



Behavioral and Self-report Measures Influencing Children's Reported Attachment to Their Dog

Nathaniel J. Hall^{1,2}, Jingwen Liu¹, Darlene A. Kertes¹, and Clive D.L. Wynne³

¹Department of Psychology, University of Florida, Gainesville FL

²Department of Animal and Food Sciences, Texas Tech University, Lubbock, TX

³Department of Psychology, Arizona State University, Tempe, AZ

Abstract

Despite the prevalence of dogs as family pets and increased scientific interest in canine behavior, few studies have investigated characteristics of the child or dog that influence the child-dog relationship. In the present study, we explored how behavioral and self-report measures influence a child's reported feelings of attachment to their dog, as assessed by the Lexington Attachment to Pets Scale (LAPS). We tested specifically whether children ($N=99$; Age: $M=10.25$ years, $SD=1.31$ years) reported stronger attachment to dogs that were perceived as being more supportive (measured by a modified version of the Network of Relationships Inventory), to dogs that are more successful in following the child's pointing gesture in a standard two-object choice test, or to dogs that solicited more petting in a sociability assessment. In addition, we assessed whether children's attachment security to their parent, and whether being responsible for the care of their dog, influenced reported feelings of attachment to the dog. Overall, perceived support provided by the dog was highly predictive of all subscales of the LAPS. The dog's success in following the child's pointing gesture and lower rates of petting during the sociability assessment were associated with higher ratings on the general attachment subscale of the LAPS, but not of other subscales of the LAPS. Caring for the dog did not predict the child's reported attachment to dog, but did predict the dog's behavior on the point following task and petting during the sociability task. If the child cared for the dog, the dog was more likely to be successful on the pointing task and more likely to be petted. These results indicate a dyadic relationship in which the child's care for the dog is associated with the dog's behavior on the behavioral tasks, which in turn is related to the child's reported feelings of attachment. The direction of influence and nature of this dyad will be a fruitful area for future research.

Keywords

Human animal interaction; dogs; *canis familiaris*; children

Recent years have seen increased scientific interest in the field of human animal interaction, and the results have suggested several potential benefits to pet ownership. One simple

benefit of owning a pet dog may be increased exercise in the form of taking a dog for a walk (Anderson, Reid, & Jennings, 1992; Cutt et al., 2007). Interacting with and petting a dog has been shown to have several positive physiological benefits such as increases in β -endorphins, prolactin, β -phenylethylamine, oxytocin, and dopamine (Odendaal, 2000; Miller et al., 2009; Nagasawa et al., 2009; Nagasawa et al., 2015), and a reduction in blood pressure (Friedmann et al., 1983; Anderson, Reid, & Jennings, 1992; Demello, 1999). Even mutual gazing with a dog has been shown to increase urinary oxytocin levels (Nagasawa et al., 2009, 2015). Pet ownership may also be beneficial in providing a social catalyst increasing positive social interaction with others (Wells, 2004), and interaction with a therapy dog has been shown to increase social interactions amongst residents in a nursing home (Fick, 1993). Children can also form a strong emotional bond with pets (Beck & Madresh, 2008) and pets may provide children a source of non-evaluative companionship (Allen et al., 1991).

Children have also been shown to receive social and emotional benefits from animals. These benefits include reduced blood pressure, higher empathy scores, and greater emotional stability and social cohesion in the classroom (Friedmann et al., 1983; Friedmann & Thomas, 1985; Poresky, 1990; Vidović, Štetić, & Bratko, 1999; Kotrschal & Ortbauer, 2003; K. L. Anderson & Olson, 2006). In addition, the benefits of animal presence may extend to clinical settings. For example, pet visits may improve the welfare of children in hospital (Wu et al., 2002), and pet assisted therapy programs may extend to clinical populations such as children with developmental disorders (Limond, Bradshaw, & Cormack, 1997; Martin & Farnum, 2002; K. L. Anderson & Olson, 2006; Nimer & Lundahl, 2007). It is important to note, however, animals can also pose serious risks to children, especially dog bites (Schalamon et al., 2006; Jalongo, 2008). Dog bites in children, compared to adults, are more likely to result in medical treatment (Gilchrist et al., 2008). The high benefits, but potentially high costs, of children interacting with dogs highlights the importance of research on human animal interaction, particularly with children.

Pets are prevalent in American homes, with 68% of homes now including a pet (American Pet Products Association survey, 2014). With this high prevalence of pet ownership there has been increasing interest in assessing the relationships formed between people and pets. Among the most widely known measures is the Lexington Attachment to Pets Survey (LAPS), developed by Johnson, Garrity and Stallones (1992), to assess peoples relationship with their pets by having participants respond to what degree they agree or disagree with statements such as, "Quite often I confide in my pet." This empirically derived measure assesses the rater's feelings of attachment to their pet in three subscales: General Attachment, Animal Rights and Welfare, and People Substituting. The LAPS has been used with several populations, including children. For example, Daly and Morton (2006) have shown that children scoring higher on the LAPS attachment scale also tend to be more empathetic.

Although dogs are among children's most common 'favorite' pets (Westgarth et al., 2013), little is known about what influences children's feelings of attachment to their dogs. One hypothesis is that children's feelings of attachment towards their dog are linked to their attachment security with their parent. According to Bowlby (1982), the quality of

attachment to a parent influences a child's "internal working model" of relationships in general, such that secure attachment between mother and child could extend to higher quality relationships between the child and other social partners. A history of secure attachment to parents predicts better social competence, including the inclination to form closer relationships with others in childhood (Sroufe, 2005), and higher perceived support from their partners upon reaching adulthood (Collins & Feeney, 2004).

