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The Anodyne-Agent Model: A Framework for Conceptualizing the Animal's Role in Animal-Assisted Intervention

Angela K. Fournier[1] Elizabeth A. Letson[1]; Thomas D. Berry[3]
Jennifer Laitala[2]; Lauren Proels[1]; & Kelli Kavanaugh[1]

[1]Department of Psychology, Bemidji State University
[2]Eagle Vista Ranch & Wellness Center
[3]Department of Psychology, Christopher Newport University

This research introduces the anodyne-agent model as a framework for conceptualizing the animal's role in animal-assisted interventions. The model suggests animals assist interventions aimed at human health and well-being by (a) enhancing positive emotion and decreasing negative emotion, and/or (b) serving as agents in the therapeutic process. An experiment is described to demonstrate the anodyne-agent model. This investigation engaged 45 women and men in a between-groups, posttest-only experiment. Participants were randomly assigned to one of three conditions (i.e., a horse, a dog, or a no-animal control condition). Dependent measures included quantity of human-animal interaction measured with the Human-Animal Interaction Scale, positive and negative emotion measured with the Modified Dimensional Emotions Scale, and psychosocial learning measured via participant qualitative report. Results showed positive emotion was higher following sessions with an animal and correlated with quantity of human-animal interaction. Psychosocial learning differed by condition and was also associated with human-animal interaction. Findings illustrate the utility of the anodyne-agent model. Replication with larger, more diverse samples is warranted.

Keywords: Animal, Animal-Assisted Intervention, Human-Animal Interaction, Anodyne, Agent

Correspondence concerning this article should be addressed to Angela Fournier, PhD, LP, Professor, Dept. of Psychology, Bemidji State University, 1500 Birchmont Dr. NE, Bemidji, MN 56601, 218-755-2530, Angela.Fournier@bemidjistate.edu.

The field of human-animal interaction (HAI) is teeming with important questions; the quest to understand clinical applications for human health is key among them. In animal-assisted intervention (AAI), participants engage with an animal for some physical, social, emotional, or cognitive outcome (Animal-Assisted Intervention International, 2016). AAI can be aimed at providing comfort and improving quality of life (i.e., animal-assisted activity), obtaining academic or educational goals (i.e., animal-assisted education/learning), or enhancement of a treatment process (i.e., animal-assisted therapy) (American Veterinary Medical Association, 2018; Chandler, 2017; Vitztum, 2013). The research on AAI outcomes is increasing, with meta-analyses showing strong to moderate effect sizes in treating autism spectrum disorders, medical conditions, behavioral problems, and emotional well-being (e.g., Nimer & Lundahl, 2007). Scholarship in this area includes a growing number of empirical studies and explanatory theories aimed at better understanding AAI. We aim to provide a framework for organizing the multitude of outcomes resulting from a broad range of interventions by introducing the anodyne-agent model. This framework categorizes the roles of animals in assisting or facilitating intervention, suggesting animals can impact an intervention process by (a) eliciting an anodyne effect, and/or (b) serving as an agent in the intervention process.

Anodyne Effect

An anodyne is something that relieves hurt or pain, or that brings relaxation or comfort (Merriam-Webster, 2017a). The anodyne-agent model posits that animals facilitate intervention, in part, by eliciting an anodyne effect – causing a superficial, perhaps temporary, reduction in distress (i.e., improved mood state, reduced tension or state anxiety). Just as an aspirin can relieve headache pain without treating the underlying cause (e.g., muscle tension), interacting with an animal may result in a reduction of subjective distress, without necessarily treating the source of the distress. This distress reduction may be an end in itself or may help to facilitate a therapy or learning process aimed at longer-term change.

Various research on AAI implies an anodyne effect, wherein interactions with animals are associated with reduced physical or emotional distress (e.g., Kaminski, Pellino, & Wish, 2002; Kloep, Hunter, & Kertz, 2017). Crossman, Kazdin, and Knudson (2015) conducted a randomized controlled trial testing the effects of unstructured interaction with a dog, a non-interaction control, and a no-treatment control. College students who interacted with a dog showed reductions in distress (i.e., mood and anxiety) more so than those merely in the presence of a dog or in the no-treatment control condition. More recently, Pendry, Carr, Roeter and Vandagriff (2018) tested a stress prevention program for college students with a randomized controlled trial. Students randomly assigned to interact with a dog or cat had greater positive emotion and less negative emotion than those in the wait-list and control conditions.

Beyond individual studies, the summative HAI literature supports the notion of an anodyne effect. Germain, Wilkie, Milbourne, and Theule (2018) conducted a meta-analysis on animal-assisted psychotherapy for individuals with trauma and found large effect sizes for pre-post comparisons on depression and anxiety. In a systematic review, Crossman (2017) synthesized the research literature, implicating HAI in distress reduction and calling for in-depth examination of HAI as a phenomenon, beyond AAI outcome studies. The present research aimed to address this need, measuring individual HAI behaviors and using experimental methods to test distress reduction – hereafter referred to as an anodyne effect – as an outcome of HAI. The purpose of the Anodyne-Agent Model is to organize studies such

as these into categories based on the animals' role in the intervention. The animal's role in the studies just summarized can be categorized as eliciting an anodyne effect – humans engaging with animals may experience a reduction in distress.[1][2] As to *how* this occurs, researchers have suggested several theories explaining anodyne-related outcomes. Theoretical explanations include, but are not limited to, activation of the social response mechanism which increases reward hormones such as oxytocin and dopamine (Odendaal, 2000; Odendaal & Meintjes, 2003), buffering of the stress response through social support (Garrity & Stallones, 1998; Serpell, 1996), distraction from aversive experiences and mental states (Barker, Knisely, Schubert, Green, & Ameringer, 2015), and an innate predisposition to attend to living organisms (i.e., biophilia) (Wilson, 1984). Additionally, we argue that animals can impact an intervention beyond feeling states – they may serve as agents in the intervention process, such that intervention happens *through* interaction with the animal(s).

Intervention Agent

An agent can be defined as "one who is authorized to act for or in place of another" (Merrian-Webster, 2017b). We suggest the second possible role animals play in a learning or treatment process is as an agent, or stand-in, in the intervention process. Although not described in this way, the literature refers to the animal's role as an agent or substitute. For example, in Aydin et al.'s (2012) finding that an unfamiliar dog helped socially-excluded participants, they suggest dogs serve as stand-ins for humans, mediating social isolation. Corson and O'Leary Corson (1980) indicate therapy dogs helped with loneliness by serving as communication mediators, providing non-threatening nonverbal communication. Animals are frequently described as helping people by offering social support (e.g., Serpell, 1996; Serpell, McCune, Gee, & Griffin, 2017). In psychotherapy, investigators suggest animals can serve as something onto which thoughts and feelings can be projected (e.g., David, 2013; Fournier, Letson, Berry, & Pasiuk, 2018; Wells, Rosen, & Walshaw, 1997), allowing the client to identify and work on therapeutic issues with or through the animal. In addition, the literature describes animals modeling desirable or undesirable behavior to help people learn appropriate social conduct, (e.g., Fine, 2015) or serving as a social other to interact with and provide feedback (Brooks, 2001). The examples mentioned here describe animals serving as attachment figures, social mediators, transitional objects, and sources of social support.

