

Attachment Bonds Between Cohabitant Pairs of Domestic Cats and Their Owners

by
Arden Smith

A THESIS

submitted to
Oregon State University
Honors College

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degree of

Honors Baccalaureate of Science in Zoology
(Honors Scholar)

Presented May 28, 2021
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Monique Udell

Domestic cats have been shown to form secure attachment bonds with humans, allowing them to use their owners as a secure base and giving them comfort and confidence when exploring an unfamiliar environment. Many cat owners believe that cohabitation with other cats is beneficial for their pets, and that cohabitant cats offer comfort in the owner's absence. The purpose of this study was to evaluate the attachment behavior of cohabitant cats and compare this to bonds with their owners. Eighteen cat dyads (36 individual cats) underwent a modified secure base test with six stages in order to observe their behavior, both alone and with the owner or cohabitant cat present. Attachment styles were assigned to each cat-human and cat-cat pair, and behavior was measured through coding of recorded video of each session. While evidence of attachment bonding between cohabitant cats was observed, cats were found to be more soothed by and more likely to form secure attachment bonds with their owners. However, there is also evidence that some soothing effects occur as a result of a cohabitant cat's presence. These findings help expand our understanding of cat social cognition and their ability to bond in both intraspecific and interspecific relationships.

Key Words: Cat attachment, cat behavior, cohabitant cats, human-animal interactions

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Honors Baccalaureate of Science in Zoology project of Arden Smith presented on May 28, 2021.

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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.

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Introduction

Attachment is a phenomenon defined by Ainsworth & Bell (1970) as an enduring affectional tie that bonds one individual person or animal to another. Both intraspecific and interspecific attachment behaviors have been observed and classified throughout decades of attachment research, and often describe an individual's bond with a caregiver (Ainsworth & Bell 1970; Harlow 1959; Vitale et al. 2019a). The classification of attachment bonds as “Secure” or “Insecure” through the Infant-Caregiver ethogram originated with Ainsworth’s Strange Situation Test (SST), a methodology designed to observe attachment behavior in infants involving eight phases wherein a mother, child, and stranger are introduced, separated, and reunited (1970). A Secure classification is assigned to an individual who is able to use the attachment figure as a secure base, allowing them to receive comfort and confidence when exploring an unfamiliar environment (Ainsworth & Bell 1970; Vitale et al. 2019a). Conversely, an Insecure classification is assigned when a secure bond is not established, and the focal individual may exhibit either clinging or proximity-seeking behavior (Ambivalent) or little response (Avoidant) to the return of the attachment figure (Ainsworth & Bell 1970; Vitale et al. 2019a).

Multiple species, including primates, dogs, and cats, have been shown to form secure bonds with humans in a manner consistent with human infant-caregiver relationships (Harlow 1959; Vitale et al. 2019a). Recent research has also shown that adapting sibling attachment methodology can be effective for evaluating attachment in cohabitant conspecific domestic animal pairs. In a study by Sipple et al. (2021), cohabitant dog relationships were successfully classified using an attachment ethogram designed by Kier & Lewis (1993) to describe human sibling attachment. However, there is much to learn about these relationships, and the nature of

both intraspecific and interspecific bonding in pet animals. Cat social cognition, in particular, is a subject that has gone under-explored in recent decades of attachment research. Vitale, Behnke, and Udell (2019a) found that cats are capable of forming a variety of secure and insecure attachment bonds to their owners. This corroborates the findings of Edwards et al. in their 2007 study adapting the SST which indicate that cats can form similar bonds with their owners to the ones children exhibit towards their mothers.

Despite success in recent research in observing secure attachment behavior between cat-owner pairs, multiple studies have attempted to assess cat attachment behaviors with adaptations of Ainsworth's Strange Situation Test (1970) with mixed results (Edwards et al. 2007, Potter and Mills 2015). Challenges interpreting results from the eight-episode version of the SST can be attributed to the long duration and order effects of this testing methodology, which make maintaining motivation of the subject and interpreting their behavior difficult (Vitale et al. 2019a). However, assessing cat attachment behavior has been done successfully using a modified Secure Base Test (Vitale et al. 2019a), which originates from the Open Field Test described by Harlow in 1958. This test involves only three phases and focuses exclusively on the Secure Base Effect and attachment style (Vitale et al. 2019a). Vitale, Behnke, and Udell's 2019 study found that cats do exhibit significant Secure attachment to their owners, along with Insecure Ambivalent and Avoidant attachment styles. Variation in attachment style may result from a number of factors, including resource availability, socialization during development, and other environmental factors (Vitale & Udell 2019b). The variability in success of attachment studies on cats exemplifies the difficulty in performing these studies, because despite their similarities with dogs and children cats exhibit a unique range of social behaviors. This disparity in cat