Variation in dog behaviors, such as how often a dog solicits petting, may also be related to children's feelings of attachment to their dog. Given that petting has known positive physiological effects on the person petting (e.g., Odendaal & Meintjes, 2003; Miller et al., 2009; Nagasawa et al., 2009), such as increased oxytocin levels, it is possible that children may form stronger feelings of attachment to dogs that solicit more petting. The same may be true for dogs that gaze more towards children, as gazes between an adult owner and dog have also been shown to increase oxytocin (Nagasawa et al., 2009, 2015). Finally, interacting with a dog that can better respond to human social behavior may increase feelings of attachment. Work on canine cognition has focused on dogs' remarkable sensitivity to human social behavior, in particular, dogs' ability to follow a human pointing gesture to a target location (Hare, Call, & Tomasello, 1998; Miklósi et al., 1998; Udell, Dorey, & Wynne, 2008). Dogs are also adept at reading human behavior and can utilize a variety of gestures (Miklósi & Soproni, 2005; Udell et al., 2012; Udell et al., 2013), and types of gazes (Hare & Tomasello, 1999; Agnetta, Hare, & Tomasello, 2000; for a review see Miklósi & Soproni, 2005). Dogs also seem to follow the pointing gesture of children (4.5-5.5 years) with similar success as when adults give the pointing gesture (Scheider, et al., 2013). Perhaps dogs that perform better on a point-following social cognitive task may be better able to engender stronger feelings of attachment from their child owners.

Unfortunately, little research has assessed the child-dog relationship in terms of observed behavioral interactions. The one exception is a series of studies in the 1980s that explored child-dog communicative interactions from videotape (Filiâtre, Millot, & Montagner, 1986; Millot & Filiâtre, 1986; Millot et al., 1988). This research indicated that, in general, children are the initiators of child-dog interactions twice as often as dogs (Millot et al., 1988), and are the ones most likely to seek out contact with the dog (Filiâtre, Millot, & Montagner, 1986). What is not known, however, is how the dog's response to a child's bids for interaction has an impact on the child's feelings of attachment to the dog.

The aim of the present study was to explore the effect of five variables (enumerated below) on children's reported feelings of attachment to their dogs (LAPS General Attachment scale), their reported view of the dog's role in the house (LAPS Animal Rights and Welfare scale), and how central the dog is to their life (LAPS People Substituting scale). We hypothesized that children will report stronger feelings of attachment, more importance, and a more central importance in the child's life to dogs that (1) are more responsive to the child's pointing gesture and, (2) are more likely to seek out contact with the child. With respect to child predictors, the reported feelings of attachment to pet will be examined according to (3) how supportive children report their pet to be as measured by the Network Relationship Inventory scale, and (4) the attachment security children have with their parent (measured by Kerns security scale). Lastly, although Johnson, Garrity and Stallones (1992)

showed that, for adults, the level of care provided to their pet did not correlate with reported attachment, given developmental differences in the nature of attachment relationships between children and adults, we also tested (5) whether children who are responsible for caring for their dogs will have stronger feelings of attachment to their dogs that those who are not.

In addition to examining predictors of children's feelings of attachment to their dogs, this study also examined two predictors of pet dogs' behavior towards their child owners. Based on evidence that dogs' social-cognitive abilities to follow human points are in part a product of ontogenetic and phylogenetic processes (Gácsi et al., 2009; Udell, Dorey, & Wynne, 2010), we expected that the types of experiences the dog has with the child would influence the dog's performance on following the child's point. Specifically, if responsiveness to human gestures is in part related to the dog learning to associate the child's hand with positive consequences, we would expect dogs that are regularly given positive consequences with the child's hands (e.g. feeding the dog, taking the dog for a walk, grooming the dog) would better follow the child's points. In addition, dogs that are fed, walked, or groomed by the child may also be more likely to seek contact and proximity from the child. Thus, we expected the dog's responsiveness to the child to be related to whether the child is typically responsible for feeding, walking or grooming the dog.

Methods

Subjects

A total of 101 children were recruited for this study, of whom 99 children and their dogs completed all phases and were entered in to the analysis. The ninety-nine children (50 male, 49 female) ranged from 7 to 12 years of age (mean=10.25 years, SD=1.31 years). Children were recruited through directed mailings, public radio advertisements, and school flyers. To participate in the study, families were required to have a dog living in the home for the past six months, with no prior history of aggression. Testing sessions were scheduled either between 10:30–12:00 or 15:30 – 17:00.

General procedure

Children along with a parent and pet dog participated in the study at the research laboratory at the University of Florida. Parents and children were provided with written consent and assent materials, respectively. Participants and parents were then asked to complete questionnaires in separate rooms (see Questionnaires). The child completed the questionnaires with the aid of an experimenter to ensure comprehension while the dog waited with the parent who filled out questionnaires in the other room. All rooms were temperature controlled and water was available for the dog in the waiting room. In addition, every 45 min an assistant took the dog for a brief walk outside. Following completion of the questionnaires, child-dog interactions were behaviorally measured in a sociability assessment followed by an evaluation of the dog's ability to follow the child's pointing gesture. All procedures were approved by the University of Florida Institutional Review Board and the Institutional Animal Care and Use Committee.

