

**Effects of Human-Animal Interaction on Positive Youth Development: A Replication Study**

Allison Pachunka<sup>1</sup>, Jay Jeffries<sup>2</sup>, Lisa Karr<sup>1</sup>, Lena Luck<sup>1</sup>, Bryan A. Reiling<sup>1</sup>, Douglas H. Schultz<sup>3,4</sup>, and Jeffrey R. Stevens<sup>3,4</sup>


<sup>1</sup>Department of Animal Science, University of Nebraska-Lincoln, Lincoln, Nebraska USA


<sup>2</sup>Department of Educational Psychology, University of Nebraska-Lincoln


<sup>3</sup>Department of Psychology, University of Nebraska-Lincoln


<sup>4</sup>Center for Brain, Biology & Behavior, University of Nebraska-Lincoln


**Author Note**


Allison Pachunka  <http://orcid.org/0009-0000-3510-8618>


Jay Jeffries  <http://orcid.org/0000-0003-1105-1463>

Lisa Karr  <http://orcid.org/0009-0004-1798-2554>

Lena Luck  <http://orcid.org/0009-0005-8264-6386>

Bryan A. Reiling  <http://orcid.org/0000-0002-5913-0614>

Douglas H. Schultz  <http://orcid.org/0000-0003-0809-9036>

Jeffrey R. Stevens  <http://orcid.org/0000-0003-2375-1360>

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Correspondence concerning this article should be addressed to Jeffrey R. Stevens, Department of Psychology, University of Nebraska-Lincoln, Email: [jeffrey.r.stevens@gmail.com](mailto:jeffrey.r.stevens@gmail.com)

**Abstract**

Interacting with animals can improve health and well-being across the lifespan. Some programs such as 4-H and FFA center around youth interacting with animals, potentially enhancing youth development. Mueller (2014) investigated whether these interactions and attitudes about animals influenced measures of positive youth development. The aim of our studies was to replicate Mueller's methods and extend her work by evaluating whether membership in animal-focused youth programs moderate associations between interactions, attitudes, and positive youth development. We did not find strong relationships among human-animal interaction and positive youth development, which failed to replicate Mueller's findings. However, we did find relationships between animal attitudes and positive youth development. Membership in animal-focused youth programs did not moderate observed effects. Thus, though animal attitudes are associated with positive youth development, membership in a youth program does not enhance these relationships, and human-animal interactions do not have strong associations with positive youth development.

*Keywords:* animal attitudes, attachment, commitment, human-animal interaction, positive youth development

The interaction between humans and animals can serve many functions including companionship, labor, and food. Understanding the various facets that contribute to these interactions can improve the potential benefits of these relationships. Animal interactions play key roles in the development of children by increasing their empathy (Daly & Morton, 2006), decreasing loneliness (Piper & Uttley, 2019), supplying social support or a social buffer (Beetz et al., 2011; O’Haire, 2010), and granting an outlet to perform nurturing behaviors (Melson, 2003). Current literature, however, provides inconsistent conclusions about how human-animal interactions (HAI) lead to perceived benefits. These inconsistencies highlight the context in which individuals interact with animals (Overton, 2010).

Understanding the context of animal interactions is crucial, especially for programs such as 4-H and FFA. 4-H and FFA are youth development programs in the United States that provide hands-on training and experiences to help promote success later in life. Both programs often use animals to facilitate positive youth development. The framework of *positive youth development* emphasizes the person-context relations found in developmental systems theories (Damon, 2004; Lerner et al., 2005a; Jellicic et al., 2007; Lerner et al., 2005b), which views an individual as a collection of interacting systems that affect the environment as the environment mutually affects the system (Overton, 2010). Positive youth development is composed of the Five Cs (competence, connection, confidence, character, and caring), plus the ‘sixth C’ of contribution (we refer to the combination of these as the Six Cs). Each of these constructs captures important components of positive youth development.

Limited research has connected human-animal interaction and positive youth development. However, Mueller (2014) did examine this relationship by surveying participants in a wave of the ‘4-H Study of Positive Youth Development’. She included measures of human-animal interactions (experience with different types of interactions with animals), animal attitudes (related to animal attachment, commitment, and use), positive youth development, and well-being to investigate the relationship between interactions with animals and any positive developmental outcomes.

Mueller (2014) found that individuals who were involved in animal-related activities or owned an animal were more active in their community. In addition, she found relationships among positive youth development and various measures of animal attachment, commitment, and perception of animal use.

### Research Question

Our current research attempted to replicate and extend Mueller’s (2014) study to examine whether human-animal interaction influences positive youth development in individuals that have interacted with animals during a youth development program such as 4-H or FFA. In two studies, we replicated Mueller’s methods by measuring aspects of human-animal interaction, animal attitudes, positive youth development, and well-being in undergraduate samples. We replicated Mueller’s analyses to test the same research questions. We then extended the work by categorizing whether the participants were members of 4-H or FFA youth programs to determine if organizational membership influences potential effects of human-animal interaction on positive youth development.

### Methods

We conducted two studies with separate online, cross-sectional surveys to identify potential factors related to outcomes of positive youth development. Though the first study was

based on Mueller's methods, we did not have access to all measures used in the original study. For Study 2, we had access to the original study materials, so we used measures more similar to Mueller's original study.

## Study 1

### *Participants*

We recruited 432 undergraduate students enrolled at the University of Nebraska-Lincoln in the College of Agricultural Sciences and Natural Resources and the Department of Psychology as study participants (Table S1). To approximate Mueller's sample, we restricted participation to those between 17-24 years of age. Of the participants, 81.7% identified as woman/female, 16.7% identified as man/male, and 1.4% identified as neither/both. The participants self-reported as 9.3% Latina/o/x or Hispanic, 4.9% African American/Black, 2.1% Native American/American Indian/Indigenous, 1.4% Middle Eastern/Arab/Turkish/Iranian, 4.9% Asian/Asian American/Pacific Islander, 84.3% White/European American, and 2.8% Biracial/multiracial. Participants indicated that 31.5% of the sample grew up in rural areas, 29.9% in suburban areas, 32.2% in small to medium sized cities, and 6.5% in large cities. Lastly, 31.9% of the sample reported 4-H and/or FFA experience, and 59.3% currently had an animal at home.