sociability is not limited to their relationships with humans, as similar phenomena is shown in their engagement with conspecifics (Izawa & Doi 1994). While cats are often thought of as solitary hunters, they are known to exhibit distinct social behaviors with other cats, such as the formation of free-roaming cat colonies and communal rearing of kittens (Crowell-Davis et al. 2004).

Many cat owners claim anecdotally that their pets are highly bonded to one another, but the extent of pet cats' ability to form attachment bonds with conspecifics is largely unknown. Surveys indicate the average number of cats owned per household is 2 (AVMA 2018), but it is unclear whether multi-cat households are more beneficial, as preference and social inclination of an individual cat may influence how they are affected by cohabitation with a conspecific. A survey-based study by Elzerman et al. (2019) suggests that affiliative signs between cats were observed more frequently in multi-cat households, with physical contact between cohabitant cats observed at least daily in around half of households surveyed. Evidence also suggests that cats' stress levels are not correlated with the number of cats in the household, but rather with other environmental factors such as interactions with humans and resource availability (Ramos et al. 2013). The growing body of research describing cats' ability to securely bond with their human caregiver raises the question of whether cats are able to form attachment bonds with their conspecifics, and how these relationships may compare to those with their owners. As such, the aim of this study was to evaluate and compare cat-human and cat-cat attachment relationships of cats living in the same household using methodology and attachment style ethograms consistent with those previously used in infant-caregiver, sibling, and cat-human attachment literature (Vitale et al. 2019a; Sipple et al. 2021).

Methods

Ethical considerations

The study conducted was approved and in compliance with the regulations set forth by Oregon State University's Institutional Animal Care and Use Committee (IACUC # 2019-0013). Owner consent was obtained for each cat prior to involvement in the study.

Subjects

Thirty-six cohabitant cats (18 cat dyad pairs) were recruited to participate in this study. Cat owners were recruited via flyers, online postings, and word of mouth. Each cat pair had lived together at least 6 months, ranging up to 8 years, with an average of 2.88 years. The cats ranged in age from 8 months to 17 years old. Four of the dyads consisted of a pair of related cats, with each related pair being siblings.

Testing area

The testing area was an empty room 3.3 meters by 4.2 meters with a 1-meter tape grid covering the entire floor to facilitate coding of proximity measures during analysis. Video footage of each session was captured using an overhead camera (Indoor Nest Cam™, NC1104US or AXIS M3058-PLVE Fixed Dome Network Camera) and/or a video camera attached to a tripod. 3 clean cat toys were placed around the room at random. No cat interacted with the room more than once in a 5-day period for the duration of the study.

Procedure

To assess cat attachment, a counterbalanced version of the Secure Base Test (SBT) methodology was used, previously validated to analyze cat-human attachment relationships with respect to a caregiver (Vitale et al. 2019a). SBT methodology has also been used to analyze

attachment relationships between cohabitant dog dyads (Sipple et al. 2021). Each participating unit consisted of two cohabitant cats and their primary human caregiver, all living within the same household. Each cat served as the focal cat for one session, and as a potential attachment figure in a second session, with each session taking place on a different visit and scheduled at least 5 days apart. Each session was 12 minutes in duration, constructed as follows. The testing order determining whether the human caregiver conditions or cohabitant cat conditions were performed first was randomized for each dyad.

Owner Baseline (2 min): The owner and focal cat entered the room together. The human was instructed to interact freely (petting, talking, walking etc.) with the cat (without restraining it). Cats were able to freely explore the room as well.

Alone Phase 1 (2 min): The owner exited the testing room, leaving the focal cat alone.

