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The Influence of Interactions with Dogs on Affect, Anxiety, and Arousal in Children

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Interactions with animals represent a promising way to reduce the burden of childhood mental illness on a large scale. However, the specific effects of child–animal interactions are not yet well-established. This study provides a carefully controlled demonstration that unstructured interactions with dogs can improve clinically relevant symptoms in children. Seventy-eight children (55.1% female, 44.9% male) ages 10 to 13 (M = 12.01, SD = 1.13) completed the Trier Social Stress Test for Children, followed by (a) interaction with a dog, (b) a tactile-stimulation control condition, or (c) a waiting control condition. The Positive and Negative Affect Schedule for Children, Short Form and the State/Trait Anxiety Inventory for Children were completed at baseline and posttest, and salivary cortisol was assessed at 5 time points. Adjusting for baseline scores, participants in the experimental condition showed higher scores on the Positive Affect scale than participants in both control conditions and lower scores on the State/Trait Anxiety Inventory for Children than participants in the waiting control condition at posttest. Negative affect was not assessed reliably, and we detected no effect of the interactions on salivary cortisol, as measured by area under the curve with respect to ground. Brief, unstructured interactions with dogs boosted children's positive emotions and reduced anxiety. Additional research is needed to further clarify which features of the interactions produce these benefits and the extent to which interactions with animals offer benefits that exceed the effects of other common coping strategies, activities, and interventions.

Mental illness is the leading source of childhood disability and a top contributor to the overall burden of disease (Erskine et al., 2015). In the United States, approximately one in five children are affected by mental illness each year, with an annual financial cost of approximately $247 billion (Centers for Disease Control, 2013; Kessler et al., 2005). These estimates do not include consideration of subthreshold symptoms, which add considerably to the burden of disease (Balzás et al., 2013). Despite the considerable prevalence and consequences of childhood mental illness and subthreshold symptoms, roughly 80% of children in need do not receive treatment (Kataoka, Zhang, & Wells, 2002). Simple, scalable approaches to reducing the burden of childhood mental illness and subthreshold symptoms are urgently needed.

Animal-assisted activities (AAAs) represent a promising type of intervention to bridge the gap between children in need of mental health services and those receiving treatment. AAAs are unstructured programs that provide participants with opportunities to interact with animals (most commonly domestic dogs; *Canis familiaris*), with the goal of improving mental health and alleviating stress (International Association of Human–Animal Interaction Organizations, 2013). AAAs are promising as a method for improving children's mental health because they are appealing, enjoyable, credible, low cost, and easy to implement (Crossman & Kazdin, 2015). Indeed, AAAs are already prevalent as a strategy for improving children's mental health. Prominent examples include AAAs for pediatric patients, child victim witnesses, children who have experienced traumatic events, students learning to read, and even those without any special status at all. The

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rationale is that contact with the animals may improve mood and affect and alleviate anxiety and stress by promoting emotion-focused coping, serving as sources of social support, providing enjoyable experiences, and/or transmitting positive emotions through emotional contagion (Crossman, 2017; Kruger, Trachtenberg, & Serpell, 2004).

Preliminary evidence in support of the effects of AAAs on children's affect, anxiety, and stress-related symptoms comes from a small number of rigorously designed studies (e.g., Beetz, Julius, Turner, & Kotrschal, 2012; Kerns, Stuart-Parrigon, Coifman, Van Dulmen, & Koehn, 2017; Kertes et al., 2017). These studies have focused primarily on interactions with dogs and have documented the effects of these interactions on self-reported, behavioral, and physiological outcomes. However, the majority of research in this area has focused on adults (Nimer & Lundahl, 2007; Souter & Miller, 2007). In addition, most studies have focused on whether interactions with dogs buffer against the negative effects of stress (i.e., prevent increases in symptoms during stress exposure; Beetz et al., 2012; Kerns et al., 2017; Kertes et al., 2017; Krause-Parello, Thames, Ray, & Kolassa, 2018; Vagnoli et al., 2015). Although some AAAs focus on supporting children during stress exposure (e.g., while giving testimony in court), many focus on alleviating symptoms after exposure to an acute stressor (e.g., at the sites of tragedies/natural disasters), or among children facing conditions of chronic stress (e.g., children undergoing long-term hospitalizations), and it is not yet clear whether findings on the stress-buffering effects of AAAs will apply in situations where the goal is to promote recovery following a stressful event. Most important, the bulk of this research has been exploratory in nature (e.g., Kaminski, Pellino, & Wish, 2002; Tsai, Friedmann, & Thomas, 2010). As a result, the effects of AAAs on children are not yet well-established.

The preliminary state of the literature has resulted in one particularly important gap in our understanding of the effects of AAAs for children. Namely, it is not yet clear whether the interactions with the animals are really the active ingredient (Crossman, 2017; Marino, 2012). In other words, we cannot yet say whether the improvements observed in studies of AAAs can really be attributed to the interactions with the animals, rather than to other aspects of the interventions or to more general factors, such as engagement in any distracting or appealing activity (Marino, 2012). The issue is that the majority of studies have relied exclusively on no-treatment control conditions, if they have included any control condition at all (e.g., Braun, Stangler, Narveson, & Pettingell, 2009; Kerns et al., 2017; Vagnoli et al., 2015). Studies that use no-treatment control conditions demonstrate that AAAs can alleviate clinically relevant symptoms in children and suggest that the observed improvements are not simply due to extratherapeutic factors. However, these studies do not clarify what specific component of the intervention produced the improvements.

A handful of studies have attempted to isolate the effects of the interactions with the animals. The most common approach has been to compare the effects of support from an animal to support from a human (e.g., a parent or a friendly confederate; Beetz et al., 2012; Beetz et al., 2011; Kertes et al., 2017). In some cases, these studies have also included support from toy dogs as an additional control (Beetz et al., 2012; Beetz et al., 2011). Findings from these studies are mixed; some show positive effects of support from a dog on physiological arousal but not perceived stress, and some show positive effects on perceived stress but not physiological arousal (e.g., Beetz et al., 2012; Kertes et al., 2017). These findings provide initial hints that animals may be effective sources of social support for children. However, key questions remain. For example, do the effects of AAAs exceed the effects of other common approaches to improving children's affect and anxiety? One additional study attempted to isolate the effects of AAAs by ruling out participation in any distracting activity as an alternative explanation for the benefits (Barker, Knisely, Schubert, Green, & Ameringer, 2015). However, this study showed no differences between the effects of the two conditions, highlighting the fact that it is not yet clear whether interactions with animals convey specific benefits for children.

