
</tr>
<tr>
<td></td>
<td>UO: S1 vs S2 (episode 2)</td>
<td>Mann-Whitney: p = .8857 NS</td>
</tr>
<tr>
<td></td>
<td>UC: S1 vs S2 (episode 2)</td>
<td>Mann-Whitney: p = .8857 NS</td>
</tr>
<tr>
<td></td>
<td>HO and HC: O vs S (all)</td>
<td>Mann-Whitney: p = .8857 NS</td>
</tr>
<tr>
<td></td>
<td>UO and UC: O vs S (all)</td>
<td>Mann-Whitney: p = .6454 NS</td>
</tr>
<tr>
<td></td>
<td>HO and HC vs UO and UC (all)</td>
<td>Mann-Whitney: p = .6529 NS</td>
</tr>
<tr>
<td></td>
<td>Anny vs Macie</td>
<td>Mann-Whitney: p = .4776 NS</td>
</tr>
<tr>
<td></td>
<td>HC vs HO Episode 1</td>
<td>Mann-Whitney: p = .6667 NS</td>
</tr>
<tr>
<td></td>
<td>UO vs UC Episode 1</td>
<td>Mann-Whitney: p = .6857 NS</td>
</tr>
<tr>
<td>At Right</td>
<td>HO and HC vs UO</td>
<td>Mann-Whitney: p = .3271</td>
</tr>
</tbody>
</table>
Table 9: Summary of Results, The one significant comparison is bolded
Key: O=Owner S= Stranger S1=Stranger 1 S2= Stranger 2
HO=Handled Original Condition; HC= Handled Counterbalanced Condition
UO= Unhandled Original Condition; UC= Unhandled Counterbalanced Condition

<table>
<thead>
<tr>
<th>Door/Right Square</th>
<th>and UC (episode 5)</th>
<th>NS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owners Square Vs Stranger Square</td>
<td>HO and HC: O vs S all</td>
<td>Mann-Whitney: p= &gt;.9999 NS</td>
</tr>
<tr>
<td><strong>Stranger 1 Square Vs Stranger 2 Square</strong></td>
<td>UO and UC: L(S1) vs R (S2)</td>
<td>Mann-Whitney: p=.207 S</td>
</tr>
<tr>
<td>Right vs Left Square</td>
<td>HO and HC: L vs R</td>
<td>Mann-Whitney: p=.1143 NS</td>
</tr>
<tr>
<td>Right Door</td>
<td>HO and HC vs UO vs UC all</td>
<td>Mann-Whitney: p=.6828 NS</td>
</tr>
</tbody>
</table>

*Physical Contact*

There was no statistical significance in any of the physical contact comparisons. It is possible that these results confirmed the prediction that physical contact rates would be similar for the dogs in both conditions, but likely, the small sample size allowed individual variance among the dogs to show more in the statistics.

Handle dogs in either condition were no more likely to engage in physical contact to either individual compared to unhandled dogs (see Figure 4; Mann-Whitney: p=.6529).
Figure 4: Handled vs Unhandled Condition Frequency of Physical Contact
Mann Whitney: p=.6529; Not Significant
Handled: N=8 Mean=.2407; Std Deviation=.08837, Std Error of Means=.03124
Unhandled: N=16; Mean=.2068; Std Deviation=.123; Std Error of Means=.03076

Comparisons were also run to compare the rates of physical contact of the dog to the
owner or stranger in the handled condition (see Figure 5; Mann Whitney: p=.8857) and well as to
compare rate of physical contact of the dog to Stranger 1 and Stranger 2 in the unhandled
condition (see Figure 6; Mann-Whitney: p=.6454). There was no statistically significant
difference between the two populations as predicted and the resulting graphs looked quite similar
to each other.
Figure 5: Handled Condition Frequency of Physical Contact Across Episodes
Mann Whitney: p=.8857; Not Significant
Owner: N= 4 Mean= .2353; Std Deviation=.0883, Std Error of Means=.04415
Stranger: N=4; Mean= .2461; Std Deviation=.1017; Std Error of Means=.05085

Figure 6: Unhandled Condition Frequency of Physical Contact Across Episodes
Mann Whitney: p=.6454; Not Significant
Stranger 1: N= 8 Mean= .1968; Std Deviation= .1337, Std Error of Means= .04728
Stranger 2: N=8; Mean= .2168; Std Deviation=.197; Std Error of Means= .04232

