

The Influence of Scent and Owner Presence on Cat Attachment Behavior

by
Alexandra Behnke

A THESIS

submitted to
Oregon State University
Honors College

in partial fulfillment of
the requirements for the
degree of

Honors Baccalaureate of Science in Animal Sciences
(Honors Scholar)

Presented May 20, 2019
Commencement June 2019

AN ABSTRACT OF THE THESIS OF

Alexandra Behnke for the degree of Honors Baccalaureate of Science in Animal Sciences presented on May 20, 2019. Title: The Influence of Scent and Owner Presence on Cat Attachment Behavior.

Abstract approved: _____

Monique Udell

Domesticated cats frequently use their sense of smell to navigate their environment, convey social cues, and communicate with other individuals. In applied contexts, cat owners are often encouraged to leave items holding their scent with their cat in periods of absence with the aim of reducing stress. The purpose of this research was to evaluate if and how an owner's scent reduces a cat's anxiety while in an unfamiliar environment. A sample size of 42 adult cats (> 1 year old) underwent a five-stage secure base test that examined the cat's behavior with the owner present, without the owner present, and with a scent object present. Behavioral measures were coded later from video and included anxiety-related and attachment behaviors. On average, cats displayed a lower frequency of stress-related behaviors when the owner was present, an effect not seen when alone with the scent object. The order in which cats were presented with the stimuli had an impact on the attachment behaviors displayed towards their owner. The results of this research will deepen our current understanding of feline olfactory and social cognition, including ways to reduce cat anxiety during owner separation.

Key Words: Attachment, feline behavior, scent cognition

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Honors Baccalaureate of Science in Animal Sciences project of Alexandra Behnke presented on May 20, 2019.

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I understand that my project will become part of the permanent collection of Oregon State University, Honors College. My signature below authorizes release of my project to any reader upon request.

Alexandra Behnke, Author

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Chapter I. Introduction

Despite an estimated 85 million domesticated cats (*Felis sylvestris catus*) that can be found living in American households (APPA, 2018), little research has been conducted on the cat-human bond or feline social cognition (Vitale Shreve and Udell, 2015). Attachment behavior, which is a mechanism in which an individual develops an enduring bond to another out of dependency or wellbeing, has been explored in a wide variety of species, including humans (Bowlby, 1969; Bowlby, 1973). While less is known about the social bond cats form with conspecifics or owners, it may prove advantageous to study cat-human attachment. Through studying this relationship, we may develop a better understanding of cat success in human environments and its role in applied settings, including animal welfare implications.

Attachment is considered a natural part of human social development (Bowlby, 1969). Responses from the children, which included crying during separation and clinging to the mother upon reunion, are behaviors used to support the presence of the attachment bond (Bowlby, 1958; Bowlby, 1969). This was also seen in Ainsworth's Strange Situation Test (SST), which was designed to examine how human infants reacted with to a stressful situation and how that impacted their attachment to their parent (Ainsworth and Bell, 1970). Such behaviors, like proximity seeking and vocalizing during separation, can be said to be evolutionarily advantageous, as mothers (both human and non-human) provide food, shelter and protection following parturition and, in some species, disseminate acquired skills or knowledge (Bowlby, 1969; Ainsworth and Bell, 1970). In humans, the effectiveness of a bonded caretaker's presence in reducing anxiety or fear varies due to the attachment style (which is related to the reliability of the caretaker's attentiveness), and in some cases, age of the dependent and degree of dependency on the caretaker (Bowlby, 1973).

Attachment behavior is not exclusive to human-human relationships and can even manifest itself in the form of cross species relationships and attachment to inanimate objects. Throughout the 1930s, Konrad Lorenz researched certain innate behaviors in geese and was able to describe the concept of filial imprinting, an attachment response formed by goslings (and other young animals) towards an individual or object after coming into contact with it following birth (Lorenz, 1935; Munz, 2011). In 1958, Harry Harlow tested attachment security in juvenile monkeys, observing the Secure Base Effect, a concept to describe the phenomena when a caregiver, conspecific, or object serves as a source of comfort from which an individual feels comfortable to explore (Bowlby, 1969). Even young monkeys that grew up with a “cloth mother” or a “wire mother” (surrogates of sorts) were able to form an attachment to these figures, including using them as a secure base, and were more likely to explore and seek comfort from the surrogate than monkeys that were alone or that grew up without a surrogate (Harlow, 1958). Multiple studies have also found evidence that supports the claim that owners can serve as a secure base for their dogs (Palmer et al, 2007; Mariti et al, 2013; Rehn et al., 2013a; Rehn et al., 2013b).

Several studies have also found evidence that children that become attached to inanimate objects, also referred to as transitional objects (such as a security blanket), were able to adapt more readily to a novel environment than children who were not attached to a blanket or had no attachment stimulus at all (Passman and Weisberh, 1975; Passman, 1977; Donate-Bartfield and Passman, 2004). Children attached to a transitional item were not more likely to display insecure attachment styles towards their primary caretakers, especially when compared to children who were not attached to such objects (Passman, 1987; Bachar et al., 1998; Donate-Bartfield and Passman, 2004). However, the relationship with their mothers seems to impact the effectiveness

of a security blanket (Donate-Bartfield and Passman, 2004). For example, children who were avoidantly attached to their mother relied more on the transitional object when left alone (Donate-Bartfield and Passman, 2004). Interestingly, children securely attached to their mother and a security blanket did not rely on the blanket as much as the insecure styled children (Donate-Bartfield and Passman, 2004). While attachment behavior is largely social, it is also a mechanism that allows dependent individuals to explore their environment from a place of security (Bowlby, 1969).