Owner Return (2 mins): The owner re-entered the testing room, and was again allowed to freely interact with the focal cat as in baseline.

Cat Baseline (2 mins): The owner exited the testing room, but the focal cat remained. The non-focal cohabitant cat was brought into the room and could move and interact freely.

Alone Phase 2 (2 mins): The cohabitant cat was removed from the room, leaving the focal cat alone.

Cat Return (2 mins): The cohabitant cat was brought back into the room, both cats able to move and interact freely as in baseline.

Infant-Caregiver Attachment Style Classification

Infant-Caregiver attachment classifications were determined by two independent expert observers watching recorded video of each session and categorizing cats into attachment styles

(based on the original infant-caregiver classifications described in Ainsworth & Bell (1970)) from their behavior during the return phase of the SBT. The Infant-Caregiver attachment style of each cat was determined using the holistic analysis method (Ainsworth & Bell, 1970; Vitale et al. 2019a). An Infant-Caregiver attachment style was assigned to each focal cat with respect to both the human caregiver and cohabitant cat. Independent inter-rater reliability for exact attachment style (5 possible options, chance value 20%) was 53% (Binomial Probability Test, $p < 0.00001$) for cat-human attachment and 81% (Binomial Probability Test, $p < 0.00001$) for cat-cat attachment. After the independent coding process, the two coders re-watched videos for which they had selected different classifications and mutually agreed upon the final classification for each subject (Vitale et al. 2019a). If an agreement could not be reached, the cat was assigned as “unclassifiable” and excluded from further analysis. Infant-Caregiver Attachment Style Classifications taken from Vitale et al. (2019a) were as follows:

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.

Insecure-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).

Insecure-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).

Insecure-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 non-resting, non-sleeping cat).

Unclassifiable: Coders were unable to reach consensus on group placement for cats from this classification category. Unclassifiable cats were excluded from further analysis on cat attachment.

SPPIR Attachment Style Classification

Previous research on attachment bonds of cohabitant dogs found that the Infant-Caregiver attachment classifications did not effectively describe intraspecific dog attachment patterns, but an ethogram derived from sibling attachment literature was used successfully (Sipple et al. 2021). While previous attachment research has indicated that both cat-human and dog-human bonds can be categorized using the Infant-Caregiver attachment styles using the SBT (Vitale et al. 2019a), the appropriateness of the Infant-Caregiver ethogram for describing cat-cat bonds is yet unknown. Therefore, the SPPIR – Soothed, Partly Soothed, Playing, Ignoring, and Resistant (Kier & Lewis 1993; Sipple et al. 2021) – attachment style classification system was also used to classify each focal cat to describe their attachment to both the human caregiver and cohabitant cat. This was done to evaluate whether intraspecific cat bonds were better classified using the Infant-Caregiver or SPPIR ethograms. SPPIR attachment was classified by two independent coders in the same procedure as the Infant-Caregiver classification. Independent inter-rater

reliability was 86% (Binomial Probability Test, $p < 0.00001$) for cat-human attachment and 89% (Binomial Probability Test, $p < 0.00001$) for cat-cat attachment. SPPIR Attachment Style Classifications (Kier & Lewis 1993; Sipple et al. 2021) were as follows:

Soothed: Cat begins the return phase by crying/vocalizing and/or hovering near the door but ends the phase in joint play and/or relaxed behavior with the conspecific and no longer shows any signs of distress. (The cat may also engage in some solitary play.)

Partly Soothed: Cat begins the return phase by showing distress (crying/vocalizing and/or hovering near the door), acknowledges the conspecific's presence, and yet continues to periodically cry/vocalize and/or hover near the door during the phase and does not appear to be entirely soothed.

Playing: Cat begins the return phase in solitary play (with no signs of distress) and initiates interaction with the conspecific once the conspecific enters the room.

Ignoring: Cat may or may not briefly acknowledge the conspecific's presence, but mostly behaves during the return phase as if the conspecific was not present, engaging in solitary play or crying/vocalizing and/or hovering near the door.

Resistant: Cat becomes more irritable and rejecting during the return phase. This is shown by increased crying/vocalizations, resistance to contact and play, aggressing, active avoidance, fear, or stereotypies during the conspecific's presence.

