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Companion animals and profiles of peer social behavior in adolescence

Abstract

Introduction: Relationships with companion animals have been associated with higher levels of prosocial behavior and lower levels of socioemotional difficulties for children and adolescents.

Companion animals may be supportive of developing prosocial behavior in youth through practice with positive social interactions and the development of empathy and reciprocity skills.

The goal of this study was to use a person-centered approach to investigate if living with a pet (including pet species) is associated with profiles of adolescent peer social behaviors (i.e., prosocial, aggressive), and size of their peer network.

Methods: This study used data from the Adolescent Brain Cognitive Development (ABCD) Study®, a large, nationally representative dataset of American adolescents.

Results: In a cross-sectional sample of 5,218 adolescents, we found that youth clustered into four different distinct profiles of peer social behavior. Female youth living with dogs were less likely to be in the High Aggression profile as compared to youth without pets or youth with other types of pets. However, having a pet was not associated with whether youth were in the profiles characterized by prosocial behaviors or size of peer network.

Conclusions: Overall, future research should explore how gender intersects with companion animal interactions—both in terms of frequency of interactions as well as relationship quality/emotional attachment—as well as examine these relationships over time to assess causality.

Keywords: *human-animal interaction; companion animals; adolescence; prosocial behavior; peer interactions*

Companion animals and profiles of peer social behavior in adolescence

Companion animal relationships have been associated in prior research with increases in prosocial behavior and decreases of socioemotional difficulties for children and adolescents (Christian et al., 2020; Vidović et al., 1999; Wenden et al., 2021; Wice et al., 2020). This relationship has been found for pets generally, but the effect appears to be particularly strong for those living with dogs (Christian et al., 2020; Vidović et al., 1999; Wenden et al., 2021; Wice et al., 2020). Companion animals may be supportive of developing prosocial behavior in youth through practice with positive social interactions and the development of empathy, which is in turn associated with prosocial behavior (Wice et al., 2020). Similarly, through the development of these skills, youth with pets may be less likely to engage in negative social behaviors. While pets should not be relied upon exclusively for social support, they can provide some comfort as part of a larger social network (Fox, 2016). However, the specific associations between companion animal relationships and patterns of prosocial and negative social peer interactions in early adolescence have been understudied. Specifically, there has been a lack of person-centered approaches (which focus on how the variables unique to each individual relate to those of other individuals)—as opposed to variable-centered approaches (which investigate relationships between variables; Kusurkar et al., 2020)—to assessing human-animal relationships that can elucidate the role of pets in development for early adolescents.

Development of Social Competencies in Early Adolescence

Psychosocial development is a key feature of early adolescence (the age of the sample in this study; Meeus, 2016; Smetana et al., 2006). As youth grow and transition from childhood into adolescence, their social value orientations (i.e., individual-level preferences for how to approach others; Van Lange et al., 1997) change. Van Lange et al. (1997) posits that these changes may be

informed by different patterns of peer social interactions and levels of attachment. As youth age, self-beliefs in academic competence decline (Jacobs et al., 2002); however, competence and trajectories of psychosocial adjustment may be partially attributable to parenting style (Lamborn et al., 1991; Steinberg et al., 1994). Steinberg (2004) explored why adolescents may be more prone to risk-taking behaviors, theorizing that novelty- and sensation-seeking behaviors increase during puberty, and also that self-regulatory competence is not fully developed until adulthood. Hartup (1996) also noted that the quality and social behavior of friends may impact development and adjustment; specifically, the potential variance in reported friendships (differentiation between friend/best friend) as well as behavioral difficulties. Interventions targeting social and emotional learning have shown to be effective in improving related outcomes compared to control groups (Taylor et al., 2017), indicating the malleability of outcomes in this age group.

Empathy and Prosocial Behavior

It should be noted that much of the literature examines both empathy and prosocial behavior together, but they are distinct constructs; empathy refers to an understanding of another's state of mind whereas prosocial behavior refers to behaviors that benefit one or more people. Specifically, in adolescence, prosocial behaviors such as sharing and helping become established and others such as prosocial risk and volunteering start to be explored (Padilla-Walker & Van der Graaff, 2023). Antisocial behavior, on the other hand, can manifest as behaviors such as theft or assault (Loeber, 1990). Although a high degree of empathy can be associated with prosocial behaviors, it is not a directly causal relationship. As such, we refer to empathy in our review of the literature because of the association with prosocial behavior and the prevalence in the literature, but we are not able to measure empathy in our analyses. Our study intends to expand upon the findings related to prosocial behavior, not empathy.

Companion Animals and Youth Prosocial Behaviors

The association between having a pet and youth development broadly has been widely studied (e.g., Barker & Wolen, 2008; Endenburg & van Lith, 2011; Purewal et al., 2017). A recent systematic review by Purewal et al. (2017) found that having a pet has been shown to be protective or neutral against loneliness, but that the findings on social development were mixed, partially due to a lack of high-quality longitudinal research. However, prior research has demonstrated that interactions with animals have been associated with positive outcomes related to empathy and prosocial behavior (Daly & Morton, 2006; Mueller, 2014; Poresky & Hendrix, 1990). Prior research has also found that the presence of an animal (such as in a classroom setting) resulted in significant changes in socially-oriented behavior, such as a reduction of aggressive behavior and parent- and teacher-reported increases in prosocial behavior (Kotrschal & Ortbauer, 2003; McCullough et al., 2021).

