

Do Dog Behavioral Characteristics Predict the Quality of the Relationship between Dogs and Their Owners?

Christy L. Hoffman and Pan Chen
The University of Chicago

James A. Serpell
University of Pennsylvania

Kristen C. Jacobson
The University of Chicago

This paper explores whether dog behavioral characteristics predict the quality of the relationship between dogs and their owners (i.e., owner attachment to dog), and whether relations between dog behavior and owner attachment are moderated by demographic characteristics. In this study, $N = 92$ children and $N = 60$ adults from 60 dog-owning families completed questionnaires about their attachment to their pet dog, their level of responsibility for that dog, and their general attitudes toward pets. They also rated their dogs on observable behavioral characteristics. Individuals who held positive attitudes about pets and who provided much of their dog's care reported stronger attachments to their dogs. The strength of owners' attachments to their dogs was associated with dog trainability and separation problems. Relationships between owner attachment and both dog excitability and attention-seeking behavior were further moderated by demographic characteristics: for Caucasians but not for non-Caucasians, dog excitability was negatively associated with owner attachment to dog; and for adults, dog attention-seeking behavior was positively associated with owner attachment, but children tended to be highly attached to their dogs, regardless of their dogs' attention-seeking behaviors. This study demonstrates that certain dog behavioral traits are indeed associated with the strength of owners' attachments to their dogs.

Key Words: attachment, attitudes, behavior, C-BARQ, dog

Christy Hoffman, Pan Chen, and Kristen C. Jacobson, Department of Psychiatry and Behavioral Neuroscience, The University of Chicago.

James Serpell, Department of Clinical Studies, School of Veterinary Medicine, University of Pennsylvania.

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Correspondence concerning this article should be addressed to Christy Hoffman, Department of Animal Behavior, Ecology, and Conservation, Canisius College, 2001 Main St., Buffalo, NY 14208

Contributing to the literature on for whom and under what conditions dog ownership is beneficial to humans, this paper explores whether dog behavioral characteristics are predictive of the quality of the relationship between dogs and their owners (i.e., owner attachment to dog), and whether relations between dog behavior and owner attachment are the same across genders, ages, and races/ethnicities. The effects of dog behavior and owner demographics on owner attachment to dog might elucidate why some studies suggest that pet ownership can be beneficial to human health (Barker & Wolen, 2008; Cutt, Giles-Corti, Knuiman, & Burke, 2007; El-Alayli, Lystad, Webb, Hollingsowrth, & Ciolli, 2006; Friedmann & Son, 2009; Headey & Grabka, 2011; O'Haire, 2010; Wells, 2009), while others have failed to detect such positive findings (for a review, see Herzog, 2011). An important distinction between studies that have reported beneficial health effects of human-animal interactions (HAI) and those that have not is that the latter have all focused specifically on *pet ownership* as the primary predictor and not on *attachment to* or *attitudes toward* pets. Evidence indicates that the stress-reducing benefits of HAI are moderated by attachments to companion animals (Garrity, Stallones, Marx, & Johnson, 1989; Sable, 1995), and interaction with a dog lowers cardiovascular stress reactivity for individuals with positive attitudes toward dogs but increases stress reactivity for individuals with negative attitudes toward dogs (Friedmann, Zuck Locker, & Lockwood, 1990). Such findings indicate that the benefits of HAI are not broadly generalizable. Thus, pet ownership itself may not directly lead to more positive outcomes; instead, the quality of the human–pet relationship, owner attitudes toward animals, and experiences that are either shared with, or result from, the companionship of animals likely mediate the effects of pet ownership on behavior and well-being.

Dog Characteristics

The quality of individuals' attachments to their pets, as well as the benefits they derive from pet ownership, are related to how they perceive both their relationships with their pets and their pets' behaviors or temperaments. For example, individuals who identify themselves as their pets' guardians, rather than owners, tend to have stronger attachments to their pets (Carlisle-Frank & Frank, 2006). As humans and their dogs constitute dyadic relationships in which the dogs are active participants, studies of companion animals' behavioral characteristics (or temperaments) have the potential to clarify why some human-pet relationships flourish while others flounder. Serpell (1996) found that the strength of dog and cat owners' attachments to their pets was related to the animals' behavioral compatibility with the owners' 'ideal' expectations. Using the same methodology, Budge, Spicer, Jones, & St. George (1998) determined that owners who reported a high degree of behavioral compatibility between their pets and themselves not only were more attached to their animals, but also experienced better overall mental health, enhanced feelings of well-being, less distress, more positive affect, less anxiety, and fewer physical symptoms of ill health than those with less compatible pets (Budge et al., 1998). Based on a version of the Big Five Inventory (John & Srivastava, 1999), which was originally designed to assess humans on their degrees of openness, conscientiousness, extraversion, agreeableness, and neuroticism but was modified to assess dog personality (Gosling, Kwan, & John, 2003), owners whose dogs scored highly on openness (e.g., "Is curious about many different things") and agreeableness (e.g., "Is cooperative") reported greater relationship satisfaction with their dogs (Cavanaugh, Leonard, & Scammon, 2008). Finally, Marinelli, Adamelli, Normando, & Bono (2007) tested the effects of both dog characteristics and owner characteristics on

owners' attachment to their dogs. They reported that none of the dog characteristics examined, including dog age, breed, or neuter status, affected owners' levels of attachment, but whether owners had children and the number of human emotional bonds the owners had were factors that influenced owner attachment.