Results & Discussion

Attachment Style Analysis

Infant-Caregiver:

Out of 36 cats, 35 were successfully classified using the traditional Infant-Caregiver attachment style classification system with respect to their human caregiver. 17 (47%) were classified as Secure, 10 (28%) were classified as Insecure Avoidant, and 8 (22%) were classified as Insecure Ambivalent. Out of 36 cats, 34 were successfully classified into an Infant-Caregiver attachment style with respect to the cohabitant cat. 26 (72%) were classified as Avoidant, 6 (17%) were classified as Secure, and 2 (6%) were classified as Ambivalent. While both cat-human and cat-cat attachment relationships were able to be classified using the Infant-Caregiver ethogram, cats were significantly more likely to form secure attachments to the human caregiver (Fisher's Exact test, $p < 0.01$). This suggests that, although the secure base effect can occur between cohabitant cats, cats securely bond more readily to a primary caregiver. This is not inconsistent with findings describing attachment of human infants to their siblings, where some infants have been found to use older siblings as a Secure Base in the absence of their primary caregiver (Stewart 1983).

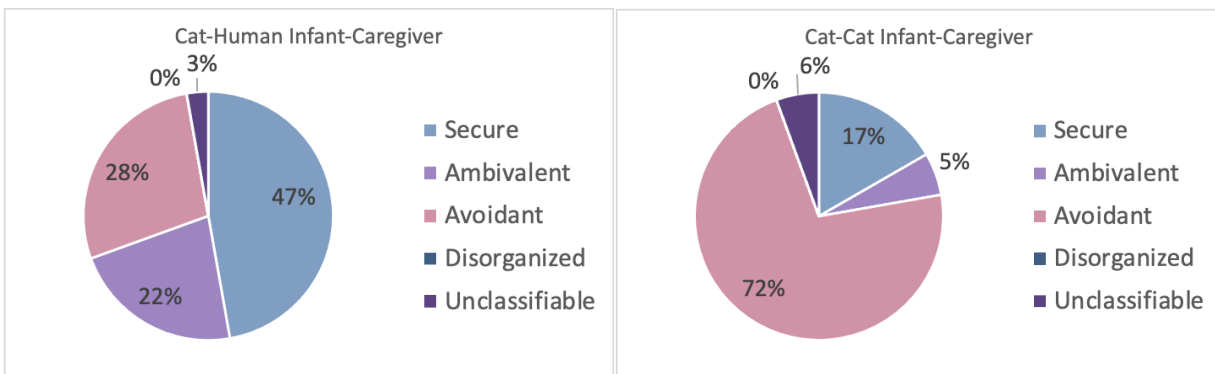


Figure 1: Cat-human and cat-cat Infant-Caregiver attachment style classifications.

SPPIR:

All 36 cats were successfully classified into an SPPIR attachment style with respect to their human caregiver. 21 (58%) were classified as Soothed, 7 (19%) were classified as Partly Soothed, 6 (17%) were classified as Ignoring, and 2 (6%) were classified as Resistant. All 36 cats were successfully classified into an SPPIR attachment style with respect to the cohabitant cat. 22 (61%) were classified as Ignoring, 8 (22%) were classified as Partly Soothed, 4 (11%) were classified as Soothed, and 2 (6%) were classified as Resistant. Cats were found to be Soothed significantly more by the presence of the human caregiver than the cohabitant cat (Fisher's Exact Test, $p = 0.0002$). This holds true even when expanding the criterion to include both cats classified as Soothed and Partly Soothed (Fisher's Exact Test, $p = 0.0003$), indicating that the presence of the human caregiver results in significantly more stress reduction in an unfamiliar environment. However, the classification of 12 (33%) cats as either Soothed or Partly Soothed suggests that some cats are able to experience some amelioration of stress as a result of a cohabitant cat's presence.