Within the context of pets within the home specifically, frequent interaction with companion animals has been associated with greater empathy, which in-turn is associated with prosocial behavior (Wice et al., 2020). Prior research has found associations between attitudes toward pets and prosocial behavior in adolescents (Jacobson & Chang, 2018) as well as attachment to pets and empathy and prosocial orientation in children and adolescents (Vidović et al., 1999). Furthermore, having a pet generally, and a dog \specifically, has been associated with lower odds of peer problems and higher prosocial behavior scale scores for youth both cross-sectionally and over time (Christian et al., 2020; Wenden et al., 2021). Additionally, family dog walking (at least 1 time per week) and playing with the family dog (at least 3 times per week) were associated with higher odds of having an above-average score on prosocial behaviors,

compared with those who walk their dog less than once per week and play with their dog less than three times per week, respectively (Wenden et al., 2021).

Prior evidence indicates that species of companion animal can also predict differences in prosocial behavior and empathy. One study of older children and adolescents found that there were no differences in empathy between those with and without pets regardless of attachment, but that youth with dogs showed higher levels of empathy and those with cats reported lower empathy (Daly & Morton, 2003). Another study found that the prosocial orientation scores of those with no pets or pets other than cats and dogs decreased with age while the mean scores of youth with dogs and/or cats stayed stable with age (Vidović et al., 1999).

Species-Level Differences in Companion Animals

One possible reason why there are differences based on animal species is that humans may prefer animals that are biologically or behaviorally similar to them (Batt, 2009).

Hirschenhauser et al. (2017) found that younger children develop stronger bonds with animals that are taxonomically closely related (i.e., cats and dogs) compared to pets like birds or fish; but that this relationship diminishes as the children reach early adolescence. Another explanation for these differences in species could be attributed to an individual's attribution of mental states to non-human animals and how that tendency could change based on the physiology and behavior of different animal species (Urquiza-Haas & Kotrschal, 2015).

Dogs in particular have characteristics uniquely suited to fostering social behaviors, as they possess underlying social competence in certain domains, such as gaze communication (Koyasu et al., 2020), visual perspective taking (Kaminski et al., 2009), responsiveness to pointing gestures (Soproni et al., 2002), and the ability to distinguish between intentional and unintentional human actions (Schünemann et al., 2021). Dogs have also been shown to engage in

behaviors which appear to mimic empathic concern (Custance & Mayer, 2012)—and regardless of the underlying processes—the behaviors could help encourage emotional closeness between an adolescent and their dog. Furthermore, it is possible that certain interactions may activate the oxytocin systems of both dogs and humans (Beetz et al., 2012; Kis et al., 2017). The social relationship between dogs and humans could provide an additional pathway for practicing social interactions that could then be generalized to human-human social interactions.

Peer Interactions, Aggression, and Pets

In addition to understanding how companion animals may foster the development of positive prosocial behaviors that contribute to positive peer relationships, it is crucial to consider how other types of peer interactions may interact with companion animal relationships and social development. During adolescence, the characteristics of friendships shift, and become more focused on disclosure, intimacy, and support (Berndt, 2002; Smetana et al., 2006). Close friendships especially provide adolescents with opportunities to improve their social competencies (Smetana et al., 2006). Along with positive social interactions, engaging in negative peer-related aggression in children and adolescents is another key indicator of social relationships. There could be links between aggression toward other humans in youth and aggression toward animals, but the topic is understudied. However, one study found that overt aggressive behavior in children was linked to animal cruelty, and lower empathy scores, with boys having stronger correlations (Akdemir & Gölge, 2020). In the same way that interactions with pets may promote the development of prosocial behaviors, practicing empathy and providing social support may be a way of supporting skills that reduce the likelihood of youth engaging in aggressive behavior towards peers. For example, a meta-analysis of 148 studies on child and adolescent aggression found that prosocial behavior is negatively correlated with both

indirect and direct aggression (Card et al., 2008). Additionally, Farrell et al. (2017) found that the prosocial behavior of adolescents' friends is negatively associated with teacher-reported physical aggression (although the correlation was small). As such, it is possible that pets could result in a decrease in friends involved in aggressive behaviors (i.e., delinquent friends).

Peer Network

Particularly during adolescence, a youth's social network has a meaningful impact on their development (Lamblin et al., 2017). Size of youth peer network is a key factor to explore in the context of the potential effect of pet ownership on supporting positive social behaviors. In addition to network size alone, there are other contextual factors that impact youth development; for example, peer behavior has been shown to impact adolescent behaviors including delinquency, substance use, and smoking, among others (Lamblin et al., 2017) and additionally, perceptions of closeness and reciprocity can moderate peer influences on aggression (Meter et al., 2015). Although research on the intersection of peer and pet interactions has been limited, Black (2012) found that the number of people in an adolescent's peer network was positively associated with the emotional attachment to their companion animal, furthering the hypothesis that pets may provide the opportunity to engage in positive social behaviors that would link to human-human relationships. Companion animals can also serve as "social lubricants" for people to interact with each other (Koohsari et al., 2021; McNicholas & Collis, 2000; Wells, 2004), and can be a reason for youth to connect with their peers. For example, dog adoption has been associated with a brief increase in visits from peers (Paul & Serpell, 1996). However, it may also be the case that if a teenager has a large peer network, they may not rely on their pet as much for socio-emotional connection. Therefore, it is important to explore how friend network size aligns

with both prosocial behavior and peer interactions, and if pet ownership is related to these patterns.

The Current Study

The development of prosocial behaviors and positive peer relationships are key features of adolescent social development, and it is crucial to understand factors within an adolescent's developmental context that may contribute to the positive development of social skills and adaptive peer relationships. In the context of this theoretical framework, we consider adaptive peer social behavior as being prosocial, and maladaptive peer social behavior as consisting of greater aggression. However, we acknowledge that this framework paints a broad stroke over peer relationships, which can be adaptive even with aggression (e.g., Banny et al., 2011).