In the anodyne-agent framework, these examples can be categorized as situations in which animals serve as therapeutic agents in the intervention process. This is consistent with human-animal relational theory (Chandler, 2018), which suggests introducing an animal into the counseling process increases psychodynamics, providing greater opportunity for significant relational moments which can then be processed in the context of the intervention objective(s).

Species Comparison

AAIs incorporate a range of animals, such as companion animals (e.g., Fournier, Geller, & Fortney, 2007), farm animals (e.g., Artz & Bitler Davis, 2017), and small mammals (e.g., Gocheva, Hund-Georgiadis, & Hediger, 2018). Any number of variables that

[1] Note that improved mood or affect is not the only short-term outcome of HAI, but is a frequently-studied outcome. Framing several related outcomes (i.e., mood, emotion, affect, distress) as an anodyne effect can help organize findings and may assist in the development of programmatic research.

[2] We acknowledge some studies examining the effects of HAI on distress have been inconclusive and some with positive findings are limited by methodological deficiencies (e.g., Anestis, Anestis, Zawilinski, Hopkins, & Lilienfeld, 2014; Chur-Hansen, McArthur, Winefield, Hanieh, & Hazel, 2014).

differ across species (e.g., animal behavior and aesthetics) can potentially impact AAI. Research is needed to understand whether the effects of an animal-assisted intervention are attributable to *any* animal or a *specific* animal. Therefore, this study explored differences and similarities between two species – a dog and a horse – in the context of an AAI. These species were chosen because they are common intervention animals (Fine, 2015) and researchers suggest differences in human-dog versus human-horse interaction and attachment (e.g., Payne, DeAraugo, Bennett, & McGreevy, 2016).

The Present Study

The anodyne-agent model is illustrated in Figure 1, where a solid line indicates the direct effect of HAI on distress reduction (i.e., anodyne effect) and a dashed line indicates an indirect effect on intervention outcome (i.e., agent effect). The present research demonstrates the model in an experiment with extraneous variables held constant and participants randomly assigned to engage in an intervention (i.e., experiential learning session) with a live animal or inanimate object. Engaging with an inanimate object in the control condition avoided some cofounds as AAI can differ from traditional intervention beyond the animal (e.g., novelty, experiential modality, setting, provider). These variables were held constant in the present study to help identify the animal's role in the intervention process. Dependent measures included HAI, positive and negative emotion, and psychosocial learning. Psychosocial learning was defined as increasing awareness of one's thoughts, feelings, and behaviors in interactions with others. Researchers suggest animals facilitate psychosocial learning by helping clients engage in self-discovery, share threatening experiences, and gain self-awareness (Chandler, Portrie-Bethke, Minton, Fernando, & O'Callaghan, 2010). A posttest-only design was implemented to avoid a pretest effect (Dimitrov & Rumrill, 2003) wherein the pretest impacts the participants' response to the intervention or the posttest self-report.[3]

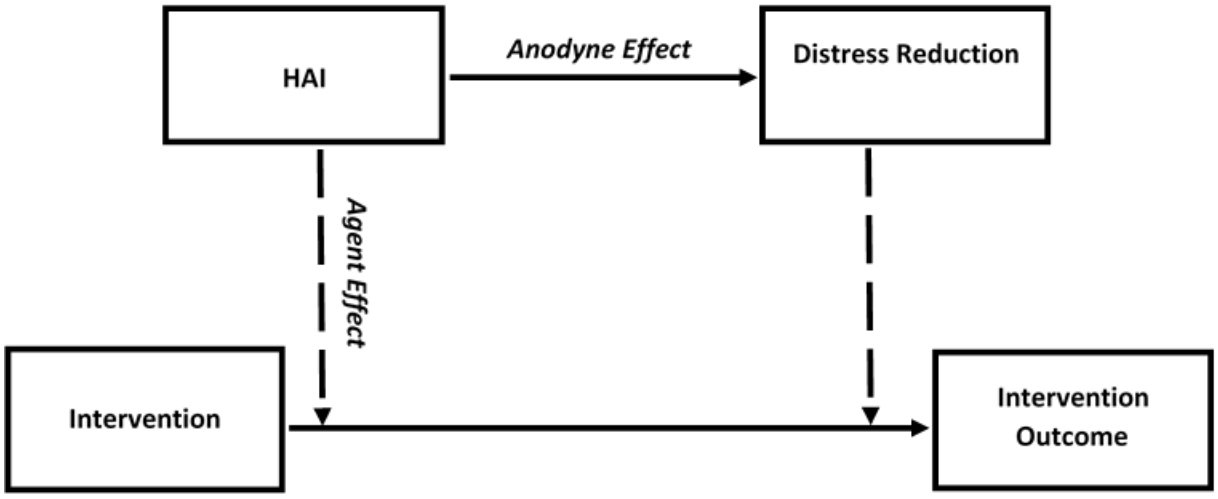


Figure 1. The anodyne-agent model. Solid lines indicate direct effects; dashed lines indicate indirect (i.e.., moderation) effects.

[3] Although a posttest-only design reduces power, there was greater concern for a pretest-treatment interaction (Pasnak, 2018) increasing the chance of a Type I error.

This research tested the model via two hypotheses. Hypothesis 1 tested for an anodyne effect – we predicted sessions involving animals would result in greater positive emotion and less negative emotion than control sessions. Hypothesis 2 tested for an agent effect – we predicted participants in animal sessions would experience greater psychosocial learning than those in control sessions. Research comparing horses and dogs is sparse and inadequate to support a priori inter-species predictions. Therefore, comparisons between dog and horse conditions were exploratory.

Method

Setting. Sessions took place at a private-practice counseling center that provides animal-assisted psychotherapy and learning. More specifically, sessions occurred within a 15m x 23m indoor arena, supplied with props for experiential learning (e.g., cones, barrels, blocks, toys).

Human participants. Human participants were 45 undergraduate students enrolled in a psychology course at a mid-size university in the Midwestern United States. The sample was 80% women (n =36) and 20% men (n = 9). Participant age ranged from 18 to 36 (M = 20.45, SD = 3.58). Regarding race/ethnicity, most students identified as Caucasian or White (84.4%, n = 38), while 6.7% identified as Native American (n = 3), 4.4% identified as African American or Black (n = 2), and 2.2% identified as Asian (n = 1). These rates are consistent with the department demographics.