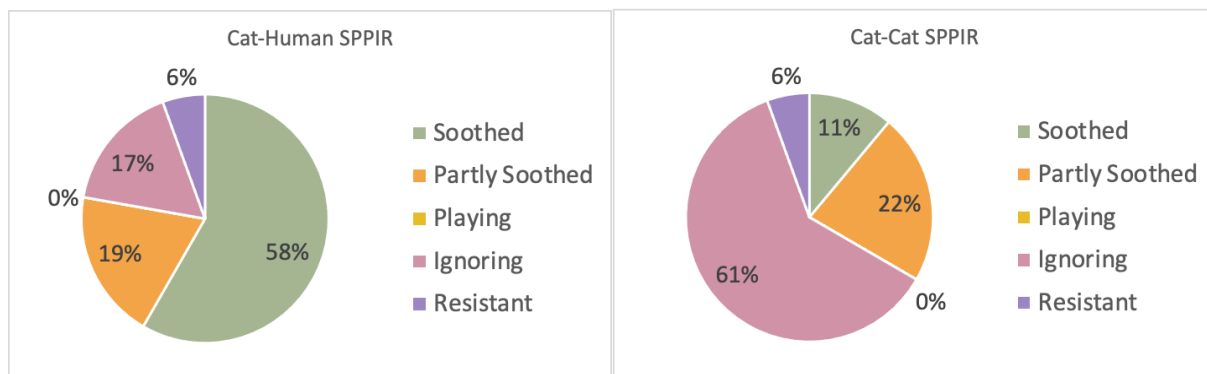


Figure 2: Cat-human and cat-cat SPPIR attachment style classifications.

Behavior Analysis

Proximity-seeking:

Seeking proximity to the door during the alone phase of the SBT is a behavior associated with mild distress and may indicate the subject's seeking to reestablish proximity with the attachment figure (Ainsworth & Bell 1970). There was not a significant difference in the average proportion of time that focal cats spent in proximity to the door when alone after the owner versus the cohabitant cat exited the room (Wilcoxon Signed-Rank Test: Alone phase (owner), $M = 0.28$, $SD = 0.36$; Alone phase (cat), $M = 0.08$, $SD = 0.36$, $W = 139$, $p = 0.75656$). This suggests that mild distress and seeking behavior was triggered in the absence of both the owner and cohabitant cat. However, the average proportion of time focal cats spent in proximity to the door after reunion with the owner was significantly lower compared to reunion with the cohabitant cat (Wilcoxon Signed-Rank Test: Return phase (owner), $M = 0$, $SD = 0.28$; Return phase (cat), $M = 0.35$, $SD = 0.43$, $W = 16.5$, $p = 0.00036$), indicating that the distress and seeking behavior associated with door proximity are more alleviated in the presence of the human caregiver. Increased proportion of door proximity during the cohabitant cat reunion phase compared to the owner reunion phase may indicate a greater inclination of the focal cat to seek the owner, even when in the presence of the cohabitant cat.

During the reunion phases, focal cats spent significantly more time in proximity to the owner versus the cohabitant cat (Wilcoxon Signed-Rank Test, owner proximity $M = 0.85$, $SD = 0.34$; cat proximity $M = 0.24$, $SD = 0.38$, $W = 77$, $p = 0.00046$). This supports the fact suggested by the attachment data that cats are more often soothed and more readily form a secure attachment bond with their human caregiver than the cohabitant cat, as seeking proximity and comfort from the attachment figure is characteristic of these attachment styles (Ainsworth & Bell 1970; Vitale et al. 2019a).