Companion animals provide a potentially positive source of social interactions for teenagers, creating an opportunity to foster empathy and enhance positive social behaviors. Prior research has shown that pet ownership has been associated with both positive and negative peer social behaviors, but these relationships have not been studied in depth. Based on these findings in the existing literature, we predict that a supportive relationship with a companion animal could help youth practice prosocial behaviors and empathy, which would then be associated with increased peer prosocial behaviors and decreased aggressive behaviors. However, there are significant gaps in the literature regarding specific profiles of youth for whom a companion animal would be efficacious in fostering positive social behaviors. Specifically, there is a lack of person-centered approaches to studying youth-pet relationships. Youth development is non-ergodic, and prior variable-centered approaches to human-animal interaction and youth development have produced mixed findings (e.g., Mueller et al., 2022) that are perhaps in part due to the highly idiographic nature of youth-pet interactions. Pet relationships are not uniform,

and may be associated with different types of outcomes for different youth depending on the individual adolescent and their specific social behaviors.

As such, the goal of this study is to investigate profiles of adolescent peer social behaviors (i.e., prosocial, aggressive), size of their peer network, and their companion animals. Using a person-centered approach offers increased flexibility in analysis in addition to decreasing bias through specificity in classification and allowing for integration of both person- and variable-centered approaches (Berlin et al., 2018; Muthén & Muthén, 2000). In this analysis we focus on a person-centered approach in an attempt to better capture the individual within their own context (Murdock & Bolch, 2005). As is reflected in contemporary practices in developmental science, person-centered approaches are a more appropriate tool for understanding developmental processes (Lerner, 2019; Molenaar, 2004).

The aim of this study was to utilize a large, nationally representative dataset to assess whether having a pet and pet type (dog vs. other types of pets) relate to profiles of prosocial behaviors and peer interactions in adolescents using a person-centered approach. Specifically, this study investigated if whether a youth has a pet predicts specific co-occurring patterns of prosocial and negative social behaviors as well as size of friend network, and if these patterns are differential based on species of pet. We hypothesized that youth would cluster into different profiles of positive and negative peer social behaviors (i.e., prosocial behavior, aggressive behavior, and friend networks), and that these profiles would be differentially associated with pet ownership status. Specifically, we hypothesized that having a dog would be associated with more adaptive patterns of peer behaviors as compared to having non-dog/other pets or no pet at all, and that having a non-dog (other) pet would be associated with more adaptive profiles of peer behaviors as compared to no pet. Although we have no hypotheses based on demographic

variables, they are included in the analyses here in order to better understand the nuances of the relationship between pets and peer social behavior profile membership.

Method

Procedure

This study used data from the Adolescent Brain Cognitive Development (ABCD) Study®, a longitudinal study of brain development and youth health outcomes in the United States. The ABCD Study® is collecting annual and/or bi-annual physical, cognitive, social, emotional, environmental, behavioral, and academic assessments of youth over a ten-year period. A baseline cohort of 11,878 youth enrolled at 9-10 years of age, along with their parents/guardians; and participants are included in the study until they are 19 or 20 years old. Initial participants were recruited to participate in the ABCD Study® between July 2016 and August 2018. Recruitment areas were determined by locations of 21 study sites (catchment areas), which closely matched the sociodemographic composition of the United States population. Within the catchment areas, participants were recruited through school-based probability sampling, where schools within each area were coded based on geographic location and sociodemographic characteristics using data from the National Center for Education Statistics and converted into databases that were used to generate lists for random selection (Garavan et al., 2018). The sample target uses a slight oversampling of racial/ethnic minority youth to ensure a demographically diverse sample. For more information on recruitment see <https://abcdstudy.org/scientists/> and Garavan et al. (2018).

The overall data collection procedures for the ABCD Study® are comprehensive and well documented as part of the ABCD Study® documentation, see <https://abcdstudy.org/scientists/protocols/> and Garavan et al. (2018) for more information. The

analysis for this paper used self-report survey data from the 3 year follow up time point (Release 4.0). Due to the COVID-19 pandemic, most of the data collected for the 3-year follow-up were collected remotely, via video chat, tablet, or telephone. For the 3-year follow-up, ABCD Study® researchers collected a range of data related to physical health, mental health, substance use, neurocognition, culture and environment, mobile technology and other data sources, as well as biospecimens (for those who were in-person). The specific subset of self-report measures used in the analysis for this paper are reported below.

Participants

This study analyzed a subset of surveys from 6,251 participants who were included in the 3-year follow up data of the ABCD Annual Curated Release 4.0 (DOI: [10.15154/1523041](https://doi.org/10.15154/1523041)) and who completed the relevant survey measures. The final analytic sample included 5,218 participants, as some participants were missing data or responded “Don’t know” or “Refuse to answer” on certain measures (as shown in Table 1), and so were excluded from analyses. Demographics of the analytic sample are presented in Table 1.

Measures

Below we describe each construct and report sample items, ranges, means and standard deviations or frequencies where appropriate, and internal consistency for scales with multiple items. Following the recommendations of Trizano-Hermosilla and Alvarado (2016), reliability analysis was conducted using the omega coefficient, an alternative to Cronbach’s alpha (interpreted on the same scale and using the same general, field-dependent guidelines), which accounts for the skewed distribution of self-report prosocial behaviors, aggressive behaviors, number of friends, and number of delinquent friends.