To date, there have only been two studies published on cat-human attachment. In the first study, Edwards et al. (2007) used an adapted Ainsworth's SST (Ainsworth and Bell, 1970) to determine if cats demonstrated attachment behavior towards their owners. The researchers found that cats exhibited similar attachment behaviors to that of human mothers and their children (Ainsworth and Bell, 1970), such as vocalizing during separation and approaching the caregiver when reunited (Edwards et al., 2007). On the other hand, Potter and Mills (2015) employed a counter-balanced version of the SST and concluded their evidence did not support a secure base effect between cat and owner (Potter et al., 2015). The authors suggested that instead of forming an attachment to their owner like dogs, cats have a disposition towards autonomy and have a preference towards a familiar individual's company over a stranger (Potter et al., 2015). A cat's preference towards their owner however did not equate that the cat used their owner as a secure base in the criteria the authors defined for secure attachment (Potter et al., 2015).

Cats are known to rely heavily on scent and olfactory cues to navigate their environment and interact socially (Rosenblatt 1972; Mermet et al., 2007; Vitale Shreve and Udell, 2017). Following birth, kittens' eyes remain closed until about seven to seventeen days of age (Mermet et al. 2007). During this time, kittens use pheromones, which are species-specific chemical

signals, that are secreted from their mothers and help them orient themselves to find their mother's nipple (Arteaga et al., 2013). Additionally, kittens display several behaviors that indicate they rely on olfactory cues, such as exhibiting nipple preferences while nursing, sniffing, and moving towards canned food (Arteaga et al., 2013; Mermet et al., 2007). Rosenblatt found that even newborn kittens, whose eyes have not yet opened, are able to decipher if and seemingly how far they are away from their nest and/or their mother (Rosenblatt, 1971; Rosenblatt, 1972; Mermet et al. 2007). When moved away from these familiar environments, kittens produced distress vocalizations until they were returned to their nest or mother. Even when introduced to an unfamiliar queen (an unneutered female cat) and her litter for a two-day period, the kittens were comforted by their mother's cage while they continued to show disfavor to the unfamiliar cage (Mermet et al., 2007).

Numerous studies have shown how the olfactory senses play an instrumental part in the development and social conditioning of kittens, however the extent to which scent is related to attachment is less clear. While scent may assist in establishing a bond between a cat and another individual, it may not be as effective in eliciting a secure base response. Soennichsen and Chamove (2002) found that cats prefer to be petted by their human counterparts along the temporal gland, a region along the forehead that secrete pheromones. Cats often use this area to rub against conspecifics and owners and is regarded as a social behavior called allorubbing (Hart, 1977; Soennichsen and Chamove, 2002). It has been noted that allorubbing between cats is an attachment behavior (Bradshaw, 1992; Soennichsen and Chamove, 2002), and that through olfactory cues, allorubbing may potentially promote security (Soennichsen and Chamove, 2002). Since cats engage in the same behavior with their human owners, this may indicate that the owner's presence and possibly even scent can comfort them (Soennichsen and Chamove, 2002).

The goal of the current study was to assess if an owner's scent would provide a source of comfort (reduce stress indicators) in cats when they were left alone in an unfamiliar space. The study was also designed to evaluate if an owner, the owner's scent or both would serve a "secure base" function for cats under these conditions as a product of a secure attachment bond. It was hypothesized that cats would prefer their human caretaker over a scent stimulus alone. It was also expected that cats would exhibit different behavioral responses in the scent condition depending on the cat's attachment style to the owner. Ambivalent styled cats are predicted to seek proximity during the scent object phase more so than the secure styled cats. Furthermore, it was predicted that cats would be comforted by their owner's scent. This would be shown through vocalizations in the scent return significantly decreasing when compared to the alone phases.

Chapter II. Methods

Overview

The Secure Base Test (SBT) methodology chosen was based on Harlow's open field test (Harlow, 1958), an approach previously used to analyze dog attachment (Schoberl et al. 2016, Thielke et al 2017; Wanser and Udell, 2018) and cat attachment (Vitale, 2018) to a human caretaker. Prior to the session, owners were asked to bring an unwashed object with their scent on it to be used as the scent stimulus during the scent secure base test. Scent objects could include the owner's shoe, sock, night shirt, or blanket. The choice of the scent object was left to the discretion of the owners as they were asked to bring an object in which they believed would be a strong scent stimulus, just as the owner would in an applied setting, such as boarding or trips to the veterinary clinic.

Ethical Considerations

The study conducted was in compliance with regulations set forth by the Institutional Animal Care and Use Committee (IACUC), under ACUP #4837.

Subjects

Forty-two cats who were at least one year old and in good health participated in this study. Only cats who had not been tested in the behavioral evaluation space before were enlisted as to keep the environment novel to each cat. Participants were recruited throughout the Corvallis area through email advertisements and posts on social media such as Facebook and Craigslist. The sample size consisted of 16 male cats and 26 female cats. The ages of the participants ranged from 1 to 13.5 years of age, with the average age being 6 years old. However, exact ages of pet cats are only estimations due to the difficulty in aging adult cats.