Animal participants. Sessions with animals included either one live horse or one live dog. The horse was a 30-year-old gelding Paint who served in Eagala-model equine-assisted psychotherapy services. The dog was a 9-year-old neutered Labrador Retriever who had completed Canine Good Citizen and Therapy Dog International training. Both animals were healthy and current on vaccinations. The animals lived at the counseling center facility and had been involved in animal-assisted psychotherapy and learning for three years before the study began.[4]

Materials

Human-Animal Interaction Scale (HAIS). The HAIS is a 24-item self-report instrument completed by an individual after interacting with a non-human animal (e.g., animal-assisted therapy/activity session, laboratory interaction). Respondents rate the extent to which they or the animal engaged in various behaviors on a 5-point Likert scale, ranging from 0, indicating "not at all" to 4, indicating "a great deal." Cronbach's alpha calculations indicate good internal consistency with university students, (α = .76-.89), convergent and discriminant validity are both in the acceptable range (Fournier, Berry, Letson, & Chanen, 2016).

Human-Human Interaction Scale (HHIS). The HHIS was created for this study in order to identify any differences in social interaction among participants across the three conditions. This is a 19-item rating scale similar in form to the HAIS. After observing a session, researchers rated from 0, indicating "not at all" to 4, indicating "a great deal," the extent to which they observed various interactive behaviors between group members. Reliability analysis, via Cronbach's alpha, suggests the instrument had adequate internal consistency (α = .73).

[4] Animal involvement was limited to serving in the group sessions. The research did not influence the animals' housing, diet, or handling. Interactions with the animals was limited to the trained owner/session facilitators and the research participants during sessions. Researchers did not handle or interact with the animals.

Modified Differential Emotions Scale (MDES). The MDES is a self-report instrument designed to measure positive and negative emotions (Fredrickson, 2004). Respondents rate the degree to which they experience each of 20 different emotions – ten positive (e.g., joyful, happy, amused) and ten negative (e.g., irritated, suspicious, annoyed). The instrument has adequate reliability (α = .75) and criterion-related validity (Galanakis, Stalikas, Pezirkianidis, & Karakasidou, 2016).

Plush animal. The no-animal control condition incorporated a 1m x 1.3m tan plush horse that stood on its own and could make running and neighing sounds when a button on the ear was pushed. The plush horse served as a control, providing a four-legged being to interact with and allowing researchers to use the same instructions for each session.

Animal experience form. Created for this study, this form asked participants to rate their affinity for a variety of animals and describe their experience with the horse/dog/plush animal during the session. The form included open-ended questions aimed at gathering data on psychosocial learning, asking participants (a) *What, if anything did you learn about yourself or your life?* and (b) *What, if anything, did you learn about problem solving?* Participants were also asked a broad question about the horse/dog/plush animal in the session – *Write about the animal in the session and any impact it had*.

Procedure[5]

Recruitment. Participants were recruited through in-class announcements, offering extra credit for participation in a study on group experiential learning. To reduce selection bias, the announcement did not mention animals. Students interested in the study signed up through the psychology department's participant pool system. Sign-ups were posted by session and were scheduled on the same day and time, across several weeks during the 2017-2018 and 2018-2019 academic years. Cluster random assignment (Bloom, Bos, & Lee, 1999) was implemented where each session was randomly assigned to one of the three conditions (i.e., horse, dog, or control). Participants signed up individually for a time that fit their schedule, unaware of condition.

Researchers emailed each participant before their scheduled session. Those in the horse and dog conditions were told the session would include a horse/dog and that they could withdraw if they had a fear of or allergy to the animal[6]. Those in the control condition were told they would not be interacting with animals, but would be in a space where animals had been, and they could withdraw if they had allergy concerns. One participant, from the horse condition, withdrew due to allergies.

Group learning session. The researchers and the facilitation team collaborated to develop a group activity that could be conducted with a horse, a dog, or the plush animal. The topic of problem solving was chosen, as it is in the psychoeducational domain and could be beneficial to college students (e.g., Belzer, D'Zurilla, & Maydeu-Olivares, 2002). Session instructions and facilitation were standardized across the three conditions.

Each session, students reported to the psychology department and completed written informed consent. Researchers then drove the students to the research site in a university van. The facilitation team – a licensed clinical counselor and an animal specialist – greeted

[5] Methods were reviewed and approved by an Institutional Review Board (IRB) and Institutional Animal Care and Use Committee (IACUC). Researchers were trained in research methods and completed ethics training in social and behavioral research through the Collaborative Institutional Training Initiative.

[6] There were several other extra credit opportunities available for students who could not participate in this research.

the researchers and participants. Both team members were certified in providing canine- and equine-assisted psychotherapy and learning and had over ten years of experience working together in the field. The facilitators were aware of the general purpose of the study (i.e., to compare group sessions with a horse, dog, or plush animal), but were not informed of the hypotheses or dependent measures.

Initially, facilitators brought the participants into the office where they briefly introduced themselves and gave participants instructions to complete a task: "*This is a session on problem solving. We would like you to decide on a goal, then use whatever you see in your environment to create a path to that goal. Along the path to your goal, please create and label two barriers to achieving the goal. Then you should move the four-legged being (gesture toward the horse/dog/plush animal) through the path to your goal. All four feet of the four-legged being must remain on the ground. You have 30 minutes to complete your task.*" In addition, participants were given notecards, markers, and tape to label their goal/path/barriers. Prior to beginning animal sessions, facilitators engaged participants in a brief discussion on safety around horses/dogs.[7] In the animal conditions, the four-legged being was not wearing a collar/halter and was not tethered by a leash/rope.

While participants completed the task, facilitators and researchers stood in a corner of the arena, their roles kept separate. Researchers gathered observational data and administered post-session self-report measures; they did not engage with the animals, participants, or facilitators during the session. Researchers observed each session and recorded interactions among participants on the HHIS. Consistent with the Equine Assisted Growth and Learning Association (Eagala) model of equine-assisted learning (Eagala, 2015), the facilitators created a safe space[8] for the participants and the four-legged being to interact; they did not participate in the activity with them or make interpretations during the session.

Once the task was completed the facilitators processed the session with the participants, aiming for consistency across sessions and within the Eagala model. They asked standard questions for each session, using clean language[9] to allow for participants' genuine responses. Standard prompts included, "*What happened?*" "*Tell us about that,*" and "*Tell us about the four-legged being.*"

After several minutes of processing, the facilitators concluded the session and invited participants back to the office. Researchers administered posttest measures and gave the students a card for extra credit and a debriefing form. Participants were driven back to campus, thanked, and dismissed. At the conclusion of the study, researchers debriefed participants via email.

Results

Session Descriptives

There were 12 group sessions – 5 horse, 3 dog, and 4 control. Group sessions included 2 to 8 participants, with a mean of 3.75 people per group. An ANOVA indicated there were

[7] The discussion included a statement that animals can be unpredictable, suggestion that they prioritize safety over completing the task, and a brief list of dos (e.g., be aware of your environment, watch the animal's body language) and don'ts (e.g., don't stand behind the horse, don't feed the animals).