Demographics and Companion Animals

Participants' parents/guardians were asked to identify their child's racial and ethnic identity, gender identity, and age. To capture the lived gender of participants (Bauer et al., 2017) and due to sample sizes in the categories, gender identity was combined into mutually exclusive analytic categories of: Male (Male, Trans male); Female (Female, Trans female); and Gender queer, other, don't know, refuse to answer, or missing. Due to sample size limitations, the gender category of 'Gender queer, other, don't know, refuse to answer, or missing' was not included in the regression models. Due to sample sizes in the categories, racial/ethnic identity was combined into non-mutually exclusive analytic categories of: White; Black/African American; Asian (Asian Indian, Chinese, Japanese, Vietnamese, Korean, Filipino); Indigenous (American Indian, Native American, Alaska Native); Other Race (Other Race, Native Hawaiian, Guamanian, Samoan, Other Pacific Islander); and Hispanic/Latinx. Participants' parents/guardians were also asked to report their total combined family income for the past 12 months. Income was reported in categories, with the following values: 1 = Less than \$5,000; 2 = \$5,000 through \$11,999; 3 = \$12,000 through \$15,999; 4 = \$16,000 through \$24,999; 5 = \$25,000 through \$34,999; 6 = \$35,000 through \$49,999; 7 = \$50,000 through \$74,999; 8 = \$75,000 through \$99,999; 9 = \$100,000 through \$199,999; 10 = \$200,000 and greater; 999 = Don't know; 777 = Refuse to answer.

Pet status was measured by asking youth participants if they had a pet, and if so, what kind of pet(s) did they have (dog, cat, horse, fish, small animal [e.g., rabbit, hamster, bird], or other; Jernigan et al., 2021). Overall, 4,794 participants (76.7% of the sample) reported currently having a pet. Species of pet was re-coded into three categories: no pet, dog (dog only or dog plus another pet), and non-dog pets (any pet other than a dog). The types of pets categorized in the "other pet" category included cats, horses, fish, small animals, and other. In the full sample,

1,945 (31.1%) report having a cat, 56 (0.9%) report having a horse, 688 (11%) report having a fish, 1,012 (16.2%) report having a small animal, and 357 (5.7%) report having another type of pet. See Table 1 for pet status stratified by demographic variables.

Prosocial Behavior

The Prosocial Behavior Survey is a subscale from the Strengths and Difficulties Questionnaire (Goodman et al., 1998). The Prosocial Behavior Survey assesses tendency to engage in behaviors to help others (i.e., “I try to be nice to other people. I care about their feelings,” “I am helpful if someone is hurt, upset, or feeling sick,” “I often offer to help others (parents, teachers, children)”). The ABCD Study® uses a shortened version of the Prosocial Behavior subscale from this instrument. The original subscale has five items and the ABCD Study® retained the three items with the highest factor loadings (Jernigan et al., 2021). Youth were asked to rate each item on a 3-point scale: 0 = Not True; 1 = Somewhat True; 2 = Certainly True. The three items were summed, with a max score of 6 and a minimum score of 0. The average score was 5.1 ($SD = 1.06$). The items had an omega coefficient of .62.

Delinquent Peer Involvement

Delinquent peer involvement was measured using the Rule Breaking/Delinquent Peer Involvement subscale of the Youth Peer Behavior Profile (Bingham et al., 1995, as cited in Jernigan et al., 2021). This subscale consists of a 3-item self-rated scale, which asks youth how many of their friends have engaged in certain behaviors associated with delinquency (e.g., skipped school, been suspended from school, shoplifted occasionally). The measure is scored based on a five-point scale: 1 = None or almost none; 2 = A few; 3 = Half; 4 = Most; 5 = All or almost all; 999 = Don't know. The average score was 1.18 ($SD = 0.33$). The items had an omega coefficient of .63.

Aggressive Behavior

To measure aggressive behavior towards peers, we used a subset of nine items from the Peer Experiences Questionnaire measuring whether the youth participant has perpetrated overt (physically or mentally harming others; e.g., “I threatened to hurt or beat up another kid”), relational (harming another through social relations; e.g., “I did not invite a kid to a party or other social event even though I knew the kid wanted to go”), or reputational (manipulating or damaging another’s social standing; e.g., “I gossiped about another kid so others would not like him/her”) aggression towards peers (Jernigan et al., 2021). Participants were asked to rate each item on a 5-point scale indicating how often they engaged in the behavior: 1 = Never; 2 = Once or twice; 3 = A few times; 4 = About once a week; 5 = A few times a week. Overt, relational, and reputational aggression subscales were calculated by averaging the three items in each subscale, and these had omega coefficients of .66, .66, and .68, respectively. The average scores for overt, relational, and reputational were 1.06 ($SD = 0.19$), 1.23 ($SD = 0.32$), and 1.04 ($SD = 0.15$), respectively. Fourteen (0.22%) participants were missing data for these measures. Inter-item correlations for each subscale ranged from 0.11 to 0.55 (see Supplemental Table 1).

Friend Network

The ABCD Study® asked youth participants to report the number of friends and close friends they have that are boys, girls, and another gender (e.g., nonbinary; Jernigan et al., 2021). Close friends were defined as “those you like spending time with, have fun with, and trust,” and the measure did not specify if friends were inside or outside of the school setting. Any values greater than 100 were truncated at 100. To aid with interpretability of the analysis, friend network counts were binned into five groups. For friends: 0 = 0 friends ($n = 33$, 0.5%); 1 = 1–9 friends ($n = 1,712$, 27.4%); 2 = 10–15 friends ($n = 1,621$, 25.9%); 3 = 16–25 friends ($n = 1,360$,

21.8%); 4 = 26 or more friends ($n = 1,525$, 24.4%). For close friends: 0 = 0 close friends ($n = 107$, 1.71%); 1 = 1–3 close friends ($n = 5,152$, 82.4%); 2 = 4–5 close friends ($n = 678$, 10.8%); 3 = 6–7 close friends ($n = 206$, 3.3%); 4 = 8 or more close friends ($n = 108$, 1.7%).