Testing Area

A circle with a 1-meter radius was taped on the ground of an empty behavioral evaluation room, measured 3.3 meters by 4.2 meters. A Nest camera and a camcorder on a tripod were set up to record behavior and vocalizations respectively. Before each testing session, the room's floors, surfaces, and toys were cleaned with disinfecting wipes and 3 cat toys were placed around the room as is standard in attachment tests (Thielke et al., 2017; Vitale, 2018).

Secure Base Test

The following procedure was followed for each session:

Baseline: The owner was instructed to sit in the middle of the taped circle (marked by an "X") and only interact with their cat when it was within the circle. After two minutes, the owner was asked to exit the room.

Alone Phase 1: After the owner left, the cat was alone in the space for two minutes.

Return Phase 1: At this stage in the test, the stimulus present differed to counterbalance order effects. For half of the sample, an unfamiliar person placed the scent object within the taped circle whilst wearing gloves. The other half had their owner return first (Table 1). The cats had two minutes to interact with the stimulus.

Alone Phase 2: If the owner returned for the first return phase, they were asked to step out of the room at the conclusion of two minutes. If the cat had been presented with the scent object, the same unfamiliar person collected the item out of the room. The cat was alone again for two minutes.

Return Phase 2: For the final segment, the cat had the opposite stimulus that they had in the first return phase. If the owner returned in the third stage, then the scent object was placed in the room. Likewise, if the scent object was presented prior, then the owner reunion was the final stage. This also lasted two minutes.

Order S-O	Order O-S
Baseline	Baseline
Alone Phase 1	Alone Phase 1
Scent Stimulus Return	Owner Reunion Phase
Alone Phase 2	Alone Phase 2
Owner Reunion Phase	Scent Stimulus Return

Table 1: A counterbalanced methodology was utilized to control order effects. Half of the sample followed Order S-O while the other half followed Order O-S.

Data Coding and Analysis

The attachment style of each cat was determined from the owner reunion phase of the secure base test. Cats were placed into one of four attachment style classifications (see Table 3) by two independent coders, who were blind to the conditions of the experiment. Inter-observer reliability was calculated and then the coders met to mutually determine the final classification of each cat. When there were differences in the two assigned classifications, the coders would review the videos to see if a consensus could be made. Inter-observer reliability agreement in regard to attachment style coding was 74% prior to discussion, and following discussion, 100% of the sample was placed into an attachment style group.

Attachment Style	Description
Secure	Little or no resistance to contact or interaction. Greeting behavior is active, open and positive. Seeks proximity and is comforted upon reunion, returning to exploration or play.
Ambivalent	Shows exaggerated proximity-seeking and clinging behavior but may struggle if held by owner. Mixed persistent distress with efforts to maintain physical contact and/or physically intrusive behavior directed toward the owner. (Cats who the judges agreed seemed essentially secure but with ambivalent tendencies, were included in the secure group).
Avoidant	May show little/no distress on departure. Little/no visible response to return, ignores/turns away but may not resist interaction altogether (e.g. rests or stands without bodily contact, out of reach or at a distance).
Disorganized	Evidence of strong approach avoidance conflict or fear on reunion, for example, circling owner, hiding from sight, rapidly dashing away on reunion, “aimless” wandering around the room. May show stereotypies on return (e.g. freezing or compulsive grooming). Lack of coherent strategy shown by contradictory behavior. “Dissociation” may be observed, that is, staring into space without apparent cause; still or frozen posture for at least 20 seconds (in the nonresting, nonsleeping cat).
Unclassifiable	Classifiers were unable to reach consensus on group placement for cats from this classification category. Unclassifiable cats were excluded from further analysis on cat attachment.

Table 2: Cats were assigned an attachment style classification adapted from Schoberl’s criteria (Thielke et al., 2017; Wanser and Udell, 2018; Vitale, 2018).

At the conclusion of data collection, the videos recorded by both cameras were coded by five coders for the following behaviors (Table 3):

Baseline: Proportion of allorubs out of 24 bins

Alone Phases: Frequency of vocalizations and duration seeking proximity

Return Phases: Frequency of vocalizations, duration seeking proximity, proportion of allorubs or object rubbing out of 24 bins

Behavior Coded	Definition
Frequency of Vocalizations	Whenever the cat meowed within a 2-minute phase. A new meow began following the end of the previous meow.
Proportion of Allorubbing and Object Rubbing	Allorubbing and object rubbing were defined as a cat rubbing against their owner or scent object with its head or body. This was coded using the bin method. Each phase was divided into 24, five-second bins and the proportion of bins in which allorubs occurred was reported.
Duration of Proximity Seeking	The cat had to have at least two paws within the blue taped circle to count. The proportion of time spent seeking proximity during a 2-minute phase was analyzed.

Table 3: These behaviors were coded for and analyzed using the above definitions and methodologies (Vitale and Udell, 2019; Stanton et al., 2015).

Statistical Analysis

Data analysis was conducted using the statistical program R. All but two tests displayed non-normal distributions (Shapiro-Wilk $P < 0.05$) and were thus analyzed using non-parametric statistics. Subsequent analysis of the average data employed two-tailed Mann-Whitney U-test, using the Vassar-Stats program. Two datasets were found to have normal distribution, which included the correlation of attachment style and proximity seeking during the owner return, and the correlation of attachment style and the proximity seeking during the scent return phase. For normally distributed data, ANOVA tests were used to analyze the data. Attachment style data was examined using Fisher's exact test, analyzed by a 2x2 contingency table (attachment style x return order) on GraphPad. All statistical tests conducted had an alpha level of 0.05.