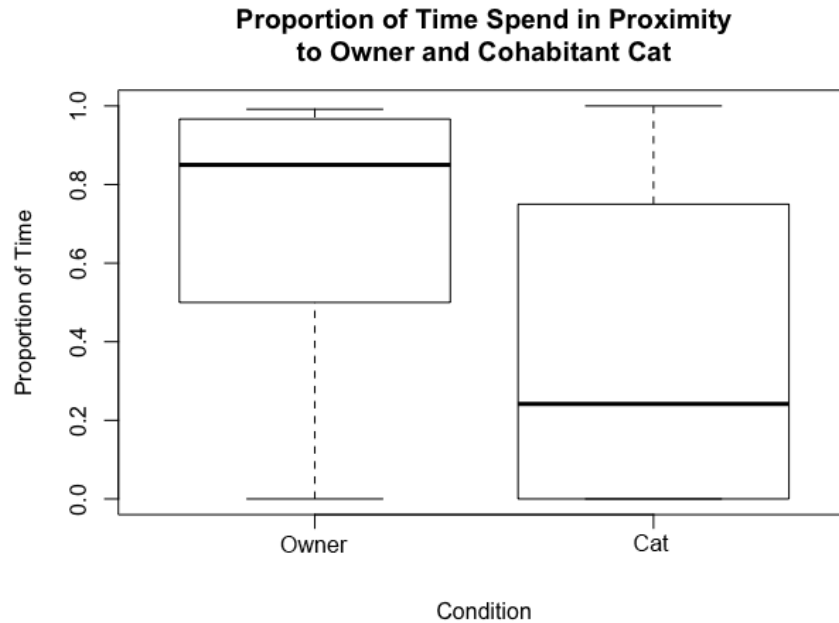


Figure 3. Proportion of time in proximity to owner vs non-focal cat.

Vocalizations:

Vocalizations are another behavior that often indicate measures of stress upon separation, and may be used as a means of attempting to reestablish proximity with the attachment figure, protest their departure, or signal the subject's distress (Ainsworth & Bell 1970). Among focal cats, there was no significant difference between the frequency of vocalizations during the alone phase following the departure of both the owner and cohabitant cat (Wilcoxon Signed-Rank Test: Alone after owner baseline, $M = 0.04$, $SD = 0.15$, after cat baseline, $M = 0.01$, $SD = 0.09$, $W = 130.5$, $p = 0.09894$). Frequency of vocalizations was shown to decrease significantly upon the return of both the owner (Wilcoxon Signed-Rank Test, alone phase (owner) $M = 0.04$, $SD = 0.15$, owner return $M = 0$, $SD = 0.02$, $W = 33.5$, $p = 0.0003$) and cohabitant cat (Wilcoxon Signed-Rank test, alone phase (cohabitant cat) $M = 0.09$, $SD = 0.09$, cohabitant cat return $M = 0$,

SD = 0.03, $W = 3.5$, $p = 0.00036$). There was no significant difference between frequency of vocalizations in the owner return phase versus the cohabitant cat return phase (Wilcoxon Signed-Rank test: After owner return, $M = 0$, $SD = 0.02$, after cat return, $M = 0$, $SD = 0.03$, $W = 73$, $p = 0.73746$). This supports the determination that cats are able to experience reduction in stress from the presence of a cohabitant cat even if they do not form secure attachments to their conspecifics as readily as to their human caregivers.

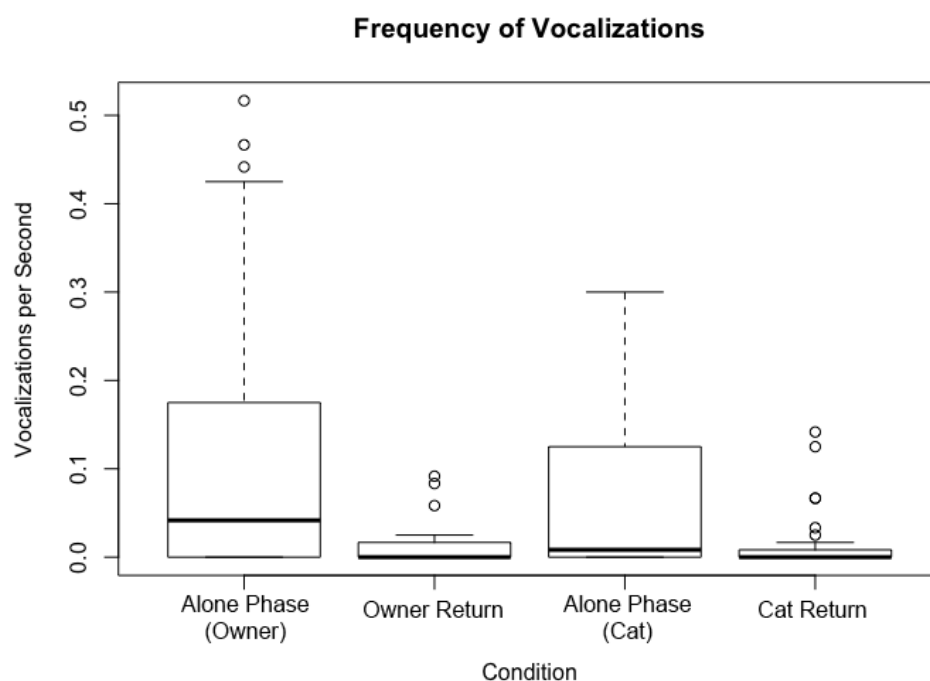


Figure 4. Frequency of vocalizations in the alone phase compared to the return phases of owner and cohabitant cat.