### *Procedure*

We recruited participants differently in the Agriculture and Psychology samples from March to May 2022. The Agriculture students received the digital survey through email listservs and received a \$10 Visa gift card as compensation. We collected data from 239 Agriculture students after aiming for 200 participants. Psychology students were recruited through the Department of Psychology study pool (SONA). Psychology students could voluntarily select this study to receive course credit. We collected data from 193 Psychology students after running the study through the end of the semester.

### *Measures*

The survey, administered through Qualtrics, consisted of sections regarding animal experience and interactions, attitudes towards animals, 4-H and FFA experience, positive youth development outcomes, well-being measures, and demographics.

**Animal experience and interactions.** Participants first reported their experience with animals by ranking how much experience they had with a list of species (i.e., dog, cat, fish, bird, rabbit, ferret, small rodent, reptile, horse, cow, pig, goat, sheep, llama, and poultry). After assessing their experience with each animal on a five-point Likert scale, from *None at all* to *A great deal*, participants selected one animal from the list to use as their focus for the remaining questions. They were asked to choose the animal that they had the greatest experience with or that they viewed as the most important. They then categorized whether they considered the animal to be a companion or livestock animal before reporting how much time they spent in various interactions with their animal (responses could be *None at all*, *Once per month*, *Twice per month*, *Once per week*, *Two to three times per week*, or *Daily*). To match Mueller's (2014) measure of the *amount of care* given to the animal, we calculated the mean score for feeding, cleaning, grooming, and training.

For the other activities, we converted the responses to numbers of days per month (0, 1, 2, 4, 12, or 30) for analysis. We then summed the scores across petting/playing, engaging in therapy sessions, riding/handling, and shows/competitions to generate the *frequency of activities*. This score was akin to Mueller's (2014) intensity of activities measure, though our activities and

frequency scale were slightly different (Mueller included participation in animal clubs, whereas we included petting/playing with their animal). To match Mueller's models, we dichotomized the frequency measure into *presence of activities*, that is, they had some type of animal-related activities or none.

Participants reported their *animal ownership* by stating whether they have a pet/companion or livestock animal at their current residence (*Pet/companion animal*, *Livestock*, *Pet/companion animal and livestock*, or *Neither*) and if they have ever been prescribed with an emotional support animal.

**Animal attitudes.** We assessed attitudes toward animals (Mueller's (2014) "cognition and emotions regarding animals") by measuring animal attachment, commitment, and perceptions of animal use (Mueller's "moral orientation"). Two scales measured emotional attachment to one's animals, including the 11-item Comfort from Companion Animals Scale (CCAS, Zasloff, 1996) and an adapted 11-item version of the Lexington Attachment to Pets Scale (LAPS, Johnson et al., 1992). Items within both scales were adjusted to better fit general animal ownership rather than specifically pet ownership (typically by replacing 'pet' with 'animal'). Participants were asked, while thinking of the specific animal they selected, 'How much do you agree or disagree with the following?' with response options listed on a five-point Likert scale ranging from *Strongly Disagree* to *Strongly Agree*. The CCAS responses had a Cronbach's  $\alpha$  of 0.94 and the LAPS responses had a Cronbach's  $\alpha$  of 0.92. These two scales were combined to represent the measure of *attachment*.

The Miller-Rada Commitment to Pets Scale (MRCPS, Staats et al., 1996) determined one's emotional and financial commitment to animals. This scale presented four scenarios, such as an animal destroying personal belongings, and asked participants if they would surrender the animal. Participants were prompted with the questions, asked to rate their agreement, and given a five-point Likert scale ranging from *Strongly Disagree* to *Strongly Agree* for each item on these scales. The MRCPS responses had a Cronbach's  $\alpha$  of 0.88 for the measure of *commitment*.

The Animal Attitude Scale (AAS, Herzog et al., 2015) evaluated one's perception of uses of animals. This 10-item scale included different uses of animals such as animal consumption or medical research. Participants were prompted with the questions, asked to rate their agreement, and given a five-point Likert scale ranging from *Strongly Disagree* to *Strongly Agree* for each item on these scales. The AAS responses had a Cronbach's  $\alpha$  of 0.84 for the measure of *perception of animal use* (Mueller's (2014) "moral orientation").

**Youth program experience.** Participants reported whether they have participated in 4-H or FFA (*4-H*, *FFA*, *4-H and FFA*, or *Neither*). If they had participated, they reported how many years they were active in the organization, whether they participated in animal-based projects, and whether they had shown animals in competitions. If they reported participating in animal-based projects, they reported whether this taught them various things such as responsibility, compassion, and respect on a five-point Likert scale from *None at all* to *A great deal*.

**Positive youth development.** Participants completed the Positive Youth Development Short Form (Lerner et al., 2005a; Phelps et al., 2009; Bowers et al., 2010; Geldhof et al., 2014), which measured five outcomes of positive youth development (the Five Cs): competence, connection, confidence, character, and caring. We asked participants 'How much are the following statements like you', with 34 questions presented on a five-point Likert scale ranging from *Not at all like me* to *Just like me*. Along with this, a 12-item Contribution scale (Mueller, 2014) gauged participation in activities such as volunteering or other community involvement.

The questions for all Six Cs (competence, connection, confidence, character, caring, contribution) were created from the Profiles of Student Life-Attitudes and Behaviors (PSL-AB, [Benson et al., 1998](#)), the Self-Perception Profile for Adolescents ([Harter, 1988](#)), the Teen Assessment Project (TAP, [Small & Rodgers, 1995](#)), the Empathic Concern Subscale of the Interpersonal Reactivity Index ([Davis, 1980](#)), and the Eisenberg Sympathy Scale ([Eisenberg et al., 1996](#)). Cronbach's  $\alpha$  for each of the Six Cs were *caring*  $\alpha = 0.87$ , *character*  $\alpha = 0.74$ , *competence*  $\alpha = 0.77$ , *confidence*  $\alpha = 0.91$ , *connection*  $\alpha = 0.84$ , and *contribution*  $\alpha = 0.76$ .