Observational findings from prior studies suggest one especially important plausible alternative explanation for the benefits of AAAs. These studies have shown that children who engage in more physical contact with the dogs over the course of their interactions show lower levels of stress following those interactions, suggesting that tactile stimulation may be driving the benefits that we typically attribute to the animals (e.g., Beetz et al., 2012; Kertes et al., 2017). Indeed, the benefits of tactile stimulation for mental health are well-established (see Ardiel & Rankin, 2010, for a review). Of course, it is likely that interactions with animals produce benefits in part because of tactile stimulation. However, the key question in terms of isolating the effects of AAAs is whether the benefits are attributable entirely to the effects of tactile stimulation.

Identifying the active ingredient in AAAs and ruling out alternative explanations is a crucial step in ensuring that these programs are as effective and efficient as possible (Chambless & Hollon, 2012). This is particularly important in light of the fact that these programs have already been widely implemented. In addition, interventions that involve interactions with animals introduce concerns about the welfare of the animals, the possibility of exposing individuals with allergies to and/or fears of the animals, and the risk of contamination/disease transmission. These concerns underscore the importance of ensuring that the animals are contributing meaningfully to the process of change. As a starting point, the field needs carefully controlled laboratory studies to isolate the effects of the types of child–animal interactions that compose AAAs and to rule out alternative explanations for their effects. Such investigations will provide a foundation of evidence on which to build our understanding of the role of AAAs in children's mental health care. Specifically, these investigations will inform efforts to develop guidelines for practice, identify populations of children that may be especially likely to benefit, and determine the precise role(s) of AAAs in clinical child psychology.

The present study evaluated the effects of brief, unstructured interactions with unfamiliar dogs on children's anxiety, affect, and physiological arousal, following exposure to a stressful task. We compared the effects of these interactions to the effects of tactile stimulation, as well as to no intervention. A secondary goal was to evaluate whether findings from prior studies, which have focused on whether interactions with dogs buffer against the negative effects of stress, would extend to interactions with dogs that occur *after* stress exposure, when symptoms are already elevated. We predicted that brief, unstructured interactions with unfamiliar dogs would increase children's positive affect and reduce negative affect, anxiety, and physiological arousal, relative to tactile stimulation or no intervention. In addition, we were interested in how children who did not have pets of their own would respond to the interactions, based on suggestions that prior experiences with animals may be necessary to gain the full benefits of AAAs (e.g., Stewart & Strickland, 2013). We therefore explored the role of children's ownership of, experience with, and feelings and behavior toward pets in their responses to the interactions.

METHOD

Human Participants

Participants were 78 children (43 [55.1%] female, 35 [44.9%] male), ranging in age from 10 to 13 (M = 12.01, SD = 1.13) and drawn from the local community surrounding a university in the northeastern United States. The county includes a mix of urban, suburban, and rural towns and has a total population of approximately 900,000 (U.S. Census Bureau, 2016). The county is predominantly White, Non-Hispanic, and the median household income as of 2015 was approximately $60,000, with a poverty rate of 13.6%. Per parent report, 44 participants (56.4%) were White, 6 (7.7%) were Hispanic/Latino, 5 (6.4%) were Asian, 4 (5.1%) were Black/African American, 1 (1.3%) was Native American/Alaska Native, and 18 (23.1%) were multiracial/multiethnic. One additional participant began the study but did not complete the full procedure and was excluded from all analyses. For this participant, the procedure was terminated during the Trier Social Stress Test for Children (discussed below) to prevent excessive stress. Detailed demographic and background information is available in Table 1.

Participants were recruited from September 2015 through September 2016 using a range of methods including online postings, e-mail, advertisements, fliers, and in-person at local sites. Exclusion criteria included fears of dogs and allergies to animal dander, saliva, or urine. Each child participant received a $5 gift certificate, a small toy, and a certificate of appreciation; parents also received a $15 gift certificate. This study was reviewed and approved by the Institutional Review Board and the Institutional Animal Care and Use Committee of Yale University. Parents and child participants provided informed consent and assent, respectively.

We elected to use an unselected community sample in light of the need for intervention methods that can reach a broad range of children. In addition, the goal of this investigation was to contribute to efforts to isolate the effects of interactions with dogs on clinically relevant symptoms in children rather than to establish the efficacy of AAAs for any full syndrome disorder. We selected this age group (10–13) because older children making the transition to adolescence are particularly susceptible to barriers to treatment such as perceived stigma, discomfort talking about mental health problems, and wanting to cope independently (Gulliver, Griffiths, & Christensen, 2010). In addition, AAAs are already in widespread use for children of this age group (Friesen, 2010).

Sample Estimate

We based our target sample of 75 participants (actual N = 78) on a sample estimate for a repeated measures analysis of variance (ANOVA) with a small effect (f = 0.2), three groups, a correlation of .7 between repeated measurements, and 95% power (Faul, Erdfelder, Lang, & Buchner, 2007). The results suggested that a sample of 63 participants was needed. We added four participants per condition to account for dropout, experimenter error, and related issues. We used this method in light of ongoing debate about how to calculate a sample estimate for our particular analytic approach (analysis of covariance [ANCOVA], adjusting for baseline scores on the outcome measures), as well as the clear consensus that this approach increases power relative to the ANOVA approach (Van Breukelen, 2006; Vickers & Altman, 2001; Zhang et al., 2014). In other words, our sample estimate reflects a conservative approach.

Measures

Positive and Negative Affect Schedule for Children, Short Form

We used the Positive and Negative Affect Schedule for Children, Short Form (PANAS-C-S) to assess affect at

TABLE 1
Participant Characteristics

Characteristic	*Full Sample (N = 78)*	*Dog (n = 26)*	*Tactile Stimulation Control (n = 26)*	*Waiting Control (n = 26)*
Age				
Range	10.00–13.96	10.13–13.92	10.27–13.94	10.00–13.96
M (*SD*)	12.01 (1.13)	12.16 (1.18)	12.18 (1.17)	11.69 (1.02)
Sex (%)				
Female	43 (55.10)	14 (53.80)	15 (57.70)	14 (53.80)
Male	35 (44.90)	12 (46.20)	11 (42.30)	12 (46.20)
Race/Ethnicity (%)				
White, Non-Hispanic	44 (56.40)	16 (61.50)	11 (42.30)	17 (65.40)
Black	4 (5.10)	1 (3.80)	2 (7.70)	1 (3.80)
Hispanic/Latino	6 (7.70)	2 (7.70)	4 (15.40)	0 (0.00)
Asian	5 (6.40)	0 (0.00)	0 (0.00)	5 (19.20)
Native American/Alaska Native	1 (1.30)	0 (0.00)	1 (3.80)	0 (0.00)
Multiracial/Multiethnic	18 (23.10)	7 (26.90)	8 (30.80)	3 (11.50)
Pet Ownership (%)				
Current	62 (79.50)	22 (84.60)	18 (69.20)	22 (84.60)
Past	60 (76.90)	21 (80.80)	18 (69.20)	21 (80.80)
Dog Ownership (%)				
Current	43 (55.10)	16 (61.50)	16 (61.50)	11 (42.30)
Past	34 (43.60)	12 (46.20)	10 (38.50)	12 (46.20)
CABS	28.02 (5.23)	27.94 (5.75)	27.88 (4.00)	28.21 (5.88)
EDI				
Positive	31.46 (5.64)	33.16 (5.60)	31.09 (5.70)	30.04 (5.38)
Negative	10.42 (2.88)	10.40 (2.43)	9.78 (2.52)	11.04 (3.53)
PANAS-C-P *M* (*SD*)				
Positive	18.36 (3.66)	18.88 (3.79)	17.88 (3.76)	18.31 (3.51)
Negative	8.23 (3.13)	7.42 (1.90)	7.40 (2.45)	9.85 (4.05)