Human Demographic Characteristics

No studies to date have examined how human characteristics, such as gender, age class, and race/ethnicity, may moderate the relationship between dog behavior and owner attachment, but studies have shown mean-level differences in pet attachment across genders, ages, and races/ethnicities. A number of studies have concluded that women form stronger attachments to pets than do men (Johnson, Garrity, & Stallones, 1992; Kidd & Kidd, 1989; Woodward & Bauer, 2007), but not all studies have found significant gender differences in pet attachment (Bagley & Gonsman, 2005; Cavanaugh et al., 2008). Male and female dog owners may have different expectations for their dogs' behaviors, as females are more likely than males to report having dogs that are highly trainable and sociable (Kubinyi, Turcsan, & Miklosi, 2009). It should be noted that many existing HAI studies on attachment to pets have had limited statistical power to detect main effects of gender and/or have included a disproportionate number of female participants, which restricts the conclusions that can be made about the effects of gender on attachment to pets.

Age is another variable that may impact how dog behavior relates to owner attachment because the traits individuals find desirable in pets may not be static across the life course. Among children aged 3 to 12 years, older individuals tend to form stronger bonds with their dogs than do younger individuals (Bodsworth & Coleman, 2001). Furthermore, interest in pets tends to peak between 8 and 12

years (Melson, 1988; Paul & Serpell, 1992; Paul & Serpell, 1996). There is a positive relationship between age and pet attachment for individuals between 18 and 54 years, suggesting that individuals in this age range become more attached to their pets over time (Bagley & Gonsman, 2005).

Race/ethnicity may also moderate relations between dog behavior and pet attachment, but of the studies that have examined racial/ethnic differences in pet ownership, few have actually examined degree of owner attachment to pet. Within North America, Caucasian families are more likely to have companion animals than African American, Hispanic, or Asian families (Risley-Curtiss, Holley, & Wolf, 2006; Siegel, 1995). Siegel (1995) reported that among urban-dwelling children between 12 and 17 years, Caucasian children are more likely to have pets than are children of other races/ethnicities, but African American children are more likely than Caucasian, Hispanic, or Asian children to have sole responsibility for their pets. Additional research has shown that pet dogs tend to be equally valued among Hispanics and Caucasians (Johnson & Meadows, 2002; Schoenfeld-Tacher, Kogan, & Wright, 2010), but Caucasian veterinary students tend to own more pets and are more highly attached to their pets than are their African American peers (Brown, 2003). Differences across races/ethnicities in housing conditions for pets may at least partially account for the differences in attachments to pets that have been reported. In a study of non-traditional college students living in the Midwestern United States, Shore, Riley, & Douglas (2006) concluded that Caucasians and Hispanics are more likely than African-Americans to house their dogs indoors, and that individuals who house their dogs indoors tend to have greater attachment to their dogs and more sensitivity to their dogs' needs than individuals who keep their dogs outdoors.

The Present Study

In this study, we assessed whether dog behavioral characteristics related to the strength of owners' attachments to their dogs. We predicted that dog behaviors indicative of trainability and attention-seeking behavior would be positively associated with owners' attachments to their dogs, whereas we expected that dog problem behaviors, such as aggression and separation problems, would be negatively associated with owners' attachments. Because we also hypothesized that more positive attitudes towards pets and greater responsibility for dog's care would be positively associated with owner attachment, we further tested whether dog behavioral characteristics independently contributed to strength of owner attachment to dog while controlling for the effects of participants' general attitudes toward pets and the level of care they invested in their dogs. Finally, we explored whether owner characteristics, namely race/ethnicity, gender, and age class (i.e., children vs. adults), moderate the relationship between dog behavioral characteristics and owner attachment to dog.

Method

Participants

Data for this study were analyzed from 92 children and 60 adults from 60 dog-owning families, who were part of a larger, ongoing community-based study of individual differences in child and adolescent socio-emotional outcomes. The study took place in Dr. Kristen Jacobson's laboratory at the University of Chicago and recruited families of children who had, with their caregivers' consent, completed a prior in-school survey that comprised the first phase of this ongoing study. Exclusion criteria included the presence of severe physical, psychological, or neurological problems in children which would have interfered with study participation (< 2% of

families contacted) and/or a primary caregiver who could not read or write English (~6% of families contacted). To date, 159 families have participated in the laboratory-based portion of this study, and 42% ($N = 66$) of those families own a dog and 38% ($N = 60$) completed the questionnaires described below. Of the dog-owning participants included in the present analyses, children ranged between 11 and 18 years ($M = 14.1$, $SD = 1.7$), and 55% ($N = 51$) were female. Adults ranged between 30 and 62 years ($M = 43.8$, $SD = 6.8$), and 88% ($N = 53$) were female (primarily biological mothers), as is standard in most family-based studies of children. Participants were initially classified by self-report as Caucasian (52.0%; 50 children and 29 adults), African American (30.9%; 27 children and 20 adults), Hispanic (16.4% %; 15 children and 10 adults), or Asian (0.7%; 1 adult). Due to the small sample of individuals in the Hispanic and Asian categories, the race/ethnicity variable was collapsed into two categories: Caucasian and not Caucasian.