Chapter III. Results

Attachment Style

Out of the sample size of 42 cats, 19 or 45% were determined to have a secure attachment to their owner while 23 cats or 55% were coded as having insecure attachment styles. Out those 23 insecure cats, 14 were characterized as ambivalent, 7 as avoidant, and 2 as disorganized.

When further broken down based on the return order, the results are almost inversely proportional to each other. When the owner returned before the scent stimulus, the ratio of secure to insecure styled cats was 14:7 (Figure 10. If the scent return was the third phase instead, the ratio became 6:15 for secure to insecure attachment respectively (Figure 1). This pattern was found to be significant by Fisher's exact test when analyzing the difference between the number of secure and insecure cats between the two return orders ($P= 0.0294$).

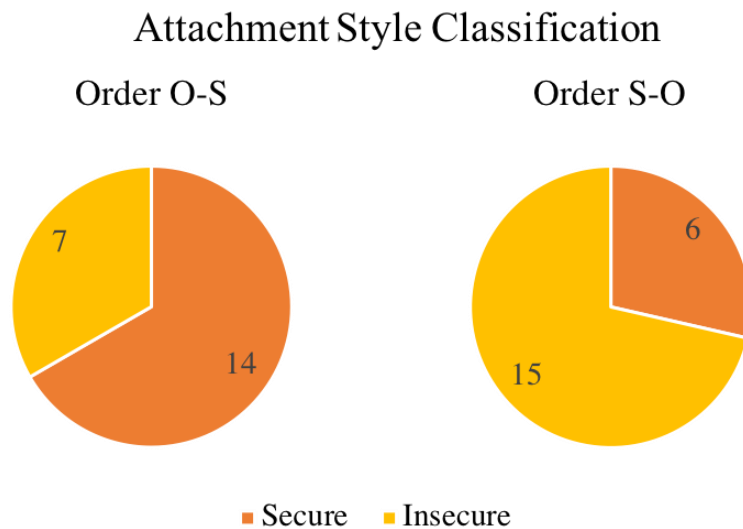


Figure 1: The number of secure cats was more abundant than insecure cats when the owner returned following the first 2-minute alone phase. Furthermore, the number of insecure cats were more abundant than secure cats when the owner returned after six minutes (3 phases).

Vocalizations

Similar patterns of vocalization were observed between the two counterbalanced groups. For example, independent of testing order there was a significant increase in vocalizations when presented with the scent object compared to the owner return (S-O Order, $P = 0.00064$; O-S Order, $P = 0.00064$) after being left alone for 2 minutes. In the S-O order group, cats vocalized significantly less in the company of their owner when compared to both alone phases (Alone Phase 1, $U(21) = 81$, $Z = -3.5$, $P = 0.00046$; Alone Phase 2, $U(21) = 114.5$, $Z = -2.65$, $P = 0.00804$). This pattern was also found to be significant in the O-S order (Alone Phase 1, $U(21) = 48$, $Z = 4.33$, $P < 0.00001$; Alone Phase 2, $U(21) = 48.5$, $Z = 4.31$, $P < 0.00001$). Furthermore, when comparing the two alone phases in the O-S order, there was no significant difference in vocalizations ($U(21) = 171.5$, $Z = 1.22$, $P = 0.22$).

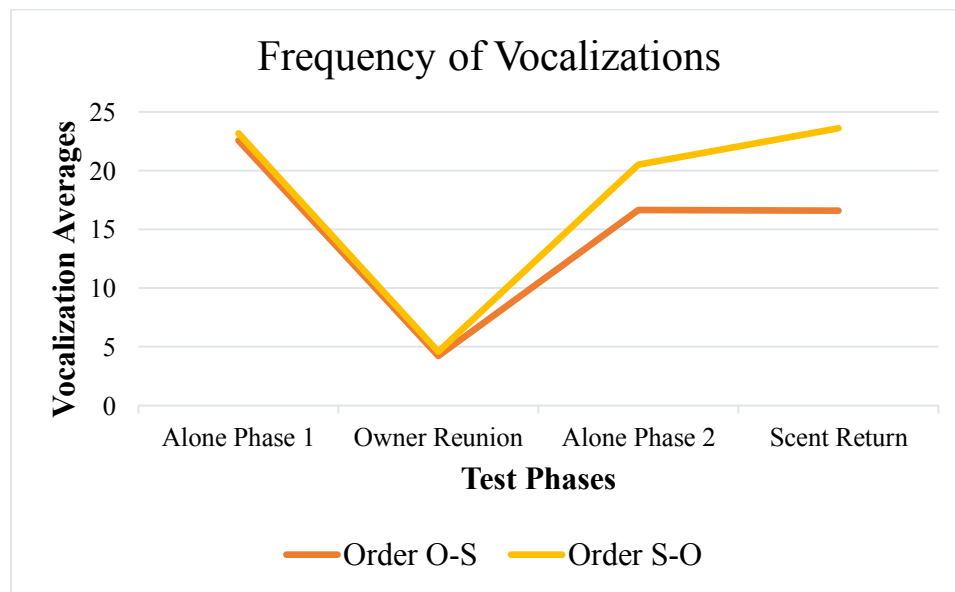


Figure 2: The average number of vocalizations throughout the test are given for both orders. This trend demonstrates the similarities within each phase between Order O-S and Order S-O.