Note: CABS = Companion Animal Bonding Scale; EDI = Experiences with Dogs Inventory; PANAS-C-P = Positive and Negative Affect Schedule for Children-Parent Report, Short Form.

baseline and after the intervention. The PANAS-C-S includes a five-item Positive Affect scale and a five-item Negative Affect scale (Ebesutani et al., 2012). Children were asked to indicate the extent to which they felt each item "right now" using a 5-point Likert scale. For example, children were asked to rate the extent to which they felt "happy" and "miserable" for the Positive and Negative Affect scales, respectively. The items are summed to yield separate Positive and Negative Affect scales.

The Positive and Negative Affect scales in the PANAS-C-S have higher inter-item correlations than their full-length counterparts. In the present investigation, Cronbach's alpha was .90 for the Positive Affect scale at baseline. However, Cronbach's alpha for the Negative Affect scale at baseline was .57, indicating that negative affect was not assessed reliably. We examined the intra-item correlations to evaluate whether there were items with low correlations to the rest of the scale, but we did not find any such items and the Negative Affect scale was excluded from further analysis. The PANAS-C-S has discriminant validity comparable to that of the full-length measure. Baseline scores on the Positive Affect scale were comparable to those reported among other nonclinical samples and among children experiencing chronic physical illness (e.g., Hexdall & Huebner, 2008; Reddy, Palmer, Jackson, Farris, & Alfano, 2017).

State/Trait Anxiety Inventory for Children

We used the State portion of the State/Trait Anxiety Inventory for Children (STAI-C) to assess anxiety at baseline and after the intervention period. The STAI-C consists of 20 items, and children are asked to report how they feel "right now, at this very moment." For example, children are asked to indicate whether they feel "very relaxed," "relaxed," or "not relaxed" (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1973). Responses on all 20 items are summed. Cronbach's alpha at baseline was .85. The STAI-C has demonstrated construct, concurrent, and discriminant validity for children and adolescents (e.g., Seligman, Ollendick, Langley, & Baldacci, 2004; Spielberger et al., 1973). Baseline STAI-C scores were similar to those reported for other unselected samples but were lower than those reported for samples of children with clinically significant anxiety disorders (e.g., Flannery-Schroeder & Kendall, 2000; Kendall, 1994; Muris, Rapee, Meesters, Schouten, & Geers, 2003; Reddy et al., 2017; Spielberger et al., 1973).

Salivary Cortisol

Salivary cortisol is a reliable measure of activation of the Hypothalamic-Pituitary-Adrenal axis, which regulates the body's stress response, and has been extensively validated as a measure of physiological stress (see Kirschbaum & Hellhammer, 1989, for a review). Salivary cortisol was assessed as a physiological indicator of stress at five time points: Baseline; immediately after the stress induction; and at 5, 10, and 15 min into the intervention period. Thus, accounting for the time to collect the cortisol samples, the last cortisol sample was collected approximately 41 min after stressor onset and 23 min after its conclusion. Although a longer time line of assessment (45 to 60 min post-exposure) is commonly used to capture complete cortisol recovery, the timing of the cortisol assessments was selected based on consideration of a number of factors. Previous research examining the use of an intervention to promote cortisol recovery following stress exposure showed group differences at approximately 20 min post-exposure (Khalfa, Bella, Roy, Peretz, & Lupien, 2003). Studies of cortisol recovery in children and adolescence additionally show recovery at approximately 20 min post-exposure (Hankin, Badanes, Abela, & Watamura, 2010). Finally, in previous pilot work, our research group found that absent any intervention, child participants showed nearly complete cortisol recovery using this time line. In light of these findings and because our priority was to detect differences in the rate of cortisol recovery between groups, we chose to prioritize more frequent assessments to maximize our chances of capturing between-group differences in the rate of cortisol recovery. In addition, we selected the length of the interaction (15 min, not including breaks for cortisol assessments) based on our expectation of what would be maximally effective for the children and in the best interests of the dogs. Extending the cortisol assessment period would thus have meant continuing the assessments beyond the conclusion of the interactions, which might have diluted the between-group effects.

Participants were instructed not to consume any food in the hour before coming to the lab (Kirschbaum & Hellhammer, 1989). Salivary cortisol was collected using Saliva Bio Oral Swabs (Salimetrics, Carlsbad, CA), which participants chewed for 1 min per sample. After collection, samples were frozen (below −20 °C) until assay. Samples were assayed in duplicate according to the manufacturer's recommended protocol (#1–3002, Salimetrics, Carlsbad, CA) using a highly sensitive enzyme immunoassay designed for analyzing saliva samples and a sample test volume of 25 μL of saliva per determination. The lower limit of sensitivity of the assay is 0.007 μg/dL, and the standard curve ranges between 0.012 μg/dL to 3.0 μg/dL. The average intra-assay coefficient of variability (CV) was 7.92%, indicating that cortisol concentration was assessed reliably.

To evaluate cortisol output over the course of the study, we computed the area under the curve with respect to ground (AUC_G; Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). AUC_G provides a summary of the overall cortisol output, allowing for straightforward analysis of repeated measures data. AUC_G takes into account change over time with respect to baseline scores, as well as the overall magnitude of the cortisol response (Khoury et al., 2015; Pruessner et al., 2003).

