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Shut up and pet me! Domestic dogs (*Canis lupus familiaris*) prefer petting to vocal praise in concurrent and single-alternative choice procedures

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ABSTRACT

The nature of the interactions that maintain the social behavior of dogs toward humans and which interactions dogs prefer have not been thoroughly investigated. We focused here on dogs' preference for petting and vocal praise, and the influence that familiarity (owner vs. stranger) has on that preference. We first used concurrent choice to evaluate dogs' preference for petting or vocal praise and measured the initial choice, the time spent with each alternative, and the number of within-session alternations. We assessed dogs' preference for petting or vocal praise in (1) shelter dogs, (2) owned dogs with strangers providing both interactions, and (3) owned dogs with the dog's owner providing the interactions. Across all experimental groups, dogs preferred petting to vocal praise. We next assessed time spent with each alternative when only one alternative was available at a time in shelter dogs and owned dogs (Experiment 2). Shelter dogs were tested with a stranger and owned dogs were tested with their owners providing the interaction. Dogs alternated between petting and vocal praise, vocal praise and no interaction, or received only petting for eight 3-min sessions of each comparison. Both shelter and owned dogs spent significantly longer in proximity to the experimenter when the interaction was petting compared to vocal praise. Vocal praise produced as little proximity-seeking behavior as did no interaction. Additionally, dogs did not show any sign of satiation with petting across all eight sessions. Overall, petting seems to be an important interaction between dogs and humans that might maintain inter-specific social behavior but vocal praise likely has to be specifically conditioned.

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1. Introduction

Dogs enjoy a uniquely intimate relationship with humans, often occupying a role similar to that of another human family member, with 84% of respondents on the American Animal Hospital's 1999 survey referring to themselves as their pet's "mom" or "dad" ("Survey Says," 2000). The social behavior that dogs emit toward humans lends itself to research into the genesis and maintenance of that relationship, especially regarding the role of human behavior for dog behavior.

In adult dogs attachment to humans has been explored using the strange situation test (Topál et al., 1998). In one study an experimenter interacted three times with a shelter dog for 10 min each time (30 min total), including vocal interaction, petting, basic obedience and play with a toy. After the last 10 min session, the dogs were tested on the strange situation test. Each dog's behavior toward the experimenter and a stranger was measured during seven orchestrated episodes in which the handler was instructed to interact with the dog, a stranger entered the room, the handler left, the stranger tried to interact with the dog, and finally the handler was reunited with the dog. After just three 10 min interactions, shelter dogs showed an increase in contact seeking to the person who had handled them compared to a group of shelter dogs that did not have the prior handling experience (Gácsi et al., 2001). This suggests that attachment behaviors, at least in shelter dogs, can emerge rapidly and with minimal interaction from the human.

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Food delivery as an interaction has been demonstrated in several contexts to be an influential human interaction for dogs. Elliot and King (1960) found that food delivery from a human facilitated dogs' social behavior toward humans. During a handling test, food-deprived puppies consistently showed more "attraction" behaviors to the experimenter and fewer avoidance behaviors than a control group fed twice as much (both groups were fed by a human). This difference was magnified when the person conducting the handling test was the experimenter who fed the puppies rather than a stranger. These results suggest that food, especially under conditions of deprivation, can enhance dogs' social behavior toward humans. In a concurrent choice, shelter and owned dogs typically preferred food to petting and remained in proximity longer to the feeding person, but the schedule of food reinforcement, familiarity of context, familiarity of the person providing petting, and population (owned vs. shelter dogs) affected this preference (Feuerbacher and Wynne, 2014). Food also functions as a potent reinforcer for dogs for arbitrary operant responses (Feuerbacher and Wynne, 2012; Fukuzawa and Hayashi, 2013). Together, these results suggest that food is an important variable that can facilitate affiliative behavior in dogs toward humans. Nevertheless, other non-food interactions might also be functional in producing and maintaining social behavior in dogs toward humans and producing attachment.

Brodbeck (1954) found that puppies that received human interaction unpaired with food delivery were as just social toward people as another group of puppies for which the interaction was paired with food. Others have specifically investigated non-food interactions such as petting and vocal praise. Gantt et al. (1966) reported that dogs' heart rate and blood pressure decreased when the experimenter petted them, and petting even mitigated the typical tachycardiac response when the dogs received a shock to their paws (Lynch and McCarthy, 1967). Similarly, McIntire and Colley (1967) reported that petting, but not vocal praise alone, functioned as a reinforcer for operant responses in Army dogs. In a concurrent choice versus food delivery, petting was sometimes preferred to food, especially in shelter dogs, and owned dogs in an unfamiliar environment with their owner providing petting. Physiological evidence also points to human interaction (petting and talking) having an effect on dog behavior. Odendaal and Meintjes (2003) reported that dogs' serum levels of hormones and neurotransmitters associated in humans with feelings of euphoria (β-endorphin), social bonding (prolactin), intimate bonding (oxytocin), and exhilaration (dopamine), increased in dogs that had been petted and talked to by an unfamiliar human for a mean of 15 min (range 5–23 min). The relative contributions of the petting and talking on the effect seen, however, were not quantified.

Except for the work by McIntire and Colley (1967) little research has directly assessed the effect of vocal praise on dog behavior; it is usually combined with petting (e.g., Feuerbacher and Wynne, 2012; Odendaal and Meintjes, 2003). In the current study, we were interested in assessing dogs' preference for petting or vocal praise and which produced the most social behavior measured by proximity to the person. Proximity seeking is a measure of attachment in humans (Bowlby, 1973) and proximity to a human is a measure of sociability in dogs (Barrera et al., 2010). A high degree of sociability measured mainly by proximity behavior is also thought to be predictive of successful dog adoptions (Great Dog Productions, 2007).

We first assessed preference using a concurrent choice procedure in which dogs were able to choose between interacting with a person providing petting or a person providing vocal praise. The time allocated to available alternatives can be used as a measure of preference (Baum and Rachlin, 1969), in this case dogs' preference for different types of human social interaction. By measuring proximity, our results might point to interactions that could be relevant in producing attachment behaviors. We tested shelter dogs and owned dogs. Shelter dogs comprise a unique population in that they are relatively deprived of human interaction and reside in a stress-inducing environment (Tuber et al., 1999), both of which might function as motivating factors for making certain forms of interaction more reinforcing. In a choice between food and petting (Feuerbacher and Wynne, 2014), shelter dogs stood out as a group for their high preference for petting when the food schedule was thinned, and even sometimes preferred petting to food when food was readily available. We tested owned dogs as a comparison to determine the effect of having an attachment figure and consistent human interaction might have on preference. We tested owned dogs with two strangers providing petting to parallel the procedures for the shelter dogs, but we also tested owned dogs when their owner was one of the people providing the interaction. We tested this last group to determine if there are any conditioning effects on preference. Earlier research has shown that dogs react differently when their owner pets them compared to a stranger (Kuhne et al., 2012) and we found that the presence of the owner impacted dogs' preference for types of interaction (Feuerbacher and Wynne, 2014).

Based on our results from the concurrent choice procedures in Experiment 1, we also conducted an experiment using a single choice alternative in which only one interaction was available at a time. We altered across sessions which type of interaction was available to the dogs so that we compared preference for petting versus vocal praise, and vocal praise versus no interaction within dogs. We also evaluated whether dogs that only received petting across the same experimental time frame would show satiation for petting. We tested shelter dogs with a stranger providing the interaction. We also tested owned dogs in an unfamiliar environment with the dog's owner providing the interaction, conditions that would maximize the possibility that dogs would show social behavior (Topál et al., 1998), including for a non-food interaction (Feuerbacher and Wynne, 2014). By comparing shelter dogs and owned dogs in these studies, we can assess any effects on preference that a history of reinforcement with the interaction provider might have and whether these interactions might be unconditioned reinforcers or have to be specifically conditioned to affect domestic dog behavior.

2. Experiment 1: concurrent choice

2.1. Methods

2.1.1. Subjects

We tested shelter dogs and owned dogs. Shelter dogs were available for adoption at Marion County Animal Services, Ocala, FL. Dogs were selected based on the criteria that they were over 6 months old, approached the front of the kennel when the experimenter approached, allowed a leash to be put on them, and walked out of the kennel. All dogs tested had been in the shelter for a minimum of five days (see Table 1 for dog demographics, including time in shelter for individual dogs). Dogs were strays, owner-surrenders, or confiscates for cruelty.