[8] During the session, the animal specialist watched the animal's body language for signs of stress, irritation, or aggression; watched the participants for any problematic behavior (e.g., wrapping leash/rope around themselves, acting aggressively toward the animal); and was ready to intervene if participants or animals seemed to be at-risk.

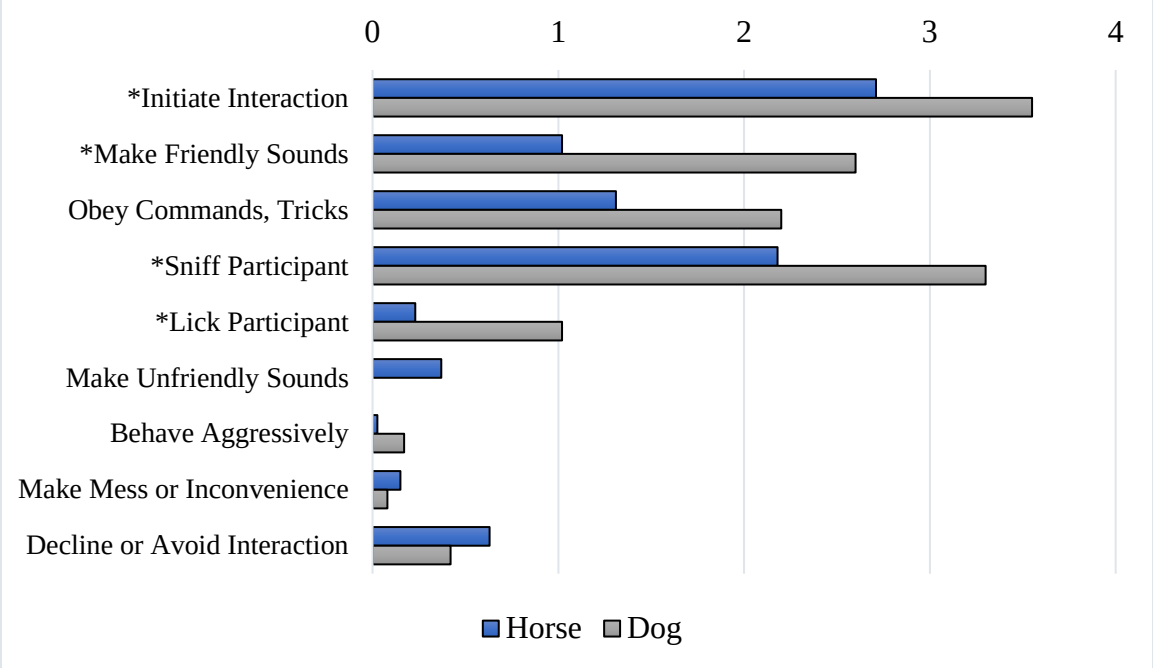
[9] Clean language is a therapeutic approach in which the practitioner questions the client, using the client's words and avoiding any interpretation so as not to interfere with the client's process (Grove & Panzer, 1989). The Eagala model promotes use of clean language in EAP sessions (Eagala, 2015).

no differences in age across the conditions; chi square analyses indicated no differences in gender or race/ethnicity. Participants were asked to rate their affinity for several different species (i.e., cats, dogs, horses) on a 5-point scale from 1, indicating "*I don't like the animal at all*" to 5, indicating "*I like the animal a great deal*." Affinity ratings were relatively high for horses (M = 4.42, SD = 0.78) and dogs (M = 4.79, SD = 0.51). One-way ANOVAs indicated no differences in affinity for horses or dogs by condition or session (p's > .10).

Session length was recorded from the time the facilitators gave instructions until the group was done processing the session. This was further broken down into time spent completing the task and time spent processing. One-way ANOVAs comparing time across conditions (in minutes) showed no differences in length of session overall (M = 22.76, SD = 5.61), time to complete the task (M = 16.17, SD = 5.68), or time spent processing the task with the facilitators (M = 6.48, SD = 1.14), (p's > .10).

Human-Animal Interaction

Comparisons between conditions were made at the session level, so that the mean HAIS score for each session was the unit of analysis. An independent-samples t-test was calculated to determine whether there were differences in HAIS scores between horse and dog sessions. Total HAI was higher in the dog condition (M = 31.78, SD = 7.27) than the horse condition (M = 22.46, SD = 4.14), t (6) = -2.37, p = .05. Looking at the subscales, the quantity of reported animal-initiated interactions was greater in the dog condition (M = 12.00, SD = 2.02) than the horse condition (M = 6.06, SD = 1.00), t (6) = -5.66, p = .001. Figure 2 illustrates the individual animal behaviors reported on the HAIS, showing which behaviors differed. The dog was perceived by participants to have initiated interaction, made friendly sounds, sniffed, and licked more than the horse.



*p < .05.

Figure 2. Animal Behavior across Species

In addition, the figure illustrates that positive desirable behaviors (i.e., initiate interaction, make friendly sounds, sniff, lick) were rated higher than negative undesirable behaviors (decline interaction, make unfriendly sounds, behave aggressively). Researcher observations indicated unfriendly sounds consisted of the horse whinnying. Aggressive behaviors were limited to the animal nudging or lightly pushing the participant or taking or chewing on a prop. There was no kicking, biting, scratching or growling. Neither the participants nor the facilitators reported any harm to the people or animals involved.

Participants in the control condition completed the HAIS, reporting interactions with the plush animal. Scores were relatively low ($M_{Total\ HAI}$ = 3.97, *SD* = 2.66) and consisted mostly of human behaviors – watch (*M* = 1.43, *SD* = 0.95) and spend time near the plush animal (*M* = 1.54, *SD* = 1.27). Animal-initiated interaction was limited to make friendly sounds – neighing when button was pushed (*M* = 0.64, *SD* = 0.89) – and decline or avoid interaction (*M* = 0.13, *SD* = 0.25).

Human Social Interaction

In order to explore whether social interactions between humans differed with the presence of a live animal, scores on the HHIS were compared across conditions. There were no differences in social interaction between the horse (*M* = 8.60, *SD* = 2.88), dog (*M* = 8.33, *SD* = 1.53), and control conditions (*M* = 11.75, *SD* = 4.99), *F* (2, 9) = 1.13, *p* = .365.

Anodyne Effect

Emotion across condition. Comparisons between conditions were made at the session level, with the mean MDES score per session as the unit of analysis. Independent-samples t-tests comparing emotion between animal and control sessions revealed that positive emotion was higher following animal sessions (*M* = 24.88, *SD* = 5.27) than control sessions (*M* = 12.07, *SD* = 4.65), *t* (10) = 4.10, *p* = .002. There was no difference in negative emotion, which was rated relatively low in both animal (*M* = 2.62, *SD* = 1.03) and control sessions (*M* = 3.41, *SD* = 1.67). To explore species-specific effects, positive emotion was compared across all three conditions. As Figure 3 illustrates, positive emotion was greater in both the horse condition *(M* = 23.38, *SD* = 4.32) and dog condition (*M* = 27.38, *SD* = 6.70) than the control condition (*M* = 12.07, *SD* = 4.65), *F* (2, 9) = 9.19, *p* = .007. The horse and dog condition did not differ significantly (*p* = .305). The positive emotion score is the sum of ten items addressing specific emotions (e.g., joyful, serene, love). ANOVAs did not identify any particular items/emotions that differed by condition; small differences between animal and control sessions on most items accumulated to a higher score overall. In addition to condition-level analyses, positive emotion was examined in relation to reported HAI.