Positive and Negative Affect Schedule for Children–Parent Report, Short Form

We hypothesized that children's affect would change over the course of the study. However, change in affect may be influenced by more long-term moods. Accordingly, we included the Positive and Negative Affect Schedule for Children–Parent Report, Short Form (PANAS-C-P) as a possible adjustment variable. The PANAS-C-P is the same as the child-report version (see earlier), but in this case parents were asked to respond based on how their children have felt "during the past few weeks." Cronbach's alpha was .86 for the Positive Affect scale and .81 for the Negative Affect scale. The PANAS-C-P has demonstrated construct validity (Ebesutani, Okamura, Higa-McMillan, & Chorpita, 2011). Scores on the PANAS-C-P in the present sample were similar to those reported previously among a large, school-based sample (Ebesutani et al., 2011).

Companion Animal Bonding Scale

We included the Companion Animal Bonding Scale (CABS) to explore the role of children's feelings and behavior toward companion animals in their responses to the interactions in our study. The CABS is a self-report measure that assesses children's day-to-day interactions with and feelings toward their companion animals. Children indicate the frequency of each of eight behaviors and feelings relating to their bonding with their pet (e.g., "How often do you feel that you have a close relationship with your companion animal?") on a 5-point Likert scale. The CABS has established convergent validity and internal consistency (Cohen, 2002; Poresky, Hendrix, Mosier, & Samuelson, 1987; Triebenbacher, 1999). Cronbach's alpha for the CABS was .70. Participants in all three conditions who had a pet at the time of the study completed the CABS. Participants who did not have a pet at the time of participation did not complete the CABS.

Experiences with Dogs

We were interested in exploring the role of each child's general prior experiences with dogs, in addition to their level of bonding with a particular companion animal. In addition, we wished to quantify children's general exposure to dogs, regardless of whether they themselves had a dog at the time of the study. We therefore asked parents of child participants to report on current and past pet ownership and to specify the species of those pets. This allowed us to analyze the effects of pet ownership in general, as well as dog ownership in particular. In addition, we included an adapted version of the Experiences with Dogs Inventory (EDI; Crossman, Kazdin, & Knudson, 2015). The EDI asked parents to rate how frequently their children had engaged in each of 20 experiences involving dogs, including 13 positive/neutral experiences (e.g., "My child has touched/petted a dog") and seven negative experiences (e.g., "My child has been harmed by a dog"), which yield separate Positive and Negative sum scores. Responses are made using a Likert scale ranging from 1 (*never*) to 5 (*very frequently*). Cronbach's alpha for the Positive dimension of the EDI was .69. We therefore removed one item ("My child has worked with dogs to earn money [e.g., dog walker, dog sitter]," which had a small, negative correlation; $r = -.01$) with the rest of the scale. Cronbach's alpha for the resulting 12-item Positive dimension was .70, and we therefore used this version. Cronbach's alpha for the Negative dimension was .72. The EDI has established convergent validity (Crossman et al., 2015).

Stress Task

We used the Trier Social Stress Test for Children (TSST-C) to induce moderate psychosocial stress (Buske-Kirschbaum et al., 1997). The TSST-C involves an anticipation phase, a public speaking phase, and a mental arithmetic phase. The TSST-C reliably elicits moderate psychosocial stress in children ages 7 to 14 (Gunnar, Talge, & Herrera, 2009).

Selection and Protection of the Dogs

Eight dogs (four male, four female) participated in data collection. Two additional dogs participated but were not involved in data collection for the experimental condition (i.e., only participants in the control conditions interacted with these dogs, after completing the study). Although it would have been preferable to limit the number of dogs (and consequently the amount of variability in the nature of the interactions), this number of dogs was needed to facilitate participant scheduling. In addition, the variability introduced by the eight dogs included in the present study was less than is introduced in studies evaluating interactions between children and their own dogs (e.g., Kerns et al., 2017; Kertes et al., 2017). All dogs were certified or registered as therapy dogs with leading therapy dog organizations (e.g., The Good Dog Foundation, Pet Partners) or had successfully completed an equivalent behavioral evaluation. Veterinary records were provided for all dogs to indicate that they were up-to-date on vaccinations and free of parasites.[1] Before enrollment, each dog completed an orientation visit at the lab, which included time for acclimation to the facility, orientation of the handler and dog to the study procedures, and evaluation of the dog's behavioral response to the procedures.

A key component of the hypothesis was that interaction with a dog (rather than a dog and handler) would alleviate stress and improve affect. In addition, a primary limitation of past human–animal interaction research has been the failure to disentangle the effects of interaction with the dogs from interaction with the dogs' handlers and other program participants (Marino, 2012). Accordingly, it was important that participants in the present study interact independently with the dogs without extensive intervention from human handlers. We achieved this goal by having a member of the research team sit in the corner of the room to supervise the interactions, intervening only as necessary to protect the well-being of the dog and/or child. The dog's handler waited in a separate room.

To address concerns raised by separating dogs from their handlers, our procedure included a number of protections for both the dogs and the child participants. First, a central component of the orientation visit was to evaluate the dog's response to being separated from the handler. After familiarization with the facility and the members of the research team, each dog was left with a member of the research team for a test period of 5–10 min. During this test period, the handler was free to observe the dog through a two-way mirror or closed-circuit television system. If dogs showed signs of stress, the test was ended. Dogs that showed signs of stress or otherwise demonstrated inappropriate behavior were not accepted into the study.[2]

During the study, handlers were again able to watch all interactions through a two-way mirror and had the option to stop any interaction to protect their dog's safety or well-being. However, an interaction was terminated early (after 10 min) on only one occasion, due to experimenter concerns about signs of stress (e.g., barking).[3] Finally, participants were given instructions for safe interactions with dogs and were provided brief, scripted prompts to remind them of these instructions as needed. All members of the research team were trained to detect signs of stress and

[1] Therapy dog registration/certification was used as an indicator of dogs' behavioral suitability for interactions with unfamiliar children. Because the interactions in this study were conducted without the handler in the room, these interactions are not considered therapy dog visits/interactions.

[2] One dog that demonstrated appropriate behavior and did not show signs of stress at the orientation visit later showed signs of stress during its first days of participation in the study. This dog was accordingly withdrawn from participation following consideration of changes in her behavior in and around the lab by the members of the research team and the dog's handler.

[3] In that instance, the dog was reunited with its handler, and the child waited for the remaining 5 min of the interaction period. Because the majority of the interaction was completed, that participant was retained for all analyses. However, we also confirmed that the pattern of results (including main and supplementary analyses) does not change when that participant is removed from the analyses.

aggression in dogs and received hands-on training for monitoring child–dog interactions. To prevent fatigue, dogs never participated in the study 2 days in a row and never had more than two sessions per day, with breaks provided between sessions.