Owned dogs were recruited from two local dog daycares. They were at least 6 months old and had lived with their current owner for at least 4 months (see Table 1 for dog demographics). We tested 14 dogs in each group: Shelter Dogs, owned dogs tested with strangers (Owned with Stranger), and owned dogs tested with their owners (Owned with Owner). One Shelter dog and three Owned with Stranger dogs were dropped from the experiment because they did not approach either alternative in the first 5 min period.

Table 1
Canid demographics.[a]

Dog	Breed	Age	Gender	Days in shelter	Source
Shelter dogs: concurrent choice					
Coco	Labrador retriever x	3y	SF	6	Owner surrender – OTC
Dad	Beagle	6y	NM	21	Stray – field
Daisy	Pit bull x	5y	SF	12	Owner surrender – OTC
Faith	Redbone hound x	3y	SF	12	Stray – field
Godzilla	Labrador retriever	>2y	NM	10	Stray – field
Hemi	Hound x	3y	NM	63	Confiscate – cruelty
January	Labrador retriever x	8y	SF	38	Stray – OTC
Martin	Pit bull x	1y	NM	30	Stray – OTC
Patsy	Hound x	3y	SF	9	Stray – OTC
Penny	Labrador/Shepherd x	6m	SF	5	Owner surrender – OTC
Quincy	Hound/Pit bull x	1y 1m	NM	28	Stray – field
Red	Hound x	2y	NM	43	Stray field
Snoopy	Labrador retriever x	1y 2m	NM	5	Return – OTC
Twinky	Dachshund/Terrier x	2y	NM	27	Stray field

Dog	Breed	Age	Gender
Owned dogs: concurrent choice with strangers			
Abby	Golden retriever	3y	SF
Beauty	Golden retriever/Collie x	7y	NM
Boots	Border collie/Labrador x	>2y	NM
Hannah	Rottweiler x	>2y	SF
Katya	Siberian husky	9m	SF
Lada	Pit bull	>2y	SF
Lady	Pointer x	2y 6m	SF
Mia	Terrier x	8m	SF
Mousse	Labrador retriever	6y	NM
Nick	Yorkshire terrier	9y	NM
Ollie	German shepherd	6m	NM
Shana	Pit bull/Labrador x	3y	SF
Snickers	Yorkshire terrier	8y	NM
Thriller	Terrier x	>2y	SF
Owned dogs: concurrent choice with owner			
Brandie	Golden retriever	12y	SF
Brodie	Golden retriever	11y	NM
Bryson	Golden retriever	7y	NM
Damon	Pit bull	2y	NM
Draco	Saluki	7y	UM
Harper	Shetland sheepdog	6m	UM
Kai	Labrador retriever x	9m	NM
Maverick	Labrador retriever	9m	UM
Melody	Border collie x	1y	SF
Melody	Australian shepherd	1y	SF
Nala	Labrador retriever x	4y	SF
Scorch	Saluki	7y	NM
Snickers	Pit bull/Beagle x	7y	SF
Trapper	Australian shepherd	5y	NM

[a] Demographic data of the dogs used in Experiment 1. Age is reported in years (y) and months (m). Sex: F is female, M is male, S is spayed, N is neutered. Under breeds the predominant breeds are listed and an x indicates the dog is a mix. For shelter dogs, the ages and breeds were what the surrendering owner reported (owner surrender dogs) or the shelter staff's best estimate for stray dogs. Days in shelter indicates how long the dog had been in the shelter when it was used in the study. Source was how the dog came to be in the shelter: owner surrenders, returns (adopted and surrendered again), stray and brought into the shelter by a community member (Stray – OTC), stray and picked up by an animal control officer (Stray – Field), or confiscated by an animal control officer (Confiscate).

2.1.2. Settings

Shelter dogs were tested in a 3.05 m × 4.25 m room at Marion County Animal Services. The room had chairs and a table along the periphery. A large doorway into a hallway was blocked with a metal exercise pen, which could be moved to bring the dog in and out of the room.

Owned dogs recruited from daycares were tested in the lobby of their daycare. We arranged a metal exercise pen and plastic safety netting, in conjunction with available walls and the front desk to make the testing area a rectangle of similar size to the room in which we tested shelter dogs. At Camp Marlin Doggie Daycare, Gainesville, FL the room was approximately 3.75 m × 4.50 m and at Dogwood Park and Daycare, Gainesville, FL the room was approximately 3.75 m × 5.50 m.

The experimenter remained behind the exercise pen during the sessions to operate the camera, as well as to coach the owner when the owner acted as one of the assistants. During the sessions, the experimenter remained neutral and did not interact or make any eye contact at all with the dog. The experimenter entered and exited the experimental space by moving the exercise pen.

Along one of the long sides of each room, two chairs were arranged in which two assistants would be seated (Fig. 1). The distance from the center of one chair to the center of the other was 1.5 m. Around each chair we marked a circumference with tape (0.3 m to either side of the chair, and 0.3 m in front of the assistant's feet which equated to 0.9 m across, and 1.15 m from the wall). This delineated where the dog met one of the criteria for being in proximity to the person seated in the chair. The distance between the two nearest edges of the two perimeters was 0.76 m. This distance precluded even large dogs from being in both perimeters simultaneously. The criteria used to designate when a dog was in proximity to an assistant were that the dog had to (1) have at least two paws in or on the tape circumference, (2) have any part of its body (except the tail) in contact with the experimenter, or (3) have at least 50%

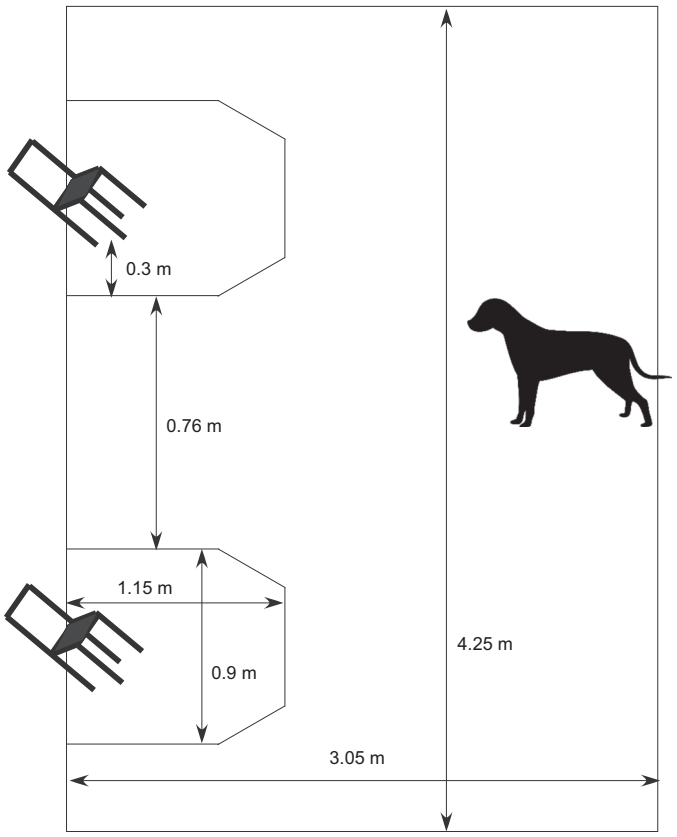

Fig. 1. Schematic and dimensions of the room arrangement for concurrent choice procedures. The drawing is approximately to scale and the room dimensions based on those of the room at the shelter.

of its body in the perimeter regardless of the dog's position (e.g., sit, lying down).

2.1.3. Concurrent interaction choices

The two assistants provided either petting or vocal praise. Each assistant provided the programmed interaction for the dog as long as it met the criteria for being in proximity to that assistant. When providing petting, the assistant petted and scratched the dog with one hand on the side closest to the assistant so that the petting did not interfere with the dog's ability to move away. The assistant petted whatever body area was closest to her and moved her hand back and forth in such a way that her finger tips lifted the dog's fur and the dog's skin moved across the underlying muscle (Hennessy et al., 1998); this was typically the side of the neck or shoulder, but the dog could orient so that the assistant scratched its back or hindquarters or its belly if it rolled over.