Questionnaires

Lexington Attachment to Pets Scale—To measure children’s attachment to their dogs, they completed the Lexington Attachment to Pet Scale (Johnson, Garrity, & Stallones, 1992). The scale asks children to rate their agreement to statements on a 1–4 Likert scale, with higher scores indicating stronger feelings of attachment. The scale contains three subscales: General Attachment, Animal Rights and Welfare, and Person Substituting. General Attachment includes statements relating to the general relationship the respondent has with the dog, such as “My pet and I have a very close relationship,” and “I consider my pet to be a great companion”. Animal Rights and Welfare indicates the pet’s status in the household and includes statements such as “I think my pet is just a pet,” and “I believe pets should have the same rights and privileges as family members.” Person Substituting indicates how central the dog is to the respondent’s life, which is assessed through ratings of statements such as, “My pet means more to me than any of my friends,” and “I love my pet because it never judges me.” Cronbach’s α for this study was 0.75.

Kerns Security Scale—Children’s perceived attachment security with their mother was assessed using the Kerns Security Scale (Kerns, Klepac, & Cole, 1996). On this scale, children are asked to rate 15 statements such as “Some kids find it easy to trust their mom BUT other kids are not sure if they can trust their mom,” on a 1–4 scale with higher scores indicating more secure attachment. A total security score was computed by averaging all item scores. Cronbach’s α in this study was 0.75.

Modified NRI—Perceived support from pet dogs were reported by children using the Network of Relationships Inventory (NRI; Furman & Buhrmester, 1985). The original NRI, which had 21 items, was designed to assess perceived support across various diverse social relationships such as teachers and peers. An example of the items is “How often do you tell this person everything that you are going through?” The NRI was evaluated in a pilot study with children owning pet dogs to determine the relevance of items for assessing child-pet relationships. With the exception of three items reflecting instrumental aid (e.g., “How much does this person help you figure out things?”), all items were retained, resulting in a modified questionnaire of 18 items. Items were scored on a 1 – 5 Likert scale and the scores were averaged to create a total score of perceived support. Cronbach’s α in this study was 0.91.

Dog information—Parents completed questionnaires indicating the dog’s breed, age, and sex. The dog’s breed was subsequently classified into one of the following categories to test for possible confounding effects of breed: lap dogs (toy breeds such as Maltese and Chihuahua, $n=32$), sporting breeds (Labrador retrievers and golden retrievers, $n=20$), herders (e.g., German shepherds, Australian shepherds, $n=19$), terriers/ratters (e.g., Jack Russell terrier, rat terrier, $n=13$), bully/fighting breeds (e.g., Pit bulls, bulldogs, boxers, $n=11$), and unknown mixes ($n=5$; (Protopopova et al., 2012). The questionnaire also asked parents whether children were responsible for any of three aspects of pet care: walking the dog, feeding the dog, or grooming the dog. Nine parents reported that their child engaged in none of these behaviors, thirty-nine children were reported as responsible for at least one task, and fifty-one were responsible for multiple tasks. This information was used to create a binary

variable, which indicated either the child was responsible for at least one aspect of dog care or the child did not have any responsibility in caring for the dog.

Behavioral measures

Sociability assessment—The aim of this assessment was to measure the amount of time the child and dog spent interacting while the child was sitting quietly in a room (4.5m by 3m) that contained a chair, desk, and lamp. During this 10-min task, adapted and developed from one reported by Jakovcevic, Mustaca and Bentosela, (2012), the child sat in a chair at the center of a 1 m radius semi-circle that was marked with tape. The child was asked to stay in the seat during the test and was instructed to call the dog over once at the beginning of the session and once again halfway through. The child was asked to otherwise remain neutral unless the dog entered the semi-circle. If the dog entered this circle the child was permitted to pet the dog and interact with it as if they were at home. Two observers were present during every session and provided appropriate guidance to the child if necessary. One observer was previously familiar with the dog from waiting with the dog with the parent. The dog had a brief period to greet the other observer (<5 min), while the child was given instructions for the task. During the assessment, observers stood in the back of the room and were unresponsive to the dog if it approached.

Behavioral coding—Two trained observers scored each session live on two dimensions: gazing and petting. Each behavior was scored using partial-interval recording by breaking the ten-minute session into 120 5-s epochs. If the dog engaged in a target behavior during that epoch, the interval was scored. The proportion of epochs in which a behavior was scored was calculated for each behavior, and averaged across the two observers. Gazing was defined as the percentage of 5-s intervals in which the dog's head and eyes turned to look at the child's upper body and head for at least 1 sec. Petting was defined as the percentage of intervals in which the dog and child made physical contact. Inter-observer agreement was calculated by dividing the number of epochs in which the two-observers agreed by the total number of epochs. Inter-observer agreement was 87.4% for gazing and 94.7% for petting.

Gesture following—The aim of the gesture following test was to assess the dog's ability to utilize the child's social communicative cues in a two-object choice task. Specifically, we assessed the dog's spontaneous ability to follow a momentary distal point to one of two paint cans using a procedure modified procedure from Udell, Dorey and Wynne (2008). In the present study a clicker was not used to mark correct choices. In this task the child was placed between two cans (1 m apart) and made a brief gesture toward one of the paint cans while the dog was watching 1.5 m away. The aim of this task is to assess whether the dog comprehended the child's pointing gesture and followed the gesture to the correct can.

Task familiarization—Prior to the testing session the child and dog each received a brief introduction to familiarize them with the materials and environment. Testing was conducted in the same room as the sociability assessment. First, the child was instructed on how to point to one of the cans in the absence of the dog. The experimenters conducted five practice trials with the child to insure the child was comfortable with the procedure. If the child performed all five practice-trials correctly, an assistant brought the dog into the room. If the

child did not perform all practice trials correctly, additional trials were conducted until the child responded appropriately. Once the dog entered the room, it was familiarized to the paint cans, by having the child place a dog treat on top of the left and right paint cans alternately, twice each. Pupperoni™ was used as the dog treat, or if a dog showed hesitancy to take Pupperoni™, small pieces of a commercial brand hot dog were used. Four dog showed signs of fear of the cans, and in these cases the lids of the can were used instead of the cans themselves.