The order of owner versus cohabitant cat phases was found to result in no significant difference in the proportion of time seeking owner proximity (Owner first order: Median = 0.75, $SD = 0.33$; Cat first: Median = 0.94, $SD = 0.35$, Mann-Whitney $U = 103$, $p = 0.20054$). The

same is true for the proportion of time spent seeking proximity of the cohabitant cat (Owner first order: Median = 0.41, SD = 0.40; Cat first: Median = 0.025, SD = 0.37, Mann-Whitney U = 83, $p = 0.35238$).

Conclusions & Future Directions

This study indicates that although cat-human and cat-cat bonds may be different in how they manifest as a result of the owner's primary caregiver role, cats' relationships between both humans and conspecifics can be classified in similar ways. Cats' bonds with both their human caregiver and cohabitant cat are able to be classified through both Infant-Caregiver and SPPIR methods with relative success. This may be related to the fact that human siblings, upon which the SPPIR classification system is based, have been noted to exhibit secure attachment in events where their primary caregiver is absent (Stewart 1983). As such, the fact that cat-cat bonds can be classified using the Infant-Caregiver ethogram does not necessarily contradict the proposition that cats may experience differential attachment between human and cat cohabitants. In either case, the fact that cat-cat relationships were able to be classified using the Infant-Caregiver ethogram may indicate that intraspecific and interspecific attachment in cats is more similar than in other species, such as dogs, for whom cohabitant conspecific attachment could not be classified using the Infant-Caregiver ethogram (Sipple et al. 2021).

While the attachment behaviors and the ability to classify attachment bonds as secure occur in both cat-human and cat-cat pairs, the evidence in this study suggests that cats form secure bonds more readily with their human caregivers. This is consistent with the bond one might expect between a cat and primary caregiver, where the focal cat depends on the human for shelter, food, and security. In this case, the bond with the cohabitant cat may be more

supplemental in nature, and despite having similarities to the cat-human bond, the secure base effect does not occur as readily because the focal cat is less likely to depend on the conspecific to fulfill their survival needs. This is supported by the increased soothing effect of the owner's presence compared to that of the cohabitant cat, as the Soothed SPPIR style can be considered congruous with a Secure Infant-Caregiver attachment style (Sipple et al. 2021).

However, despite the increased tendency in cats to bond securely to their owners and increased soothing effects of the owner's presence, cats are shown in this study to experience some ameliorative effects as a result of the presence of a cohabitant cat. In particular, the significant decrease in vocalizations upon return of the cohabitant cat may indicate a decrease in stress, even in cats who did not exhibit secure attachment toward the conspecific. This indicates that even in the absence of a secure base effect, the presence of a cohabitant conspecific may benefit a cat and result in reduced stress in an unfamiliar environment. These findings have implications for cat caregiving strategies and are consistent with data that indicate that multi-cat households tend to have a neutral or positive impact on individual cats (Ramos et al. 2013; Elzerman et al. 2019). While further investigation is needed to fully characterize the attachment bonds form with cats and each other, a significant consideration is the fact that while there are suggestions that multi-cat households may be positive and result in soothing effects for individual cats, the Secure Base Effect does not occur as readily as between cats and humans and a cohabitant cat is not a replacement for proximity to a human caregiver.

Additional research is needed to further understand how cat attachment bonds manifest, both with humans and members of their own species. A future study in this topic could consider the propensity toward attachment exhibited by cats toward humans with whom they share a

household who are not their primary caregiver and investigate whether this attachment would more closely resemble that of their primary caregiver or a cohabitant cat. Further exploration of attachment relationships between related cats may also reveal more about how cats bond with conspecific caregivers, such as a cohabitant mother cat and offspring (of which there were none in this study). Further survey of the attachment behaviors and social cognition of cats may inform the success of the domestic cat as a species and improve strategies for cat care.

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