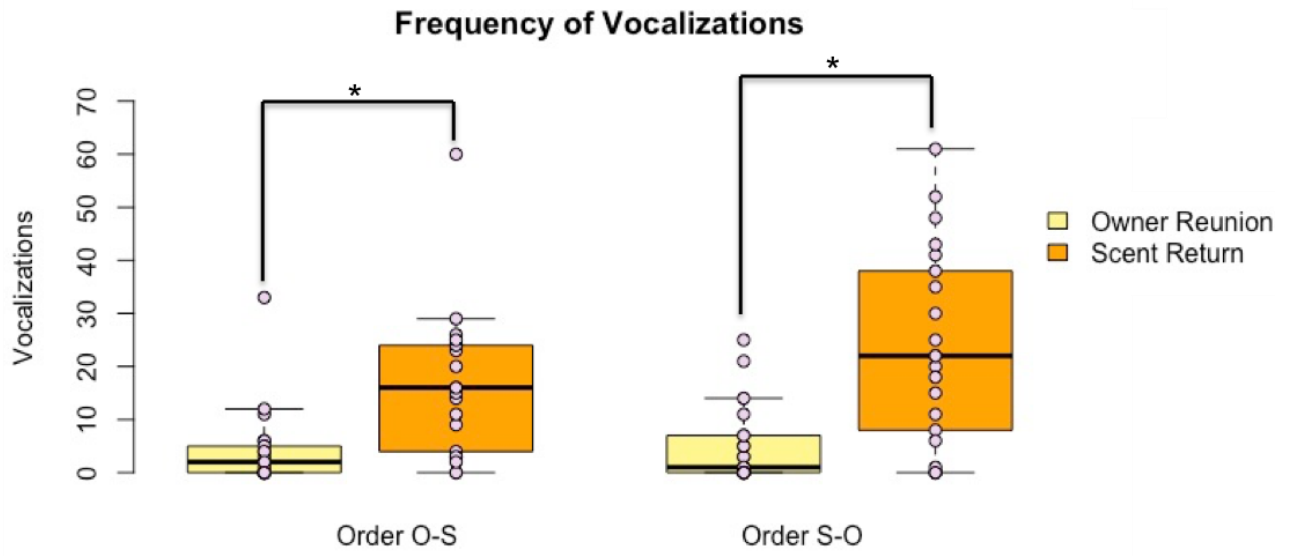


Figure 3: Significant differences were found between the owner reunion phase and the scent return phase for both counterbalanced orders.

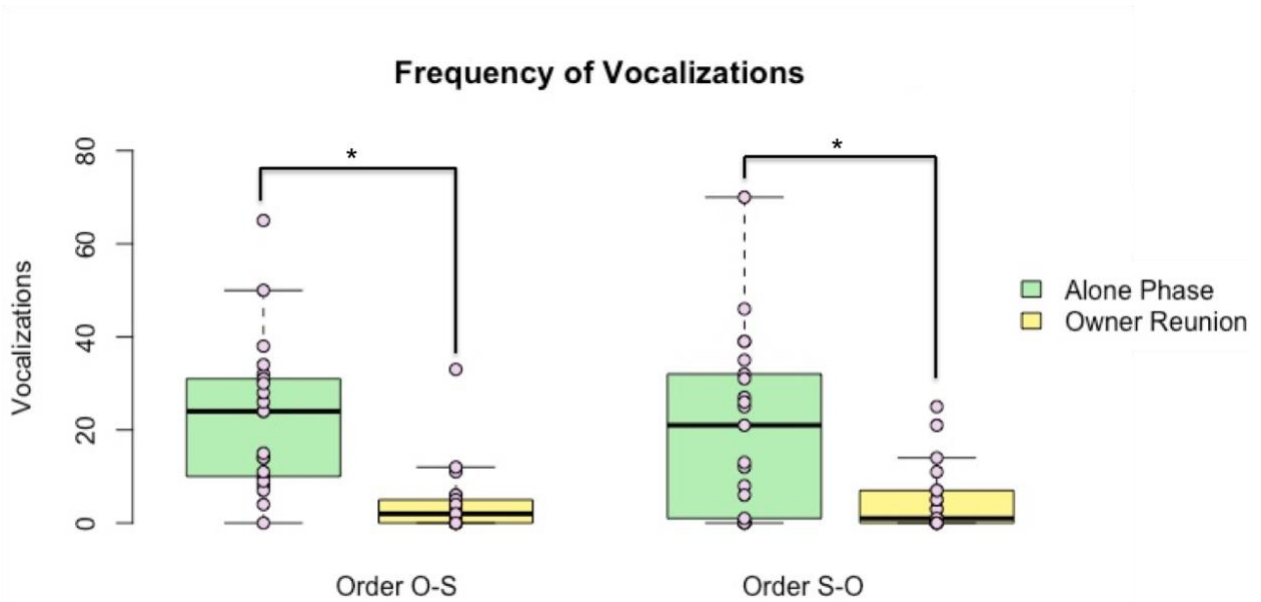


Figure 4: Significant differences were found between the owner reunion phase and the alone phase preceding the owner return for both counterbalanced orders.