Test trials—The test trials assessed whether, when a child pointed to one of two objects, the dog responded to this gesture as communicative and investigated the pointed-to object. Alternatively, the dog could investigate the opposite object or not respond to either object. To insure the child correctly implemented the procedure, the child was guided through each component of this assessment by an assistant. The child was first directed to stand between two empty paint cans 1 m apart and then asked to call the dog to gain its attention, while a second assistant held the dog back at least 1.5 m. Once the dog attended to the child, the child was told which can to point to. The child then pointed to that can for approximately 2 sec and was told to return to a neutral position. The dog was then released to assess whether it would follow the child's point and approach the pointed-to can. A choice was defined as touching one of the paint cans, or approaching within 10 cm of a can. If the dog approached the correct can, the child was told to place a treat on top of the can for the dog. The child only held a few treats in their non-pointing hand at a time, and an assistant gave the child more treats if needed throughout the session. If the dog approached the incorrect can, it was called back for the next trial without receiving a treat. If the dog failed to approach either can within 30 sec, a no-choice was recorded and scored as incorrect. 'No choices' were scored as incorrect because we were interested in the dog's spontaneous response to a child's pointing gesture. In some prior studies on point following in dogs, if a dog does not make a choice, the trial is repeated until it does so (e.g, Pongrácz et al., 2013). We did not do this, because we expected that the child may form different feeling of attachment to a dog that immediately attends to their pointing gesture compared to dogs that only attend to their pointing gesture after several attempts. If the dog failed to respond for two trials in a row, or made three incorrect responses in succession, two trials in which food was simply placed on top of the can were conducted to insure the dog was sufficiently food motivated to participate and not fearful of the cans. If a dog failed to approach the can and take the food on these trials, it was considered insufficiently motivated to continue participation. This occurred for two dogs, and they were not included in the final sample.

Control trials—Control trials were conducted to insure the dog was following the child's gesture and not unintentional cues such as odor. For these trials, all procedures were identical to test trials except the child did not point (i.e., the child was still informed of the 'correct' can and the dog was reinforced if it went to the 'correct' can). If the dog was successfully following only the pointing cue, and not relying on unintentional cues then we expected its performance on these trials never to exceed chance.

Each dog received a total of ten test trials and six control trials. Control trials were interspersed after every two test-trials and two control trials were conducted at the end of the

session. For each trial, the location of the correct can was pseudo-randomly determined so that the same side was not correct more than twice in row and counterbalanced so that each side was correct on half of the trials.

Statistical Analyses

Linear regression was used to assess whether children reported higher scores on each LAPS scale if (1) dogs were reported as being more supportive, (2) dogs were more responsive to their pointing gestures, (3) dogs spent more time in proximity, gazing or contact with the child in a sociability assessment, (4) children were responsible for dogs' care, (5) or children reported more secure attachments to the primary caregiver. Backwards elimination was used to determine those factors most strongly associated with children's attachment to the pet dog. To test the five hypotheses, an initial regression model was fit with control variables for the breed of the dog and sex of the child. The experimental predictors were then added to the full model, which was subjected to backwards elimination based on Akaike's Information Criterion (AIC) utilizing the step routine in statistical software package R 3.2.0 (Vienna, Austria) to identify the optimal regression mode.

In addition, we also wanted to assess whether the children's responsibility for caring for their dog was associated with the dog's behavior. Here we tested whether having the child care for the dog was associated with two outcome variables: (1) how much petting occurred during the sociability assessment, and (2) how well the dog followed the child's pointing gesture. We hypothesized that if children care for the dog, we would observe higher rates of petting during the sociability assessment. In addition, we hypothesized that caring for the dog would lead to more success at following the child's gesture. To explore these hypotheses, two separate linear regressions were conducted. The first explored whether petting during the sociability assessment was predicted by whether the child cared for the dog, and included the dog breed and child gender as control variables. The second regression assessed whether these same predictors and control variables were related to success in following the child's pointing gesture. Both models were then subjected to backwards elimination using the AIC as described above.

Results

Summary of behavioral measures

Sociability assessment—Petting was observed on average during 50% of the observed epochs of the sociability assessment (SD= 31%). On average, gazing was observed much less than petting and in only 19% of the epochs (SD= 15%).

Gesture following—Overall, dogs responded correctly on 74% of the children's points, which is significantly greater than chance (one sample t-test, $t_{98} = 10.40$, $p < .0001$). The dog's accuracy for following children's points fell well within the expected range for dogs following a momentary distal point given by an experimenter or an adult owner (Udell, Dorey, & Wynne, 2008). In addition, based on performance on control trials there was no indication that children were giving their dogs unintentional cues. Although dogs performed above chance when the child pointed, they were not above chance on control trials when the

child refrained from pointing (mean performance on control trials 28%, one-sided t-test, $t_{98} = -9.19, p = 1$). Thus, the dogs were overall following the children's points and were not influenced by unintentional cues from the child.

Predictors of Child Attachment to Dog (LAPS)

Subscale: General Attachment—The final reduced model following backward elimination (adjusted $R^2 = .27, p < .001$) indicated that children reported stronger feelings of attachment to dogs that scored higher on the pointing task ($F_{(1,94)} = 7.38, p = < .01, \beta = .24$) and to dogs that were petted less during the sociability assessment ($F_{(1,94)} = 4.21, p = .04, \beta = -.18$). Children also indicated stronger feelings of attachment to dogs that were reported as being more supportive ($F_{(1,94)} = 27.58, p = < .001, \beta = .46$), but only marginally stronger if they reported greater attachment security with their parent ($F_{(1,95)} = 2.74, p = < .10, \beta = .15$). The breed of the dog, sex of the child, and gazing during the sociability task were removed as non-significant predictors of feelings of attachment during model selection.