Measures

Dog Behavioral Characteristics. All participants rated their dogs' behavioral characteristics by completing the first 74 questions of the Canine Behavioral Assessment and Research Questionnaire, or C-BARQ® (www.cbarq.org; Hsu & Serpell, 2003). The C-BARQ measure includes 101 items and forces respondents to report on concrete, observable dog behaviors on a series of 5-point ordinal rating scales. The scales rate either the intensity (aggression, fear, and excitability subscales) or frequency (all remaining subscales and miscellaneous items) of behaviours, with a score of 0 indicating the absence of the behaviour and a score of 4 indicating the most intense or frequent form of the behaviour. The C-BARQ includes 14 subscales¹, of which the following 6

¹ The subscales that were assessed but not included in the present analyses are: aggression to dogs, fear of

subscales were considered in this study: trainability (“When off leash, returns immediately when called”; Cronbach’s $\alpha = 0.66$), stranger aggression (“[Shows aggression] when an unfamiliar person approaches you or another member of your family at home”; $\alpha = 0.94$), stranger fear (“[Shows fear] when approached directly by an unfamiliar adult while away from your home”; $\alpha = 0.84$), separation problems (“Shaking, shivering or trembling [when left alone]”; $\alpha = 0.80$), excitability (“[Acts excited] when you or other members of the household come home after a brief absence”; $\alpha = 0.84$), and attachment/attention-seeking behavior (hereafter referred to as attention-seeking behavior; “Tends to follow you or other members of household about the house, from room to room”; $\alpha = 0.83$). Relevant items were averaged to create composite scores for each subscale.

The C-BARQ has been widely used to evaluate trainability, aggression, and other behavior problems in dogs (Duffy, Hsu, & Serpell, 2008; Segurson, Serpell, & Hart, 2005; Serpell & Hsu, 2005; van den Berg, Heuven, van den Berg, Duffy, & Serpell, 2010). Hsu and Serpell (2003) established the validity of the C-BARQ subscales by demonstrating that dog problem behaviors that owners reported in the C-BARQ corresponded with the diagnoses that veterinary behaviorists assigned the dogs after in-depth behavioral evaluations. Lending further support to the validity of the C-BARQ, a factor analysis conducted on C-BARQs completed by

dogs, rivalry with other dogs, non-social fear, touch sensitivity, and owner-directed aggression. We eliminated the first 5 of these subscales because we did not predict that they would be related to human emotional attachment to dogs. In addition, over 35% of the sample reported no owner-directed aggression, which limited variation in this subscale. The subscales for dog energy and chasing behavior were not assessed because items comprising these subscales were not part of the 74 questions of the C-BARQ that participants completed.

3,288 American dog owners demonstrated that the subscales generated by Hsu and Serpell’s (2003) original factor analysis are meaningful (Nagasawa, Tsujimura, Tateishi, Mogi, Ohta, Serpell, & Kikusui, 2011). A recent study of success rates in a large sample of guide and service dogs has also confirmed the predictive validity of the majority of C-BARQ items and subscales (Duffy & Serpell, 2012).

Attitudes toward Pets. All participants completed the Pet Attitude Scale-Modified (PAS-M; Templer, Salter, Dickey, Baldwin, & Veleber, 1981). This measure includes 18 questions ($\alpha = 0.91$) and assesses participants’ general attitudes about companion animals. Scores range from 1 (very negative attitudes toward pets) to 7 (very positive attitudes toward pets). Questions are phrased both positively (e.g., “You should treat your house pets with as much respect as you would a human member of your family”) and negatively (e.g., “The world would be a better place if people would stop spending so much time caring for their pets and started caring more for other human beings instead”). Negatively phrased questions were reverse-coded, and all items were averaged to create a composite score.

Responsibility for Pets. All participants completed the Dog Care Responsibility Inventory (DCRI; Davis, 1987). This measure includes 18 questions ($\alpha = 0.89$) indexing responsibility for dog-related chores (e.g., “Usually fixes dog’s meals”). Scale scores were computed as the proportion of chores performed by the respondent.

Attachment to Dog. All participants completed the Pet Attachment Scale (PAS; Holcomb, Williams, & Richards, 1985), which has 27 questions ($\alpha = 0.90$) and assesses the quality of the relationship between owner and dog. The PAS includes questions from a pet attachment

questionnaire developed by Katcher, Friedmann, Goodman, & Goodman (1983), such as “You show pictures of your pet to your friends.” In addition, the PAS includes questions adapted from studies of human attachment styles, such as “When you feel bad, you seek your pet for comfort.” For the purposes of this study, the PAS was modified to gauge participants’ attachment to their pet dogs by replacing the word “pet” with “dog.” Responses range from 1 (weakly attached) to 4 (strongly attached), and items were averaged to create a composite score of human attachment to dog.

Missing data at the item-level was very rare (< 1%). All participants in the current analyses had non-missing data on at least 90% of the items used in the scales. We do note that there are $N = 6$ additional dog-owning families in the full sample who did not complete the C-BARQ because the measure was not included in the study at the time of their visit. Therefore, these families are not included in the current analyses. All variables were standardized prior to analysis. The C-BARQ subscale stranger fear was positively skewed and was therefore log-transformed prior to standardization for analysis.

Procedure

All participants completed the questionnaires described above during a 4-hour laboratory visit. As part of the larger, ongoing study, all participants provided a blood sample for future analysis of hormonal and genetic data. Children completed several other self-report questionnaires and participated in computerized tests assessing impulsivity and emotional processing, while caregivers completed a clinical interview and self-report questionnaires. Participants were provided with lunch, and each participant’s lunch break generally occurred halfway through the study visit. Study procedures were approved by the University of Chicago’s Institutional Review Board. Caregivers provided written consent for

themselves and their children to participate in the study and children provided written assent. Both caregivers and their children received financial compensation for participation in the study.

A subset of participants completed the questionnaires a second time so that we could assess test-retest reliability of the current measures. On average, 5.8 months passed between when subjects completed the laboratory visit and the mailed questionnaires (range: 2-13 months). Test-retest reliability was substantial for the following C-BARQ measures: trainability ($r = 0.66, p = 0.004, N = 17$), stranger aggression ($r = 0.77, p < 0.001, N = 17$), excitability ($r = 0.66, p = 0.006, N = 16$), and attention-seeking behavior ($r = 0.78, p < 0.001, N = 17$). Test-retest reliability was more modest for stranger fear ($r = 0.46, p = 0.06, N = 17$) and separation problems ($r = 0.33, p = 0.20, N = 17$). Test-retest reliability was significant for attitudes towards pets (PAS-M; $r = 0.65, p < 0.001, N = 40$), responsibility for dog (DCRI; $r = 0.89, p < 0.001, N = 40$), and attachment to dogs (PAS; $r = 0.68, p < 0.001, N = 47$).