Allorubbing and Object Rubbing

For both order groups, cats rubbed their owners significantly more than the scent object (Owner Return 1st, $U(21) = 13$, $Z = 5.21$, $P < 0.00001$; Scent Return 1st, $U(21) = 72.5$, $Z = 3.71$, $P = 0.0002$; Entire Sample, $U(42) = 168.5$, $Z = 6.38$, $P < 0.0001$). Continuing this pattern, cats also engaged in this behavior significantly more during the owner return phase than the baseline in the O-S order, but not in the S-O order (O-S Order, $U(21) = 102$, $Z = 2.97$, $P = 0.00298$; S-O Order, $U(21) = 160.5$, $Z = 1.497$, $P = 0.13362$). There was no significant difference in allorub proportion during the owner return phase between the two orders ($U(21) = 195.5$, $Z = -0.616$, $P = 0.53526$).

Patterns also arose when examining allorubbing in regard to cat attachment style. Cats with a secure attachment style were significantly more likely to allorub their owner during the owner return than rub the scent object in the scent return phase ($U(23) = 0.5$, $Z = 5.38$, $P = 0.0003$). The same pattern was also found to be significant for insecure attached cats as well ($U(19) = 87.5$, $Z = 3.6$, $P = 0.0003$). There was not a significant difference found between attachment style and the proportion of rubs in either the scent return phase or in the owner reunion phase (Scent Return Phase, $U(42) = 220$, $Z = 0.0126$, $P = 0.992$; Owner Reunion Phase, $U(42) = 147.5$, $Z = -1.81$, $P = 0.07$). In other words, a certain attachment style was not found to be more likely to allorub or object rub over the other.

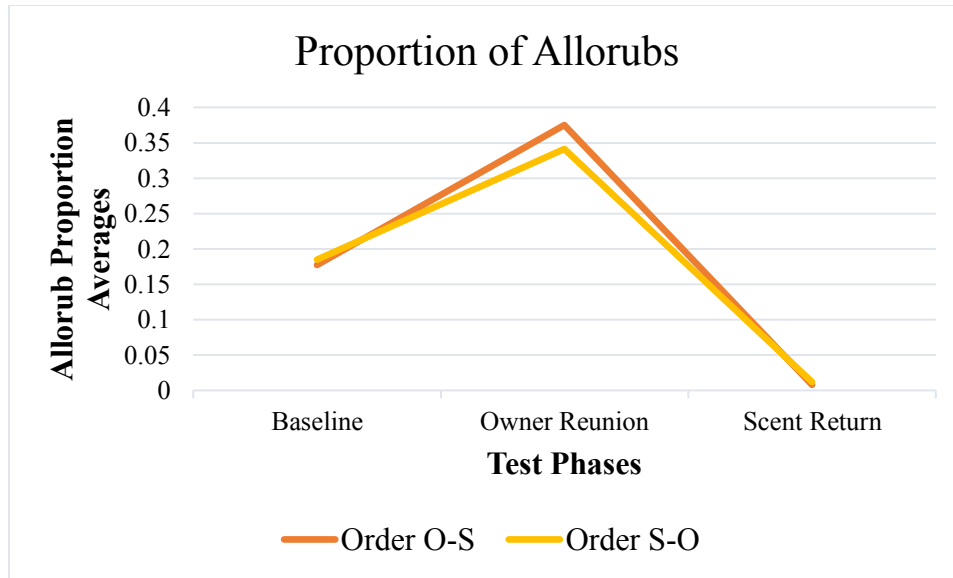


Figure 5: The proportion of allorubs or object rubs followed a similar trend between the two counterbalanced orders. This pattern indicates that the order did not impact allorubbing/object rubbing frequency.

Proximity Seeking

Cats classified as insecure were significantly more likely than secure cats to seek proximity of the scent object (standing within the blue taped circle during the scent return phase), regardless of order ($P=0.0214$). However, there was no significant difference between insecure and secure cats in the duration of proximity seeking towards the owner in the owner return phase ($P=0.0914$). The average time seeking proximity to the scent object was not significantly different between the two counterbalanced orders ($U(42) = 179.5, Z = -1.02, P = 0.30772$).

While cats generally did not spend a lot of time in proximity to the scent object, 27 out of 42 cats approached or were in proximity to the stimulus at some point during the two-minute phase. Only 4 of these cats spent over 50% (60 seconds) of the time within proximity to the scent stimulus.