Subscale: Animal Rights and Welfare—Using the same procedure as for General Attachment, we assessed which variables predicted the Animal Rights and Welfare Scale from the LAPS (adjusted $R^2 = .12, p < .01$). Unlike General Attachment, only perceived support (modified NRI) predicted Animal Rights and Welfare in the final model ($F_{(1,95)} = 13.19, p = < .001, \beta = .35$). Petting and child gender were retained in the final model based on fit statistics but neither significantly predicted the Animal Rights Welfare scale ($F_{(1,95)} = 2.47, p = .12, \beta = -.15; F_{(1,95)} = 2.46, p = .12, \beta = -.15$, respectively). All other experimental variables were removed during model selection.

Subscale: People Substituting—The final model for People Substituting (adjusted $R^2 = .28, p < .001$) was only influenced by the perceived support modified NRI measure ($F_{(1,97)} = 38.27, p < .00001, \beta = .53$). All other variables, however, did not improve model fit according to the AIC and were removed.

Predictors of sociability and gesture following—Above we identify the variables that influenced the child's reported feelings of attachment to their dog. Next we tested the hypothesis that, if children are responsible for providing dogs with reinforcers such as feeding or walking, their dogs would be more responsive to their gestures, and more petting would be observed during the sociability task. Dogs that were cared for by the children scored higher overall on the gesture following task than dogs that the child did not feed, walk or groom (see Figure 1; $F_{(1,97)} = 5.43, p = .02, \beta = .23$). The breed of the dog and child gender were removed as non-significant predictors of gesture following during model fitting. Similarly, dogs that were fed, walked or groomed by children were more likely to be in contact and petted during the sociability assessment (see Figure 1; $F_{(1,97)} = 6.21, p = < .01, \beta = .24$), but petting was not predicted by the breed of the dog or child gender, both of which were removed as non-significant predictors.

Discussion

The results indicate that several child and dog characteristics are associated with children's reported general attachment (LAPS General Attachment) to their dog. Prior research has

found several benefits children and adults may gain from a relationship with a pet. For example, stronger attachments to pets are associated with higher empathy scores in children (Daly & Morton, 2006), and relationships with pets may provide a secure attachment relationship for adults (Beck & Madresh, 2008) and provide a source of non-evaluative support (Allen et al., 1991). The present research extends upon this by exploring variables that contribute to the strength of this relationship. Our results indicate that the strength of child-dog attachment is associated with how supportive the dog is reported to be, how well the dog follows the child's gestures, and is associated with less petting during our sociability task.

Our finding that children reported stronger feelings of attachment to dogs that followed their pointing gesture, builds upon the work of Filiâtre, Millot and Montagner (1986) who showed that children are the major initiators of interactions with pet dogs. Here, we show that children report stronger feelings of attachment to dogs that are better able to respond appropriately to their gestures. Petting during the sociability assessment was also associated with child feelings of attachment towards the dog, but the direction of the association was reversed compared to our hypotheses. Higher General Attachment scores were associated with less petting during the sociability assessment. The reason for this negative association is not clear, but perhaps children report stronger feeling of attachment to dogs that solicit less petting in novel surroundings when the dog might be expected to engage in more exploratory behavior rather than solicit petting. Further research, however, is needed to determine what is driving this association. Regardless of the direction of effect, however, both significant associations indicate that children attend to dogs' behaviors, which influences their reported feelings of attachment to their dogs.

Interestingly, dog behaviors were associated only with General Attachment and not with the Animal Rights and Welfare or the People Substituting scales of the LAPS. This suggests that feelings of attachment towards a pet dog are directly influenced by the dog's behavior, but feelings on the dog's role in the family or how central the dog is to the child's life are not. Those components of children's feelings towards their pets may be dependent on other dog behaviors not assessed in this study, or more general attitudes about animals or pets. The results across the three LAPS subscales suggest that the dog's ability to follow points and the amount of petting that was observed in the sociability task are not associated with all types of attitudes and feelings regarding pets, but are associated specifically with feelings of attachment towards the pet.

The level of social support the dog provides (as reported by the child via the NRI) was highly associated with children's reported attachment to their dog. In fact, the social support scale was the only variable strongly related to all three subscales of the LAPS. This indicates that the dog's perceived social support is relevant not only for feelings of attachment to their pet dog but also for children's self-reported feelings regarding animal rights and welfare, and the degree to which they view pets as similar to human social partners.

Notably, the NRI has, to our knowledge, never previously been applied to assessing child-pet relationships. The observed relations between social support as indexed by the NRI with all three subscales of the LAPS provide evidence for some degree of convergent validity

between these two measures. Given that the NRI is commonly used to index children's relationships with (multiple) social partners other than parents, this measure could be useful for examining the impact of child-pet relationships within the child's broader social networks.

The results also indicated a trend towards an association between children's attachment security to their parent with their feelings of attachment towards their dog. This marginal association likely reflects the fact that attachment with the primary caregiver is a more distal (early development) predictor compared to some of the other, more proximal, predictors assessed in this study. Attachment security to a primary caregiver is widely believed to provide the foundation for children's internal working model that broadly impacts other, later developing, social relationships (Sroufe and Waters, 1977; Weinfield, Sroufe, & Egeland, 2000). Although attachment security to the parent is typically considered an early life predictor, we used this measure because there has been less methodological research on attachment in middle childhood (for exceptions see Kerns, Klepac & Cole, 1996; Target, Fonagy, & Shemueli-Goetz, 2003). Given that attachment security is an early developmental predictor, even a marginal association with attachment security in middle childhood suggests attachment security may be important in the later development of relationships with pets.