**Depression, anxiety, and demographics.** Participants completed the 20-item Center for Epidemiological Studies Depression scale (CESD, [Radloff, 1977](#)), where they reported how often they felt a particular way in the past week from *Rarely or none of the time* (less than 1 day) to *Most or all of the time* (5-7 days). The CESD responses had a Cronbach's  $\alpha$  of 0.92 for the measure of *depression*.

They also completed the 20-item State-Trait Anxiety Inventory – Trait scale (STAIT, [Spielberger, 1983](#)), where they rated how often they felt certain things about themselves with a 4-point scale from *Rarely or none of the time* to *Most or all of the time*. The STAIT responses had a Cronbach's  $\alpha$  of 0.93.

Lastly, participants reported demographics including gender, race/ethnicity, and community growing up (*Rural, Suburban, or Urban*), relationship status, and total parental income.

## Study 2

### Participants

We recruited 265 undergraduate students enrolled at the University of Nebraska-Lincoln in College of Agricultural Sciences and Natural Resources and the Department of Psychology as the study participants (Table S1). Participants reported that 75.8% of the sample identified as woman/female, 21.9% identified as man/male, and 2.3% identified as neither/both. The participants self-reported as 7.2% Latina/o/x or Hispanic, 4.2% African American/Black, 0.8% Native American/American Indian/Indigenous, 0.8% Middle Eastern/Arab/Turkish/Iranian, 4.9% Asian/Asian American/Pacific Islander, 88.3% White/European American, and 2.3% Biracial/multiracial. In addition, 41.1% of the sample grew up in rural areas, 22.6% in suburban areas, 27.2% in small to medium sized cities, and 9.1% in large cities. Lastly, 41.1% of the sample reported 4-H and/or FFA experience, and 83.8% currently had an animal at home.

### Procedure

We collected data from participants in three batches, totaling 265 participants. The first batch ( $N = 82$ ) recruited Agriculture freshmen students (to avoid resampling participants from Study 1) in June 2023 through email listservs. Participants received a \$10 Visa gift card upon completing the survey. Because of the low sample size, statistical model fit was inadequate, necessitating additional data collection. The second batch ( $N = 84$ ) recruited Agriculture students in two Animal Science courses (primarily freshmen) for course credit in January and February 2024. Duplicate participants from the first batch and Study 1 were removed. The third batch ( $N = 99$ ) recruited participants from the Department of Psychology SONA study pool from January to March 2024. Participants received course credit and could not enroll in this study if they completed Study 1.

### Measures

This survey also used Qualtrics and was similar to Study 1 but followed the measures of Mueller ([2014](#)) more closely, as we requested and received access to the research materials.



**Animal experience and interactions.** This survey recorded the presence of *animal ownership* of any animals and what kind of animal. They chose any that applied from the list of a dog, cat, horse, a group of small animals (fish, bird, rabbit, or small rodent), livestock (cow, pig, goat, or other large animal), or other (they were asked to specify). To gain an understanding of the *amount of care* provided to the owned animal(s), they reported how often they are responsible for its care from *Almost always* to *Almost never*. Unlike in Study 1, they were not asked to focus on a single animal for the subsequent questions.

All participants reported how often they participate in activities, including horseback riding, dog showing or livestock competitions, animal-related club or extracurricular activity, and volunteering in an animal shelter or animal therapy program (matching Mueller's measures of activities). Responses could be *Never or Rarely*, *Once a month*, *Twice a month*, *Once a week*, *Twice a week*, or *Almost every day*. These activities and frequencies matched Mueller's (2014) methods, so we summed the number of days per month across all items to generate the *frequency of activities* and dichotomized the scores into 0 and 1 or more activities for *presence of activities*.

**Animal attitudes.** Participants responded to six modified questions from the CCAS and LAPS scales to measure emotional attachment towards their animal(s) (Johnson et al., 1992; Zasloff, 1996), four modified questions from the MRCPS to evaluate commitment to ownership (Staats et al., 1996), and six modified questions from the AAS to evaluate perception of animal use (Herzog et al., 2015). Participants reported agreement on a 5-point scale from *Strongly Agree* to *Strongly Disagree*, or a sixth option for the attachment questions was *Does Not Apply*. Cronbach's  $\alpha$  for these measures were *attachment*  $\alpha = 0.90$ , *commitment*  $\alpha = 0.89$ , *perception of animal use*  $\alpha = 0.81$ .

**Youth program experience.** Participants indicated whether they participated in 4-H, FFA, both, or neither and if so, they answered whether they participated in animal-based projects.

**Positive youth development.** We again used the Positive Youth Development Short Form, but this time we used a slightly different version from Study 1 that focused on older adolescents and was used in Mueller (2014). This included a 34-item scale to measure the Five Cs (competence, connection, confidence, character, and caring). For the first section of this scale, participants rated agreement on a 5-point Likert scale from *Strongly Agree* to *Strongly Disagree*. The second portion asked, 'How important is each of the following to you in your life?' in which they could report *Not important*, *Somewhat important*, *Not sure*, *Quite important*, or *Extremely important*. Next, the form asked 'Think about the people who know you well. How do you think they would rate you on each of these?' reported on a five-point Likert scale from *Not at all like me* to *Very much like me*. The next section of this positive youth development form asked, 'How well do each of these statements describe you?' reported on a five-point Likert scale from *Not well* to *Very well*. Lastly, there were two sections with the first asking, 'How much do you agree or disagree with the following?' regarding adults in their life and, 'How true is each of these statements for you?' with both sections using a five-point Likert scale from *Strongly Agree* to *Strongly Disagree*. The next scale included was the same Contribution scale from Study 1 that measured contribution to their community such as student government, helping a friend, or volunteering (Mueller, 2014). Cronbach's  $\alpha$  for each of the Six Cs were *caring*  $\alpha = 0.88$ , *character*  $\alpha = 0.75$ , *competence*  $\alpha = 0.71$ , *confidence*  $\alpha = 0.87$ , *connection*  $\alpha = 0.83$ , and *contribution*  $\alpha = 0.74$ .