Inter-item correlations for the prosocial and peer behaviors measured in this study ranged from -0.19 to 0.43.

Data Analysis Plan

All statistical analyses were conducted using R (R Core Team, 2019) with additional packages (Aragon, 2020; Bernaards & Jennrich, 2005; Demin, 2022; Hothorn et al., 2008; Kassambara, 2020, 2021; Kuhn, 2022; Revelle, 2022; Rosenberg et al., 2018; Rosseel, 2012; Scrucca et al., 2016; Tierney et al., 2021; Venables & Ripley, 2002; Warnes et al., 2022; Wickham, 2011, 2021; Wickham et al., 2019; Wickham et al., 2022; Wickham & Girlich, 2022; Zeileis & Hothorn, 2002). The secondary data analysis plan for this study was preregistered on the Open Science Framework

(https://osf.io/5gx4z/?view_only=29c9913fc74c4488b290c0897ccda2a5).

We conducted a latent profile analysis (LPA) to identify subgroups of peer social behaviors using the following indicators: prosocial behavior; perpetrator behavior, number of friends, number of close friends, and number of delinquent friends. LPA is a person-centered modeling technique in which participants' scores on indicators are allowed to cluster together to identify latent sub-groups in the population. There are two considerations for final model selection: variance/covariance structure (i.e., whether the variance around the mean of each variable should be held equal or allowed to vary and whether the variables should be allowed to covary) and enumeration (i.e., number of profiles). The R package mclust with tidyLPA interface (Scrucca et al., 2016) was used to conduct the analysis.

For the model selection we first examined model fit statistics, including approximate likelihood ratio tests such as the BLRT, which tests whether a model with k profiles provides a statistically significant improvement in model fit compared to a model with $k - 1$ profiles, and the BIC, in which lower scores indicate improved model fit. We also examined entropy, which is an index of the accuracy with which individuals are placed into latent classes based on the posterior probabilities of class membership. Entropy values can range from 0 to 1, with values near 1 indicating completely discrete classes (van de Schoot et al., 2017). We also considered the size (i.e., proportion of the sample in each class) and number of profiles, with preference for parsimony and interpretability.

Regarding model structure, the least computationally intensive model specification is to hold variances equal and restrict covariation, but relaxing these restrictions may better reflect reality (i.e., it is more likely that variables in a profile covary and variances are unequal across profiles; Johnson, 2021). The *mclust* package in R compares relative fit indices for four combinations of variance/covariance structures (variances equal or unequal; covariances freed or constrained to zero) and provides a recommendation for the best-fitting model.

Once the number and structure of the profiles were determined, participants' individual class probabilities were then used to specify their probability of membership into each latent profile. Finally, the covariates were regressed on the most likely class membership using multinomial logistic regression. Covariates included participants' race, income, age, gender, and pet ownership status. Pet status was examined as a categorical variable with three levels: dogs, non-dog pets, and no pets.

Interactions between pet status and demographic covariates of age, income, and gender were included in the regression models. Interactions between pet status and racial/ethnic identity

interaction effects were not included due to small sample sizes in each cell. For parsimony, the final multinomial logistic regression models retained only the gender x pet status interaction as none of the other interaction terms were significant ($p < .05$). For interaction effects, we examined odds ratios to help us interpret the magnitude of the effect. Using the estimates of the coefficients from the logistic regression models, we calculated the odds of moving from the referent group to the comparison group for each outcome of interest following recommendations by Chen (2003).

Prior to analysis, data were cleaned for analysis and inspected for the standard statistical assumptions, including: (1) independence of observations (assessed using the Durbin-Watson statistic); (2) a linear relationship between the dependent and independent variables (assessed using the Box-Tidwell approach for logistic regression); (3) homoscedasticity of residual plots; (4) normal distribution of residuals (assessed using a histogram of the standardized residuals, and the normal probability plot (P-P)); (5) multicollinearity between independent variables (tested by inspecting correlation coefficients).

Results

The first step in our analysis was the multivariate mixture model, or latent profile analysis. As these analyses were largely exploratory, we allowed the model structure selection fit indices to drive our decision about which of the four common variance/covariance structures (variances equal or unequal; covariances freed or constrained to zero) were most appropriate for these data. We selected the model with equal variances and covariances fixed to zero, as it was the best-fitting model for these data according to the BIC and yielded a more favorable class enumeration solution in terms of entropy, class sizes, and interpretability. The model with variances and covariances allowed to vary within and between classes did not converge.

Next, we examined latent profiles for one through nine classes and determined that a four-class multivariate mixture model with equal variance was favorable in terms of entropy, class sizes, and interpretability. Table 2 reports these values for the model. Although the 5-class model had a lower BIC than the 4-class, we chose the 4-class solution due to higher entropy and higher minimum probability of class membership, which suggested better class separation. Correlations between prosocial and peer variables can be found in Table 3.

The mean scores of prosocial and peer variables separated by profile can be found in Table 4 and Figure 1. The profiles clearly describe distinct groups of participants. The majority of participants (62%) fell into one profile, which we will refer to as the ‘Typical’ profile, categorized by high prosocial behaviors, low peer aggression, and having an average number of friends. The second profile (14% of the sample) characterized overall highly prosocial youth, who had high scores on prosocial behaviors, many friends, and low aggressive behaviors, which we will refer to as the ‘High Friends’ profile. It should be noted that “high friends” in the context of this study refers to the size of the friend group. These two profiles appear to be indicative of youth who are engaging in largely positive prosocial and peer behaviors. The third profile (19% of the sample) included youth who reported low peer aggression and had an average number of friends, but also reported engaging in fewer prosocial behaviors (‘Low Prosocial’). The final profile (5%) characterizes the least adaptive cluster of behaviors, with moderate prosocial behaviors and higher reported peer aggression, with an average sized friend group (‘High Aggression’).

