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The Importance of Client–Canine Contact in Canine-Assisted Interventions: A Randomized Controlled Trial

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ABSTRACT

Researchers have claimed that canine-assisted interventions (CAIs) contribute significantly to bolstering participants' wellbeing, yet the mechanisms within interactions have received little empirical attention. The aim of this study was to assess the impact of client–canine contact on wellbeing outcomes in a sample of 284 undergraduate college students (77% female; 21% male, 2% non-binary). Participants self-selected to participate and were randomly assigned to one of two canine interaction treatment conditions (touch or no touch) or to a handler-only condition with no therapy dog present. To assess self-reports of wellbeing, measures of flourishing, positive and negative affect, social connectedness, happiness, integration into the campus community, stress, homesickness, and loneliness were administered. Exploratory analyses were conducted to assess whether these wellbeing measures could be considered as measuring a unidimensional construct. This included both reliability analysis and exploratory factor analysis. Based on the results of these analyses we created a composite measure using participant scores on a latent factor. We then conducted the tests of the four hypotheses using these factor scores. Results indicate that participants across all conditions experienced enhanced wellbeing on several measures; however, only those in the direct contact condition reported significant improvements on all measures of wellbeing. Additionally, direct interactions with therapy dogs through touch elicited greater wellbeing benefits than did no touch/indirect interactions or interactions with only a dog handler. Similarly, analyses using scores on the wellbeing factor indicated significant improvement in wellbeing across all conditions (handler-only, $d = 0.18$, $p = 0.041$; indirect, $d = 0.38$, $p < 0.001$; direct, $d = 0.78$, $p < 0.001$), with more benefit when a dog was present ($d = 0.20$, $p < 0.001$), and the most benefit coming from physical contact with the dog ($d = 0.13$, $p = 0.002$). The findings hold implications for post-secondary wellbeing programs as well as the organization and delivery of CAIs.

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Administrators, faculty, and staff on post-secondary campuses face an ongoing challenge of devising and implementing ways to support the psychological health of students in response to concerns raised over post-secondary students' mental health and wellbeing. Post-secondary students, particularly first-year students, are especially vulnerable to compromised mental health. It has been posited that an array of factors contributes to this, including, but not limited to, cyber-aggression, loneliness, stress, drug and alcohol use/misuse, financial distress, and conflict within social spheres (Knoesen & Naude, 2018; Wilson, 2020). Supporting students' mental wellbeing is paramount to academic retention, to student learning, personal and intellectual development, and academic success (Kotzé & Kleynhans, 2013; Miller et al., 2017; O'Keeffe, 2013; Pritchard & Wilson, 2003; 2007). As stress, especially the experience of elevated stress over time, can erode students' resiliency and undermine their academic potential, the implementation of stress-reduction programs for students is an important dimension of students' post-secondary experience (Downs & Eisenberg, 2012). One low-cost intervention that has been effective in reducing stress in students is to have them participate in a canine-assisted stress-reduction program in which therapy dogs are routinely brought to campus to support students' wellbeing (Barker et al., 2016; Binfet et al., 2018; Crossman et al., 2015; Dell et al., 2015; Pendry & Vandagriff, 2019; Robino et al., 2020; Sokal & Martin, 2021; Ward-Griffin et al., 2018).

There has been a proliferation of such programs across campuses, and although limited causal research has been conducted, a growing body of research now attests to the positive effects of having university students spend time with therapy dogs to improve their wellbeing (Binfet, 2017; Grajfoner et al., 2017). Spending time with therapy dogs as part of on-campus stress-reduction programs has been shown to elicit a host of benefits. Researchers have examined the psychological and physiological effects of interacting with therapy dogs and have reported reductions in self-reports of stress (Barker et al., 2016) and homesickness (Binfet & Passmore, 2016), boosts to campus connectedness (Binfet, 2017) and self-esteem (Muckle & Lasikiewicz, 2017), and decreases in biomarker indicators of stress (Pendry & Vandagriff, 2019). The empirical question "Does spending time with therapy dogs improve mental health and wellbeing?" has been explored and now the field is challenged to dig deeper to answer "What dimensions or aspects of canine-assisted interventions (CAIs) best elicit wellbeing outcomes in students?"