While not statistically significant (Figure 7; Mann-Whitney: p=.6667), the mean rates of physical contact in the original condition Episode 1 when the owner arrived first were larger than those of the handled counterbalanced condition Episode 1 when the stranger arrived first. As might be expected, while also not statistically significant (Figure 8; Mann-Whitney: p=.6857), comparison of physical contact for Stranger 1 in the unhandled original condition Episode 1 and Stranger 2 in the unhandled counterbalanced condition Episode 1 showed very similar rates since both experimenters were strangers to the dog.

Figure 7: Handled Original vs Handled Counter Frequency of Physical Contact Episode 1
Mann Whitney: p= .6667; Not Significant
Owner First: N= 2; Mean= .5714; Std Deviation= .4445, Std Error of Means= .3143
Stranger First: N=2; Mean= .2384; Std Deviation=.1073; Std Error of Means= .0759
Comparisons of physical contact rates were also run between both individuals in each condition during Episode 2. Episode 2 in the trial is the first time that both individuals are present with the dog, for those in the handled condition, regardless of original or counter condition, the owner and the stranger are present, while in the unhandled condition, both strangers are present.

While not statistically significant (Figure 9; Mann-Whitney: p>0.9999), when looking at the graph, dogs in the handled original condition showed slightly higher rates of physical contact to the stranger as observed in Palmer and Custance (2010). In that study, owned dogs seemed to be less wary to the new stranger in Episode 2 than dogs in the handled counter condition. This was also seen when comparing the handled original condition dogs to the handled counter
condition dogs (Figure 10; Mann-Whitney: p>.09999). The rates of physical contact for Stranger 1 vs Stranger 2 in either the unhandled original (Figure 11; Mann-Whitney: p=.8857) or counterbalanced condition (Figure 12; Mann-Whitney: p=.8857) were quite similar to each other.

Figure 9: Handled Original Frequency of Physical Contact, Episode 2
Mann Whitney: p = >0.9999; Not Significant
Owner: N= 2; Mean= .1691; Std Deviation= .1245, Std Error of Means= .088
Stranger: N=2; Mean= .3379, Std Deviation=.4788, Std Error of Means= .3379
Figure 10: Handled Counter Frequency of Physical Contact, Episode 2
Mann Whitney: p = >0.9999; Not Significant
Owner: N = 2; Mean = .2206; Std Deviation = .312, Std Error of Means = .2206
Stranger: N = 2; Mean = .1368, Std Deviation = .09779, Std Error of Means = .06915

Figure 11: Unhandled Original Frequency of Physical Contact, Episode 2
Mann Whitney: p = .8857; Not Significant
Stranger 1: N = 4 Mean = .3012; Std Deviation = .2317, Std Error of Means = .1158
Stranger 2: N=4; Mean= .2353, Std Deviation=.143; Std Error of Means= .07151

Mann Whitney: p= .8857; Not Significant

One possible confounding variable that could occur during the trial was possible preference for one experimenter over the other. A comparison was run comparing the rates of physical contact for all dogs in the study to the two experimenters (Anny and Macie) regardless of which condition. There was no statistically significant difference in frequency of physical contact across all episodes and conditions for either experimenter (Figure 13; Mann-Whitney: p=.4776)
Location and Proximity to individuals

Location in relation to the owner or the stranger was investigated by comparing the dog’s location in either the owner or stranger’s square which was a .5 meter square located around the chair. In the handled condition, the square of the owner or stranger could be either left or right depending on the owner since chairs were assigned to each experimenter. When looking at handled condition dogs’s location in the owner or stranger square, the results were not statistically significant (Figure 14; Mann-Whitney: p>0.9999) and the graph means were quite similar. However, because owner and stranger square could have been located in either the right or left square, in order to get a truer understanding of location relative to the rest of the room, the same comparison was run for the handled dogs but looking purely at the squares as left or right regardless of owner or stranger. This comparison was also not statistically significant (Figure 15;
Mann-Whitney: p = .1143) but the p-value was much lower with a higher rate towards the right square which could relate to its location relative to the right door.