We found no evidence that caring for the pet dog (walking, feeding, or grooming) was associated with increased feelings of attachment towards the dog. These results are consistent with findings in adults (Johnson, Garrity, & Stallones, 1992). None of our control variables, the breed of the dog nor child gender, were significantly associated with any of the LAPS scales. Children reported no stronger feelings of attachment for companion dogs (toy breeds such as Maltese) over other dogs such as larger family dogs (e.g. golden retrievers), or bully breeds such as pit bulls.

Although we found no association between whether a child was responsible for care of their dog and the LAPS scales, caring for the dog was a significant predictor of the dog's gesture-following behavior, as well as the probability it would be petted during the sociability assessment. These results suggest an interesting bi-directional influence on the child-dog relationship, such that dogs may be sensitive to whether children interact with the dog, and children are sensitive to how well dogs responds to their communicative gestures.

There are several limitations worth considering in the present study. One is that our outcome variable was reported attachment to the dog using the LAPS. Although the psychometric properties of the LAPS have been discussed previously (Johnson, Garrity, & Stallones, 1992), and it has been associated with higher empathy scores in children (Daly & Morton, 2006), it is not clear whether higher LAPS scores are associated with benefits to the child. Further research will be needed to determine how the reported attachment to a dog is related to benefits the child may receive from the dog. Another limitation is that although we observed that whether the child cared for the dog was a potentially import factor in the dog's behavior, we did not directly observe the quality and nature of the care the child provided, but instead relied on parent report. A future research program could evaluate how the child's

behavior and interaction with the dog more directly influences the dog's social behavior towards the child.

In sum, we show that children's reported feelings of attachment to their dog are positively associated with the dog's ability to follow the child's pointing gesture, children's reported social support provided by the dog (NRI scale), and negatively associated with the amount of petting that occurred spontaneously in a laboratory environment while the child sat quietly. No associations with reported attachment to the dog were observed for the breed of the dog, child gender, or whether the child was typically responsible for the care of the dog at home. Children's feelings about animal rights and welfare, as well as the degree to which they view pets similarly to people, were only related to how supportive the child rated the dog. The dog's ability to follow gestures and amount of petting, however, were related to whether the child was responsible for the care of the dog. Overall, these findings reveal dyadic relationships in which dogs' behaviors are associated with the children's reported feelings of attachment towards their dogs, and the dog's behavior was associated with whether the child was responsible for caring for the dog.

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References

- American Pet Products Association. Household penetration rates for pet ownership in the United States from 1988 to 2013. Statista - The Statistics Portal. July. 2014 Retrieved October 24, 2014, from <http://www.statista.com/statistics/198086/us-household-penetration-rates-for-pet-owning-since-2007/>
- Agnetta B, Hare B, Tomasello M. Cues to food location that domestic dogs (*Canis familiaris*) of different ages do and do not use. *Animal Cognition*. 2000; 3:107–112.
- Allen KM, Blascovich J, Tomaka J, Kelsey RM. Presence of human friends and pet dogs as moderators of autonomic responses to stress in women. *Journal of Personality and Social Psychology*. 1991; 61:582–589. DOI: 10.1037/0022-3514.61.4.582 [PubMed: 1960650]
- Anderson KL, Olson MR. The value of a dog in a classroom of children with severe emotional disorders. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 2006; 19:35–49. DOI: 10.2752/089279306785593919
- Anderson W, Reid C, Jennings G. Pet ownership and risk factors for cardiovascular disease. *The Medical Journal of Australia*. 1992; 157:298–301. [PubMed: 1435469]
- Beck L, Madresh EA. Romantic partners and four-legged friends: An extension of attachment theory to relationships with pets. *Anthrozoös*. 2008; 21:43–56. DOI: 10.2752/089279308X274056
- Bowlby J. Attachment and loss: Retrospect and prospect. *American Journal of Orthopsychiatry*. 1982; 52:664–678. DOI: 10.1111/j.1939-0025.1982.tb01456.x [PubMed: 7148988]
- Collins NL, Feeney BC. Working Models of Attachment Shape Perceptions of Social Support: Evidence From Experimental and Observational Studies. *Journal of Personality and Social Psychology*. 2004; 87:363–383. DOI: 10.1037/0022-3514.87.3.363 [PubMed: 15382986]
- Cutt H, Giles-Corti B, Knuiiman M, Burke V. Dog ownership, health and physical activity: A critical review of the literature. *Health & Place*. 2007; 13:261–272. DOI: 10.1016/j.healthplace.2006.01.003
- Daly B, Morton LL. An investigation of human–animal interactions and empathy as related to pet preference, ownership, attachment, and attitudes in children. *Anthrozoos: A Multidisciplinary*