Emotion and HAI. HAIS scores were analyzed by calculating correlations between total positive emotion and the summative scores on the HAIS, at the participant level. Positive emotion was correlated with total HAI, *r* = .711, *p* < .001. Looking at the subscales, positive emotion was correlated with both human-initiated HAI, *r* = .701, *p* < .001, and animal-initiated HAI, *r* = .565, *p* < .001. Exploratory correlations were calculated between positive emotion and each HAIS item (horse and dog combined), to detect whether specific behaviors elicited an anodyne effect. Positive emotion was positively associated with five human behaviors – watch (*r* = .455, *p* = .01), spend time near (*r* = .512, *p* = .002), pet (*r* = .589, *p* < .001), talk (*r* = .547, *p* = .002), and play (*r* = .643, *p* < .001); avoid interaction was negatively associated (*r* = -.381, *p* = .031). Several animal behaviors were also associated with positive emotion – initiate interaction (*r* = .374, *p* = .038), make friendly sounds (*r* = .392, *p* = .029), and sniff (*r* = .419, *p* = .019).

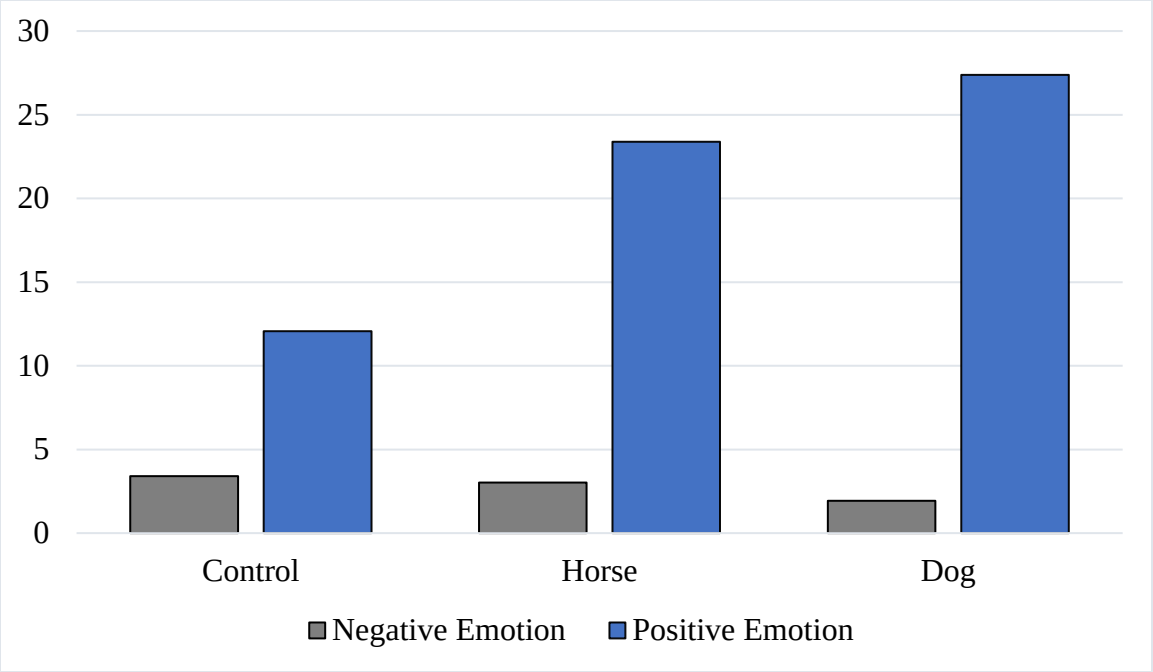


Figure 3. Emotion across Condition

The correlation coefficients for positive emotion and individual human behaviors are provided in Table 1, separated by species. Some behaviors were significant in both the horse and dog conditions (e.g., play and pet), some were significant in just the horse condition (i.e., talk to, spend time near, hold), and some were significant in just the dog condition (i.e., hug, watch). Positive emotion was not associated with any animal behavior when separating horse and dog conditions. There were no correlations between positive emotion and HAIS scores in the control condition (*p*'s > .10).

Table 1.
Correlation of Human-Initiated HAI and Positive Emotion, by Species

Behavior	Horse	Dog
Play	**.633****	**.623***
Pet	**.525***	**.696****
Talk to	**.678****	.382
Spend time near	**.619****	.439
Hug	.321	**.595***
Watch	.289	**.746****
Hold	**.540***	.122
Groom	.413	.145
Do tricks or training	.169	.211
Offer food	.122	--
Total Human-Initiated HAI	**.713*****	**.738****

*$p < .05$,**$p < .01$, ***$p < .001$.

Agent Effect

The intervention targeted psychosocial learning – learning about problem solving and learning about self in the context of problem solving within a group. Participants' written comments were analyzed to determine whether learning occurred and whether the animal served as an agent in the learning process, following the constant comparative method (Brunner, 2004). Researchers inductively drew themes, and then discussed the themes until reaching agreement concerning the importance of each theme and its conclusion. Then each response was coded for theme; all comments were rated independently by three researchers. Percent agreement was 80% for learning about self, 81% for learning about problem-solving, and 86% for identifying the animal's role.

Learning about self. In response to the question "W*hat, if anything, did you learn about yourself or your life*?" three themes emerged: (a) life lessons, (b) awareness of behavior, and (c) awareness of cognition. The greatest proportion of responses (37.8%, n = 17) seemed to reflect a life lesson; the comment was about life in the abstract rather than about them specifically (e.g., *"If you have the right tools and stay focused you can accomplish your goals"*). The life lesson was most often about persevering in the face of challenge (n = 10). Other responses reflected insight on behavior patterns, making up 28.9% (n = 13) of responses (e.g., "*I'm a follower not a leader*"). For the cognitive theme, 22.2% (n = 10) of responses reflected awareness of or changes in thinking. For example, some participants identified thought patterns – "*I learned that I always think there's a difficult path to reach my goal*," while some seemed to reflect a cognitive change – "*I learned I can think my way through a problem even when I am unsure how to go about it.*" In addition to these themes, two respondents wrote brief, abstract comments (e.g., "*perseverance*," "*self-reflection*") and three participants did not comment at all. Chi-square analyses were conducted to test for differences in theme between animal conditions and the control condition and between all three conditions. There were no differences in theme by condition (p's > .10).