![Owner Square vs Stranger Square Frequency of Events](image)

**Figure 14:** Handled Condition Owner Square vs Stranger Square Frequency of Events
Mann Whitney: p = >.9999; Not Significant
Owner Square: N = 4; Mean = .3246; Std Deviation = .1146, Std Error of Means = .05731
Stranger Square: N = 4; Mean = .3182; Std Deviation = .1105; Std Error of Means = .05527
In the unhandled condition, Stranger 1 was always located at the left square and Stranger 2 was always located in the right square. When comparing the time spent in each square, unhandled dogs spent a statistically significant amount of time in the Stranger 2 square (Figure 16; Mann-Whitney: \( p=.0207 \)), which also was the right square, by the right door.
Location at right door

Because there appeared to be a tendency to higher time spent in the right area of the room, statistics were run to investigate time spent in the right door across all episodes for dogs in the handled vs. the unhandled condition. There was no statistical significant difference of frequency at the right door for handled and unhandled dogs (Figure 17; Mann-Whitney: p=.6828). Statistical comparison was also run on handled vs unhandled dogs for amount of time spent by the right door and right square in Episode 5 when the dog was left alone. Both data points for right door and right square were gathered due to the close location of both in the small experimental room. While not statistically significant (Figure 18; Mann-Whitney: p=.3271),
handled dogs showed slightly higher rates of time spent in the right square and right door during Episode 5 when the dog was alone.

Figure 17: Handled vs Unhandled Frequency at Right Door Frequency of Events
Mann Whitney: p = .6828; Not Significant
Handled: N= 4; Mean = .215; Std Deviation = .1223, Std Error of Means = .06116
Unhandled: N=8; Mean = .1846; Std Deviation = .1669; Std Error of Means = .059
Figure 18: Handled vs Unhandled Frequency at Right Door/Right Square Episode 5
Mann Whitney: p = .3271; Not Significant
Handled: N= 8; Mean= .4322; Std Deviation= .2102, Std Error of Means= .7432
Unhandled: N=16; Mean= .3401; Std Deviation=.3018; Std Error of Means= .07544

**Individual Results**

One potential issue of analyzing data from a small sample size is the potential for variation in the individual skewing data. In order to obtain a better understanding of where variation might occur, graphs were produced looking at physical contact for all dogs across each episode as well as graphs looking at the frequency of location and behavior for all episodes. Individual analysis for each dog and their respective graphs are provided in Appendix A.

**Discussion**

This study investigated the potential attachment behavior between shelter dogs and individuals. Due to the limited socialization for adoptable dogs in most United States shelters, I expected that there would be similar rates of physical contact for the dogs regardless of whether previously handled or not but that dogs in the handled original condition would show a difference in physical contact during Episode 1 and that overall, all dogs would maintain
proximity to an individual regardless of previous handling. These predictions were based on results from previous studies utilizing the modified Stranger Situation Test to investigate attachment behavior in pet dogs and their owners, as well as in shelter dogs and assumed-owners (Topal et al., 1998; Gasci et al., 2001; Prato-Previde et al., 2003). While none of the analyses showed statistical difference, possibly confirming the prediction, it is more likely that no statistical significance was observed due to the small sample size.

Due to the close connection of dogs and humans, the Strange Situation Test was modified to investigate whether dogs displayed similar behaviors of an attachment bond as infants did to mothers (Topal et al., 1998). A follow up study then investigated whether dogs living in a shelter environment, without true owners, would display attachment behavior to a stranger (Gasci et al., 2001). While pet dogs understandably show preference to their owners over a stranger due to constant contact with the owner, Gasci noted that shelter dogs, whether interacting with someone they engaged with for thirty minutes or a complete stranger, were interested and somewhat engaged in contact seeking to both individuals. They proposed that dogs living in environments of low or restricted contact would retain an ability to form new attachment relationships, being more responsive to new humans (Gasci et al., 2001). The current study built off this fundamental idea to determine whether dogs living in a shelter in the United States with higher levels of restricted contact to both humans and other dogs would demonstrate preference for relatively new individuals.