**Self-regulation, depression, and demographics.** For Study 2, we added the Selection, Optimization, and Compensation questionnaire (Baltes et al., 1999) to measure Intentional Self-Regulation (ISR). The participants chose whether they were more similar to Person A or Person B for each item's posed scenario. For example, Person A's item may include 'Even in difficult situations, I don't burden others' while Person B's item would include 'When things aren't going so well, I accept help from others' (Baltes et al., 1999). The ISR responses had a Cronbach's  $\alpha$  of 0.53 for the measure of *self-regulation*.

Participants then completed a 15-item Center for Epidemiological Studies Depression scale (CESD, Radloff, 1977). The CESD responses had a Cronbach's  $\alpha$  of 0.92 for the measure of *depression*.

The survey ended with the same demographics from Study 1 plus a question about their college rank (*Freshmen, Sophomore, Junior, Senior*) and college major (for batches 2 and 3).

### **Ethics**

All procedures were conducted in an ethical and responsible manner, in full compliance with all relevant codes of experimentation and legislation and were approved by the Institutional Review Board (IRB) (protocol #21725). All participants offered consent to participate, and they acknowledged that de-identified data could be published publicly.

### **Data analysis**

We used R (Version 4.5.1; R Core Team, 2025) for our analyses (packages used are included in Supplementary Materials). The manuscript was created using *quarto* (Version 1.5.1, Allaire & Dervieux, 2024) and the *apaquarto* Quarto extension (Schneider, 2024). Data, analysis scripts, supplementary materials, and reproducible research materials are available at the Open Science Framework (<https://doi.org/10.17605/OSF.IO/8TKHP/>).

We conducted structural equation model (SEM) methods using the *lavaan* package (Version 0.6.17, Rosseel, 2012) to examine the relationships among the human-animal interaction, positive youth development, and well-being variables. We evaluated comparisons of model fit between nested models using a likelihood ratio test of differences in model deviances. We implemented robust maximum likelihood estimation to handle estimations of non-normally distributed continuous variables (Yuan & Bentler, 2000) and full information maximum likelihood to ensure estimations used all available data. In all models, the defined threshold for statistical significance was set at  $\alpha = .05$ . Using established criteria from previous literature (Bentler, 1990; MacCallum et al., 1996; Hu & Bentler, 1999), model fit indices included the comparative fit index (CFI > .90 indicates adequate fit), root mean square error of approximation (RMSEA < .08 indicates adequate fit), and standard root mean residual (SRMR < .08 indicates good fit).

Using the item parcels provided by Mueller (2014), we generated measurement models for the Six Cs of positive youth development, depression, intentional self-regulation, attachment, commitment, and perception of animal use. We specified latent variables with the fixed variance method, permitting estimation of all factor loadings.

Guided by Mueller (2014), the first SEM examined how participation in human-animal interaction relates to positive youth developmental outcomes. To do so, we regressed the Six Cs of positive youth development, depression, and intentional self-regulation latent outcomes on animal ownership, amount of animal care, and presence and intensity of animal activities. In a separate model, the Six Cs of positive youth development, depression, and intentional self-regulation latent outcomes were regressed on animal ownership. To ascertain the relationships



between animal attitudes and positive and negative youth development, a second SEM introduced attachment, commitment, and perception of animal use as predictors of the Six Cs of positive youth development, depression, and intentional self-regulation latent outcomes. Following the process of Mueller (2014), SEM paths that exhibited non-significant regression coefficients were removed from the model in a stepwise manner. To do so, we dropped the path coefficient with the largest  $p$ -value, re-estimated the model, and compared the fit of the newly trimmed model to the previous model. This model-trimming process continued until model fit significantly deviated from the original model fit. Tables S7 and S8 display the path trimmed and model fit at each step of model trimming for Studies 1 and 2, respectively.

Because intentional self-regulation data were not collected in Study 1, the latent variable for intentional self-regulation was not used in any Study 1 models. Otherwise, data analysis for both studies was similar, excluding differences in measures described in Study 2. Model fit information can be found in the Supplementary Materials.

In all models from Study 1 and 2, the moderating effects of participation in either 4-H or FFA was tested to examine differential relationships between those who identified as members and non-members of either group. Using a multigroup confirmatory factor analysis approach (MGCFA, Jöreskog, 1971), identical models were tested over both groups. Pairs of equality constraints were placed on all regression paths from either group's model. This allowed us to examine whether modeled relationships significantly differed between 4-H or FFA members and non-member models. Using model-derived modification indices, pairs of equality constraints were sequentially lifted from the models and a likelihood ratio test evaluated differences in model fit between the model with all pairs of equality constraints and the model with the freed pair of equality constraints. If modification indices proposed that more than one relationship differed among the two group's models, then an individual pair of equality constraint was lifted, one at a time, in successive models and differences in model fit were assessed from the prior model. This was iterated through until all equality constraints on regression paths were investigated. After freeing a pair of equality constraints from a model, a significant difference in model fit indicates moderation effects, where the strength or sign of the relationship depends on group membership.

## Results

### Model Findings

#### *Participation in Human Animal Interaction and Positive Youth Development*

The effects of four measures of human-animal interaction (animal ownership, amount of care directed to animals, and presence and frequency of engaging in activities with animals) on positive youth development (the Six Cs), depression, and intentional self-regulatory behavior are illustrated in Table 1.

In Study 1, animal ownership did not predict any measures of positive youth development. In Study 2, animal owners expressed greater competence ( $\beta = 0.221$ ,  $SE = 0.090$ ,  $z = 2.46$ ,  $p = .014$ ) and confidence ( $\beta = 0.166$ ,  $SE = 0.068$ ,  $z = 2.43$ ,  $p = .015$ ) than non-owners.