Study Conditions

Assignment to the three study conditions was made using a random number generator (https://www.randomizer.org/).[4] The experimental condition involved a 15-min interaction with a dog, which was supervised by an experimenter. Participants were permitted to interact freely with the dogs so long as they maintained appropriate behavior (e.g., no touching the dogs' eyes/ears/mouths, no yelling) and the dogs did not show signs of stress or aggression.

To establish whether the interactions conveyed benefits beyond the effects of tactile stimulation, we included a tactile-stimulation control condition in which children were given a soft blanket. The goal was to evaluate whether something about the act of interacting with the dogs, rather than just the tactile stimulation they provide or the presence of any novel and comforting object, would reduce children's stress. We also included a waiting control condition to evaluate whether interaction with a dog is more effective than children's independent coping skills and to rule out the effects of factors such as completing the measures repeatedly, familiarization with the setting, and the simple passage of time as alternative explanations. As in the experimental condition, the experimenter remained in the corner of the room during both control conditions.

Procedure

Participant sessions were scheduled to begin between 1 and 6 p.m. After providing informed consent, parents of child participants completed a background questionnaire about their children, which included the PANAS-C-P. After providing assent, child participants provided baseline saliva samples and then completed baseline self-report measures (PANAS-C-S, STAI-C). The TSST-C was then completed, followed immediately by collection of the second cortisol sample. Participants then engaged in their respective conditions for 15 min, with the third, fourth, and fifth cortisol samples collected at 5-min intervals. Participants then completed the posttest PANAS-C-S and STAI-C, and participants in both control conditions were given the chance to interact with a dog. Participants were then debriefed and provided their toys, gift certificates, and certificates of participation.

[4] After Participant 44, random assignment was split up by gender (i.e., there were separate random assignment lists for male and female participants) to ensure similar proportions of male and female participants in each condition.

Data Analytic Plan

Treatment of Missing Data

We computed sum scores for all self-report measures. For cases in which individual items were missing, missing data were prorated using the mean of the completed items. Measures missing more than one fourth of the items were excluded. The average number of missing items per measure per participant was 0.57.

Preliminary Analysis

We checked for differences on background and demographic variables by condition using chi-squares and one-way ANOVAs. We used Pearson product–moment correlations to evaluate the relations among baseline variables and to check for redundancy of measures. We used a threshold of .71 (indicating a shared variance of 50%) to evaluate redundancy of measures. In case of correlations exceeding .71, we evaluated the correlations between change scores on those measures, with the intention that we would combine measures where change scores were also highly correlated. For participants in the experimental condition, we used one-way ANOVAs to check for differences in change scores for the STAI-C and the Positive Affect scale, as well as for differences in AUC_G, based on the dog with which participants interacted.

Effects of the Interactions

We used a one-way ANCOVA to evaluate the effect of condition on each self-report measure (the Positive Affect scale and the STAI-C), adjusting for scores on that same measure at baseline. We used this approach (rather than a repeated-measures ANOVA) because baseline measures were collected before the stress induction and the intervention (rather than immediately before the intervention). In cases of significant effects, planned contrast were conducted to evaluate the difference between the experimental condition and each of the two control conditions. For ANCOVAs, adjusted means are presented unless otherwise noted. For planned contrasts, Cohen's d was calculated using adjusted means and the square root of the mean square error. We used a one-way ANOVA to evaluate differences in AUC_G based on study condition.

Supplementary Analysis

We conducted exploratory analyses to examine the importance of children's current and past ownership of pets and of dogs in particular, experiences with dogs, and their self-reported feelings and behaviors toward their dogs. For this analysis, we focused only on participants in the experimental condition. We used Pearson's partial correlations to examine the relations between the continuous animal experience variables (EDI, CABS) and each self-report outcome (PANAS-C-S, STAI-C), adjusting for baseline scores on the same self-report measure. We additionally used Pearson product–moment correlations to evaluate the relations between AUC_G and EDI and CABS scores. For the pet ownership variables (current and past pet ownership, current and past dog ownership), we used one-way ANCOVAs to evaluate the effects on posttest scores on each self-report measure, adjusting for baseline scores on the same self-report measure and one-way ANOVAs to evaluate the effects of these pet ownership variables on AUC_G.

RESULTS

Preliminary Analysis

Participants in the three conditions did not differ in terms of age, race/ethnicity, sex, current or past dog ownership, EDI scores, or CABS scores (*ns*).[5] In light of the low number of participants who did not have pets at the time of participation (n = 11) or in the past (n = 13), the sample size was insufficient to evaluate whether the conditions differed in terms of current and/or past pet ownership of participants. Frequencies of current and past pet ownership are presented in Table 1. Participants in the different conditions did not differ at baseline on the Positive Affect scale, the STAI-C, or cortisol (*ns*). Parent reports of participants' positive affect "during the past few weeks" using the PANAS-C-P also did not differ by condition (*ns*). However, parent reports on the Negative Affect scale of the PANAS-C-P did vary across conditions, $F(2, 74) = 5.87$, $p = .004$, $\eta_p^2 = 0.14$. Parent-reported Negative Affect scale scores were higher for participants in the waiting control condition ($M = 9.85$, $SD = 4.05$) than for participants in the experimental condition ($M = 7.42$, $SD = 1.90$), a mean difference of 2.42 points, 95% CI [0.79, 4.05], $p = .004$, $d = 0.77$. Scores for participants in the waiting control condition were also higher than for those in the tactile-stimulation control condition ($M = 7.40$, $SD = 2.45$), a mean difference of 2.45 points, 95% CI [0.80, 4.09], $p = .004$, $d = 0.73$. However, parent-reported Negative Affect scores were not significantly correlated with change in Positive Affect scale scores, $r(73) = .06$, $p = .623$, change in STAI-C scores, $r(73) = -.05$, $p = .690$, or AUC_G, $r(73) = .07$, $p = .582$. As a result, and in consideration of the fact that self-reports on the Negative Affect scale were excluded as an outcome measure, parent-reported Negative Affect was not included in subsequent analyses.

In terms of the relations among baseline measures, Positive Affect scores were negatively correlated with STAI-C scores, $r(75) = -.78$, $p < .001$. The magnitude of this correlation raised concerns about the possibility of redundancy of measures. However, change in Positive Affect scores and change in STAI-C scores from baseline to posttest were only moderately negatively correlated, $r(74) = -.46$, $p < .001$. We consequently retained the Positive Affect scale and STAI-C as separate measures. Baseline salivary cortisol was not significantly correlated with baseline Positive Affect scale scores, $r(72) = -.01$, $p = .926$, or STAI-C scores, $r(72) = .03$, $p = .800$. Within the experimental condition, there were no significant differences in change in Positive Affect scores, $F(7, 17) = 1.12$, $p = .396$, $\eta_p^2 = 0.32$; change in STAI-C scores, $F(7, 17) = 0.96$, $p = .488$, $\eta_p^2 = 0.28$; or AUC_G, $F(7, 17) = 0.79$, $p = .603$, $\eta_p^2 = 0.25$, based on the dog with which participants interacted.