When providing vocal praise, the assistant talked to the dog in a high tone of voice (McConnell, 1990), giving praise statements (e.g., "You are such a good doggie! What a sweet dog you are") to the dog.

2.1.4. Sessions

Sessions were 10 min in total duration and broken into two 5-min periods. In the first 5 min period, one assistant provided petting and the other provided vocal praise. After 5 min elapsed, a timer sounded and the two assistants changed their programmed interactions. That is the assistant initially providing petting now provided vocal praise and vice versa. We were interested in whether dogs would track the change in contingency or if any preference formed in the first 5 min would persist even with a change in interaction type. The location of the person first providing petting or vocal praise was counterbalanced across dogs. When owners were one of the assistants providing interaction, half of the owners started by providing petting and the other half started by providing vocal praise. The side of the owner and the interaction first provided were counterbalanced across dogs.

Prior to beginning the session, the experimenter or the owner (for owned dogs tested with their owner) led the dog to the experimental area and allowed the dog to explore the area for 2 min. During this time the experimenter explained to the owner how to interact with the dog and the criteria for interaction. After the 2 min acclimation period, the two assistants, who had remained at least 3 m from the experimental area during the acclimation period, entered the experimental area and sat in the designated chairs. In the group that were tested with their owners acting as one of the assistants, one assistant entered the area and that person and the owner sat in the designated chairs. The experimenter led the leashed dog up to each assistant for 1 min during which the assistant provided her initial programmed interaction, either petting or vocal praise, so that the dog would contact the different contingencies. The side and the interaction that the dog was first exposed to were counterbalanced across dogs.

After exposing the dog to the two alternatives, the experimenter led the dog back to the side opposite the two assistants and equidistant from both and removed the leash to start the session. After 5 min, a timer sounded and the assistants changed the interaction they each provided for the second 5 min of the 10 min session.

We measured the dog's initial choice during the first 5 min session, the time spent with each alternative in each 5 min session, and the number of within-sessions preference alternations. A preference alternation was scored when the dog was with one assistant but left the proximity of that assistant and came into proximity to the other assistant. A dog that was in proximity to one assistant, left that proximity, but re-entered the proximity of that same assistant was not scored as a preference alternation.

2.1.5. Analysis

We digitally video-recorded the sessions and the recordings were scored by undergraduate assistants who were blind to the whether the dog was a shelter dog or an owned dog and whether the owned dog was being tested with its owner. A second, independent observer double-coded 25% of the videos for interobserver agreement (IOA). IOA ranged from 93.3 to 100% and the average was 95.4%.

Because the times spent with the two alternatives and the within-session alternations were not normally distributed within groups, we rank transformed the data and conducted a mixed ANOVA on the ranks (Hora and Conover, 1984). To calculate the ranks, we compiled the time spent by each dog with each alternative in the first 5 min and the second 5 min (i.e., four data points for each dog: time spent with petting and time spent with vocal praise in the first 5 min, and time spent with petting and time spent with vocal praise in second 5 min). We compiled the data from all four groups of dogs together and ranked this compiled data set. Ranks were assigned such that lower ranks corresponded to larger raw data values. Equal raw data values received the same rank. The rank was calculated by assigning each of those data points a separate rank, which was assigned as describe above, and then taking the average of those ranks. This average was then assigned as the rank for each of those data points. We evaluated the effect of interaction type (vocal praise vs. petting), dog type (Shelter, Owned with Stranger, Owned with Owner with owner providing vocal praise first, and Owned with Owner with owner providing petting first), and session (first 5 min vs. second 5 min) on time allocated to each alternative and number of within-sessions alternations. We also evaluated whether dog type affected initial choice for petting or

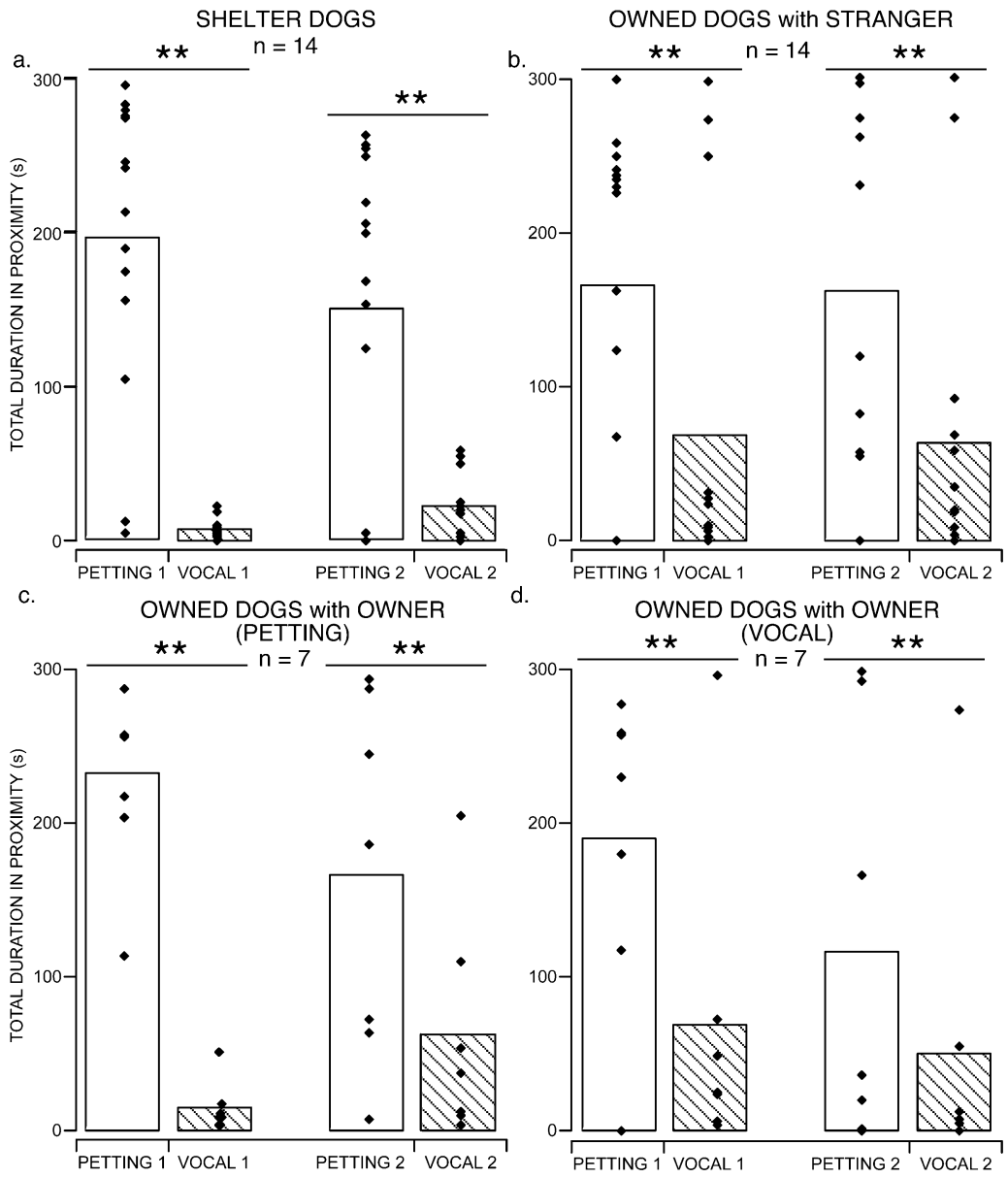

Fig. 2. Means and individual data of total duration (s) dogs spent in proximity to the petting and vocal praise alternatives in the two 5 min periods for the four experimental groups: Shelter dogs (a), Owned dogs tested with strangers (b), owned dogs tested with their owner with the owner providing petting in the first 5 min (c), and owned dogs tested with their owner with the owner providing vocal praise in the first 5 min (d). ** indicates $p < .01$.

vocal praise using a binomial test. All factors except dog type were within-subjects.

2.2. Results

2.2.1. Time allocation

Fig. 2 shows the means (bar) and individual data (scatter plot) of the time allocated to each alternative in the four different groups of dogs in the first and second 5 min periods. The main effect of interaction type (vocal praise vs. petting) was significant $F(1, 38) = 63.81$, $p < .001$, $\eta^2 = .63$ with all groups of dogs preferring petting (M rank = 107.2) to vocal praise (M rank = 64.02) in concurrent choice, even when a stranger was providing petting and the owner provided vocal praise (Fig. 2c and d). No other main effects were significant, next largest $F(1, 38) = 2.464$. Thus, there was no significant difference between groups of dogs or between the first and second 5 min period, indicating that dogs tracked the contingency change from the first 5 min to the second 5 min and continued to allocate more time to the petting alternative in both 5 min periods.