Participants who devoted more care toward their animals had higher competence in Study 1 ( $\beta = 0.187$ ,  $SE = 0.079$ ,  $z = 2.37$ ,  $p = .018$ ) and more intentional self-regulatory behavior in Study 2 ( $\beta = 0.216$ ,  $SE = 0.092$ ,  $z = 2.34$ ,  $p = .019$ ) than those who devoted less care.

The presence of engaging in animal-related activities did not relate to any measures of positive youth development in either study. However, those who engaged in more frequent

activities had higher caring scores ( $\beta = 0.133$ ,  $SE = 0.066$ ,  $z = 2.03$ ,  $p = .042$ ) and depression scores ( $\beta = 0.145$ ,  $SE = 0.068$ ,  $z = 2.14$ ,  $p = .032$ ) than those engaging in less frequent activities. The frequency of engaging in activities with animals did not predict any measures of positive youth development in Study 2.

[Table 1 here]

### ***Animal Attitudes and Positive Youth Development***

In Study 1, all three factors correlated with each other (Table S6). In Study 2, only commitment/attachment and commitment/perception of animal use correlated (Table S6). The effects of attitudes about animals on positive youth development, depression, and intentional self-regulatory behavior are illustrated in Table 2. For Study 1, the standardized regression coefficients demonstrated that the retained outcomes (competence, confidence, connection) shared a positive association with attachment. Commitment was negatively related to depression. Similar to Mueller (2014), findings related to perception of animal use varied; caring, character, and depression outcomes exhibited a positive relation with perception of animal use, whereas competence, confidence, and connection showed a negative relation with perception of animal use.

For Study 2, standardized regression coefficients suggest that competence and depression had a positive association with attachment (replicating Study 1). There were no positive youth development outcomes associated with commitment. Lastly, analogous to both Mueller (2014) and our Study 1 findings, positive associations existed between perception of animal use and caring, character, and depression outcomes, whereas negative associations were found between perception of animal use and competence, confidence, and connection.

[Table 2 here]

### ***Group Membership***

Mueller's (2014) original study specifically included former 4-H members as participants. For our two studies, we recruited participants from the College of Agriculture and Natural Resources, as well as from a Psychology subject pool. Our assumption was that the Agriculture students would be more likely to have 4-H or FFA experience, whereas the Psychology sample would have fewer members from those organizations. Here, we wanted to test whether membership in 4-H and/or FFA moderated any of the relationships between positive youth development and human animal interaction or animal attachment, commitment, and perception of animal use.

Across our samples, 31.9% of Study 1 participants were members of 4-H and/or FFA and 41.1% of Study 2 participants were members. As expected, there were more 4-H/FFA members among Agriculture students (Study 1: 48.1%, Study 2: 56.6%) than Psychology study pool participants (Study 1: 11.9%, Study 2: 15.2%) in both studies.

As an exploratory analysis, we compared positive youth development and human-animal interaction measures across members and non-members of 4-H/FFA using independent-samples t-tests with Bayes factors. For these tests, we employed the *ttestBF()* function from the *BayesFactor* R package (Morey & Rouder, 2024) using default priors ('A noninformative Jeffreys prior is placed on the variance of the normal population, while a Cauchy prior is placed on the standardized effect size' with an  $r$  scale value of  $\sqrt{2}/2$ ). Bayes factors greater than 3 represent at least moderate evidence of a difference between groups. Bayes factors less than 1/3 represent at least moderate evidence for no difference between groups. Bayes factors between 1/3 and 3 do not have adequate evidence to support either a difference or no difference.

Only commitment and perception of animal use differed between groups in both studies, where higher values on both measures were observed in non-members when compared to members of 4-H/FFA (Figure 1). Non-members also had higher values of attachment and depression in Study 1, whereas members had higher values of confidence. Members had more human-animal interaction activities and higher competence and connection in Study 2.

[Figure 1 here]

To test for effects of group membership on the relationship between human-animal interaction and positive youth development, we reran each of the previously described structural equation models but included membership as a moderator using a multigroup confirmatory factor analysis. There was no evidence of moderation effects of membership into 4-H/FFA for these associations.

### Discussion

Our primary aim for these studies was to replicate and extend Mueller's (2014) findings about the relationship between positive youth development and both human-animal interaction and attitudes about animals. Mueller found that the positive youth development component of contribution was positively associated with animal ownership, amount of caring for animals, and the presence and frequency of animal-related activities. Across our two studies, we did not find an association with any human-animal interaction variables and contribution. Instead, we found positive associations between animal ownership and competence and confidence, amount of caring for an animal and competence and self-regulation, and frequency of animal activities and caring and depression. However, none of these associations were found in both replicates of our studies—each only occurred in one replicate. Thus, we failed to replicate Mueller's associations between positive youth development and human-animal interaction, with minimal replication of significant associations across our two studies.

Mueller (2014) found a number of different associations between positive youth development and measures of animal attitudes (animal attachment, commitment, and perception of animal use). Our Study 1 replicated 6 of the 12 associations found by Mueller. In addition, we found another four associations not found by Mueller. In Study 2, we only replicated 4 of Mueller's 12 associations and found an additional four associations not found by Mueller. In all cases of replication, the sign of the association was the same in both studies. Thus, we partially replicated Mueller's associations between positive youth development and animal attitudes. In terms of our internal replication, 18 out of 21 of the association outcomes replicated between our two studies.

Finally, we extended Mueller's (2014) study by comparing members of 4-H/FFA to non-members to investigate whether this membership moderated any of the effects that we observed. Despite some differences in human-animal interaction and positive youth development characteristics between members and non-members, the addition of membership as a moderator did not affect the models. Thus, membership in 4-H/FFA did not influence the associations between positive youth development and human-animal interaction or animal attitudes.