As observed in Gasci (2001), dogs in this study in the handled condition did not significantly engage in overall physical contact any more than the unhandled condition. Gasci observed that handled dogs had less physical contact with the stranger than unhandled dogs while in this study no such effect was observed.
Unlike previous studies, this study incorporated the counterbalanced modified Strange Situation Test introduced by Palmer and Custance (2008). In their study comparing pet dogs with their owner and a stranger, they elicited the same trends of proximity-seeking, comfort-seeking and search behavior as in Prato-Previde (2008) while also providing evidence that the dog’s behavior was not a consequence to the order of the episodes but to the presentation of the person (Palmer & Custance, 2010). In the current study, as might be expected, there was no difference in the frequency of physical contact for dogs in the unhandled conditions as seen in Rehn (2013) since the dogs had no previous exposure to either individual. However, as observed in Palmer and Custance (2010), the mean rates of physical contact in this study were slightly larger for handled dogs in Episode 1 in the original condition than those in the counterbalanced condition. This study’s did not demonstrate a statistically significant difference between the two conditions but with a larger sample size it is possible a stronger trend might be seen.

Beyond physical contact, it was important in this study to take into account a dog’s proximity to an individual as well as its location throughout the room. In other modified Strange Situation Tests, dogs oriented more and tended to engage more with the location of the owner than the stranger (Prato-Previde et al., 2003). Similarly, shelter dogs showed higher frequency and longer duration in maintaining proximity to a stranger despite no previous exposure to that individual (Barrera et al., 2010). Because this study investigated a shelter population, it was proposed that dogs in either condition would maintain proximity to individuals. The only significant comparison in this study was observed in proximity to Stranger 1 and Stranger 2. This could be interpreted as Stranger 2 preference; however, because a difference when comparing preference for one experimenter or the other did not occur, it is more likely that this significance was related to Stranger 2 square being in the right side of the room. The other proximity
comparisons were not significant but showed a tendency to the right side of the room. The apparent tendency towards the right area of the experimental room regardless of individual does not support the prediction that dogs would maintain proximity to the individual. The trends to the right portion of the room may be in part due to a number of different factors: that was where greetings and exits occurred and activity throughout the trial occurred primarily outside the right door. The left door opened to the adoption kennel where, while constantly noisy, and was familiar in sound and smell. The right door opened to the outside where smells and activity was constantly changing and thus potentially more interesting and novel. This tendency towards the right door does not lead itself to the results of Gasci (2001) where handled dogs stood by the door significantly less when in the presence of the experimental owner. However, the tendencies and the one significant comparison of side preference offer some consistency with a large base of knowledge in laterality in animals where side preference does exist.

It was predicted that not many differences would occur between dogs who interacted with an individual for a brief amount of time and a stranger, which to some extent was demonstrated by the overall non-significance of the statistical analyses. However, these results were much more likely due to a low sample size a result of working in a small county shelter as well as losing part of the original trial population to adoption, illness of fostering. This is one of the inherent risks that will be a constant issue in any future shelter-based studies since adoption is a primary focus in United States shelters. The opportunity for a larger sample should provide a greater depth of analysis into potential attachment behavior.

One important socialization aspect to note for this study is the similar results observed in this study population and those of the Gasci (2001) study. At the European shelter sites, dog interaction with humans was extremely limited, just about 15 minutes a day. At this study shelter
site in Yolo County, dog interaction with humans was limited compared to what a dog might experience in an adopted home, yet overall, human interaction and enrichment was far greater than that in Gasci (2001) or even in other small, municipal shelters. Despite the stark differences in socialization and enrichment, the trends of physical contact were quite similar between the two populations perhaps providing some insight into a more generalized, innate tendency in dogs to respond for social contact even with limited interaction.

One of the initial goals for this study was to utilize a detailed behavioral ethogram investigating attachment behaviors as well as fear-appeasement behaviors. However, as a result of the manner in which footage was obtained, many of these behaviors would require more finite second-by-second information that was not possible to determine in the 5-second interval photographs. In lacking the second-by-second detail, information like greeting duration and intensity and the potential differences that might have resulted between owner and stranger were missing. Gasci (2001) had illustrated that interest in physical contact did not vary much between the owner and the stranger but did not provide information about the more detailed behavior that the dog may have been exhibiting. Barrera (2010) compared shelter dogs to pet dogs in their behavior to stranger demonstrating that shelter dogs maintained proximity to a stranger, like Gasci observed, but while maintaining proximity, more fearful behavior was displayed. It would have been preferred to obtain behavioral information not just on the holistic behavior displayed by a dog, like sitting or standing in proximity, but also what it was doing on a more detailed level such as lip licking, pinning its ears etc (Barrera et al., 2010). It is likely that many of the dogs in this study may have shown proximity and contact-seeking to the individuals but may have been simultaneously displaying minute fear-appeasement behavior.