Learning about problem-solving. In response to the question, *What, if anything, did you learn about problem solving?*, four themes emerged: (a) creativity, (b) teamwork, (c) patience and perseverance, and (d) communication. Teamwork was the most common theme, with 35.6% of participants (n = 16) indicating they learned about the need for teamwork to solve problems (e.g., "*It's much easier when you have multiple people thinking about the problem*."). There were also a number of participants (28.9%, n = 13) who commented on the need for patience and perseverance when working on a problem. For example, one person wrote "*not to give up and try different ways to solve it if one way isn't working*." Another 22.2% of the respondents (n = 10) commented on the need for creativity in solving problems (e.g., "*Think outside the box*"). Finally, 11.1% of comments (n = 10) addressed the importance of communication. For example, a participant wrote, "*we started an idea and just went with it without discussing it*". Chi-square analyses comparing the frequency of themes between conditions revealed a dependency. Comparing sessions with a live animal with the control condition, 40% of participants in the animal conditions commented on patience/perseverance while no one in the control condition did, χ^2 (3) = 8.97, p = .030. Figure 4 shows the proportion of responses in each theme, across condition. Comparing all three conditions, the proportion of responses about patience/perseverance was greater in the dog condition (53.8%) than the control condition (0.0%), χ^2 (6) = 12.48, p = .050.

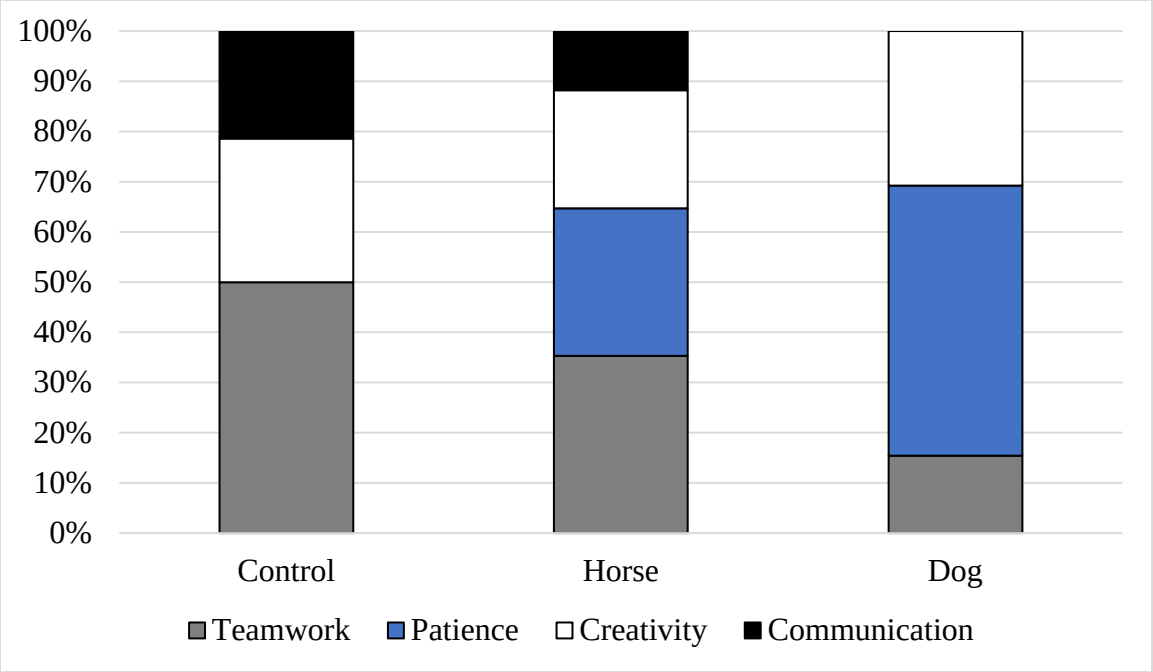


Figure 4. Learning about Problem-Solving across Condition

To further explore the agent effect, HAIS scores were compared across learning themes. Participants who reported learning about patience/perseverance had experienced greater quantities of HAI than those who reported learning about another construct. Specifically, animal-initiated interaction was higher for participants who learned about patience/perseverance (M = 9.27, SD = 4.17) as compared to those who reported learning about creativity (M = 5.83, SD = 4.65), teamwork (M = 4.87, SD = 6.07), or communication (M = 1.00, SD = 3.39), F (3, 39) = 3.48, p = .025.

The animal's role. The animal experience form asked participants to "*Describe the four-legged being and any impact it had*." Researchers rated each response based on the role the four-legged being seemed to fulfill in the session. Responses were coded as *anodyne* if they suggested the dog/horse/plush animal caused them to feel positive emotions (e.g., happy, calm, interested) or made the experience more fun or enjoyable. Comments describing the animal as an actor or symbol in their learning process were coded as *agent*. Some responses were concrete descriptions of session happenings and were coded as *neither* anodyne nor agent. A chi-square was calculated, comparing the role of the four-legged being in animal vs. control conditions. The statistic revealed a dependency between role and experimental condition, χ^2 (2) = 10.14, p = .006. The plush animal (71.6%) was more likely to be perceived as *neither* anodyne nor agent than the live animals (22.6%); and the live animals (35.5%) were more likely to be perceived as eliciting an anodyne effect than the plush animal (7.1%). As Figure 5 illustrates, a chi square calculated across all three conditions showed that *neither* anodyne nor agent was more common in the control condition (58.8%) than the horse (23.5%) or dog (17.6%) conditions, χ^2 (4) = 11.88, p = .018.