### Implications

#### *Human-Animal Interaction and Positive Youth Development*

Our study examined the associations between positive youth development and human-animal interaction across two studies, replicating and extending Mueller's (2014) methods. None of our studies nor Mueller's original work demonstrated strong or consistent effects of human-

animal interaction on positive youth development (Table 1). These findings suggest that while human-animal interaction is often viewed as beneficial for youth development, the evidence for direct associations between interacting with animals and positive youth development outcomes is weak or highly context dependent. While the literature on human-animal interaction often highlights the emotional, social, and psychological benefits of interacting with animals (Beetz et al., 2011; Melson, 2003), our findings suggest that these effects are not universal.

The inconsistency in effects across studies may reflect the complexity of human-animal relationships. For instance, different types of interactions (e.g., caregiving, companionship, competitive activities) likely contribute differently to positive youth development. Companion animals, for example, may foster empathy and responsibility in youth (Daly & Morton, 2006), while competitive or labor-based interactions might not provide the same nurturing environment. This nuance aligns with Overton's (2010) relational developmental systems theory, which emphasizes that positive youth development outcomes are shaped by the reciprocal interaction between individuals and their environments. In the case of human-animal interaction, the context in which youth engage with animals, whether in structured programs like 4-H and FFA or informal pet ownership, might dictate the developmental benefits they receive. Thus, the lack of strong, consistent effects of human-animal interaction on positive youth development across our studies likely stems from the variability in how and why young people interact with animals.

#### ***Animal Attitudes and Positive Youth Development***

In contrast to the weak and inconsistent effects of human-animal interaction on positive youth development, our studies found stronger and more consistent associations between attitudes toward animals, such as attachment, commitment, and perception of animal use, and positive youth development outcomes (Table 2). These results suggest that the way young people think and feel about animals, rather than simply their level of interaction, has a stronger association with their developmental outcomes. One possible explanation is that attitudes reflect deeper, internalized values that guide behavior, whereas interactions may not have the same lasting impact unless they are tied to emotional significance. Youths who exhibit high attachment or commitment to animals may share traits like empathy, responsibility, and care. Emotional bonds that youth form with animals may connect to traits that align with positive youth development's core elements (e.g., caring, connection).

The stronger associations between animal attitudes and positive youth development align with existing research on the role of emotions and attitudes in youth development. For example, attachment to companion animals contributes to children's emotional security and self-esteem (Zasloff, 1996) and fosters empathy, responsibility, and prosocial behaviors (Daly & Morton, 2006; Melson, 2003). In this context, youths' emotional attachments to animals may serve as a pathway through which they develop empathy and caring, essential components of positive youth development. Thus, it is not just the presence of animals in youths' lives that matters, but how they cognitively and emotionally engage with those animals.

Perception of animal use emerged as one of the most consistent predictors of positive youth development outcomes, particularly caring and depression (Table 2). This finding suggests that young people's ethical beliefs about animal use (food production, scientific research, etc.) are closely tied to their personal development. Young people with lower acceptance of a variety of animal uses likely demonstrate greater empathy and concern for others, a core component of positive youth development's caring dimension (Mueller, 2014). The literature supports this link,

showing that individuals who advocate for animal welfare often extend their empathy to human social causes as well, engaging in prosocial activities and promoting justice (Herzog et al., 2015).

Overall, our findings suggest that while human-animal interaction may offer some developmental benefits, it is young people's emotional and cognitive engagement with animals, particularly their attachment and perception of animal use, that plays a more critical role in shaping positive youth development outcomes. Programs aiming to leverage human-animal interaction for youth development, such as 4-H and FFA, should consider how a youth's emotional investment in their relationship with animals may enhance positive youth development more effectively than increasing the frequency or intensity of animal interactions.

### ***Group Membership***

One of the striking findings of this study is the lack of a difference between youth involved with 4-H and FFA (members) and those not involved (non-members) in terms of positive youth development. None of the Six Cs differed between members and non-members consistently across both data sets.

Though membership in 4-H and FFA have inconsistent relationships with positive youth development, it shows more consistent relationships with animal attitudes. Across both studies, non-members had higher commitment and perception of animal use scores and in Study 1 non-members also had higher attachment scores.

This study indicates that youth not affiliated with 4-H and FFA have higher attachment and commitment to animals than those involved with 4-H and FFA. However, non-members likely focused their interactions with family pets, whereas members likely focused on livestock. In our Study 1, we found that 97.6% of non-members choose pets over livestock, whereas only 63.8% of members chose pets. Thus, the two groups likely had in mind different types of animals when completing our survey.

Our results also indicated that non-members had lower acceptance of animal uses than members. Urban youth with less exposure to some animals uses may be more likely to be less accepting of these practices. In contrast, rural youth who interact daily with food animals (beef cattle, dairy cattle, pigs, and sheep) would likely agree with the need for humane treatment and respect of animals but be more willing to accept a wider variety of animal uses.

We found several differences in human-animal interaction and positive youth development characteristics between members and non-members. However, 4-H/FFA membership did not influence associations between positive youth development and human-animal interaction or animal attitudes. While key differences exist between members and non-members regarding background and context in development of key responses, ultimately any repeated interaction with animals appears to provide positive youth development, regardless of animal type and/or facilitation of those activities.

### ***Failure to Replicate***

We partially replicated Mueller's (2014) results, but we did not replicate several findings. We did not find an association between human-animal interaction variables and contribution. Additionally, the significant associations between other positive youth development variables and human-animal interaction variables were not consistent across our two studies. Overall, we observed smaller effect sizes for the association between positive youth development and human-animal interaction than those by Mueller. Our sample was slightly smaller than Mueller's but had similar demographic characteristics.



We partially replicated Mueller's (2014) associations between positive youth development and measures of animal attitudes, replicating 6 out of the 12 significant associations reported by Mueller. The larger effect sizes and greater consistency over our two studies suggest that associations between positive youth development and animal attitudes may be more strongly related than relationships between positive youth development and human-animal interaction. We do not conclude that there is no relationship between human-animal interaction and positive youth development based on our results, but that the nature of this relationship may be more complex and require larger sample sizes to account for other sources of variance.