Yolo County Animal Services was quite generous in providing their staff and population
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for the experiment but there where inherent limitations in the site layout. The room in which the study was conducted was one of the only locations at the shelter where relative control could be maintained for the experiment but total non-use of the room was not possible. As a result, throughout some of the trials, members of the public or shelter staff needed to go from the adoption kennel outside potentially causing error in the study.

The methodology of the current study can guide the development of further studies and the understanding of attachment behavior in shelter dogs. A larger experimental room where the locations between areas are more clearly defined would allow for more finite coding and obtaining footage in real-time to be able to tease out more minute behaviors. With a larger sample, there might be a wider collection of owner surrenders and strays for the study and comparisons could be run to analyze the potential difference between the behavior between dogs from those populations. The results of behavioral evaluations could also be incorporated into research analysis to see if differences occurred between the behavioral evaluation initially run by shelter staff and the sociability behavior potentially observed in the attachment study. Finally, dogs in unhandled conditions could be tested twice, offering them the opportunity to be introduced to two new individuals one of which would assume the role of an owner. In this way, researchers could determine whether lower rates of physical contact were due to exposure to just strangers or if it was due to a dog’s inherent sociable nature.

**Conclusion**

Differences in physical contact to an experimental owner or stranger and location in relation to these individuals were not present in this study. These results are similar to those found by Gasci (2001) who first conducted a modified Stranger Situation test in a sanctuary-shelter environment where the dogs for many years and who suggested that the social deprivation
of shelter environment encouraged sociability behaviors in dogs. Hoping to observe similar results, this study was conducted at United States shelter but where the population is constantly changing due to adoption. But as a result of a constantly changing population, only a small sample could be recruited for the study, thereby making the statistical significance of the study limited despite seeing similar findings to Gasci (2001). The small sample size demonstrated quite a range of variation in behaviors so the size and turnover in the shelter population should be taken into account for any future study. The utilization of a counterbalanced procedure, first presented in Palmer and Custance (2008), did not provide evidence as to whether the dogs differentially reacted to the experimental owner when presented first or second but a counterbalanced procedure should be included in any future studies to test the possibility of order effects.

Dogs are social beings and appear to be motivated to form attachment to humans. Conducting attachment behavior studies in shelter environments can help potential adopters with the understanding and appreciation that their new family pet can bond to their family just as well as a new puppy from a breeder or pet store. By also analyzing the corresponding way into which the dog came to the shelter and its shelter behavioral evaluation might be able to provide a greater understanding of an adoptable dog’s attachment to a future owner and how it might fit into a future home environment.
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Appendix A

Handled Original Condition

Dog 8

Dog 8, Raider, was an estimated 5-year-old Terrier mix who came to the shelter as an owner surrender. While one of the experimenters had assumed the role of owner and had previous contact with the dog, Raider did not seem to show preferential treatment to the owner over the stranger. Across the seven episodes, Raider demonstrated similar rates of physical contact to the owner and the stranger and exhibited a preference to sit in their laps (see Figure 19).
Dog 14

Dog 14, Tuscon, was an estimated 6-year-old Pit Bull mix. Tuscon arrived at the shelter as a stray. Similar to Raider, while she had previous exposure to an experimental owner, she did not show an overall preference for the owner or the stranger; both rates of physical contact were similar albeit the rates were generally lower compared to Raider (see Figure 20). It appears that Tuscon did tend to stay closer to the right door and right square. This might have been due to proximity preference to the owner who occupied the right square but this tendency might be compounded by preference to stand by the right door to exit. In Episode 2, Tuscon demonstrated more physical contact to the stranger than the owner than previously demonstrated in Episode 1 which might be due to the novel aspect of a new person entering and engaging with the dog (see Figure 20)
Figure 20: Dog 14 Graph of Total Frequency of Events; Physical Contact rates across Episodes
Handled Counter Condition