2.2.2. Within-session alternations

There were no significant main effects for the number of within-session alternations between groups or from the first to the second 5 min period (overall M rank = 43.4, largest $F(1, 38) = 1.80$).

2.2.3. Initial choice

Fig. 3 shows the percentage of dogs in each group that made an initial choice to the petting alternative. For the Owned with Owner group with the owner providing petting in the first 5 min periods, this also reflects the percentage of dogs that made an initial choice to their owner. For the Owned with Owner group with the owner providing vocal praise in the first 5 min period, this shows the percentage of dogs that made an initial choice to stranger. Shelter dogs chose the petting alternative the most of any of the groups (11 of 14 dogs); this trended but did not quite reach significance

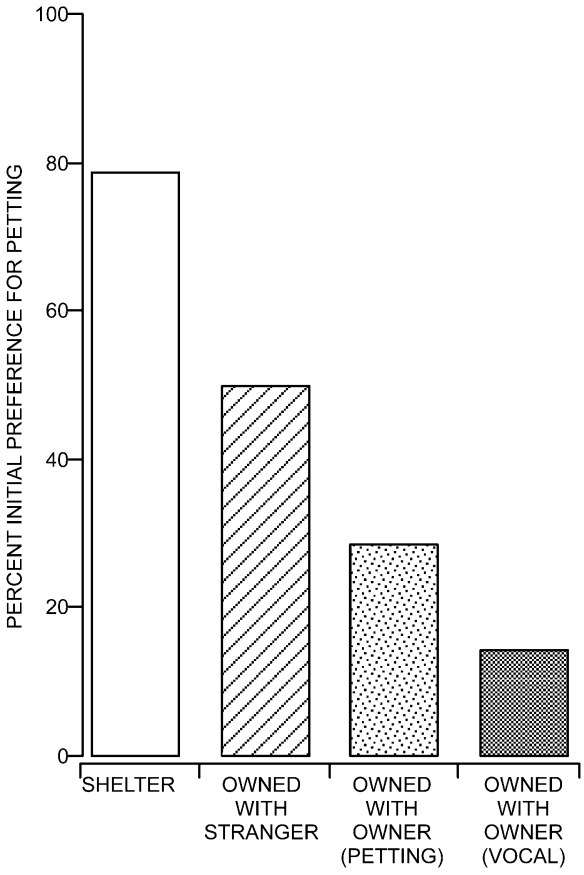

Fig. 3. Percent of dogs in each group that emitted an initial preference to the petting alternative.

(binomial $p = .057$). The remaining groups all showed decreased choice toward the petting alternative but none differed significantly from chance responding to the two alternatives. Owned dogs were initially at chance when tested with strangers. The presence of the owner decreased initial preference for petting further, although there was a higher initial preference for petting when the owner was providing it rather than a stranger.

2.3. Discussion

Across all experimental groups, dogs allocated significantly more time to the petting alternative in the first and second 5 min sessions, indicating a preference for petting over vocal praise, even when the owner provided vocal praise. Additionally, all groups of dogs tracked the contingency change after 5 min and continued to allocate more responding to the petting alternative by switching to the other assistant. This occurred even when the dog had to alternate away from the owner to a stranger to receive petting. Shelter dogs showed the greatest initial preference for petting, possibly due to their stress-inducing environment (Tuber et al., 1999), or their relative deprivation from interaction, both of which might increase the value of petting. In the Owned dog groups the presence of the owner decreased initial choice of petting to values less than when two strangers provided the interactions. These results that dogs made an initial choice to petting more often when the owner was providing petting parallels results in which dogs were more likely to interact for petting when food was concurrently available if the owner provided petting compared to a stranger (Feuerbacher and Wynne, 2014). Why the presence of the owner generally decreased dogs' initial preference for petting, however, is unclear.

3. Experiment 2: single alternative choice

Based on our results from Experiment 1, we were interested in whether dogs would engage socially and remain in proximity to an assistant for vocal praise if that was the only available social interaction, and how that would compare to the assistant providing only petting or ignoring the dog entirely. To this end, we tested shelter dogs and owned dogs in a single alternative choice procedure. Shelter dogs were tested with strangers as in Experiment 1. To maximize the likelihood that dogs would interact for vocal praise, we tested owned dogs under conditions that should produce the greatest amount of affiliative behavior based on results from strange situation tests (Topál et al., 1998) and that has produced the most preference for non-food social interactions in a food versus petting concurrent choice (Feuerbacher and Wynne, 2014): the dogs' owners providing the interaction in an unfamiliar environment.

3.1. Methods

3.1.1. Subjects

Shelter dogs were selected based on the same criteria as in Experiment 1. Owned dogs were recruited from the community and met the same criteria as dogs recruited from the dog daycares in Experiment 1 (see Table 2 for dog demographics). One owned dog was dropped from the study because the owner considered the dog stressed and ended the experiment before all sessions were completed (the dog was in the Petting vs. Vocal Praise group).

3.1.2. Settings

Shelter dogs were tested in the same room as those in Experiment 1. Owned dogs were tested in a small room at the University of Florida (3.05 m × 4.27 m) that had a table and chairs along one wall opposite the wall where the assistant sat. The arrangement of the rooms at both locations was similar to that of Experiment 1 except that only one chair, instead of two, was arranged along one wall in each room. The chair was equidistant from either sidewall and the same perimeter measures were used to demarcate proximity around the chair as in Experiment 1.

3.1.3. Single choice interactions

We used petting, vocal praise, and no interaction in this experiment. Petting and vocal praise were delivered as outlined in Experiment 1. During the No Interaction condition, the assistant made no response to the dog. If the dog made contact with the assistant, the assistant did not react; if the dog pushed the assistant's hands up, she moved her hands and placed them in her lap again. The criteria for interaction and for coding that the dog was in proximity were the same as those used in Experiment 1.

Dogs were assigned to one of three experimental groups, with each group containing 12 shelter dogs and 12 owned dogs. Dogs were randomly assigned except for those from a multi-dog household, each of which was assigned to a separate group to equalize the common living environment across all groups. Between sessions, the assistant stood up and encouraged the dog to stand by taking a few steps with vocal encouragement if needed. All dogs stood up between sessions. There was an approximately 30 s intersession interval before the assistant returned to the chair and sat down to begin the next session. Dogs were tested on a long (3 m) leash, held by the assistant, that was used to prevent Owned dogs from interacting with the experimenter who remained in the experimental room to coach the owner as needed. Because of this constraint, we also tested shelter dogs on a leash, held by the assistant. The assistant held the leash stationary and the only pressure was that produced by the dog itself. That is, the assistant did not use the leash to redirect the dog in any way.

Table 2
Canid demographics. Experiment 2.[a]