Results

Descriptive statistics

On average, families had owned their dogs for 4.7 years ($SD = 2.9$ years). Table 1 shows descriptive statistics and Pearson correlations between measures of dog behavior (C-BARQ subscales), attitudes toward companion animals (PAS-M), responsibility for dogs (DCRI), and attachment to dogs (PAS). Correlations based on caregivers’ responses are presented above the diagonal, and correlations based on children’s responses are presented below the diagonal. For caregivers, owner attachment was positively correlated with dogs’ levels of trainability ($r = 0.37, p = 0.004, N = 60$), excitability ($r = 0.40, p = 0.002, N = 60$), and attention seeking behavior ($r = 0.58, p < 0.001, N = 60$), but for children,

Table 1.

Intercorrelations, means, and standard deviations among the main study variables. Correlations based on adults' responses are presented above the diagonal, and correlations based on children's responses are presented below the diagonal. The correlations presented in the diagonal reflect the degree of parent-child agreement on the measures examined.

	Predictors								Outcome
	C-BARQ Trainability	C-BARQ Stranger Aggression	C-BARQ Stranger Fear	C-BARQ Separation Problems	C-BARQ Excitability	C-BARQ Attention-Seeking	PAS-M	DCRI	PAS
C-BARQ Trainability	0.38***	-0.09	0.01	-0.13	0.18	0.19	0.32*	0.07	0.37**
C-BARQ Stranger Aggression	-0.31**	0.35**	0.32*	0.10	0.43**	0.10	0.05	-0.16	0.05
C-BARQ Stranger Fear	-0.28**	0.49***	0.31**	0.26*	0.26*	0.25#	-0.01	-0.31*	-0.03
C-BARQ Separation Problems	-0.28**	0.33**	0.28**	0.18#	0.09	0.25#	-0.07	-0.07	0.11
C-BARQ Excitability	-0.05	0.35**	0.21*	0.24*	0.26*	0.42**	0.37**	0.17	0.40**
C-BARQ Attention-Seeking	0.03	0.20#	0.10	0.29**	0.33**	0.10	0.33*	0.03	0.58***
PAS-M	0.40***	-0.12	-0.09	-0.04	0.17	0.05	0.51***	0.17	0.70***
DCRI	0.07	-0.18#	-0.03	-0.08	-0.08	0.12	0.18#	-0.19#	0.26*
PAS	0.39***	-0.06	-0.13	0.06	0.10	0.03	0.68***	0.33**	0.38***
Means (SD), caregivers N=60	2.53 (0.59)	1.12 (0.86)	0.45 (0.74)*	0.67 (0.54)***	2.43 (0.81)	2.44 (0.77)	5.74 (0.73)	0.54 (0.29)***	2.75 (0.43)
Means (SD), children N=92	2.47 (0.64)	0.98 (0.90)	0.77 (0.93)	1.05 (0.75)	2.30 (1.00)	2.45 (0.93)	5.64 (0.83)	0.34 (0.26)	2.81 (0.56)

#p<0.10, *p<0.05, **p<0.01, ***p<0.001

Note: C-BARQ = Canine Behavioral Assessment and Research Questionnaire; PAS-M = Pet Attitude Scale-Modified; DCRI = Dog Care and Responsibility Inventory; PAS = Pet Attachment Scale

owner attachment was only correlated with dog trainability ($r = 0.39, p < 0.001, N = 92$). More positive attitudes towards pets and greater responsibility for care also correlated positively with attachment to dogs in both caregivers and children ($r = 0.68-0.70$, for attitudes; $r = 0.26-0.33$ for responsibility, all $p < 0.05$).

Caregiver-Child Agreement

The correlations presented in the diagonal in Table 1 reflect the magnitude of agreement between caregiver and child responses on the

measures examined. Caregivers and children showed moderate agreement on their dogs' levels of trainability ($r = 0.38, p < 0.001, N = 92$), stranger aggression ($r = 0.35, p < 0.001, N = 92$), stranger fear ($r = 0.31, p = 0.003, N = 92$), and excitability ($r = 0.26, p = 0.01, N = 92$). Correlations were more modest between caregiver and child reports of dog separation problems ($r = 0.18, p = 0.09, N = 92$) and of dogs' levels of attention-seeking behaviors ($r = 0.10, p = 0.36, N = 92$). There were strong correlations between children's and caregivers'

attitudes toward pets ($r = 0.51, p < 0.001, N = 92$) and their attachment to their dogs ($r = 0.38, p < 0.001, N = 92$). A negative relationship between the amount of responsibility caregivers and children reported having for the family dog approached significance ($r = -0.19, p = 0.07, N = 92$), indicating that as caregivers provided more care for the dog, children provided less care, and vice versa. Mean scores and standard deviations for caregivers and children are presented at the bottom of Table 1. Children reported higher levels of fear of strangers ($t(150) = -2.28, p = 0.02$) and separation problems ($t(150) = -3.42, p < 0.001$) in their dogs than did their caregivers, and they provided less care for their dogs than did their caregivers ($t(150) = 4.52, p < 0.001$).

Regression Analyses

To account for non-independence between individuals belonging to the same family, multi-level modeling was implemented using SPSS (Peugh & Enders, 2005). The multi-level approach accounts for the clustered data and allows the model to produce accurate standard errors and significance tests (Papp, 2004). All study constructs were assessed at the individual level.