- Journal of The Interactions of People & Animals. 2006; 19:113–127. DOI: 10.2752/089279306785593801
- Demello LR. The effect of the presence of a companion-animal on physiological changes following the termination of cognitive stressors. *Psychology & Health*. 1999; 14:859–868. DOI: 10.1080/08870449908407352
- Fick KM. The Influence of an Animal on Social Interactions of Nursing Home Residents in a Group Setting. *American Journal of Occupational Therapy*. 1993; 47:529–534. DOI: 10.5014/ajot.47.6.529 [PubMed: 8506934]
- Filiâtre JC, Millot JL, Montagner H. New data on communication behaviour between the young child and his pet dog. *Behavioural Processes*. 1986; 12:33–44. DOI: 10.1016/0376-6357(86)90068-9 [PubMed: 24924535]
- Friedmann, E.; Katcher, A.; Thomas, SA.; Lynch, JJ.; Messent, PR. Social Interaction and Blood Pressure: Influence of Animal Companions. *The Journal of Nervous and Mental Disease*. 1983. Retrieved from http://journals.lww.com/jonmd/Fulltext/1983/08000/Social_Interaction_and_Blood_Pressure__Influence.2.aspx
- Friedmann E, Thomas S. Health Benefits of Pets for Families. *Marriage & Family Review*. 1985; 8:191–203. DOI: 10.1300/J002v08n03_14
- Furman W, Buhrmester D. Children's perceptions of the personal relationships in their social networks. *Developmental Psychology*. 1985; 21:1016–1024. DOI: 10.1037/0012-1649.21.6.1016
- Gácsi M, Gyoöri B, Virányi Z, Kubinyi E, Range F, Belényi B, Miklósi Á. Explaining Dog Wolf Differences in Utilizing Human Pointing Gestures: Selection for Synergistic Shifts in the Development of Some Social Skills. *PLoS ONE*. 2009; 4:e6584.doi: 10.1371/journal.pone.0006584 [PubMed: 19714197]
- Gilchrist J, Sacks JJ, White D, Kresnow M-J. Dog bites: still a problem? *Injury Prevention*. 2008; 14:296–301. DOI: 10.1136/ip.2007.016220 [PubMed: 18836045]
- Hare B, Call J, Tomasello M. Communication of Food Location Between Human and Dog (*Canis Familiaris*). *Evolution of Communication*. 1998; 2:137–159. DOI: 10.1075/eoc.2.1.06har
- Hare B, Tomasello M. Domestic dogs (*Canis familiaris*) use human and conspecific social cues to locate hidden food. *Journal of Comparative Psychology*. 1999; 113:173–177. DOI: 10.1037/0735-7036.113.2.173
- Jakovcevic A, Mustaca A, Bentosela M. Do more sociable dogs gaze longer to the human face than less sociable ones? *Behavioural Processes*. 2012; 90:217–222. DOI: 10.1016/j.beproc.2012.01.010 [PubMed: 22342201]
- Jalongo MR. Beyond a Pets Theme: Teaching Young Children to Interact Safely with Dogs. *Early Childhood Education Journal*. 2008; 36:39–45. DOI: 10.1007/s10643-008-0272-1
- Johnson TP, Garrity TF, Stallones L. Psychometric Evaluation of the Lexington Attachment to Pets Scale (LAPS). *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 1992; 5:160–175. DOI: 10.2752/089279392787011395
- Kerns KA, Klepac L, Cole A. Peer relationships and preadolescents' perceptions of security in the child-mother relationship. *Developmental Psychology*. 1996; 32:457–466. DOI: 10.1037/0012-1649.32.3.457
- Kotrschal K, Ortbauer B. Behavioral effects of the presence of a dog in a classroom. *Anthrozoös*. 2003; 16:147–159. DOI: 10.2752/089279303786992170
- Limond JA, Bradshaw JWS, Cormack MKF. Behavior of Children with Learning Disabilities Interacting with a Therapy Dog. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 1997; 10:84–89. DOI: 10.2752/089279397787001139
- Martin F, Farnum J. Animal-Assisted Therapy for Children with Pervasive Developmental Disorders. *Western Journal of Nursing Research*. 2002; 24:657–670. DOI: 10.1177/019394502320555403 [PubMed: 12365766]
- Miklósi Á, Polgárdi R, Topál J, Csányi V. Use of experimenter-given cues in dogs. *Animal Cognition*. 1998; 1:113–121. DOI: 10.1007/s100710050016 [PubMed: 24399275]
- Miklósi Á, Soproni K. A comparative analysis of animals' understanding of the human pointing gesture. *Animal Cognition*. 2005; 9:81–93. DOI: 10.1007/s10071-005-0008-1 [PubMed: 16235075]