Effects of the Interactions

Baseline scores and unadjusted posttest scores on each of the outcome measures are presented in Table 2. The ANCOVA evaluating the effect of the interactions on Positive Affect scores revealed a significant effect of condition, $F(2, 72) = 4.37$, $p = .016$, $\eta_p^2 = 0.11$. Planned contrasts revealed that posttest Positive Affect scores for participants in the experimental condition ($M = 18.82$, $SE = 0.60$) were significantly higher than those of participants in the waiting control condition ($M = 16.90$, $SE = 0.59$), a mean difference of 1.92 points, 95% CI [0.24, 3.60], $p = .025$, $d = 0.65$.[6] Positive Affect scores for participants in the experimental condition were also significantly higher than those of participants in the tactile-stimulation control condition ($M = 16.48$, $SE = 0.59$), a mean difference of 2.35 points, 95% CI [0.66, 4.03], $p = .007$, $d = 0.79$. Following exposure to a stressful task, child participants who interacted with a dog showed higher levels of positive affect than participants who received tactile stimulation without any interaction or waited. Detailed statistics for planned contrasts are presented in Table 3.

[5] Because the majority of the sample was White and cell sizes for all ethnicities other than White were small (< 7), we collapsed across all ethnicities other than White (Asian, Black/African American, Hispanic/Latino, Native American/Alaska Native, and "other") for the purposes of this analysis. The total number of White participants was 44, and the total number of non-White participants was 34.

[6] Initially, we conducted the planned contrasts for the self-report outcomes using a Bonferroni correction for multiple comparisons. However, a reviewer raised the possibility that this approach might have been too conservative, and we consequently removed the correction. When the Bonferroni correction is applied, the comparison between participants in the experimental condition and those in the waiting control condition is not significant for the Positive Affect scale (Bonferroni corrected threshold = .025). The results for the STAI-C are unchanged.

TABLE 2
Unadjusted Means and Standard Deviations for Primary Outcome Measures at Baseline and Posttest

Measures: M *(SD)*	*Full Sample (N = 78)*	*Dog (n = 26)*	*Tactile Stimulation Control (n = 26)*	*Waiting Control (n = 26)*
Baseline Scores				
PANAS-C-S: Positive	17.58 (5.22)	18.69 (4.76)	17.40 (4.86)	16.65 (5.96)
STAI-C	28.08 (4.66)	27.15 (3.84)	28.32 (4.85)	28.77 (5.22)
Cortisol (μg/dL)	0.10 (0.09)	0.11 (0.10)	0.07 (0.04)	0.12 (0.11)
Posttest Scores				
PANAS-C-S: Positive	17.39 (5.51)	19.72 (5.18)	16.36 (4.65)	16.15 (6.03)
STAI-C	28.64 (5.86)	25.80 (4.94)	29.42 (5.43)	30.58 (6.24)
Cortisol (μg/dL)	0.19 (0.18)	0.19 (0.17)	0.16 (0.17)	0.22 (0.20)

Note. PANAS-C-S = Positive and Negative Affect Schedule for Children, Short Form; STAI-C = State/Trait Anxiety Inventory for Children (state portion).

TABLE 3
Planned Contrasts for Self-Report Outcomes

			95% CI			
Outcome	*Contrast*	*M Difference*	*LL*	*UL*	p	*Cohen's* d
PANAS-C-S: Positive	Dog vs. tactile stimulation	2.35	0.66	4.03	.007	0.79
	Dog vs. waiting	1.92	0.24	3.60	.025	0.65
STAI-C	Dog vs. tactile stimulation	2.25	−0.14	4.65	.065	0.53
	Dog vs. waiting	3.63	1.25	6.01	.003	0.86

Note: Mean differences reflect differences in adjusted posttest means (posttest scores, adjusted for baseline on the same measure). Cohen's *d* was calculated using adjusted means and the square root of the mean square error. CI = confidence interval; LL = lower limit; UL = upper limit; PANAS-C-S = Positive and Negative Affect Schedule for Children, Short Form; STAI-C = State/Trait Anxiety Inventory for Children (state portion).

There was also a significant effect of condition for STAI-C scores, $F(2, 72) = 4.69$, $p = .012$, $\eta_p^2 = 0.12$. Participants in the experimental condition ($M = 26.47$, $SE = 0.85$) had significantly lower scores than participants in the waiting control condition ($M = 30.09$, $SE = 0.83$), a mean difference of 3.63 points, 95% CI [1.25, 6.01], $p = .003$, $d = 0.86$. However, the difference between STAI-C scores in the experimental condition and those in the tactile-stimulation control condition ($M = 28.72$, $SE = 0.85$) was not significant, $p = .065$, 95% CI [−0.14, 4.65], $d = 0.53$. These findings convey that interaction with the dog did reduce anxiety relative to waiting without intervention but raise questions about whether this anxiolytic effect is specific to interaction with a dog, or whether tactile stimulation from any soothing object might convey a similar benefit.

The ANOVA for AUC_G failed to reveal a significant effect of condition, $F(2, 73) = 0.98$, $p = .381$, $\eta_p^2 = 0.03$. Participants who interacted with the dogs did not differ significantly from participants in the other conditions in terms of overall physiological arousal. A visual depiction of change in salivary cortisol concentration for each condition is presented in Figure 1.

Supplementary Analysis

Among participants in the experimental condition, we explored whether participants' responses to the interactions varied based on their EDI and CABS scores and based on current and past pet ownership.

EDI

Among participants in the experimental condition, scores on the Positive dimension of the EDI were significantly correlated with posttest Positive Affect scale scores, adjusting for baseline Positive Affect scale scores, $r(21) = .42$, $p = .047$. However, the Positive dimension of the EDI was not significantly correlated with either posttest STAI-C scores (adjusting for baseline STAI-C scores), $r(21) = -.23$, $p = .288$, or AUC_G, $r(22) = -.21$, $p = .329$. Scores on the negative dimension of the EDI were not associated with posttest Positive Affect scores, $r(21) = .16$, $p = .465$, or STAI-C scores (adjusting for baseline scores on the same measures), $r(21) = .05$, $p = .839$. Surprisingly, however, higher scores on the Negative dimension of the EDI were associated with lower AUC_G, r $(22) = -.47$, $p = .021$.