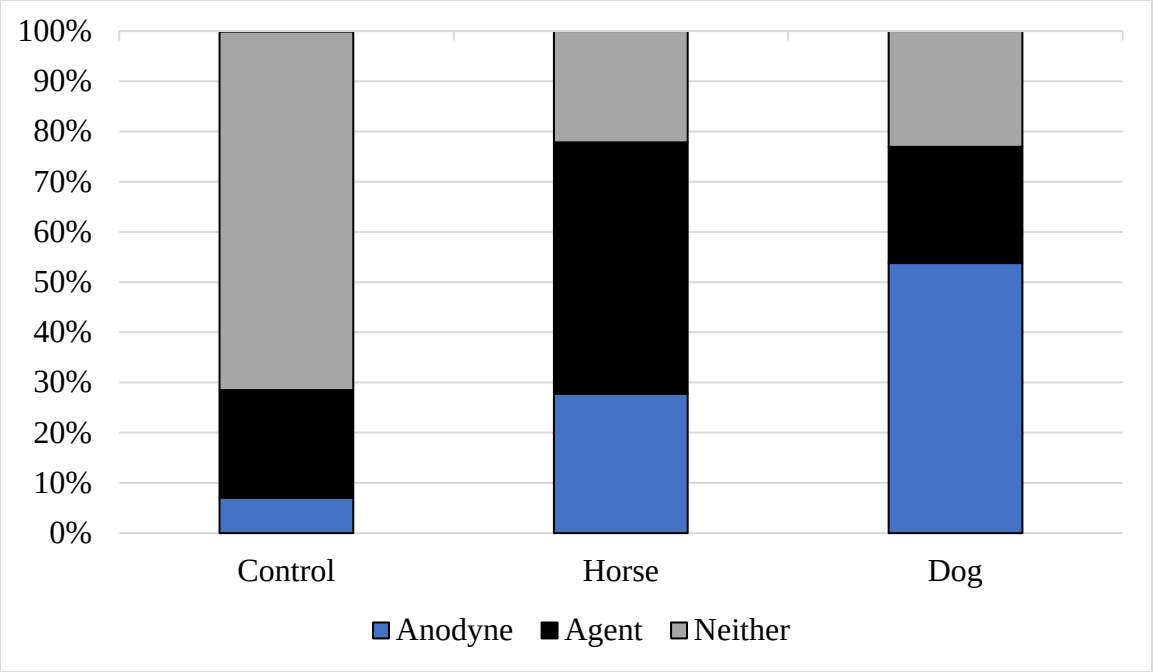


Figure 5. Animal Role across Condition

Discussion

This study was designed to demonstrate the anodyne-agent model by comparing anodyne and agent effects of an AAI with live animals or a control condition. It was hypothesized that participants in the animal conditions would report greater positive emotion and psychosocial learning, and that participant report would implicate the animal in the session as an agent in the intervention process.

Anodyne Effect

Findings on the anodyne effect, tested in Hypothesis 1, are promising. Positive emotion was higher for participants in sessions with a live animal than control sessions; this was true whether the animal was the horse or the dog. The lack of difference in negative emotion is likely the result of a floor effect, since negative emotion was rated low in all three conditions. This is not surprising, given this was a non-clinical sample of college students. Still, the difference in positive emotion is consistent with previous research showing AAI-associated improvements in relevant constructs, including reductions in depression (e.g., Souter & Miller, 2007) and state anxiety (Lang, Jansen, Wertenauer, Gallinat, & Rapp, 2010). Furthermore, the results circumvent an important limitation of previous research. AAI can differ from traditional intervention beyond the mere presence of an animal (e.g., treatment occurring outside versus inside, experiential versus verbal modality), making it difficult to attribute outcomes to the animal. Several of these variables were held constant, as is recommended to confirm causal relationships and isolate the animal's role in AAI (Serpell et al., 2017). In addition to study design, the present study aimed to illuminate the animal's role by linking outcomes to HAI.

Whereas previous studies made pre-post comparisons to test an AAI on the whole, describing time spent with the animal (e.g., Barker, Pandurangi, & Best, 2003), the present study includes reported interactions between humans and animals. The data indicate a range

of interactive behaviors are emitted by both the humans and animals involved. Results showed a positive correlation between overall HAI quantity and positive emotion. On the subscales, the association with human-initiated behavior was strong and animal-initiated behavior was moderate. The HAIS was validated to weigh all items equally and factors within have yet to be identified (Fournier et al., 2016). However, given the need for greater understanding of HAI as a basic phenomenon (Crossman, 2017) and the call to examine "the dose of the attributes of HAI required for the desired effect" (Vitztum, 2012, p. 34), closer exploration of HAI occurring within an intervention seems warranted. To that effect, some individual HAIS items (i.e., specific behaviors) were associated with positive emotion (e.g., talk to the animal) while others were not (e.g., groom the animal). The behaviors that correlated with positive emotion seem to be affiliative (i.e., watch, spend time near, talk to, pet, play, hug, and hold). The behaviors reflecting a caretaking role (i.e., feed, groom, train) were not associated with positive emotion. These results suggest items could be categorized as affiliative (i.e., behaviors to affiliate or bond with the animal) or caretaking (behaviors to care for the animal). It may be useful to manipulate HAI behaviors at this level, comparing affiliative and caretaking, in order to better understand which interactions best predict an anodyne effect.

Attributing these findings to an anodyne effect requires ruling out alternative explanations. An acquiescent response style, in which participants respond similarly to items of different constructs regardless of content, can be an important threat to internal validity with self-report data (Rammstedt, Goldberg, & Borg, 2010). However, HAI-emotion correlations do not appear to simply reflect acquiescence, since some HAIS items had relatively high ratings and did not correlate with positive emotion. For example, *watch the animal* was rated highest by participants in both the horse and dog conditions, but only correlated with positive emotion in the dog condition. In addition, positive emotion in the animal conditions does not seem to be explained by increased human social interaction. Although some previous findings of reduced depression following AAI attributed the outcome to increased social interaction between intervention recipients (e.g., Holcomb, Jendro, Weber, & Nahan, 1997), researchers in this study did not observe any differences in the quantity or quality of interaction among group members in the different conditions.

The implications of an anodyne effect are vast. Beyond replication to confirm these findings, the anodyne effect should be examined in depth and breadth. Positive emotion or reduced distress could be an end in itself (e.g., a dog visits a patient in the hospital to help them feel happier) and research is needed to further understand this phenomenon. An anodyne effect could also moderate a therapeutic process aimed at longer-term change, as depicted in Figure 1. For example, in psychotherapy, we know that outcomes are associated with attendance (e.g., Fiorentine & Hillhouse, 2003) and therapeutic alliance (e.g., Horvath & Bedi, 2002; Horvath & Symonds, 1991). Perhaps a HAI-elicited anodyne effect motivates attendance or facilitates the therapeutic alliance. Calvo et al. (2016) studied AAT as an adjunct to conventional treatment for patients with schizophrenia and found a greater attendance rate for the AAT group versus the conventional-treatment group. It is also possible positive emotion elicited from HAI allows for greater tolerance of distress associated with treatment, resulting in treatment persistence. Garcia, Sodré, Zaine, and Domeniconi (2016) examined the effect of a dog on college students' latency to escape response. Students were subjected to an aversive auditory stimulus while reading a book, spending time with a dog, or in a control condition. Students with the dog could better tolerate

the stimulus and rated the session more positively. Perhaps an animal-elicited anodyne effect can increase tolerance for the cost of intervention (e.g., physical or emotional challenge) so that the individual can persist and experience the benefit (e.g., physical or emotional healing/growth). Beyond increasing tolerance for an intervention, some suggest positive emotion can expand thought and behavior.

Despite this support for an anodyne effect, we note that HAI does not always elicit an anodyne effect. In fact, in some situations HAI could elicit the opposite – increased distress. This may suggest a mismatch between human and animal or between client and treatment modality. Or, it could be an important part of the therapeutic process. An animal eliciting negative emotion (e.g., client feels rejected by an animal that moves away or feels fear when an animal moves toward them) can be helpful in identifying thoughts and feelings relevant to the intervention goals (Chandler, 2018). This would be consistent with the animal's role as an agent in the therapeutic process.