### **Limitations and Future Directions**

Our studies had several limitations. The measurement of human-animal interaction is complex and may require additional study to describe the quality and quantity of these interactions more accurately. It is also possible that multiple other factors can also influence measures of human-animal interaction in different ways. Future studies could refine and validate measures of human-animal interaction, since there has been a rapid proliferation of the number of possible scales (Samet et al., 2023).

Secondly, interpreting nonsignificant results in replication studies (even in seemingly well-powered studies) is difficult for myriad reasons and may necessitate multiple replication studies to provide firm evidence for a hypothesis (Maxwell et al., 2015). These points all support further research focused on the effects of human-animal interaction and animal attitudes on positive youth development to help maximize youth development opportunities.

### **Conclusion**

We replicated and extended the methods of Mueller (2014) to investigate the relationship among human-animal interaction, animal attitudes, and positive youth development. We did not find strong relationships among human-animal interaction and positive youth development, which failed to replicate Mueller's findings. However, we did find clear relationships between animal attitudes and positive youth development, and many of these effects replicated Mueller's findings. We extended Mueller's work by considering membership in 4-H and/or FFA as a moderator in the analysis. Though we found a few differences between members and non-members in animal attitudes and positive youth development, these differences did not moderate any relationships that we tested. Thus, we partially replicated Mueller's original study, demonstrating that the relationship between positive youth development and human-animal interactions and animal attitudes is complex. The relationship between perception of animal use and positive youth development seems to be fairly robust. However, other animal attitudes and aspects of human-animal interaction do not seem to have reliable relationships with positive youth development. Future work in this area should ensure large sample sizes, use strong measures of human-animal interaction and animal attitudes, and consider the demographic and animal-relevant differences among participants to better understand how animal relationships and attitudes are related to positive youth development.

### **Summary for Practitioners**

Both interacting with animals and youth development programs, such as 4-H and FFA, have positively impacted participating youths' development through improvement in skills such as accepting responsibility and prosocial behavior (Melson, 2003). Little research exists that investigates the benefits of human-animal interaction in an individual's long-term development outside of animal-assisted interventions and their immediate benefits. This study applies to

educators looking to incorporate animals into their youth development programs. Our study surveyed university undergraduates about their human-animal interactions (ownership, care, activities), animal attitudes (animal attachment, commitment, and perception of animal use), positive youth development outcomes (competence, connection, confidence, character, and caring, contribution), and youth development activities membership (4-H, FFA). We found that, although animal interactions or membership in program did not have a strong correlation with positive youth development outcomes, an individual's attitudes about animals did correlate with positive youth development outcomes. However, the benefits of interacting with animals as a method of impacting youth development depend on the context.

Our work suggests that practitioners should focus on nourishing youth's attitudes surrounding animals as they build their programs or curricula. If a program's budget cannot afford to have their own animals, they can still provide beneficial activities to youth that improve attitudes towards animals. For example, our study found that individuals that reported a higher attachment score also reported higher caring and connection scores in positive youth development measures. Therefore, an individual's attitudes towards animals is more strongly related to developmental outcomes than whether they own or interact with an animal. The depth of their emotional and cognitive engagement with animals is more relevant in shaping their long-term development. Lastly, it is crucial to be aware of the types of animals that individuals have experience with to understand these context-dependent outcomes of human-animal interaction. Our study found that members of 4-H and FFA did not view their animals as pets or members of the family compared to non-members. This is an important distinction as the type of animal an individual has exposure to affects their attitudes towards animals.

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**Table 1***Standardized Model Coefficients for Human-Animal Interaction Variables*

| Measure         | Study 1   |               |                        |                         | Study 2       |               |                        |                         |
|-----------------|-----------|---------------|------------------------|-------------------------|---------------|---------------|------------------------|-------------------------|
|                 | Ownership | Care          | Presence of activities | Frequency of activities | Ownership     | Care          | Presence of activities | Frequency of activities |
| Caring          | 0.017     | -0.063        | -0.011                 | <b>0.133*</b>           | 0.041         | 0.011         | -0.036                 | -0.047                  |
| Character       | 0.072     | 0.083         | -0.055                 | 0.083                   | -0.077        | 0.048         | 0.068                  | -0.045                  |
| Competence      | -0.014    | <b>0.187*</b> | -0.019                 | -0.099                  | <b>0.221*</b> | -0.095        | 0.166                  | 0.169                   |
| Confidence      | 0.011     | 0.097         | -0.000                 | -0.038                  | <b>0.166*</b> | -0.041        | 0.115                  | 0.092                   |
| Connection      | -0.048    | 0.121         | -0.009                 | -0.061                  | 0.063         | 0.011         | -0.013                 | 0.106                   |
| Contribution    | -0.024    | 0.064         | -0.018                 | 0.008                   | -0.050        | 0.027         | -0.000                 | 0.149                   |
| Depression      | 0.027     | -0.118        | 0.045                  | <b>0.145*</b>           | -0.029        | -0.015        | 0.046                  | -0.077                  |
| Self-regulation |           |               |                        |                         | -0.060        | <b>0.216*</b> | -0.084                 | 0.086                   |