CABS

Adjusting for baseline scores, the CABS was not associated with posttest Positive Affect scale scores, $r(14) = .08$, $p = .776$, or STAI-C scores, $r(14) = -.04$, $p = .897$. The CABS was also not associated with AUC_G, $r(14) = -.37$, $p = .161$.

Pet ownership

Participants who had pets at the time of participation showed significantly higher Positive Affect scale scores at posttest ($M = 20.45$, $SE = 0.79$) than participants who did not have pets at the time of participation ($M = 15.89$, $SE = 1.88$), when adjusting for baseline Positive Affect scale scores, $F(1, 22) = 4.85$, $p = .038$, $\eta_p^2 = 0.18$. However, STAI-C scores, $F(1, 22) = 0.25$, $p = .622$, $\eta_p^2 = 0.01$ and AUC_G, $F(1, 23) = 0.93$, $p = .346$, $\eta_p^2 = 0.04$, did not vary based on

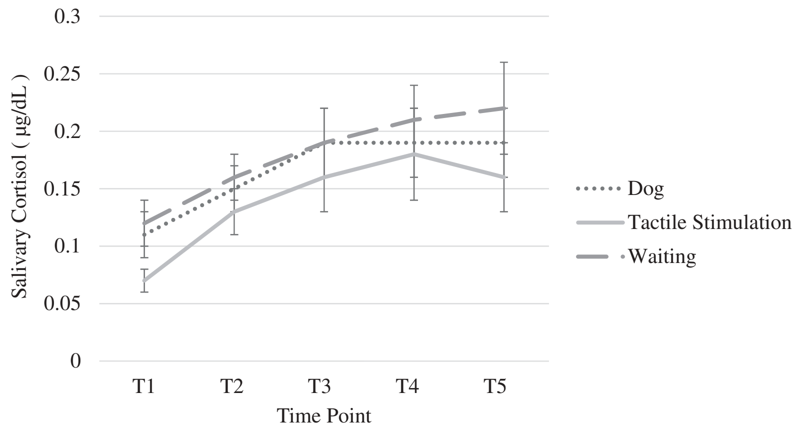

FIGURE 1 Salivary cortisol concentration, broken down by study condition. *Note*: Error bars represent standard error.

current pet ownership. Neither Positive Affect scale scores, $F(1, 22) = 3.02$, $p = .096$, $\eta_p^2 = 0.12$; nor STAI-C scores, $F(1, 22) = 0.14$, $p = .710$, $\eta_p^2 = 0.01$; nor AUC_G, $F(1, 23) = 3.26$, $p = .084$, $\eta_p^2 = 0.12$, varied based on past pet ownership. Positive Affect scale scores, $F(1, 22) = 0.04$, $p = .838$, $\eta_p^2 = 0.002$; STAI-C scores, $F(1, 22) = 0.04$, $p = .844$, $\eta_p^2 = 0.002$; and AUC_G, $F(1, 23) = 0.36$, $p = .553$, $\eta_p^2 = 0.02$, also did not vary based on current dog ownership. Finally, Positive Affect scale scores, $F(1, 22) = 0.08$, $p = .787$, $\eta_p^2 = 0.003$; STAI-C scores, $F(1, 22) = 0.99$, $p = .331$, $\eta_p^2 = 0.04$; and AUC_G, $F(1, 23) = 0.06$, $p = .805$, $\eta_p^2 = 0.003$, did not vary based on past dog ownership.[7]

DISCUSSION

We found that child participants who engaged in a brief, unstructured interaction with an unfamiliar dog after exposure to a moderate stressor showed higher positive affect, relative to participants who received a soothing object or waited for the same amount of time. Participants who interacted with a dog also showed lower anxiety relative to those who waited for the same amount of time but not relative to those who received a soothing object. These effects on positive mood and anxiety were medium in magnitude. However, we did not detect any effect of the interactions with the dogs on physiological arousal, as measured by salivary cortisol. Overall, our findings support the effects of brief, unstructured interactions with dogs on subjective but not physiological indicators of affect and anxiety.

Interaction with a dog produced increases in positive affect that exceeded the effects of tactile stimulation from a soothing object or waiting for the same amount of time. This finding suggests that the effects of interaction with a dog on positive affect are not simply attributable to the effects of tactile stimulation. Put another way, interaction with a dog produced benefits for positive affect that exceeded the effects of another commonly used coping strategy. However, in the case of anxiety, the effects of the experimental condition exceeded those of waiting but not of tactile stimulation. This suggests that although interaction with a dog reduces anxiety relative to children's independent coping abilities, children may experience similar benefits from a comforting object that provides tactile stimulation. To summarize, we found that interaction with a dog conveys some benefits beyond the effects of tactile stimulation from a soothing object. However, our findings also highlight the importance of continuing to question what it is about the interactions that drives the benefits (Marino, 2012).

We did not detect any effect of the interactions with the dogs on salivary cortisol. There are two main possible interpretations of this finding. First, it is possible that the interactions did affect cortisol but that we failed to detect this effect. We observed a high degree of variability in cortisol output within each condition, which may have obscured any effects of the interactions on cortisol. In addition, in this study the final cortisol sample was collected approximately 41 min after the onset of the stressor (and 23 min after the conclusion of the stressor). At that final time point, mean cortisol levels had not returned to baseline, and it is possible that we would have detected differences in the rate at which cortisol returned to baseline with a longer period of interaction and assessment. However, we view this possibility as unlikely, as visual inspection of the cortisol data suggests

[7] As with the main analysis, we initially conducted the supplementary analyses using a Bonferroni correction for multiple comparisons. However, at the suggestion of a reviewer, we have reported the results of the supplementary analyses without the correction for multiple comparisons in order to reveal all possibly meaningful findings to inform future hypothesis testing. When the Bonferroni correction is applied, none of the supplementary analyses are significant (Bonferroni corrected threshold = .007).

that the tactile-stimulation control condition (rather than the experimental condition) was on track to recover most quickly of the three conditions.

The second possible interpretation is that the interactions in our investigation did not reduce overall cortisol output. Findings from prior studies indicate that interaction with a dog can buffer against increases in cortisol when the interaction occurs during stress exposure (e.g., Beetz et al., 2012; Vagnoli et al., 2015). However, those stress-buffering effects may not extend to postexposure cortisol reduction. In other words, interactions with animals may affect cortisol reactivity but not cortisol recovery, as these are distinct processes (Linden, Earle, Gerin, & Christenfeld, 1997; Ramsay & Lewis, 2003). In addition, the fact that interactions with dogs appeared to affect subjective but not physiological indicators of stress in the context of our investigation is not necessarily surprising, given that many factors (e.g., cognitive appraisal, time course) may contribute to the generally low covariance between salivary cortisol and subjective reports of stress (Hellhammer, Wüst, & Kudielka, 2009). It is plausible that the interactions with the dogs caused participants to reappraise their experiences of the stress task without altering their already elevated levels of cortisol or their natural patterns of cortisol recovery. Prior studies have also used different control conditions (e.g., interaction with a person) than we used in this study; it may be that the effects of interactions with dogs on cortisol documented in prior studies are due primarily to the tactile stimulation the dogs provide rather than to the interactions with the dogs per se. Finally, consistent with our findings, a number of other studies have also failed to detect effects of interactions with dogs on cortisol (e.g., Handlin et al., 2011; Kaminski et al., 2002).