Five hierarchical models are specified in Table 2. Hierarchical models were compared using change in log likelihood (-2LL) statistics, which follows a χ^2 distribution. A significant decrease in -2LL indicates that the test model fit significantly better than the comparison model. An unconditional means model (Model 1) estimating the proportion of variability in owner attachment to dog that exists between individuals revealed statistically significant variability in attachment between individuals ($\sigma^2 = 0.64, p < 0.001$) and between families ($\tau_{00} = 0.36, p = 0.002$), supporting the use of multi-level modeling to correct for sample non-independence.² Model 2 examined the influence

of the covariates gender, age class, and race/ethnicity on degree of attachment to the family dog but did not have a significantly better fit than Model 1, indicating that these demographic characteristics do not have direct main effects on owner attachment to dogs.

Model 3 tested the main effects of the C-BARQ subscales and the covariates and had a significantly better fit than Model 2 ($\Delta\chi^2 = 100.2, \Delta df = 6, p < 0.001$). Findings indicated that attachment to dogs was associated with dog trainability ($\beta = 0.35, SE = 0.08, p < 0.001$). To prevent introducing the potential confounds of attitudes toward animals or amount of time spent with the dog when assessing owner attachment to dog, Model 4 included pet attitudes (PAS-M) and responsibility for dog (DCRI) in addition to all of the predictors and covariates included in Model 3. Model 4 had a significantly better fit than Model 3 ($\Delta\chi^2 = 76.7, \Delta df = 2, p < 0.001$). The significant main effect of dog trainability that was reported in Model 3 remained. In Model 4, attachment to dogs was also positively associated with dog separation problems ($\beta = 0.16, SE = 0.06, p = 0.01$), owner attitudes towards pets ($\beta = 0.68, SE = 0.08, p < 0.001$), and owner level of responsibility for dog ($\beta = 0.23, SE = 0.06, p < 0.001$).

To explore whether owner gender, age class, or race/ethnicity moderated³ relationships between dog behavioral characteristics and owner attachment to dog, we first tested one interaction at a time in models that also included

regression analyses. Therefore, in the present study, the σ^2 coefficient describes between-individual differences and τ_{00} the between-family differences in owner attachment to dog.

³ The moderating effect represents the combined effects of variables on the dependent variable. It can be tested by including in the regression model predicting the outcome variable (e.g., owner attachment to dogs) a focal variable (e.g., dog trainability) and a moderator (e.g., gender), as well as the interaction term between the focal variable and the moderator (e.g., gender X dog trainability). If the regression coefficient of the tested interaction term is significant, the relationship between the focal variable and the dependent variable differs across different levels or categories of the moderator (e.g., the relationship between the dog trainability and owner attachment to dog differs for male and female owners).

² The σ^2 coefficient estimates the lower level variance and τ_{00} the higher level variance of the dependent variable in multilevel

Table 2.

Multilevel regression testing whether certain dog behavioral traits and owner characteristics are predictive of the strength of owners' attachments to their dogs.

Fixed	Model 1		Model 2		Model 3		Model 4		Final Model	
	β	SE	β	SE	β	SE	β	SE	β	SE
Intercept	0.00	0.10	0.58	0.72	0.63	0.72	0.15	0.58	-0.06	0.56
Gender	x	x	0.02	0.16	0.00	0.16	0.07	0.12	0.10	0.12
Age Class	x	x	0.08	0.97	0.03	0.98	0.19	0.81	0.39	0.78
Study Age	x	x	-0.02	0.02	-0.02	0.02	-0.02	0.01	-0.01	0.01
Age Class*Study Age	x	x	-0.04	0.05	-0.03	0.05	-0.03	0.04	-0.03	0.04
Race	x	x	0.27	0.19	0.30	0.19	0.23	0.13	0.23	0.12
Obedience/Trainability	x	x	x	x	0.35***	0.08	0.20**	0.06	0.17**	0.06
Stranger Aggression	x	x	x	x	0.02	0.09	0.11	0.07	0.12	0.06
Stranger Fear	x	x	x	x	-0.09	0.08	-0.08	0.06	-0.11	0.06
Separation Problems	x	x	x	x	0.09	0.08	0.16*	0.06	0.15*	0.06
Excitability	x	x	x	x	0.12	0.08	-0.03	0.06	0.07	0.08
Attention-Seeking	x	x	x	x	0.13	0.08	0.06	0.06	0.33***	0.10
Pet Attitudes (PAS-M)	x	x	x	x	x	x	0.68***	0.08	0.65***	0.07
Responsibility (DCRI)	x	x	x	x	x	x	0.23***	0.06	0.21***	0.06
Age Class*Attention-Seeking	x	x	x	x	x	x	x	x	-0.37***	0.11
Race*Excitability	x	x	x	x	x	x	x	x	-0.22*	0.11
Random										
Residual	0.64***	0.09	0.62***	0.08	0.49***	0.07	0.36***	0.05	0.35***	0.05
Intercept	0.36**	0.11	0.37**	0.11	0.25**	0.09	0.06	0.04	0.03	0.04
Model Fit										
-2LL		477.79		473.59		373.41		296.72		282.97
Comparison model				1		2		3		4
Δ-2LL				4.20		100.18***		76.69***		13.75**
Δdf				5		6		2		2
*p<0.05, **p<0.01, ***p<0.001										

all variables described in Model 4 (results available from authors). The following interactions were either significant or approaching significance ($p < 0.10$) when tested individually: gender x dog trainability, gender x dog attention-seeking behavior, age class x dog trainability, age class x dog attention-seeking behavior, and race/ethnicity x dog excitability. When these interaction terms were included in a single model, the interaction between age class and dog attention-seeking behavior was significant, and the interaction between race/ethnicity and dog excitability was marginally significant. When the final model was reduced to include only these two interactions, along with all predictors and covariates examined in Model 4, this model had a significantly better fit than Model 4 ($\Delta\chi^2 =$

13.8, $\Delta df = 2$, $p < 0.01$). The interactions between age class and dog attention-seeking behavior and between race/ethnicity and dog excitability were statistically significant ($p < 0.05$), as were the main effects for dog trainability, dog separation problems, owner attitudes toward animals, and owner level of responsibility for dog.