Table 5 shows the estimates and odds ratios (OR) for the multinomial logistic regression model predicting class membership from pet status, controlling for demographic characteristics including race/ethnicity, gender, income, and age. The Nagelkerke pseudo R^2 indicated that the

model accounted for 5% of the total variance, and model classification accuracy was 62%, suggesting adequate model fit. These results indicated that controlling for racial/ethnic identity, age, family income, and gender, having a pet was not associated with odds of membership in either the Low Prosocial or High Friends profiles as compared to the Typical profile (see Table 5). In addition, there was no significant association between having a pet and likelihood of being in the High Aggression profile as compared to the Typical profile.

However, there was a significant interaction between gender and pet status in predicting likelihood of being in the High Aggression profile. For female adolescents, those with no pets were almost twice as likely ($OR = 1.97$) to be in the High Aggression profile as compared to those with dogs. Similarly, females who had non-dog pets were 2.37 times more likely to be in the High Aggression profile as compared to those with dogs. There was no association between pet status and odds of being in the High Aggression profile for male youth (see Table 5). These results suggest a potentially protective relationship for female youth with dogs on likelihood of engaging in aggressive behaviors towards peers, or alternatively that female youth who engage in aggressive behaviors towards peers are less likely to have dogs living in their home.

Discussion

The aim of this study was to assess the relationship between having a pet (including pet species) and profiles of prosocial and peer behaviors in early adolescence. We hypothesized that youth would cluster into different profiles of peer social behavior, and that these profiles would be differentially associated with pet status, prosocial behavior, aggressive behavior, and friend networks. We specifically hypothesized that having a dog would be associated with more adaptive patterns of peer behaviors as compared to having a non-dog pet or no pet; and that

having a non-dog (other) pet would be associated with more adaptive profiles of peer behaviors as compared to not having a pet.

Results indicated partial support for our hypotheses; we found that youth did cluster into different distinct profiles of peer social behavior, and that pet status was associated with profile membership. Specifically, we found that having a pet was associated with lower likelihood of membership in the High Aggression profile for female youth. However, having a pet was not significantly associated with the likelihood of youth being in the most adaptive High Friends profile, or the Low Prosocial as compared to the Typical profile. Overall, the results suggest that companion animal relationships are ideographic and may not impact peer social behavior or network size for all youth, but having a dog could be protective for female youth in particular in terms of aggressive behavior. However, these relationships are not directional or causal due to the cross-sectional nature of the data and should be explored further in future research.

We did not find any significant differences based on having a pet (either dog or other pet) and likelihood of being in the High Friends group. This lack of difference between groups indicates that pet ownership does not predict friend network size. One key factor that may be driving these null results is the absence of a measure of emotional attachment to pets, as attachment—as opposed to pet ownership alone—was found to be related with peer network size (Black, 2012). Additionally, because companion animals can play a role in facilitating social interactions, it is possible that adolescents without pets interact with peers who have pets, and so benefit from the same effects of pet ownership. Further research is needed in this area, however, as we do not have access to emotional attachment to pets or the number of pets owned by peers of participants.

The findings also suggest that having a dog/other pet ownership does not predict prosocial behaviors, again suggesting that if any relationship does exist between pet ownership and prosocial behaviors, relationship quality may be a key factor to assess (Vidović et al., 1999; Wenden et al., 2021; Wice et al., 2020). Further, contrary to what prior research has indicated (e.g., Daly & Morton, 2003; Vidović et al., 1999), we did not find significant differences between pet species and prosocial behavior.

The results support the idea that companion animal interactions are idiographic and not beneficial for all youth, further strengthening the rationale for future research to employ person-centered analyses. Regardless of whether they had a pet or not, female participants are less likely to be in the high aggression profile, compared to the typical profile, which aligns with previously reported research (e.g., Björkqvist, 2018; Perry & Pauletti, 2011; Quenneville et al., 2022). Males have the same likelihood of being in the high aggression profile as the typical profile, whether they have a dog, other pet, or no pet. Although female participants are generally less likely to be in the high aggression profile compared to the typical profile, non-pet and other pet-owning female participants are significantly more likely to be in the high aggression profile compared to dog-owning participants.

These findings could indicate that the relationship between dogs and female youth with dogs is protective against aggression, possibly through regular interactions that model empathy. Prior research has found gendered differences in relationship quality/emotional attachment to pets (e.g., Cassels et al., 2017; Vidović et al., 1999); it is possible that if female youth are more highly attached to their pets, they will be less likely to engage in aggressive behaviors. However, our findings do not establish causality, and an alternative explanation is that female participants who are aggressive are less likely to have dogs in the first place (e.g., if parents don't think the

pet will have a good relationship with their aggressive child), removing any possibility for these empathy-like interactions. It could also be possible that female participants who are aggressive gravitate towards other types of pets; however, any species-level differences will need to be explored in future research. The relationship between demographic variables and peer social behaviors are worthy of exploration in future studies. Due to the exploratory nature of this research, and because this study did not have specific hypotheses related to demographic variables, the results should not be overinterpreted, and should instead be used to guide future research.

Finally, there are contextual factors outside of the scope of this research that have produced this association. For example, residential mobility (i.e., moving houses) has been associated with negative behaviors among adolescents (Cotton, 2016). If a participant and their family often move houses, it could be that they are unable to own dogs, or are forced to relinquish their pets. The role of pets in preventing aggressive, peer-focused bullying behavior has not been explored extensively, and these results suggest it could be an area worth future inquiry.