Dog	Breed	Age	Sex	Days in shelter	Source
Shelter dogs: single alternative Petting vs. Vocal Praise					
Andee	West Highland White Terrier	4y	NM	6	Owner surrender
Brownie	Pit bull/Labrador retriever x	2y	SF	34	Owner surrender
Celesta	English setter x	2y	SF	14	Stray – field
Chelsey	Pit bull	1y	SF	70	Stray – field
Jacks	Jack Russell terrier	3y	NM	27	Stray – OTC
Jethro	Pit Bull x	1y 4m	NM	19	Stray – field
Joey	Treeing Walker Coonhound x	9m	NM	10	Owner surrender
Mona Lisa	Hound x	1y	SF	16	Stray – field
Panera	Brittany x	8m	SF	10	Stray – field
Rolo	Pit bull x	1y	NM	27	Stray – field
Roper	Australian cattle dog x	5y	NM	38	Stray – OTC
Shadow	Labrador retriever x	1y 1m	SF	18	Owner surrender
Shelter dogs: single alternative Vocal Praise vs. No Interaction					
Blaze	Shepherd/Terrier x	1y 2m	NM	11	Stray – field
Buddy	Labrador retriever x	2y	NM	81	Stray – field
Buddy	Pit bull	3y	NM	11	Stray – field
Camaro	Labrador retriever/Rottweiler x	10m	NM	33	Stray – OTC
Emma	Labrador retriever x	2y	SF	12	Stray – field
Fanta	Hound x	2y	SF	24	Stray – field
Lenny	Australian cattle dog x	2y	NM	18	Stray – field
Lizzy	Miniature dachshund	4y	SF	13	Owner surrender
Max	Labrador retriever x	3y	NM	7	Stray – field
Rose	Hound x	1y	SF	61	Stray – field
Sally	Australian cattle dog x	1y	SF	11	Stray – field
Sandy	Rottweiler/Shepherd x	1y 11m	SF	34	Stray – OTC
Shelter dogs: single alternative Petting Only					
Bella	German shepherd x	1y	SF	26	Stray – OTC
Betty	Golden retriever x	2y	SF	24	Stray – field
Bootsie	Chihuahua	8y	SF	62	Confiscate – cruelty
Bruno	Jack Russell terrier	4y	NM	68	Confiscate – cruelty
Buddy	German shepherd x	>1y	NM	10	Confiscate – cruelty
Drago	German shepherd	7y	NM	24	Stray – field
Faith	Beagle	7y	SF	34	Stray – OTC
Georgie	Basset hound x	7y	NM	93	Owner surrender
Penny	Beagle	4y	SF	18	Stray – field
Sammy	Terrier x	1y	UM	39	Confiscate – cruelty
T Rex	Boxer x	1y	NM	21	Stray – field
Tucker	German shepherd x	1y 3m	NM	13	Owner surrender

Dog	Breed	Age	Sex
Owned dogs: single alternative Petting vs. Vocal Praise			
Aero	German shepherd	12y	NM
Bella	Pointer/Shar pei x	2y	SF
Bessa	Pointer x	2y 6m	SF
Cleo	Vizsla/Chow/Boxer x	4y	SF
Emma	Deutsch drahthaar	4y	SF
Houston	Labrador retriever/Pointer x	4y	NM
Kobe	Akita x	4y	NM
Liam	Beagle x	1y 8m	NM
Nali	Miniature fox terrier	5y	SF
Remi	Labrador retriever/Pointer x	3y 9m	SF
Vanya	Rottweiler/Coonhound x	2y	SF
Willus	Miniature pinscher	4y	NM
Owned dogs: single alternative Vocal Praise vs. No Interaction			
Aegis	Belgian malinois	2y 2m	SF
Bell	Staffordshire terrier/Catahoula leopard dog x	5y	SF
Bella	Labrador retriever x	1y 6m	SF
Chiba	Australian cattle dog x	7y	NM
Chloe	Boston terrier/Bulldog x	4y	SF
Cookie	Labrador retriever/Hound x	6y 5m	SF
Kira	German shepherd x	1y 5m	SF
Luke	German shepherd/Labrador retriever x	10y	NM
Mikko	German shepherd	7y	NM
Semper	Chihuahua	4y 6m	NM
Sonya	Bull terrier	3y	SF
Zaki	Maltese	5y	NM
Owned dogs: single alternative Petting Only			
Buster	Boston terrier	4y	NM
Ian	Border collie	4y	NM
Jackson	Beagle/Basset hound x	7y	NM
Magpie	Labrador retriever/Shepherd x	9y	SF

Table 2 (*Continued*)

Dog	Breed	Age	Sex
Matilda	Great Dane	9y	SF
Max	Labrador retriever/Shepherd x	6y 10m	NM
Midget	Shetland sheepdog/Cocker spaniel x	6y	SF
Ninja	Labrador retriever x	2y	SF
Red	Hound x	3y 6m	NM
Reggie	Miniature pinscher	5y	NM
Sheeba	Wolf-dog hybrid	8y	SF
Lima	German shepherd x	6y	SF

[a] Demographic data of the dogs used in Experiment 2. The format and abbreviations follow that of Table 1.

3.1.4. Sessions

After entering, each dog was allowed to acclimate to the experimental room for 2 min on a 3 m leash. The assistant (owner, for owned dogs) stood in the middle of the room and did not interact with the dog during this time. Given the leash length and the size of the room, the dog had access to all parts of the room. The criteria for being in proximity to the assistant were the same as Experiment 1.

Each session was 3 min long and started when the assistant sat in the designated chair. The assistant did not make eye contact with the dog and remained in a neutral sitting position with her hands in her lap when the dog was not in proximity to preclude any confounding effects of eye contact. Whenever the dog was in proximity, the assistant engaged in the programmed activity as long as the dog remained there. As soon as the dog did not meet any of the above criteria for proximity, the assistant stopped the programmed activity, but would resume if the dog came back into proximity.

For owned dogs, the owners of the dogs functioned as the assistant, delivering the programmed consequence for the dog when in proximity. The owners were coached before each session by the first author on how to interact with the dog and the criteria for interaction.

3.1.4.1. Petting versus Vocal Praise. Dogs alternated between two sessions of Vocal Praise and two sessions of No Interaction for eight sessions such that each dog experienced both conditions twice (i.e., a total of four sessions of each condition for each dog) in an ABAB design. The order of conditions was counterbalanced across dogs.

3.1.4.2. Vocal Praise versus No Interaction. Based on the results from the Petting versus Vocal Praise group, we wanted to assess whether dogs would remain in proximity more for vocal praise than for no interaction at all. In this experiment, dogs alternated between two sessions of Vocal Praise and two sessions of No Interaction for eight sessions such that each dog experienced both conditions twice (i.e., a total of four sessions of each condition for each dog) in an ABAB design. The order of conditions was counterbalanced across dogs. As a further comparison, some of these dogs received an additional two sessions in which they received petting. This allowed us to determine whether dogs that did not remain in close proximity for vocal praise or no interaction would remain in close proximity when petting was delivered.

3.1.4.3. Petting Only. Based on our results from the Petting versus Vocal Praise group, we were interested in whether dogs would continue to remain in proximity to the experimenter to receive petting when petting was given over a longer time frame (eight consecutive sessions), or whether dogs would begin to satiate on petting. As a further comparison, some of these dogs received an additional two sessions in which they received no interaction. This allowed us to determine whether dogs that remained in close proximity for eight sessions of petting would continue to do so when the petting was terminated.

3.1.5. Analysis

All sessions were digitally video-recorded. In addition some sessions were coded live by the first author or another assistant who was blind to the purpose of the study and the results from Experiment 1. Sessions not coded live were coded from video by assistants blind to the purpose of the study, the results from Experiment 1, whether the dog was a shelter or owned dog, and whether the owner was providing the interaction. We double-coded all sessions for 25% of the dogs, using an equal number of dogs from each experimental group, to assess IOA, which ranged from 90 to 100%: mean 98.3%.

For each session we measured the total duration each dog spent in proximity to the experimenter per 3-min session. Because the dog could freely enter and leave proximity to the experimenter, we also measured the number of bouts (how many times the dog came into proximity to the experimenter). Because dogs did not always engage with the experimenter and therefore not every session had a bout, we did not analyze bout duration.

Total duration and bout number were rank transformed to normalize them (Hora and Conover, 1984) for each session and dog and ran a two-way mixed ANOVA with repeated-measures factor interaction type (Petting, Vocal Praise, or No Interaction) and between-subjects factor dog type (shelter or owned) on the ranked data for the Petting versus Vocal Praise and Vocal Praise versus No Interaction groups. To calculate the ranks, we compiled the total duration (or number of bouts) for each session for each shelter and owned dog and ranked this compiled data set (i.e., eight values for each dog corresponding to each of the dog's eight sessions). Ranks were assigned such that lower ranks corresponded to larger raw data values. Equal raw data values received the same rank. The rank was calculated by assigning each of those data points a separate rank, which was assigned as described above, and then taking the average of those ranks. This average was then assigned as the rank for each of those data points. For the Petting Only group, we ran two-way mixed ANOVA with factors session number (to assess whether dogs were satiating on petting), and dog type (shelter or owned) on the ranked data for the Petting Only group. Similar to the other groups, to calculate ranks we compiled the total duration (or number of bouts) for each session for each shelter and owned dog and ranked this compiled data set as detailed above.