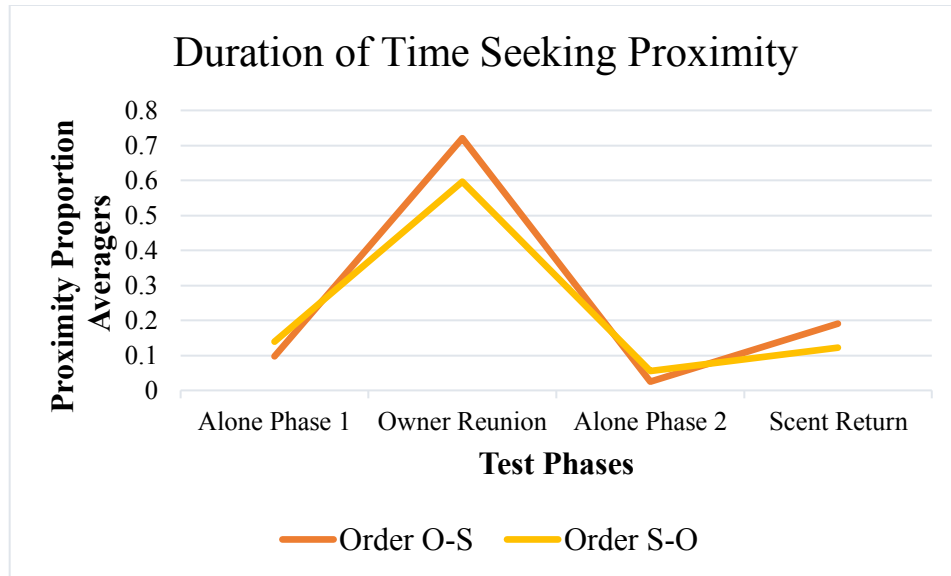


Figure 6: Similar trends were noticed between the two orders throughout the four phases. This indicates that order did not have an effect on proximity seeking.

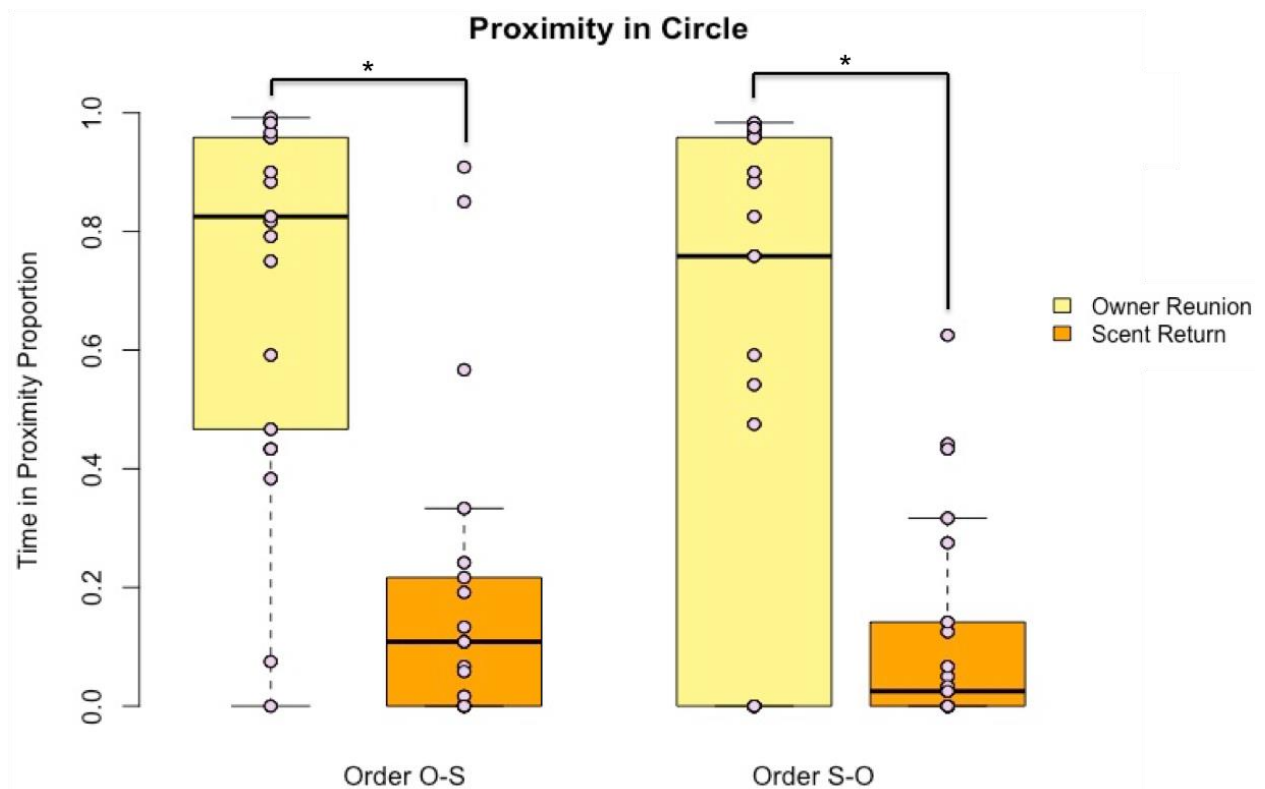


Figure 7: In both orders, cats tended to spend more time in proximity to their owner during the owner reunion phase than the scented object.

Chapter IV. Discussion

The aim of this investigation was to determine whether or not an owner's scent provides comfort or serves as a secure base to their cat in a novel environment. Prior to data collection, it was hypothesized that cats would favor their owner's presence over the scent object. This was found to be true through multiple tests. Additionally, ambivalent styled cats were predicted to seek proximity during the scent object phase more so than secure styled cats. The data provides evidence in support of this as well. It was also predicted that the scent stimulus would decrease anxiety, as seen through the decrease in vocalizations compared to the alone phases. However, there was no significant evidence to support this.

Cats were found to prefer the presence of their owner over an object that held the owner's scent in the period following a short absence during the Secure Base Test. This inclination was exhibited by a decrease in vocalizations and an increase in allorubbing during the owner return phase. For example, the number of vocalizations was the lowest during the owner return out of all the coded phases, a pattern Edwards et al. (2007) found to be significant as well. In regard to object rubbing, only 4 out of the 42 cats rubbed the scent stimulus. This is in stark contrast to the over 85% of cats that allorubbed their owner during the owner return segment. The propensity for cats to allorub their owners supports prior observations that allorubbing is a social behavior and that it creates a type of comfort response (Soennichsen and Chamove, 2002).