Dog 2

Dog 2, Hulk, was an estimated 5-year-old Pit Bull mix who arrived at the shelter as stray. Across the seven episodes, Hulk showed a similar rate for physical contact with the owner and the stranger as well as a similar preference for either right or left square where the owner and stranger sat (see Figure 21). However, in the first four episodes, while Hulk showed some physical engagement with the owner and the stranger, it was quite minimal compared to what was exhibited after the isolation episode of Episode 5 (see Figure 21). In Episode 1, Hulk was occupied by a bin in the corner of the room that held blankets from which he pulled the blankets out and would dig in them. Throughout the four episodes, he would move around the room much more than other dogs in the study and would occasionally stop to interact with whichever experimenter was in the room. During Episode 5, the isolation episode, he spent much of the time oriented to the right door but then during Episode 6 went over and engaged in physical contact with the owner. During Episode 7, while physical contact did occur, throughout much of the session, when looking at the footage, he was not actively engaged with the stranger. He was pet throughout Episode 7 but was clearly oriented to the right door, either to interact with the owner or for exit.
Figure 21: Dog 2 Graph of Total Frequency of Events; Physical Contact rates across Episodes
Dog 10

Dog 10, Alyssa, was an estimated two and a half-year-old Pit Bull mix who arrived at the shelter as a stray. Unlike any of the other dogs in the study, Alyssa played with a toy. Toys were not present during the study but during Episode 1, Alyssa could not focus or settle in the session since all her attention was to a toy. At the end of Episode 1 moving into Episode 2, the stranger went over to pick up the toy for Alyssa who held the toy in her mouth for the rest of the session. Alyssa kept the toy in her mouth while she interacted with both the owner and the stranger but promptly disengaged from chewing on it when left alone in Episode 5; similar results have been seen in previous modified Strange Situation Tests where an owned dog will stop playing without an owner or person. In Episode 6, when the owner returned, Alyssa re-engaged with the toy chewed it while lying at the owner’s feet. However, once the owner left in Episode 7 and the stranger remained, Alyssa stopped playing with the toy—similar to the higher rates of play seen in other tests where more play occurs with the owner than the stranger. Across the episodes, there was not a large difference in physical contact or right or left square preference.
Dog 3

Dog 3, Minor, was an adult Pit Bull mix, brought to the shelter as a stray. Across the episodes, there was not a large difference in total physical contact rates between Stranger 1 or Stranger 2 but when looking at physical contact rates in each episode, the rates seem to tend towards Stranger 2. Overall, physical contact rates were generally low (see Figure 23) but as seen in the footage, much of it was quite active with him standing with a wagging tail or in the lap attempting to give kisses to either experimenter. It should be noted that at second 160, there was a brief disruption as someone accidentally entered and walked through the experimental room.
Dog 3
Physical Contact Across Episodes

Figure 23: Dog 3 Graph of Total Frequency of Events; Physical Contact rates across Episodes

Dog 5
Dog 5, Finn, was a 4-year-old Boxer-Golden Retriever mix. Finn was surrendered to the shelter by his owner along with his sibling, Jake, who was initially recruited into the study but, early on, was adopted. Finn demonstrated a high rate of physical contact with both strangers but showed slightly higher rates to Stranger 1 and the left square where Stranger 1 would sit. It is possible that higher rates for Stranger 1 might have been due to the fact that that experimenter was the first person present in the Strange Situation (see Figure 24).
Figure 24: Dog 5 Graph of Total Frequency of Events; Physical Contact rates across Episodes
Dog 12

Dog 12, Ivy, was an estimated 1.5-year-old Basenji SharPei mix. Ivy arrived at the shelter as a stray. Across the episodes, Ivy demonstrated very low rates of physical contact with either stranger or the owner (see Figure 26). When analyzing just physical contact, while the rates were overall lower than many of the dogs in the trial, when physical contact did occur, it was much more directed at Stranger 1 than Stranger 2 (see Figure 25). When examining the footage, much of Ivy’s behavior throughout the trial was engaged in moving around the room and smelling the environment. As has been noted, the possibility of adult dogs being previously in the experimental room was minimal so the novelty of smells and the environment might have been a more motivating factor for Ivy than engagement. It should be noted that when not smelling the room, Ivy tended to be at the right door and oriented towards it and was in fact so eager for escape that she managed to briefly sneak past an experimenter’s legs during second 1105.
Dog 16, Maui, was an adult Pit Bull mix who came to the shelter as stray. Across the episodes, the rates of physical contact were similar for both strangers but a slight higher preference for Stranger 2, despite the fact that Stranger 2 appeared second in this condition. When going through the footage, in the episodes where Stranger 1 was alone with Maui, while active physical contact did occur (leaning, tail wagging) for portions of Episode 4 and 6, Maui would be actively sitting or standing across the room from Stranger 1. When Maui was alone (Episode 5), she either stood near the door or in the right square, Stranger 2’s square.
Figure 26: Dog 16 Graph of Total Frequency of Events; Physical Contact rates across Episodes
Unhandled Counterbalanced Condition