3.2. Results

3.2.1. Petting vs. Vocal Praise

Fig. 4a shows the overall means (bar) and individual dog means (scatter plot) for the total duration spent in proximity to the experimenter. We found a significant main effect of interaction type (petting versus vocal) $F(1, 22) = 33.24$, $p < .001$, $\eta^2 = .60$ with dogs spending significantly more time near the experimenter during the petting condition (M rank = 121) than in the vocal praise condition (M rank = 70). There were no other significant main effects, largest $F(1, 22) = 0.88$.

Fig. 5a shows the number of bouts in which a dog came into proximity to the experimenter. We found a main effect of

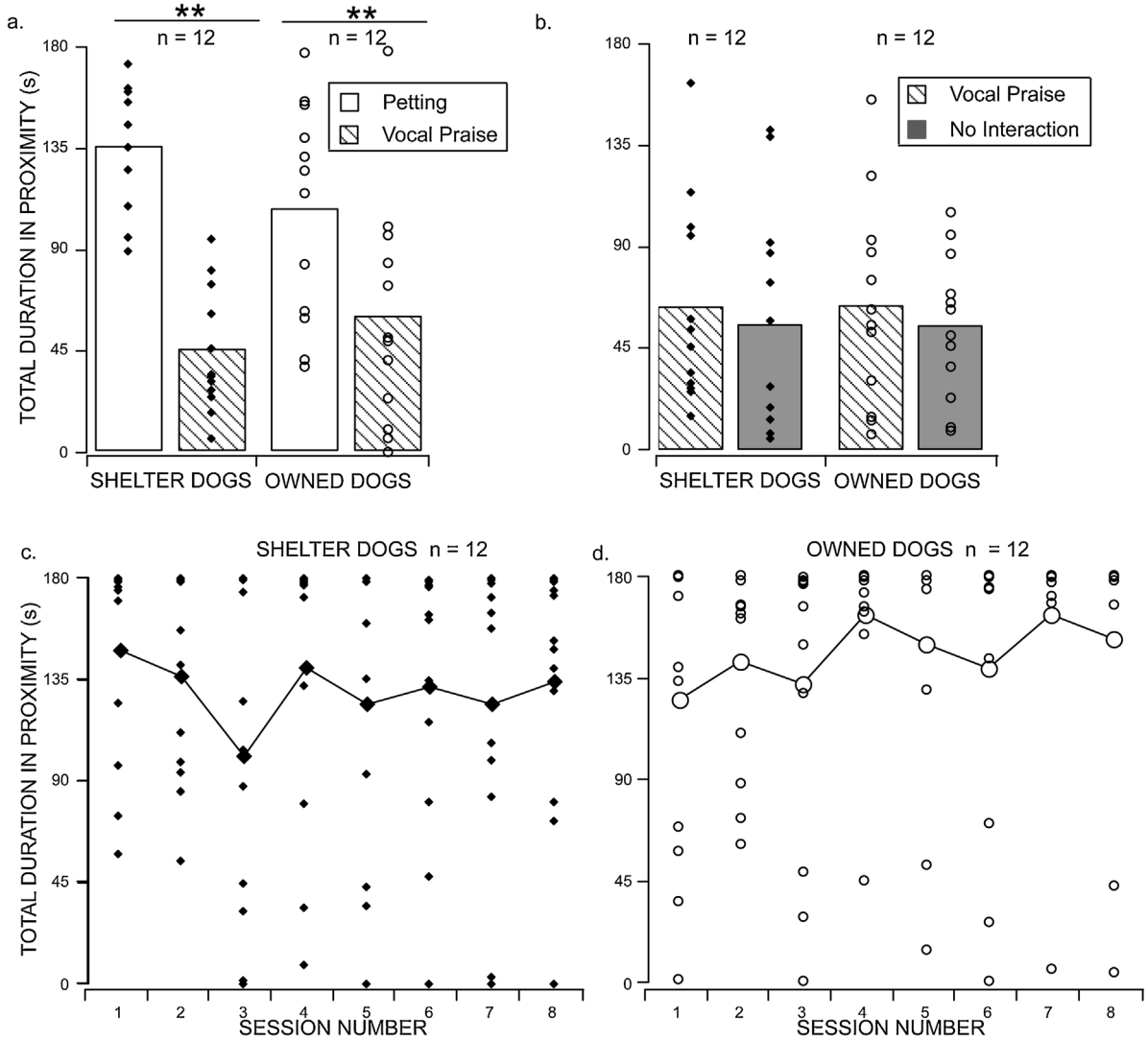

Fig. 4. Total duration (s) dogs spent in proximity to the experimenter during different conditions. Petting versus Vocal Praise (a); Vocal Praise versus No Interaction (b); Petting Only Shelter dogs (c); Petting Only Owned dogs (d). For (a) and (b), means and individual dog means are plotted. For (c) and (d) means and individual data by session are plotted. * indicates $p < .05$; ** indicates $p < .01$.

interaction type $F(1, 22) = 17.82$, $p < .001$, $\eta^2 = .45$ and a main effect of dog type (shelter versus owned dog) $F(1, 22) = 9.31$, $p < .01$, $\eta^2 = .30$. Both shelter and owned dogs engaged in fewer bouts during the Petting condition (shelter dogs: *M* rank = 102.5, owned dogs: *M* rank = 62) than in the Vocal Praise condition (shelter dogs: *M* rank = 134.7, owned dogs: *M* rank = 86). Owned dogs engaged in fewer bouts in both conditions than did shelter dogs.

3.2.2. Vocal Praise vs. No Interaction

Fig. 4b shows the total duration spent in proximity to the experimenter. We found no main effect either of interaction type (Vocal Praise versus No Interaction) dog type (shelter versus owned dog), (largest $F(1,22) = 2.95$).

Fig. 5b shows the number of bouts in which the dog came into proximity to the experimenter. We found no main effect of either interaction or dog type, although dog type trended toward significance $F(1, 22) = 3.98$, $p = .06$, $\eta^2 = .15$ with shelter dogs engaging in more bouts in both conditions (Vocal Praise: *M* rank = 113.8, No Interaction *M* rank = 109.4) than owned dogs (Vocal Praise: *M* rank = 87.8, No Interaction: *M* rank = 75.0). Six of the 12 shelter dogs, and five of the 12 owned dogs received an additional two sessions of petting.

Because we found no significant differences between conditions (Vocal Praise versus No Interaction) either in the larger group, noted above, or in these eleven dogs, $F(1, 43) = 1.881$, $p = .18$, $\eta^2 = .04$, we combined the conditions for statistical analysis and calculated the median time spent in proximity to the experimenter across Vocal Praise and No Interaction conditions for each of these eleven dogs, and the median time spent in proximity to the experimenter during the two Petting sessions. We then rank transformed these median values and conducted a repeated measures ANOVA on the rank transformations. Fig. 6a shows total duration dogs spent in proximity to the experimenter. We found a main effect of condition (Vocal Praise/No Interaction versus Petting) $F(1, 9) = 10.33$, $p < .05$, $\eta^2 = .53$. No other main effects (i.e., dog type) were significant, largest $F(1, 9) = 0.71$. Dogs spent significantly less time in proximity to the experimenter in the final two sessions in which petting was provided (*M* rank = 14.3) compared to the previous Vocal Praise/No Interaction sessions (*M* rank = 8.7).