- Miller S, Kennedy C, DeVoe D, Hickey M, Nelson T, Kogan L. An Examination of Changes in Oxytocin Levels in Men and Women Before and After Interaction with a Bonded Dog. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 2009; :31–42. DOI: 10.2752/175303708x390455
- Millot JL, Filiâtre JC. The behavioural sequences in the communication system between the child and his pet dog. *Applied Animal Behaviour Science*. 1986; 16:383–390. DOI: 10.1016/0168-1591(86)90010-9
- Millot JL, Filiâtre JC, Gagnon AC, Eckerlin A, Montagner H. Children and their pet dogs/: How they communicate. *Behavioural Processes*. 1988; 17:1–15. DOI: 10.1016/0376-6357(88)90046-0 [PubMed: 24896906]
- Nagasawa M, Kikusui T, Onaka T, Ohta M. Dog's gaze at its owner increases owner's urinary oxytocin during social interaction. *Hormones and Behavior*. 2009; 55:434–441. DOI: 10.1016/j.yhbeh.2008.12.002 [PubMed: 19124024]
- Nagasawa M, Mitsui S, En S, Ohtani N, Ohta M, Sakuma Y, ... Kikusui T. Oxytocin-gaze positive loop and the coevolution of human-dog bonds. *Science*. 2015; 348:333–336. DOI: 10.1126/science.1261022
- Nimer J, Lundahl B. Animal-Assisted Therapy: A Meta-Analysis. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 2007; 20:225–238. DOI: 10.2752/089279307X224773
- Odendaal JS. Animal-assisted therapy - magic or medicine? *Journal of Psychosomatic Research*. 2000; 49:275–280. [PubMed: 11119784]
- Odendaal JS, Meintjes RA. Neurophysiological Correlates of Affiliative Behaviour between Humans and Dogs. *The Veterinary Journal*. 2003; 165:296–301. DOI: 10.1016/S1090-0233(02)00237-X [PubMed: 12672376]
- Pongrácz P, Gácsi M, Hegedüs D, Péter A, Miklósi Á. Test sensitivity is important for detecting variability in pointing comprehension in canines. *Animal Cognition*. 2013; 16:721–735. DOI: 10.1007/s10071-013-0607-1 [PubMed: 23392852]
- Poresky RH. The young children's empathy measure: Reliability, validity and effects of companion animal bonding. *Psychological Reports*. 1990; 66:931–936. [PubMed: 2377714]
- Protopopova A, Gilmour AJ, Weiss RH, Shen JY, Wynne CDL. The effects of social training and other factors on adoption success of shelter dogs. *Applied Animal Behaviour Science*. 2012; 142:61–68. DOI: 10.1016/j.applanim.2012.09.009
- Schalamon J, Ainoedhofer H, Singer G, Petnehazy T, Mayr J, Kiss K, Höllwarth ME. Analysis of Dog Bites in Children Who Are Younger Than 17 Years. *Pediatrics*. 2006; 117:e374–e379. DOI: 10.1542/peds.2005-1451 [PubMed: 16510617]
- Scheider L, Kaminski J, Call J, Tomasell M. Dog domestic dogs interpret pointing as a command? *Animal Cognition*. 2013; 16:361–372. DOI: 10.1007/s10071-012-0577-8
- Sroufe LA. Attachment and development: A prospective, longitudinal study from birth to adulthood. *Attachment & Human Development*. 2005; 7:349–367. DOI: 10.1080/14616730500365928
- Sroufe LA, Waters E. Attachment as an organizational construct. *Child development*. 1977:1184–1199.
- Target M, Fonagy P, Shmueli-Goetz Y. Attachment representations in school-age children: the development of the child attachment interview (CAI). *Journal of child psychotherapy*. 2003; 29(2): 171–186.
- Udell M, Dorey NR, Wynne CDL. Wolves outperform dogs in following human social cues. *Animal Behaviour*. 2008; 76:1767–1773.
- Udell M, Dorey NR, Wynne CDL. What did domestication do to dogs? A new account of dogs' sensitivity to human actions. *Biological Reviews*. 2010; 85:327–345. DOI: 10.1111/j.1469-185X.2009.00104.x [PubMed: 19961472]
- Udell M, Hall NJ, Morrison J, Dorey NR, Wynne CDL. Point Topography and Within-Session Learning Are Important Predictors of Pet Dogs' (*Canis lupus familiaris*) Performance on Human Guided Tasks. *Revista Argentina de Ciencias Del Comportamiento*. 2013; 5:3–20.

- Udell, M.; Spencer, JM.; Dorey, NR.; Wynne, CDL. Human-Socialized Wolves Follow Diverse Human Gestures... And They May Not Be Alone. *International Journal of Comparative Psychology*. 2012. Retrieved from <http://escholarship.org/uc/item/9rb9d1zk>
- Vidović VV, Štetić VV, Bratko D. Pet Ownership, Type of Pet and Socio-Emotional Development of School Children. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 1999; 12:211–217. DOI: 10.2752/089279399787000129
- Weinfield NS, Sroufe LA, Egeland B. Attachment from infancy to early adulthood in a high-risk sample: Continuity, discontinuity, and their correlates. *Child development*. 2000; 71(3):695–702. [PubMed: 10953936]
- Wells DL. The facilitation of social interactions by domestic dogs. *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals*. 2004; 17:340–352. DOI: 10.2752/089279304785643203
- Westgarth C, Boddy LM, Stratton G, German AJ, Gaskell RM, Coyne KP, ... Dawson S. Pet ownership, dog types and attachment to pets in 9–10 year old children in Liverpool, UK. *BMC Veterinary Research*. 2013; 9:102.doi: 10.1186/1746-6148-9-102
- Wu AS, Niedra R, Pendergast L, McCrindle BW. Acceptability and impact of pet visitation on a pediatric cardiology inpatient unit. *Journal of Pediatric Nursing*. 2002; 17:354–362. DOI: 10.1053/jpdn.2002.127173 [PubMed: 12395303]

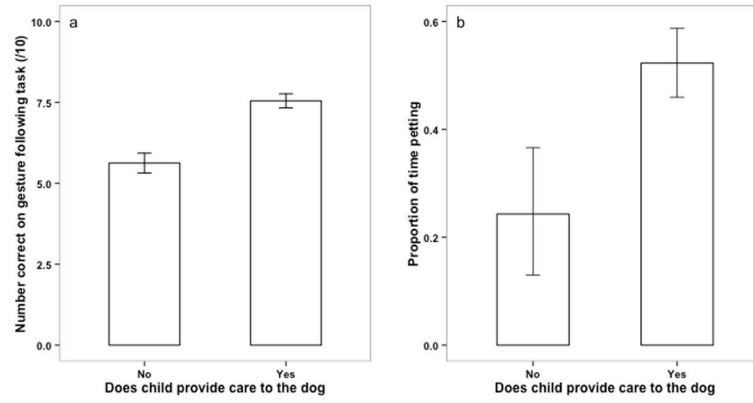


Figure 1. Performance on the behavioral tasks and whether child was responsible for caring for the dog. A: shows the mean number correct (/10) on the point following task for children that were responsible for the care of their dog compared to children that were not responsible for the care of their dog. Error bars show 95% confidence intervals. B: shows the mean proportion of intervals of the sociability assessment in which petting occurred. Bars show mean and error bars show 95% confidence intervals.