Dog 6

Dog 6, Bandit, was a 4-year-old Chihuahua mix who arrived at the shelter as an owner surrender. Bandit maintained fairly similar rates of physical contact between both strangers and sat on their laps throughout the trial (see Figure 27). In fact, in Episode 2, Bandit leapt from Stranger 2’s lap into Stranger 1’s lap once she sat down. Preference for one stranger over the other seemed more dependent on who was present in the room, since high rates were observed throughout the trial episodes. It should be noted that for seconds 910-920, Stranger 2 entered the room and held the leash in the lower frame so people could exit the adoption kennel and exit through the left to the right door.
Figure 27: Dog 6 Graph of Total Frequency of Events; Physical Contact rates across Episodes
**Dog 7**

Dog 7, Captain America, was a 1-year-old Pit Bull mix who arrived at the shelter as a stray. Across the episodes, physical contact to either stranger was fairly minimal (see Figure 28). Captain America did tend to occupy the right square more than any other location in the room, but the right square preference may have been compounded by interest in the right door where entrances and exits occurred. In the footage, he could be seen engaging in physical contact with either experimenter and then disengaging to check out the right door. When physical contact did occur, it was active, with him placing his front two paws in the lap and attempting to lick the faces of the experimenters.

![Dog 7 Physical Contact Across Episodes](image-url)
Figure 28: Dog 7 Graph of Total Frequency of Events; Physical Contact rates across Episodes

Dog 11

Dog 11, Rosey, was an estimated 2-year-old Pit Bull mix who initially arrived at the shelter in February as a stray, was adopted and then returned to the shelter as an owner surrender. Physical Contact was fairly limited for both experimenters across the episodes but an increase of physical contact was seen after the isolation episode. Like Ivy, Dog 12, Rosey was quite occupied throughout the trial with moving around the room and smelling the room. However, after Episode 5 when she was left alone, physical contact increased with her placing her front paws in the lap of the experimenters to get pets (see Figure 29).
Figure 29: Dog 11 Graph of Total Frequency of Events; Physical Contact rates across Episodes
Dog 13

Dog 13, Aubrey, was a 7-month-old Yorkshire Terrier mix. She was the youngest dog of the dogs in the trial. Aubrey arrived at the shelter as an owner surrender; she was a puppy from an accidental litter when the owner’s unaltered female was impregnated by the unaltered male in the home. It should be noted that coding was difficult for this trial due to the dog’s small stature compounded by her hiding underneath chairs in the initial episodes. While the experimenters were able to sometimes pet the dog, it was difficult to determine whether the physical contact was accepted and whether actual contact was being made. Similarly, it was hard to determine whether Aubrey was sitting, standing or lying down throughout the initial episodes.

A higher preference appears to exist for physical contact to Stranger 2 but since Stranger 2 appeared first in the trial (see Figure 30), this happened to be the first person to which Aubrey sat under the chair and it is likely that the higher rates are less due to preference and more due to not wanting to move from a safe space. However, it is important to note that in Episode 3 when Stranger 2 is out of the room, Aubrey moved out from Stranger 2’s chair and square and sought safety to Stranger 1 in the room. After Episode 5, Aubrey no longer sought any physical contact to either experimenter; instead, she lay down by the right door in the far upper frame, much of the time out of frame for the coders (see Figure 30).

It is likely that such a stark lack of engagement with the experimenters could have resulted from her young age, as well as such a recent arrival to the shelter from a home with other dogs, her littermates and a fairly established owner.
Figure 30: Dog 13 Graph of Total Frequency of Events; Physical Contact rates across Episodes