The specific bond with and attachment to pets has been shown to be an important factor in shaping the impact of pets on children and adolescence (e.g., Charmaraman et al., 2020; Marsa-Sambola et al., 2017). However, the emotional connection between adolescents and their pets weakens as youth get older (Muldoon et al., 2019). Furthermore, older children had similar attachment quality regardless of pet species, which could indicate that there is an initial preference for pets such as dogs and cats that changes over time as children enter puberty (Hirschenhauser et al., 2017). Additionally, the human relationships of youth change over time; for example, as youth move from childhood into adolescence, peer relationships become more

salient (Brown & Larson, 2009; Smetana et al., 2006). We did find that youth were increasingly likely to be in the high aggression profile compared to the typical profile as they got older, suggesting that the relationship between age, pet attachment, and peer interactions should be explored in future research that is longitudinal and has a wider age distribution of participants. Additionally, there is a body of literature that focuses on youth who display both high levels of aggression and prosocial behaviors and use the combinations of these behaviors for reaching specific status goals (see Hartl et al., 2020; Hawley, 2003). The high aggressive profile found in this study did not mirror these characteristics specifically (demonstrating moderate but not high levels of prosocial behaviors), but these types of bi-strategic controller profiles should be explored more in the future in the context of pet ownership.

Limitations

Although one of the strengths of this study is a large, nationally-representative dataset, there were several limitations to the sample. Crucially, this study did not assess the bonds between participants and their pets. Previously conducted research has reported that presence of a pet in the home alone may not fully capture the effects that companion animals may have on humans (Jacobson & Chang, 2018; Julius et al., 2012; Melson et al., 1991; Wice et al., 2020). Relying on companion animal ownership alone does not account for the immense complexities in the relationship between humans and companion animals, and the variability inherent in different types of relationships (e.g., family dog vs. guard dog), and could be one of the causes of mixed findings reported previously in the literature (Rodriguez et al., 2021). For theoretical reasons and based on prior literature, we focused on comparisons between dog owners and other species of pets; however there may be variations within these other species that should be explored in future research. Additionally, although the dataset used in this analysis is large, the

data are still limited by their cross-sectional nature, and studies of this type, shared method variance is often a significant limitation. As the ABCD Study® continues to collect longitudinal data on these measures, we hope to revisit these measures over time to continue exploring the effects of companion animal ownership over the course of adolescent development.

There were also limitations to the existing measures; the reliability analysis suggested relatively low (although still acceptable) reliability coefficients for several of the outcome measures. We also had to collapse several racial/ethnic and gender identity categories due to small cell sizes, which reduces our ability to assess the unique experiences of diverse youth. There were also a number of youth who reported that they did not know if their peers were engaging in delinquent behaviors, limiting the predictive utility of that variable. Additionally, we were not able to measure the strength of peer networks, instead relying solely on self-reported network size; as although number of close friends could be an indication of relationship quality (which could indicate more meaningful relationships and impact on outcomes), it is not an explicit measurement of quality. Furthermore, the data used in these analyses were collected during the COVID-19 pandemic—a time during which in-person interactions were limited—as such, reported information related to friend network could have been impacted.

Conclusions

Despite these limitations, this study was innovative in using a large, nationally representative sample of youth, finding that pet status predicted likelihood of membership in the High Aggression profile for female youth. Future research should explore how male and female youth engage with their pets—both in terms of frequency of interactions as well as relationship quality/emotional attachment—as well as examine these relationships over time to assess causality. Furthermore, future research could also investigate how parents may attempt to

model/encourage empathetic behaviors through dog relationships, especially for parents of highly aggressive female children.

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Table 1*Demographic Covariates Stratified by Pet Ownership Status*

	Total Sample <i>n</i> = 6,251 <i>M</i> (<i>SD</i>)	No Pet <i>n</i> = 1,457 <i>M</i> (<i>SD</i>)	Dog Owners <i>n</i> = 3,520 <i>M</i> (<i>SD</i>)	Non-Dog Pet Owners <i>n</i> = 1,274 <i>M</i> (<i>SD</i>)
Age (years)†	12.43 (0.68)	12.42 (0.67)	12.44 (0.69)	12.4 (0.68)
Family Income‡	7.76 (2.16)	7.1 (2.45)	8.0 (1.99)	7.78 (2.13)
Gender	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Male	3,256 (52.1)	824 (56.6)	1,797 (51.1)	635 (49.8)
Female	2,866 (45.8)	614 (42.1)	1,660 (47.2)	592 (46.5)
Gender queer, other, don't know, refuse to answer, or missing	129 (2.4)	19 (1.3)	63 (1.8)	47 (3.7)
Race/Ethnicity§	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Asian	395 (6.3)	120 (8.2)	168 (4.8)	107 (8.4)
Black/African American	976 (15.6)	450 (30.9)	367 (10.4)	159 (12.5)
Indigenous	220 (3.5)	36 (2.5)	143 (4.1)	41 (3.2)
Other Race	415 (6.6)	121 (8.3)	221 (6.3)	73 (5.7)
White	4,974 (79.6)	885 (60.7)	3,017 (85.7)	1,072 (84.1)
Hispanic/ Latinx¶	1,208 (19.3)	324 (22.2)	651 (18.5)	233 (18.3)

Note. Racial/ethnic identity groups are not mutually exclusive.

† 82 participants missing data

‡ 517 participants missing data or responded with “Don’t know” or “Refuse to answer”

§ 75 participants missing data or responded with “Don’t know,” or “Refuse to answer”

¶ 85 participants missing data or responded with “Don’t know” or “Refuse to answer”

Table 2

Relative Fit Statistics, Entropy, Class Membership Probability Ranges, Sample Proportion Ranges, and Test of $k-1$ Model Improvement (BLRT p -value) for Latent Profile Analysis with 1 through 9 Classes.