Among participants who interacted with the dogs in our study, those who had more extensive histories of previous interactions with pets, and with dogs in particular, seemed to benefit most. Specifically, compared to children who did not have pets, children who had pets at the time of participation showed higher levels of posttest positive affect. Similarly, children who were reported to have had more positive experiences with dogs in the past had higher levels of posttest positive affect. It may be that children who have pets and/or have histories of positive experiences with dogs are more prepared to benefit from the interactions, or else that these factors are simply indicators that a child has a particular affinity for pets. In addition, and somewhat surprising, children who were reported to have had more negative experiences with dogs in the past showed lower overall arousal in response to the interactions with the dogs. It is possible that children who have had negative experiences with dogs in the past show less excitement in response to the interactions, or else that these children show less anticipatory arousal precisely because they have already been exposed to some adverse events related to dogs and have developed a sense of mastery through those experiences. However, none of the other measures of children's feelings toward and experiences with dogs were associated with improvement on any of the three outcome measures. Thus, it is possible that these findings represent false positives, highlighting the need for further research to directly investigate the characteristics of children who are most likely to benefit from AAAs.

The present findings extend the literature on the effects of interactions with dogs on children's affect and anxiety in three key ways. First, participants in our study interacted with the dogs independently and without distractions, suggesting that something about the interactions with the dogs themselves produced the benefits. This is notable because a failure to disentangle the effects of interactions with animals from the effects of interactions with other people has been a key limitation of previous studies and an important threat to the construct validity of AAAs. Second, these findings demonstrate that, at least for positive affect, the benefits of AAAs are not attributable entirely to the effects of tactile stimulation. This is important in light of prior observational findings that show associations between the amount of touch that occurs during an AAA and the degree of improvement shown by the child. In addition, this finding makes a small but important contribution to efforts to establish the extent to which the effects of AAAs can really be attributed to the interactions with the animals specifically. Finally, our findings demonstrate that AAAs can alleviate the negative effects of stress on affect and anxiety after stress exposure, in addition to preventing increases during exposure.

We demonstrated these effects in an unselected community sample that was relatively diverse in terms of race, gender, and prior experience with and ownership of pets and that showed levels of baseline anxiety and affect that were similar to those other community samples. As detailed earlier, we elected to use a community sample for two reasons. First, the primary goal of this investigation was to provide a carefully controlled demonstration of the effects of interactions with dogs for children. The goal was not to establish the effects of these interactions for any particular disorder or population but rather to contribute to efforts to begin to understand the basic processes involved. Second, our interest in AAAs as a strategy for alleviating children's suffering comes in part from the possibility that AAAs may be used to reach a broad range of children. Thus, demonstrating the effects of AAAs among a community sample of children is a strength, because it provides initial evidence for the effects of AAAs when they are applied broadly.

Our study bears three important limitations. First, we evaluated only immediate changes in affect, anxiety, and arousal, and we did not address whether any of the observed effects are sustained in the long term. We focused on short-term changes in light of the emerging state of this literature, as well as the importance of even short-term symptom relief. As our understanding of the strength and nature of these effects is refined, it will be important to establish how long they are sustained and what impact they have on mental health and well-being in the long term. Second, due to the logistical factors described earlier, eight dogs participated in the present study, and casual observations by experimenters suggested that there were differences in the nature of the interactions with the different dogs (e.g., some engaged in more active play, whereas others were more likely to sit with the participant and be petted throughout the interaction). As a result, it is possible that there were undetected differences in the strength of the effects of the intervention, depending on the dog with which participants interacted. Third, we evaluated the influence of interactions with dogs among participants who volunteered to take part in a study involving dogs, introducing the possibility of a selection effect. As a result, the benefits of interactions with dogs observed in this study, and especially the findings relating to participants feelings toward and experiences with pets, may not necessarily hold for participants who have highly negative views toward dogs or no experience at all with dogs. However, children who participate in AAAs in applied settings are also likely to have positive attitudes toward and experiences with dogs.

The present findings suggest two important avenues for future research. First, it will be important to continue to establish how (i.e., through what processes) interactions with dogs improve affect and anxiety symptoms. Commonly proposed mechanisms of action include tactile stimulation, social support, and emotional contagion. Studies are needed that manipulate these various processes or use established paradigms from the study of interpersonal relationships to investigate them. This research will help to clarify the specific benefits of interactions with animals and inform strategies for maximizing those benefits.

The second area for future research stems from observations by experimenters in our studies that the different dogs appeared to behave differently. Specifically, it will be important for future research to evaluate whether certain characteristics of the dogs are more effective for improving affect and anxiety. For example, are more active dogs who initiate more contact and interaction more engaging and enjoyable to interact with, or do more relaxed dogs promote more relaxation in their human interaction partners? Other characteristics of potential importance include the size and age of the dogs, the amount of eye contact they naturally initiate, their responsiveness to their names or other overtures, and the softness of their coats. Of course, it is not necessarily the case that certain characteristics are better for improving affect and anxiety, whereas others are worse; instead, it may be that certain characteristics are more effective for certain individuals, under different circumstances, or with different goals in mind. We can think of this area of research as the canine version of long-standing efforts in psychotherapy research to tailor treatments to individual clients and situations.

SUMMARY AND CONCLUSION

We evaluated the influence of brief, unstructured interactions with dogs on children's affect, anxiety, and arousal, following exposure to a stressful task. These interactions increased children's positive affect, relative to waiting without any intervention or receiving tactile stimulation from a soothing object, and reduced children's state anxiety relative tactile stimulation. We did not detect any effect on physiological arousal. These findings convey that brief, unstructured interactions with dogs have a moderate impact on children's subjective experiences of anxiety and affect, following exposure to a stressor. However, additional research is needed to establish whether the benefits of interactions with animals exceed the effects of other common strategies for improving mental health and alleviating stress. The present findings support the notion that AAAs may be an efficient strategy for improving children's mental health but highlight the fact that there is not yet sufficient evidence to support their already widespread prevalence in practice.

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