Significant interactions were plotted and interpreted using methods outlined by Preacher, Curran, & Bower (2006). We plotted the relationship between dog attention-seeking behavior and owner attachment to dog as a function of age class in Figure 1. For caregivers, there was a positive association between dog attention-seeking behavior and owner attachment to dog ($\beta = 0.33$, $SE = 0.10$, $p = 0.001$), but for children, there was no association

Figure 1.

Relationships between dog attention-seeking behavior and owner attachment to dog for caregivers (—) and children (- -).

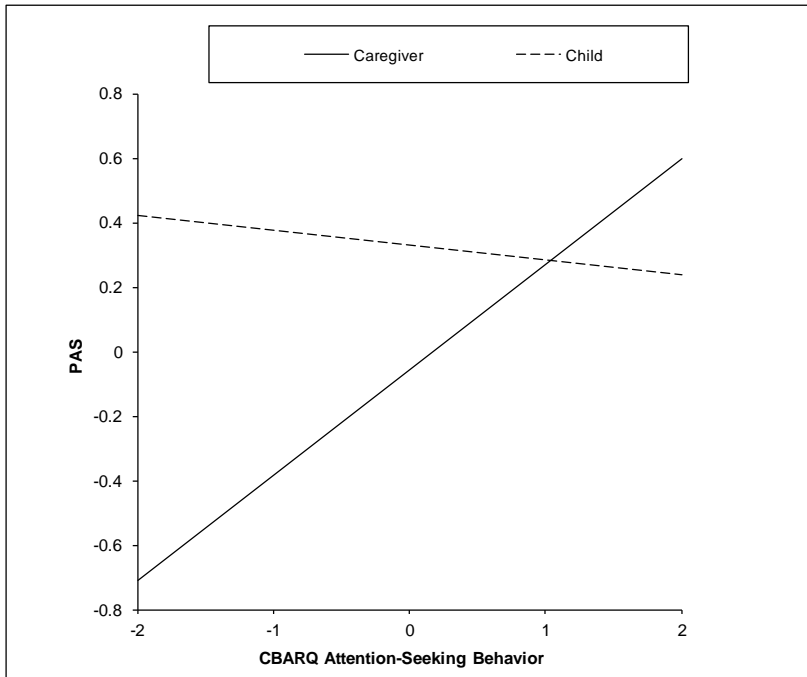
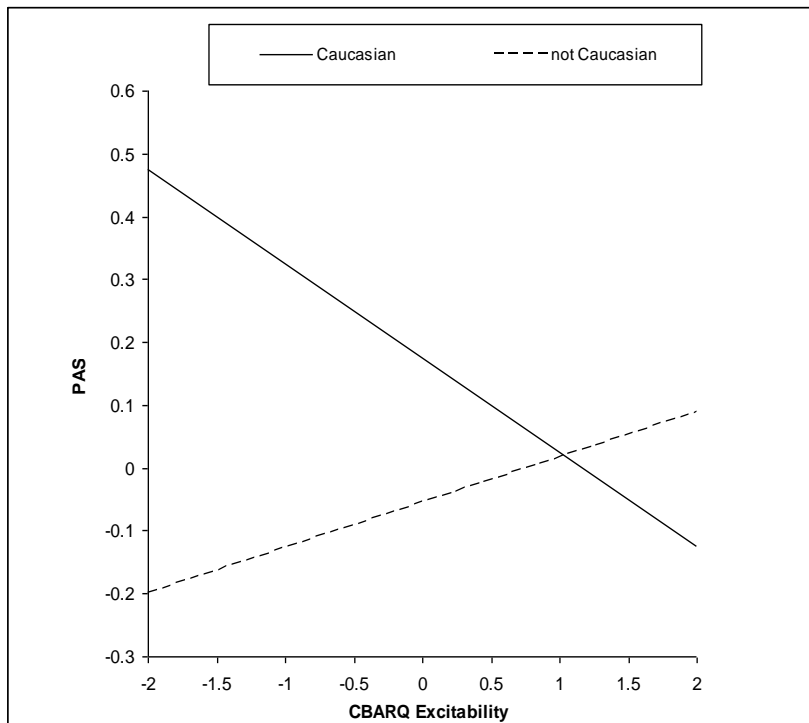


Figure 2.

Relationships between dog excitability and owner attachment to dog for Caucasians (—) and others (- -).