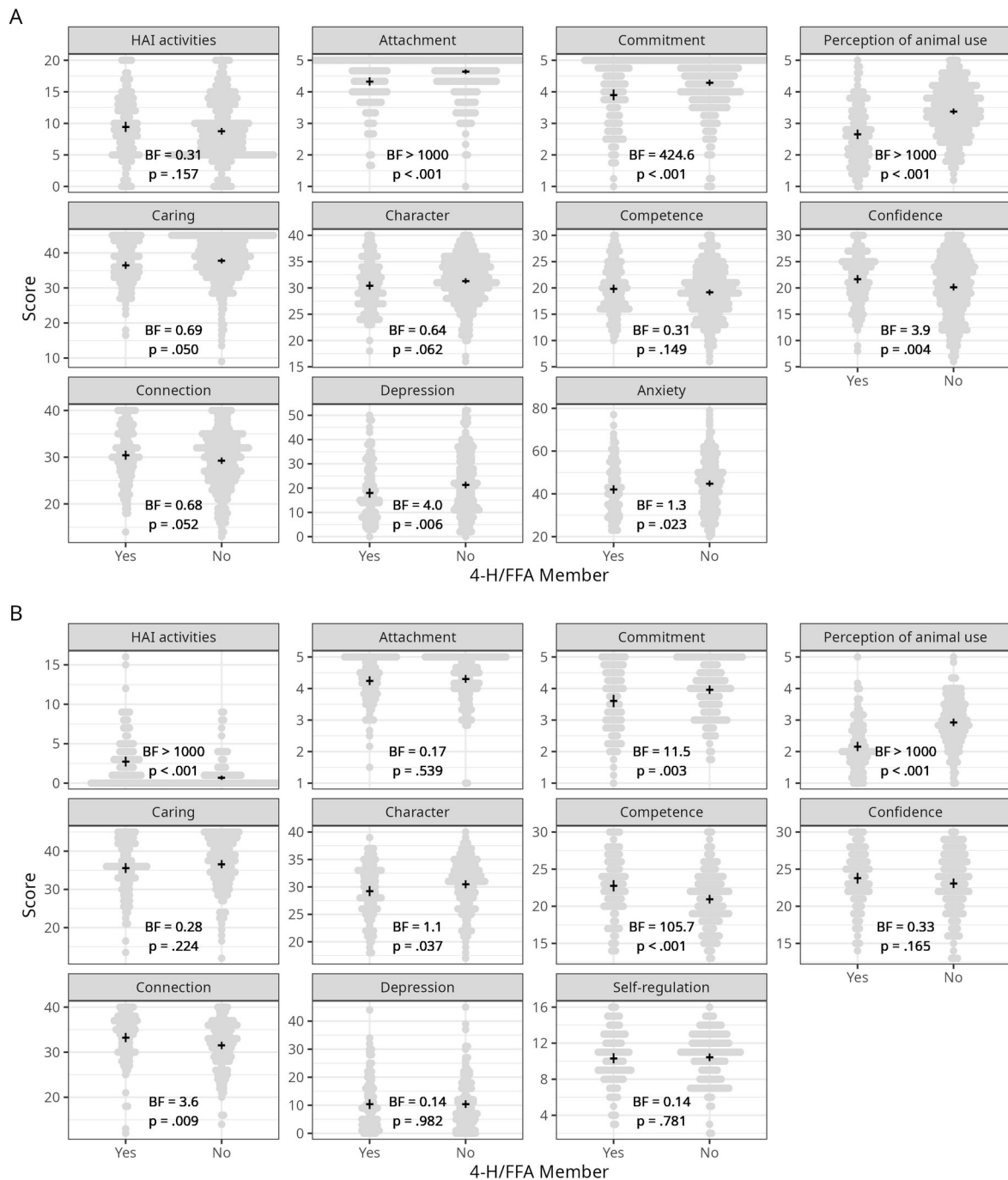
Bold values with \* represent significant effects. Grey cells represent significant effects found in Mueller (2014).



**Table 2***Standardized Model Coefficients for Animal Attitude Variables*

| Measure         | Study 1       |            |                          |               |                |                          | Study 2       |            |                          |               |            |                          |
|-----------------|---------------|------------|--------------------------|---------------|----------------|--------------------------|---------------|------------|--------------------------|---------------|------------|--------------------------|
|                 | Full model    |            |                          | Trimmed model |                |                          | Full model    |            |                          | Trimmed model |            |                          |
|                 | Attachment    | Commitment | Perception of animal use | Attachment    | Commitment     | Perception of animal use | Attachment    | Commitment | Perception of animal use | Attachment    | Commitment | Perception of animal use |
| Caring          | 0.077         | 0.059      | <b>0.211*</b>            |               |                | <b>0.266*</b>            | 0.120         | 0.057      | <b>0.171*</b>            | 0.082         | 0.078      | <b>0.188*</b>            |
| Character       | 0.032         | 0.079      | <b>0.156*</b>            |               | 0.069          | <b>0.166*</b>            | 0.085         | 0.080      | 0.119                    |               | 0.102      | <b>0.132*</b>            |
| Competence      | <b>0.198*</b> | -0.042     | <b>-0.298*</b>           | <b>0.154*</b> |                | <b>-0.306*</b>           | 0.131         | -0.176     | <b>-0.443*</b>           | <b>0.152*</b> | -0.201     | <b>-0.405*</b>           |
| Confidence      | <b>0.149*</b> | -0.056     | <b>-0.368*</b>           | <b>0.118*</b> |                | <b>-0.385*</b>           | -0.046        | -0.074     | <b>-0.209*</b>           |               | -0.104     | <b>-0.183*</b>           |
| Connection      | <b>0.158*</b> | -0.066     | <b>-0.401*</b>           | <b>0.100*</b> |                | <b>-0.415*</b>           | -0.036        | 0.067      | <b>-0.222*</b>           |               |            | <b>-0.173*</b>           |
| Contribution    | 0.027         | 0.074      | -0.000                   |               | 0.067          |                          | 0.122         | -0.043     | -0.031                   | 0.071         |            |                          |
| Depression      | 0.015         | -0.103     | <b>0.388*</b>            |               | <b>-0.138*</b> | <b>0.412*</b>            | <b>0.207*</b> | -0.023     | <b>0.186*</b>            | <b>0.186*</b> |            | <b>0.153*</b>            |
| Self-regulation |               |            |                          |               |                |                          | 0.044         | -0.086     | -0.181                   |               | -0.133     |                          |

Bold values with \* represent significant effects. Grey cells represent significant effects found in Mueller (2014). In all cases overlapping with effects in our studies, the direction of the effects were congruent.

**Figure 1***Group Differences in Human Animal Interaction and Positive Youth Development*

*Note.* Grey dots represent individual subject data points, black horizontal bars represent group means, and black vertical bars represent 95% confidence intervals. Figure used with permission under a CC-BY 4.0 license: Pachunka et al. (2024); available at <https://doi.org/10.31234/osf.io/ge7bf>.