Agent Effect

The intervention in the present study was aimed at psychosocial learning, and thus an agent effect would mean psychosocial learning occurred through interactions with the intervention agent (i.e., horse, dog, plush animal). In Hypothesis 2, we predicted participants in sessions with live animals would experience greater psychosocial learning (i.e., awareness of cognitive and behavioral patterns in the context of group work and problem solving). Content analysis of the open-ended responses to questions about learning and the animal's impact were varied. While some described learning an impersonal life lesson, other reports reflected personal insight. After coding each response for an identified theme, there were no differences in the learning content on group work in general.

However, learning about problem-solving specifically did reveal a difference by condition. Participants in the dog condition reported the need for patience/perseverance in problem-solving more than participants in the control condition. They described the dog as being distracted and taking their tools/items. Participant comments and researcher observations indicate the dog's behavior (i.e., coming and going from the task, removing items from the path) created challenge for the participants, presenting a need for patience/perseverance. It seems the animal's agency (i.e., capacity for free-willed action) impacted the participant experience. We cannot assume that learning patience or perseverance is a reliable outcome of dog-assisted interventions. The specific outcome of learning about patience/perseverance in this group activity likely resulted from a complex interaction of variables within these humans, this animal, and this situation. But we can conclude that the dog engaged with the participants (i.e., HAIS scores), the dog's behavior impacted the situation (i.e., dog was observed by participants and researchers taking items, leaving the task), and the participants implicated the dog in a subsequent outcome (e.g., learning "*not to give up and try different ways to solve it if one way isn't working"*). This is an important identification of the role of animal as intervention agent resulting from an interaction between the animal's capacity to behave independently in a situation, that behavior impacting the situation, and the humans reporting to have been impacted (i.e., learned something).

Animal-Specific Findings

As mentioned earlier, research has neglected the investigation of potential species and breed differences in the effects of HAI (Serpell, et al., 2017). Though there were no a priori predictions about species-specific differences, a discussion of the findings through that

lens may spur inquiry for future research. There were several important similarities in the findings for sessions with the dog versus the horse. In both dog and horse sessions, participants reported a range of human-initiated and animal-initiated interactions. Similarly, participants reported higher positive emotions following both conditions. There were also some notable differences between the horse and dog conditions.

Although both conditions seem to have resulted in an anodyne effect, a stronger effect was noted in the dog condition. The latter may be due to the greater quantity of animal-initiated HAI reported in the dog sessions compared to the horse sessions. Specifically, the dog was more often reported to initiate interaction with, make friendly sounds toward, sniff, and lick participants than the horse was. This is consistent with suggestions that dogs are more interested in engaging with humans (Nagasawa et al, 2015). In contrast, the horse engaged with the participants less. This is consistent with Goodwin's (2007) suggestion that horses, being prey animals, prefer to associate with their own kind and may not be as eager to interact with humans. When asked about their learning, participants in the dog condition were more likely to learn about the need for patience and perseverance than those in the control condition. Although not significant, data were trending in the direction of the dog serving more often as an anodyne and the horse more often as an agent (see Figure 5).

Because the study involved just one dog and just one horse, we do not know whether we captured species-specific differences. But these results suggest there are potential differences between different animals. Beyond inter-species differences, research indicates breeds within a species show different behaviors. Breed is associated with differences in attachment and attentiveness in dogs and anxious or excitable personalities in horses (Lloyd, Martin, Bornett-Gauci, & Wilkinson, 2008; Nagasawa et al., 2015). The research paradigm implemented here could be useful in making comparisons across species, breed, or other levels of differentiation. Research investigating these differences could unveil mechanisms underlying HAI effects, and may also aid in AAI animal selection.

Limitations

The study used a non-clinical convenience sample from a college campus in the Midwestern United States. This sample was fairly homogenous regarding demographics; most participants were white female students studying psychology. The anodyne-agent model must be studied with more diverse populations - first in controlled laboratory studies like this, then with clinical samples. This is especially true given the influence of culture on our beliefs about and interactions with animals (Hurn, 2012). In addition to cross-cultural differences, people vary in their individual affinity for animals (Driscoll, 1995). Participants in this study rated their liking of horses and dogs relatively high. Although recruitment flyers did not announce the study involved animals, selection bias is an important limitation in some AAI studies (e.g., Anestis et al., 2014). We don't know if the present findings generalize to people with less affinity to animals in general or dogs/horses specifically.

Controls designed for strong internal validity – standardized setting, instruction, and facilitation – may have limited the study's social validity. The single, brief, prescribed session used here may be quite different from AAIs conducted in the real world. For example, the brief nature of the session did not afford participants an opportunity for close connection with the animal. And the standard responses from the facilitators did not allow them to process with the groups as they would in an actual session. Thus, the sessions may have been missing some key ingredients – more intimate, genuine HAI and more personalized application of the intervention. Still, the dog was identified as an agent in participants

learning about patience/perseverance in problem solving. The sterile nature of the study likely means the findings are a conservative estimate of the potential for an agent effect. Future studies could include longer sessions; multiple sessions; or less prescribed, more psychotherapeutic sessions.

The posttest-only design, implemented to avoid a pretest effect (Dimitrov & Rumrill, 2003), introduces some limitations. Although random assignment to condition promotes equivalence at pretest *theoretically*, posttest-only measurement precludes us from being certain the groups were equivalent before the intervention. In addition, we cannot be certain whether posttest differences reflect an improvement in emotion following the session. The design also makes it impossible to determine the direction of the HAI-emotion correlations. Although the anodyne-agent model assumes HAI results in positive emotion, it is possible the relationship follows the opposite direction (i.e., participants feeling good interact with the animal more), or can be explained by a third variable. This study is an important first step in demonstrating the anodyne-agent model; future studies might incorporate pretest-posttest comparisons to avoid this limitation. Finally, with regard to design, the single-blind nature of the study makes it susceptible to experimenter bias from either the researchers or session facilitators. However, the risk for this type of bias was minimized by standardization of procedures, with minimal unscripted interaction between participants and researchers/facilitators.

Conclusion

The present research used novel methods – HAI analysis and experimental manipulation – to better understand AAI process and outcome. The HAI analysis suggests humans and animals exhibit a wide range of behaviors during AAI, interactions can differ between sessions with one animal vs. another, and some interactions seem to be associated more closely with positive emotion than others. The anodyne-agent model is a heuristic to organize AAI findings and develop testable hypotheses, assuming animals assist intervention through eliciting an anodyne effect and/or serving as an intervention agent. The present findings are promising and warrant confirmation through replication. Future research is needed to discern the strength and duration of an anodyne effect and the means by which animals can serve as intervention agents. In addition, we should investigate the influence of animal characteristics (i.e., species, breed, temperament) on the animal's role as anodyne/agent. Continuing this line of inquiry with laboratory-based experimental methods is necessary to clarify just how animals assist in the delivery of interventions for human health and well-being.

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