($\beta = -0.05$, $SE = 0.07$, $p = 0.50$). We plotted the relationship between dog excitability and owner attachment to dog as a function of race/ethnicity in Figure 2. For Caucasians, a negative association between dog excitability and owner attachment to dog approached

DISCUSSION

The majority of previous research on individual differences in the quality of the relationship between dogs and their owners (i.e., owner attachment to dog) has focused on demographic, family, and individual characteristics. Furthermore, most studies assessing whether dog characteristics affect owner satisfaction and attachment have concentrated on dogs' physical characteristics (e.g., Marinelli et al., 2007) or have adapted human personality questionnaires to assess dog personality (e.g., Cavanaugh et al., 2008). By utilizing the C-BARQ, which asks owners to rate their dogs based upon concrete, observable behaviors, the current study minimized the likelihood that owners were merely anthropomorphizing or projecting their own traits onto their dogs. Furthermore, this study is the first to test relationships between readily observable dog behavior as measured by a validated questionnaire and degree of owner attachment to dogs, and to test whether such relationships are moderated by owner gender, age class, and race/ethnicity. In addition, the study compared how children and adults within the same family rate not only their dogs on behavioral dimensions but also their levels of attachment to their dogs, their general attitudes about pets, and the level of care they invest in their dogs. Finally, by controlling for responses on the DCRI and PAS-M, the study tested the degree of emotional closeness between owner and dog without introducing the potential confounds of attitudes toward animals or amount of time spent with the dog. The data presented provide insight into "for whom" and "under

significance ($\beta = -0.14$, $SE = 0.08$, $p = 0.06$). For the combined other races/ethnicities, however, there were no associations between dog excitability and owner attachment to dog ($\beta = 0.07$, $SE = 0.08$, $p = 0.38$).

what conditions" HAI is likely to have the most positive influences.

Individual Differences in Owner Attachment to Dog

Not surprisingly, findings from this study indicated that individuals who hold positive attitudes for companion animals in general and who provide much of their dog's care report having stronger attachments to their dogs. After controlling for these variables, the strength of owner attachment to dogs related to several dog behavioral characteristics. Regardless of gender, age class, or race/ethnicity, owners reported stronger attachment for dogs that scored high on trainability and separation problems. These findings indicate that individuals are most likely to benefit from interacting with dogs that are well-behaved and show high affinity for human social contact. Neither stranger-related fear nor aggression problems were associated with owner attachment to dogs, although it should be noted that almost all owners rated their dogs extremely low on both of these characteristics. This is not unexpected given that this was a study of families, and purchasing, adopting, or keeping a dog with severely aggressive or fearful behavioral problems would put children at risk. Because there was not much variation in owners' reports on dog aggression and fear, conclusions cannot be drawn from this study about the quality of the owner-dog relationship when dogs are aggressive or fearful. Future studies with different samples would be necessary to determine how dogs with severe

aggression and/or anxiety problems affect owner attachment to dogs.

Our results also indicated that associations between other dog behavioral characteristics and owner attachment to dog were moderated by human characteristics: Race/ethnicity moderated the relationship between dog excitability and owner attachment; and age class moderated the relationship between dog attention-seeking behavior and owner attachment. Caucasians reported that their levels of attachment to their dogs decreased as dog excitability increased, but dog excitability did not predict attachment to dogs in non-Caucasian participants. This finding merits additional exploration. Possibilities that might explain this difference include racial/ethnic differences in whether dogs are housed indoors or outdoors, reasons for having a dog, and how much time per day the dogs spend with family members. Racial/ethnic differences in whether dogs are housed outdoors have been reported, and compared to owners who house their dogs outdoors, owners who keep their dogs indoors provide their dogs with more enriched care and socialization and form stronger attachments to them (Shore et al., 2006). Unfortunately, detailed information on reasons for having a dog, on where the dog is housed, and on the amount of socialization the dog receives was not available for the current study. Future studies that collect such information could help elucidate why there are racial/ethnic differences in the human-dog bond and how these differences should be addressed when developing HAI intervention, prevention, and treatment programs.

We also found that the effects of dog attention-seeking behavior on owner attachment differed between adults and children. For adults, level of dog attention-seeking behavior positively predicted their levels of attachment to their dogs, but for children, dog attention-seeking behavior did not relate to how attached they were to their dogs. Even when dogs showed

low levels of attention-seeking behavior, children's levels of attachment to their dogs were high. Although adults take more responsibility for dogs than do children, this factor cannot explain differences observed between adults and children in how strongly dog attention-seeking behavior relates to their levels of attachment to their dogs because dog responsibility was controlled for in the models tested. One possible interpretation of this difference between caregivers and children, therefore, is that caregivers may tend to be more selective than children in the types of dogs with which they bond and thus may only form emotional attachments with dogs that seek out their attention.

Surprisingly, the present study did not find any differences between males and females in the associations between dog characteristics and attachment to dogs, nor were there main effects of gender, age, or race/ethnicity on levels of attachment to dogs. Regarding gender differences, our failure to detect main or moderating effects of gender could be due to the fact that age and gender were partially confounded in this sample, as most of the caregivers were biological mothers. However, we note that prior studies have shown mixed results regarding whether there are significant gender differences in pet attachment (Bagley & Gonsman, 2005; Cavanaugh et al., 2008; Johnson et al., 1992; Kidd & Kidd, 1989; Woodward & Bauer, 2007).

In addition, while there have been studies supporting cultural and racial/ethnic differences in relationships with pets (Brown, 2003; Risley-Curtiss et al., 2006; Siegel, 1995), the present study failed to find a significant main effect of race/ethnicity, although we only had enough power to test for differences between Caucasian and non-Caucasian participants. Thus, other patterns may emerge when different racial/ethnic groups are considered separately.

Finally, the current study is the first to systematically assess owner attachment to dog in both children and adults using the same measure of attachment in a family-based design. Interestingly, mean levels of attachment to dogs were very similar for adults and children in our sample, and only a few differences emerged between caregiver and child reports of dog characteristics. Overall, this study suggests that there are few developmental differences in assessment of dog characteristics or attachment to dogs across the lifespan, although longitudinal studies that measure attachment to dogs over time across a broad range of developmental periods are sorely needed.