3.2.3. Petting Only

Fig. 4c and d shows the total duration spent in proximity to the experimenter for shelter and owned dogs, respectively. We found

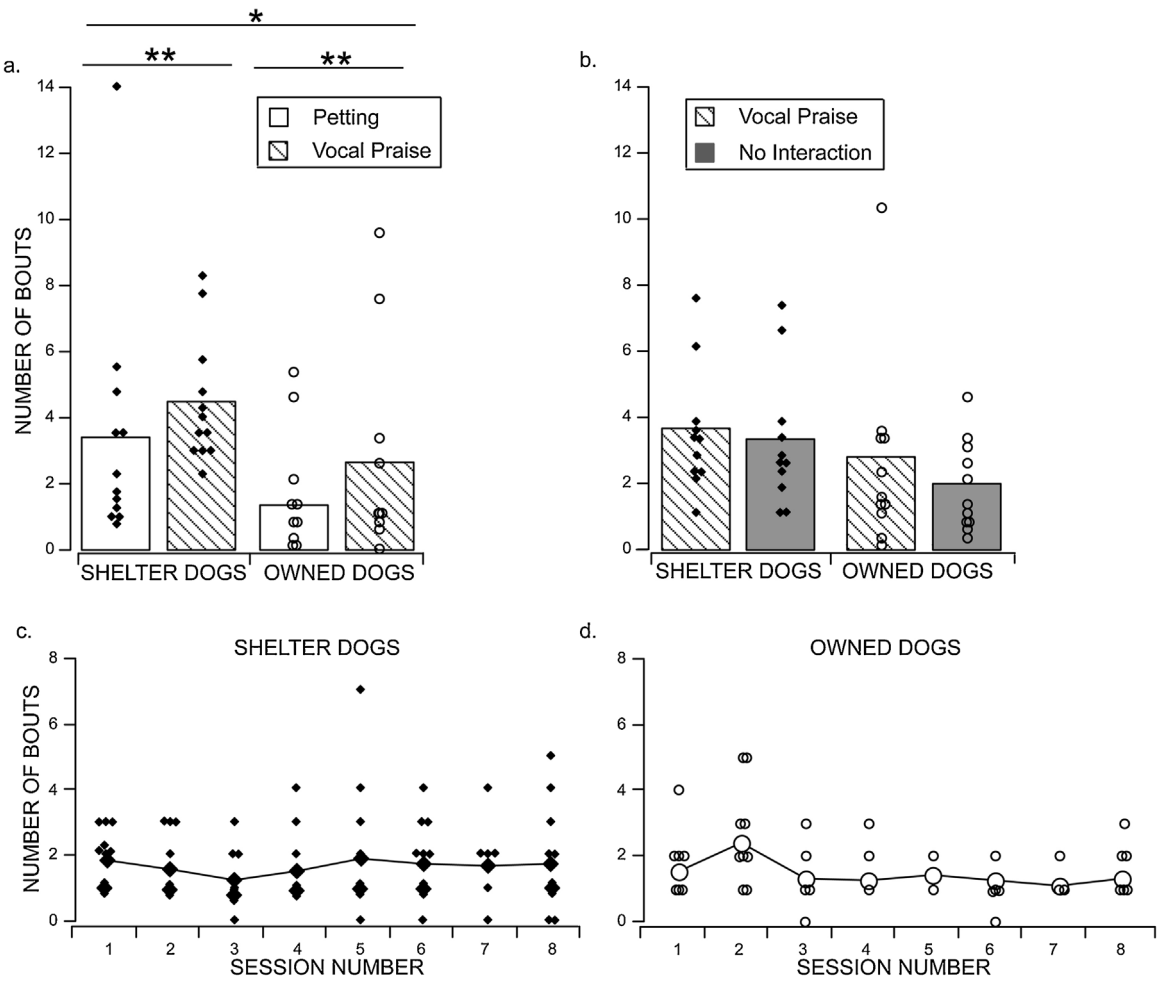

Fig. 5. Means and individual data of number of bouts (s) dogs spent in proximity to the experimenter during different conditions. All other details follow those of Fig. 4.

no main effect of either session number or dog type when petting was available in all eight sessions, largest $F(1, 22) = 2.45$.

Fig. 5c and d shows the number of bouts in which a dog was in proximity to the experimenter. We found no main effect of either session number or dog type when petting was available in all eight sessions, largest $F(1,22) = 1.84$.

Two of the 12 shelter dogs, and five of the 12 owned dogs received an additional two sessions in which the dog received no interaction. Because we found no significant differences between across sessions either in the larger group, noted above, or in these seven dogs ($F(1, 42) = .937$, $p = .49$, $\eta^2 = .14$), we calculated the median time spent in proximity to the experimenter across all eight Petting sessions for each of these seven dogs, and the median time spent in proximity to the experimenter during the No Interaction sessions. We then rank transformed these median values and conducted a repeated measures ANOVA on the ranks. Fig. 6b shows the total duration dogs spent in proximity to the experimenter. We found a main effect of condition (Petting versus No Interaction) $F(1, 5) = 23.42$, $p < .01$, $\eta^2 = .82$. No other main effects (i.e., dog type) were significant, largest $F(1, 5) = 3.84$. Dogs spent significantly less time in proximity to the experimenter in the final two sessions in which no interaction was provided (M rank = 4.1) compared to the previous eight sessions in which petting was provided (M rank = 10.8).

3.3. Discussion

Both owned and shelter dogs allocated more responding to the petting alternative than the vocal praise alternative, indicating that even when only one alternative was available at a time dogs still prefer petting to vocal praise, paralleling the results of Experiment 1. This preference occurred in owned dogs, which were tested with the owner acting as the assistant, as well as in shelter dogs, suggesting that receiving the vocal praise from a person with a history of reinforcement for the dog does not alter its preference for vocal praise. In fact, vocal praise was preferred no more than no interaction in both populations of dogs. We also found no evidence of satiation on petting. Dogs had fewer bouts when petting was the interaction provided, indicating that they stayed longer in proximity to the assistant in each bout when petting was available, and had many, short bouts when vocal praise was provided.

4. General discussion

To further our understanding of dog–human relations, we investigated the effects of different types of human social interactions on dog behavior. Specifically, we measured whether dogs would remain in close proximity to an experimenter when the experimenter provided different types of social interaction, as a measure of preference and sociability (Barrera et al., 2010; Great Dog Productions, 2007). We also compared whether shelter dogs and owned dogs differed in their responses, and whether having the owner providing interaction affected preference.

The results of the concurrent choice procedure in Experiment 1 showed that, across all experimental groups, dogs preferred petting to vocal praise even when the owner was providing vocal