Cats' preference towards human company has been seen in past research as well. Following a preference evaluation for an individual cat's favorite foods, scents, toys, and human activity interaction, the overall sample significantly preferred either some type of human interaction or food over scent stimuli (Vitale Shreve et al., 2017). While this study does not

analyze attachment or security with the stimuli, it does suggest that cats tend to gravitate towards social interaction with familiar and nonfamiliar humans (Vitale Shreve et al., 2017).

The second prediction stated that cats who had an insecure attachment style (especially specifically those categorized as ambivalent) would have higher proximity-seeking durations during the scent return stimulus. This was found to be a significant result for all insecure cats, regardless of what order they were in. Seeking close and consistent proximity to another individual, especially in a stressful scenario, is an indication of attachment (Barry and Crowell-Davis, 1999; Rehn et al., 2013b; Bowlby, 1969). Upon reunion, human infants displayed higher instances of proximity seeking towards their mothers (Ainsworth and Bell, 1970). Similar to what Ainsworth and Bell (1970) proposed, attachment, or at least anxiety-related behaviors, seems to alter depending on how an individual perceives the situation.

Lastly, it was hypothesized that when introduced to the scent stimulus, cats would vocalize less during this phase than during the alone phases. Following analysis however, this was not supported by the data. On average, cats vocalized at similar frequencies in the alone phase prior to and during the scent return phase. Edwards et al. (2007) found that cats vocalize significantly less when with either a familiar or unfamiliar individual than when alone. Further, Potter and Mills (2015) did not find a significant difference in vocalizations between the owner return or the stranger return. This seems to indicate that the owner's scent alone did not have a positive impact of the cat's anxiety, and that perhaps the physical presence of a stranger is more comforting.

Due to the structure of the experiment, it cannot be definitively said why there were more insecure cats in the S-O order, than the O-S order. This difference in attachment style distribution could be hypothesized due to several different factors. One possibility is that the

increased time spent away from the owner (to allow for the intermediate scent phase) increased the cat's anxiety, leading more cats to exhibit insecure behaviors upon owner reunion. Cats in the scent-return-first order were separated from their owner for six minutes, as opposed to only two minutes in the other order. Long testing times have been found to influence owner-directed behavior (Potter and Mills, 2015) and shorter testing times have been suggested to be more appropriate for testing cat behavior (Vitale Shreve et al., 2017).

A second factor that could have attributed to this variance was the introduction of the scent object itself. Furthermore, it is possible that the scent object the owner brought belonged to another owner or member of the household, or that the object had the scent of more than one individual. Due to their keen sense of smell, kittens are able to orient themselves in and around their family nest and determine how far away they are from the nest (Rosenblatt, 1972). When placed in an unfamiliar environment, the blind kittens displayed signs of distress, such as vocalizing. If placed in or in proximity to the nest, the kittens would vocalize significantly less. This could support the idea that in some point in their lives, cats form a secure base effect from scent alone. Other research has found that thermal (Rosenblatt, 1972) and tactile cues (Harlow, 1958; Rosenblatt, 1972) have also played a pivotal role in alleviating distress behavior. Therefore, the smell of the owner without other relevant stimuli such as the visual sight or tactile experience of the owner may have increased anxious behavior. Multiple studies have explored ways to reduce separation anxiety in dogs and have proposed that items with the owner's scent (such as blankets or shoes) can improve apprehensive behaviors (King et al., 2000; Appleby and Plujimakers, 2004; Sherman and Mills, 2008). However, these studies lack necessary empirical evidence and thus cannot conclude if an owner's scent helps ease separation anxiety in dogs, much less help make assumptions concerning cats. Further research is needed to accurately

determine the efficacy of this practice. Nonetheless, the idea of leaving the owner's scent behind has spread, inspiring products such as the *Comfort Cuddler*TM, a fabric pouch that allows owners to enclose the scent object of their choice and leave it with their pet upon separation.

Lastly, the brief appearance of a stranger who deposited the scent object in between when the owner left and returned could have potentially stressed the cat even more. Both Edwards et al. (2007) and Potter and Mills (2015) found evidence that cats were more comforted by their owner over the presence of a stranger but displayed a preference towards the stranger over being left alone. However, Potter and Mills (2015) concluded that there were no significant differences in how cats regarded their owner and a stranger in the later stages of the test, which may suggest that the brief appearance of a stranger is not a factor that would necessarily increase anxiety and therefore may not be the most likely explanation. Without further research, we cannot conclude if and to what degree these conditions affect a cat's attachment style towards their owner. Therefore, future investigations are needed to test these various hypotheses.

Given the above considerations, it cannot be determined whether or not an owner's scent is stressful to a cat while in an unfamiliar environment. However, the evidence seems to support two primary conclusions (1) in line with Edwards et al. (2007) owners appear to serve as a secure base for their cats in at least some cases, and (2) owner presence is both preferred and more likely to serve as a secure base over an object with their scent. By determining how exactly an owner's scent impacts a cat's anxiety levels in an unfamiliar environment, owners and animal care professionals can make trips to the veterinary clinic and long separations better for cats.

Chapter V. References

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