Caregiver-Child Agreement

To our knowledge, this is also the first published study to examine *agreement* between parents and children on measures related to human-animal interaction. Children and adults within the same family tended to agree on how they rated most, but not all, dog behavioral traits. The positive, significant correlations between children's and parents' reports of dog trainability, aggression towards strangers, fear of strangers, and excitability add to the literature suggesting that the C-BARQ captures readily identifiable behavioral traits (Hsu & Serpell, 2003; Nagasawa et al., 2011). As this is the first study to utilize child-completed C-BARQ reports, the lack of perfect child-parent agreement on dog attention-seeking behavior and separation problems may indicate that children interpret and respond to some of the C-BARQ questions differently than do adults. Additionally, children may not be as familiar as their parents are with their dogs' behaviors across a broad range of situations (e.g., outside the family home) because, as this study has demonstrated, adults tend to take more responsibility for dogs than do children. It may also be that dogs differentially seek attention from various family members based on the

amount of care and attention they receive from each family member. Differences in how dogs respond to various family members could be explored further by conducting observational studies of dogs and their owners. For example, the Strange Situation Test (Ainsworth & Bell, 1970), which has been modified to assess dog-owner relationships (Prato-Previde, Custance, Spiezio, & Sabatini, 2003; Topal, Miklosi, Csanyi, & Doka, 1998), could be used to test how dogs interact with individual family members and how they act when separated from or reunited with each family member.

We also note that caregivers and children showed significant positive correlations on general attitudes towards pets and attachment to the family dog. This could be the result of a shared set of experiences with family pets that shape both attitudes and attachment to pets. However, it is also possible that there are genetically-influenced characteristics, such as human personality traits, which are shared between parents and children and may be related to attitudes and attachment to pets. A recent behavioral genetic study using adult male twin pairs reported that the heritability of frequency of play with pets in adulthood was as high as 0.37 and that residual effects of shared environmental factors (which would include childhood exposure to pets) were weak and not statistically significant (Jacobson, Hoffman, Vasilopoulos, Kremen, Panizzon, Grant, Lyons, Xian, & Franz, in press). Consequently, caution should be used when interpreting causality in future extensions of this research that may explore associations between attachment to dogs and individual differences in human socio-emotional well-being. In addition, the current study suggests that there are non-human characteristics, such as dog behaviors and traits, which also need to be considered when examining how quality of the human-dog relationship is related to human psychological and physical well-being.

Limitations and Future Directions

Although the statistical models used in this study include dog behavioral characteristics as predictors and owner attachment to dogs as the outcome variable, causality cannot be determined from this cross-sectional study. While it may seem intuitive that dog behavior is likely to influence owner attachment, it is also possible that owner attachment influences dog behavior. How attached an owner is to his or her dog, for example, may affect the amount of time and care he or she gives the dog, which in turn may influence how well (or poorly) the dog behaves. A longitudinal study that tracks dog behavior, as well as owner attachment to and investment in the dog, could help disentangle whether it is dog behavior that influences owner attachment or vice versa. By collecting data at two time points, it could be determined whether, for example, dog behavior at Time 1 is predictive of owner attachment to dog at Time 2 while controlling for attachment at Time 1, or whether owner attachment at Time 1 is predictive of dog behavior at Time 2 while controlling for dog behavior at Time 1. Given the dyadic nature of the human-dog relationship, however, it is important to recognize that the relationship between dog behavior and owner attachment may very well be bidirectional, as has been well-documented in literature on the effects of parent-child relationships (Bell, 1968; Belsky, 1984; Ge, Conger, & Cadoret, 1996; Pardini, 2008; Rutter, 2009; Scarr & McCartney, 1983).

In addition to noting that causality cannot be inferred from this cross-sectional study, it is important to point out that the PAS is merely one of many measures that have been designed to assess human attachment to pets. The PAS (Holcomb et al., 1985) was selected for use in this study because a number of the questions in the PAS are derived from traditional studies of human attachment (e.g., Ainsworth & Bell,

1974). Archer and Ireland (2011) have recently validated a new measure of owner attachment to pet dogs, the Dog Attachment Questionnaire (DAQ), which is derived from the measures of attachments, or “affectional bonds,” between humans as described by Bowlby (1980). One difference between the DAQ and the PAS is that the DAQ specifically gauges three subcomponents of the human-dog bond: (1) degree of closeness between owner and dog; (2) amount of care and protection the owner invests in the dog and the companionship the dog provides to the owner; and (3) the degree to which the dog is viewed as a secure base and source of emotional comfort. These subscales could be used in future research to explore in greater detail how dog behavior relates to owner attachment. For example, extremely high scores on the degree of closeness subscale of the DAQ might indicate an interdependency between dog and owner that could contribute to a dog’s separation problems.

Finally, it must also be noted that the generalizability of this study is limited to children between 11 and 18 years and their primary caregivers. As most children participated in the study with their mothers, most adult participants were adult women in their 30s and 40s. Thus, data collected from adult males, young adults, adults without children, and the elderly are needed to determine whether the relations observed in this study between dogs’ behavioral characteristics and owners’ attachments to pet dogs also extend to these populations.

Despite these limitations, the present study demonstrates that certain dog behavioral traits are associated with the strength of owners’ attachments to their dogs. Given that there are behavioral differences across dog breeds (Duffy et al., 2008; Segurson et al., 2005; Serpell & Hsu, 2005; van den Berg et al., 2010) and that, according to the current study, age class and race/ethnicity influence the behaviors that

owners find desirable in their pet dogs, more data are needed to uncover how dog behavioral traits, owner characteristics, and owner attachment relate to one another and influence the success or failure of the human-dog bond. Future extensions of this research will help determine the circumstances under which human-animal interactions are likely to make positive contributions to human well-being.

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