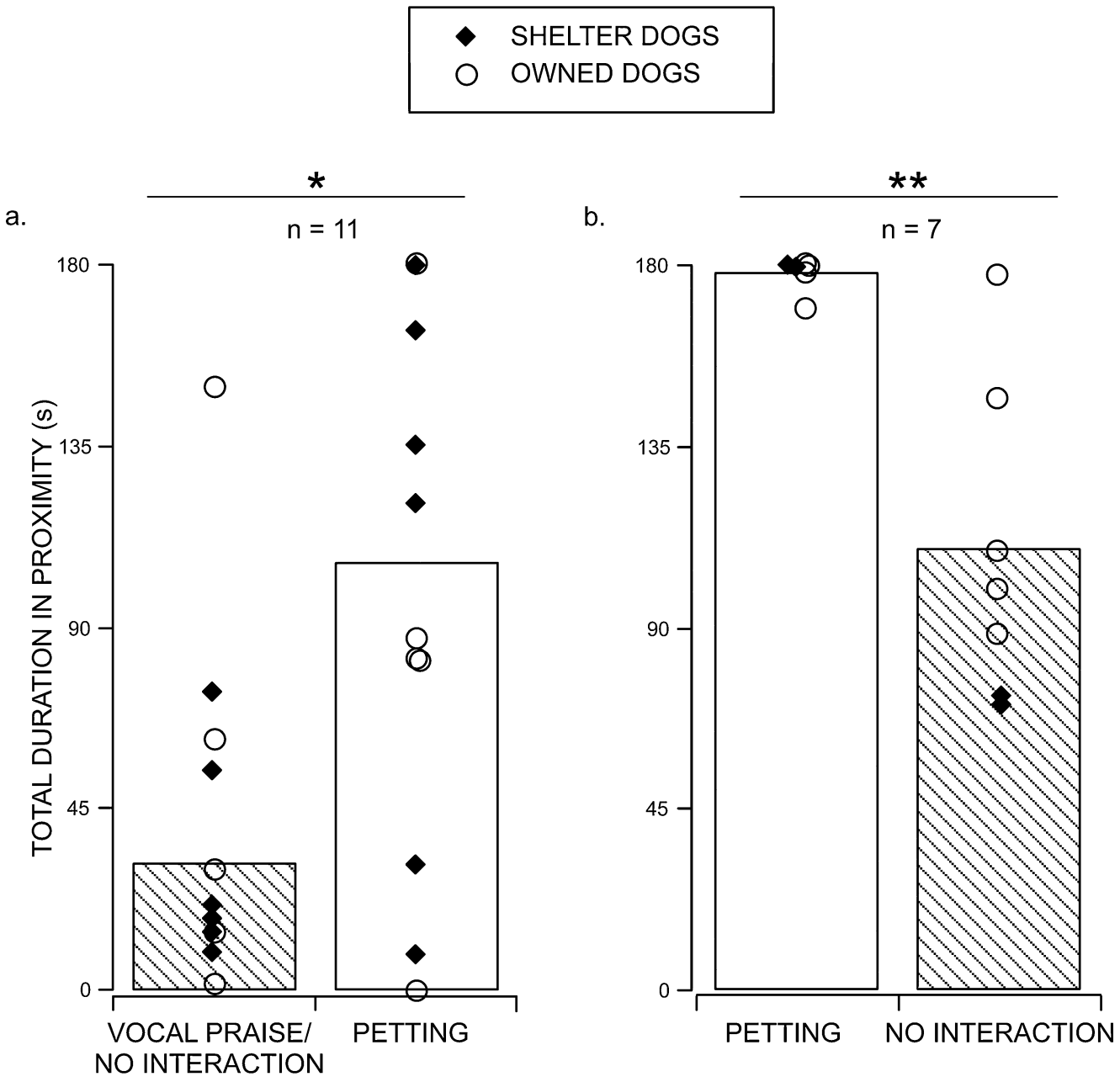

Fig. 6. Overall means and individual means across sessions of total duration (s) that a subset of dogs from the Vocal Praise versus No Interaction and Petting Only groups spent in proximity to the experimenter during different conditions. Dogs experienced an extra condition at the end of the normal experiment. Vocal Praise/No Interaction versus Petting (a); Petting Only versus No Interaction (b).

interaction. Moreover, all groups of dogs tracked the contingency changes even though they had no forced exposure to them.

This preference endured in the single alternative procedure. Even when vocal praise was the only alternative available, dogs did not remain in proximity to the experimenter to obtain it. In fact, the time dogs allocated to a person providing vocal praise was the same as that allocated to a person ignoring them. The lack of interaction for vocal praise in shelter dogs was surprising given their relative deprivation from human interaction, which might make any interaction temporarily more valuable. Shelter dogs did show a greater initial preference for the petting alternative, however, than any of the owned dog groups, which might be a reflection of their deprivation or the relatively stressful environment that magnified the value of petting (e.g., Harlow and Zimmerman, 1959). The lack of interaction for vocal praise in owned dogs in Experiment 2 was also surprising given that we arranged the conditions under which we should see maximal social interaction based on strange situation tests (Topál et al., 1998) and a concurrent choice scenario (Feuerbacher and Wynne, 2014). Finally, we also saw no indication that shelter or owned dogs would satiate on petting, at least within the 18 min duration of petting provided in Experiment 2.

In Experiment 2, the longer durations of proximity in the Petting condition in the Petting versus Vocal Praise group were produced by dogs engaging in fewer, longer bouts for petting than for vocal praise. Additionally, owned dogs engaged in significantly fewer bouts overall than did shelter dogs. The difference in bout number between the two populations might have been due to owned dogs having a greater history with certain contingencies from their assistants (owners) such that they could readily discriminate

between available contingencies and allocate responding accordingly, whereas shelter dogs had to sample the alternatives more.

The results from the subset of dogs in Experimental 2 that we tested in two additional sessions further substantiate our finding that dogs prefer petting to vocal praise or no interaction. Differences between experimental groups (low social behavior in Vocal Praise vs. No Interaction group and high social behavior in the Petting Only group) are therefore due to preference and not to individual differences between groups.

Our findings parallel earlier reports on the effects of petting on dog behavior. McIntire and Colley (1967) reported that they successfully reinforced operant responses in dogs (down, sit, come, stay, and heel) when petting and vocal praise was the consequence, but not when only vocal praise was provided. Our data also support the proposals of McIntire and Colley, and Gantt et al. (1966) that petting might be an unconditioned stimulus for dogs because even shelter dogs interacting with a novel human engaged for longer durations with the human when petting was the form of interaction offered. That petting is a preferred activity also supports results from a previous concurrent choice experiment in which petting trumped food under certain circumstances in concurrent choice (Feuerbacher and Wynne, 2014). Finally, our results mirror the neurophysiological findings of Odendaal and Meintjes (2003), but suggest that petting and not vocal praise was the driving factor behind the changes observed in their dogs after interaction. Follow up studies that investigate whether the same neurophysiological changes occur with petting alone would be useful.

That vocal praise was nearly indistinguishable from no interaction is also an interesting result. Mitchell (2001) reported that familiar and unfamiliar humans engaged in talk to dogs that shared many similarities with adults' speech to infants. However, whether this talk has a function for dog behavior is questionable. Vocal praise alone did not maintain operant responding (McIntire and Colley, 1967) and our results similarly indicate that vocal praise might not have a behavioral function for dog behavior without specific conditioning. Any conditioning effects might extinguish quickly when not backed up by other stimuli for the dog, such as food, preferred activities, or potentially petting, making it unlikely that we could detect an effect in our study.

Saito and Shinozuka (2013) reported that cats could distinguish their owner's voice from a stranger's but based on the topography of the cats' responses suggested that cats have not been evolutionarily selected to obey humans whereas, they speculated, dogs have been. Our results suggest, however, that without specific conditioning human vocalizations are as meaningless for dogs as for cats. Such conditioning likely produced the owner versus stranger discrimination that both cats and dogs (Adachi et al., 2007) exhibited.

We found that shelter dogs and owned dogs have similar preferences for human interaction under appropriate circumstances. Previous studies reported differences in sociability between shelter and owned dogs (Barrera et al., 2010) in which owned dogs tended to spend less time with the experimenter. The Owned with Stranger dogs in the concurrent study here (Experiment 1) were tested with two strangers in a familiar location in which they were used to being separated from their owner and from which the owner had left at least 30 min prior. Owned dogs in the study of Barrera et al., were tested in a room in their home and it is likely that the dog had recently been separated from the owner, the owner was home, and the dog was aware that the owner was accessible behind a closed door. The results from the Owned with Stranger dogs in our study suggest that procedural variables produced those differences in sociability, not necessarily that owned dogs are less sociable with strangers. This follows from other studies in which dogs engaged in socially incompatible behaviors when owners left, such as sitting by the door (Gácsi et al., 2001; Topál et al., 1998).

Dogs' preference for petting to vocal praise has practical implications as well. First, our results, and those of McIntire and Colley (1967), clearly suggest that vocal praise alone is not a useful training tool unless carefully and specifically conditioned. It is likely that, once conditioned, any conditioned reinforcing effect would decrease quickly if vocal praise were not regularly paired with backup reinforcers.

On the other hand, the consistent preference of dogs in this study for petting suggests that it might be a useful interaction for dogs. Previous studies have indicated that it can decrease the stress in shelter dogs (Hennessy et al., 1998; Shiverdecker et al., 2013) and these results, combined with previous concurrent choice results using petting (Feuerbacher and Wynne, 2014) point to petting as a preferred activity especially for shelter dogs possibly through a reinforcing mechanism of stress reduction.

Previously, we had reported that brief social interaction (petting plus vocal praise), did not function as a reinforcer for an arbitrary operant response for domestic dogs (Feuerbacher and Wynne, 2012). Our current data, however, point to a functional role of petting in producing human-directed social behavior in dogs. Several differences exist between the two studies that might account for the differences and suggest future lines of inquiry. First, the schedule on which social interaction was delivered in the current study more closely approximates conjugate reinforcement (Lindsley, 1963; Rovee-Collier and Gekoski, 1979). Petting as a reinforcer on a conjugate schedule is supported by the results from a shelter program that is successfully using petting on this schedule to shape calm kennel behavior (Will et al., 2013). Even if not on a conjugate schedule, longer duration petting might function as a more effective reinforcer than the brief interaction we provided previously (e.g., Fonberg et al., 1981). Second, the response in our previous study was arbitrary (a nose touch), whereas approach is a social response; a social reinforcer might be more effective in maintaining a social response. Third, although we chose the nose touch because of its perceived low effort, it is possible that it was still more effortful than standing still and that petting is a reinforcer only for minimally effortful responses.

Overall, our results point to petting, or contact comfort (Harlow & Zimmerman, 1959), as being an important interaction for dogs that can produce social behavior. It is likely also relevant in attachment formation between dogs and humans. Using petting and other preferred activities for dogs, such as food delivery, we should focus on the development of attachment between dogs and humans and the role these interactions might play in shaping and maintaining separation related problem behaviors.

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