Classes	AIC	BIC	Entropy	Probability Range	Sample Proportion Range	BLRT p -value
1	38485.21	38577.04	1	1-1	1-1	
2	36194.51	36338.83	0.9	0.98-0.99	0.47-0.53	0.01
3	30670.79	30867.58	0.91	0.94-1	0.05-0.74	0.01
4	27434.75	27684.03	0.9	0.92-1	0.05-0.62	0.01
5	26980.52	27282.27	0.84	0.67-0.99	0.05-0.44	0.01
6	26996.64	27350.88	0.69	0-1	0-0.40	0.19
7	27015.2	27421.91	0.67	0-1	0-0.41	0.01
8	24088.72	24547.91	0.69	0-1	0-0.41	0.01
9	24104.78	24616.45	0.63	0-1	0-0.28	0.01

Note. Bold indicates selected model.

Table 3*Correlation Matrix for Prosocial and Peer Behaviors*

	<i>Prosocial</i>	<i>Overt</i>	<i>Reputational</i>	<i>Relational</i>	<i>Friends</i>	<i>Close friends</i>	<i>Delinquent friends</i>
<i>Prosocial</i>	—						
<i>Overt</i>	<i>-0.19****</i>	—					
<i>Reputational</i>	<i>-0.13****</i>	<i>0.33****</i>	—				
<i>Relational</i>	<i>-0.17****</i>	<i>0.31****</i>	<i>0.38****</i>	—			
<i>Friends</i>	<i>0.096****</i>	<i>0.056****</i>	<i>0.064****</i>	<i>0.12****</i>	—		
<i>Close friends</i>	<i>0.082****</i>	<i>0.028*</i>	<i>0.026</i>	<i>0.045**</i>	<i>0.43****</i>	—	
<i>Delinquent friends</i>	<i>-0.17****</i>	<i>0.31****</i>	<i>0.22****</i>	<i>0.19****</i>	<i>0.17****</i>	<i>0.12****</i>	—

p < .05. **p < .001. **p < .0001.*

Table 4*Average Prosocial, Friend network, Delinquency, and Peer Aggression Scores by Profile*

	Prosocial	Friends	Close Friends	Delinquent Friends	Relational Aggression	Reputational Aggression	Overt Aggression
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
Low Prosocial (19%) <i>n</i> = 990	3.58 (0.62)	2.11 (1.09)	1.01 (0.27)	1.2 (0.32)	1.26 (0.34)	1.05 (0.15)	1.03 (0.08)
High Friends (14%) <i>n</i> = 725	5.49 (0.75)	3.66 (0.59)	2.46 (0.69)	1.23 (0.36)	1.24 (0.33)	1.03 (0.12)	1.02 (0.08)
High Aggression (5%) <i>n</i> = 270	4.39 (1.27)	2.64 (1.15)	1.22 (0.56)	1.56 (0.59)	1.61 (0.44)	1.24 (0.37)	1.72 (0.29)
Typical (62%) <i>n</i> = 3,233	5.66 (0.47)	2.26 (1.07)	1 (0.13)	1.13 (0.28)	1.18 (0.27)	1.02 (0.1)	1.01 (0.06)
Total <i>n</i> = 5,218	5.18 (1.03)	2.44 (1.14)	1.22 (0.6)	1.18 (0.33)	1.23 (0.32)	1.04 (0.15)	1.05 (0.18)

Table 5*Multinomial Logistic Regression Results for Pet Ownership Predicting Profile Membership*

	High Friends vs. Typical				Low Prosocial vs. Typical				High Aggression vs. Typical			
	Estimate	SE	OR†	p-value	Estimate	SE	OR†	p-value	Estimate	SE	OR†	p-value
(Intercept)	-2.54	0.83		.002	-0.47	0.74		.520	-4.52	1.33		.001
No Pet‡	-0.29	0.15	0.75	.057	-0.04	0.12	0.97	.780	-0.31	0.21	0.73	.143
Other Pet‡	-0.16	0.17	0.86	.346	0.12	0.14	1.13	.381	-0.03	0.22	0.97	.893
White	-0.03	0.16	0.98	.878	-0.37	0.14	0.69	.009	0.07	0.25	1.07	.770
Black/African American	0.48	0.17	1.62	.003	0.06	0.15	1.07	.674	0.98	0.23	2.65	<.001
Hispanic/ Latinx	0.01	0.13	1.01	.930	0.14	0.11	1.15	.215	-0.15	0.21	0.86	.474
Asian	0.40	0.17	1.49	.021	0.28	0.16	1.32	.080	-0.46	0.38	0.63	.225
Indigenous	-0.16	0.26	0.85	.525	0.12	0.21	1.12	.579	0.43	0.32	1.54	.179
Other Race	-0.13	0.23	0.88	.577	0.04	0.18	1.04	.822	0.20	0.33	1.22	.555
Age (years)	0.11	0.06	1.11	.103	0.02	0.06	1.02	.724	0.23	0.10	1.26	.026
Family Income	-0.01	0.02	0.99	.653	-0.06	0.02	0.95	.007	-0.07	0.04	0.93	.031
Female	-0.33	0.11	0.72	.004	-0.78	0.11	0.46	<.001	-1.50	0.23	0.22	<.001
No Pet x Female	0.19	0.22	1.21	.389	0.27	0.19	1.31	.170	0.99	0.36	2.69	.006
Other Pet x Female	-0.04	0.23	0.96	.877	0.15	0.20	1.16	.473	0.89	0.37	2.44	.016

†Odds ratio

‡Dog ownership is the referent group

Figure 1

Average Prosocial, Friend network, Delinquency, and Peer Aggression Scores by Profile