Findings across studies argue that interacting with therapy dogs elicits benefits to wellbeing; however, we do not fully understand the elements of interactions that contribute to optimal wellbeing in human participants. This lacuna in the human–animal interaction research landscape has recently been addressed by Fournier (2019, p. vii), who argues "There is very little study of just how humans and animals interact and which interactions with or features of the animal are therapeutic." This is especially important to understand as having knowledge of what makes an intervention effective is key to informing program design and implementation. We know that spending time with therapy dogs is beneficial for students but could this experience be enhanced by isolating and identifying the dimensions of the intervention that best contribute to wellbeing outcomes? That is, could we enhance the efficacy of an intervention that already is known to be helpful?

One aspect of CAIs requiring further investigation is that of the type of contact between a therapy dog and client or visitor to a session. In innovative research by Pendry and colleagues (2020) in which the interactions between university students (n = 150) and therapy dogs (n = 27) were video-recorded and analyzed, it was found that within any given student–dog interaction, students predominantly (i.e., > 70%) spend their time petting the therapy dog's head or neck. Three studies in which the role of touch was empirically examined are reviewed next as collectively they elucidate our understanding of the effect of touch during sessions on wellbeing outcomes in participants.

First, in a study comparing a real dog, toy dog, and friendly human in an interaction with boys (n = 31) aged 7–12 years, Beetz and colleagues (2011) found that the more the children physically touched the dog, the lower their salivary cortisol levels, thus implying that physically touching the dog was an important component of CAIs. Although the findings of this study implied a relation between physical touch and the resultant boost to biomarker indicators of wellbeing, there was no comparison with a no-touch condition using a live therapy dog rather than a toy model. Nor was physical contact controlled as an experimental variable. The second study informing our understanding of the importance of touch was conducted recently by Pendry and Vandagriff (2019), who examined the effect of a canine visitation program on undergraduate students' stress as measured via salivary cortisol levels. Participants (n = 249) were assigned to one of four conditions: (1) hands-on petting of dogs and cats; (2) observation of others petting dogs and cats; (3) viewing images of dogs and cats; and (4) a wait-list condition. Findings revealed that after a visit duration of 10 min, the salivary cortisol levels of the participants in the hands-on petting condition were significantly lower than the levels of participants in all the other groups. The last study informing our thinking around the importance of touch between visitors and therapy dogs within sessions was conducted recently by Mueller and colleagues (2021), who assessed the effect of touch in adolescents with anxiety. Participants (n = 66) were randomly assigned to one of three conditions: (1) a no-touch condition in which participants socially interacted with a therapy dog; (2) a touch condition in which participants socially interacted with a therapy dog; and (3) a control condition in which participants interacted with a toy dog. As summarized by Mueller et al. (2021, p. 1), "We found no evidence that the presence of a real dog, with or without the opportunity to touch it, reduced anxiety or autonomic reactivity or improved cognitive performance relative to the presence of a stuffed dog in the control condition, regardless of levels of preexisting social anxiety." As acknowledged by the authors, the findings are interpreted with caution in light of the small sample size.

Collectively, the above studies highlight the importance of understanding the role that hands-on interactions between visitors to sessions and therapy dogs play in eliciting optimal wellbeing outcomes for participants. The role of touch appears to be an important dimension of interactions, but might also just being in proximity to therapy dogs elicit benefits to wellbeing? How essential is touch? This study aimed to build on the above-cited literature and better understand if the type of contact (direct contact or indirect/no contact) with a therapy dog plays a role in the efficacy of the intervention. Although prior research has explored direct contact in comparison with distanced

observations, this study sought to examine direct, physical contact in comparison with close, non-physical contact (defined here as *in close proximity*). The research question driving this study was: Is direct contact through touch between clients (visitors to a CAI) and a therapy dog required for clients to experience wellbeing benefits?

It was hypothesized that:

1. Participants in each of the three experimental conditions would experience increased subjective wellbeing.
2. The intervention would be more effective when a dog was present.
3. Physical contact with a therapy dog would yield greater benefits than the dog's mere presence.

Theoretical support for the present investigation is found in both attachment (Ainsworth, 1963; Bowlby, 1969) and social support theories (Cohen & Wills, 1985). Within the context of human–animal interactions, we might consider the dog–handler team as a pseudo caregiver, providing safety and security for visiting students. The combination of the dog–handler team and the other students attending the session collectively create a sense of social support or social resource to students seeking to reduce their stress and enhance their wellbeing. Interactions within the session itself are important, and as described by Beetz (2017, p. 144), "Physical contact can represent a special means of demonstrating social support (Ditzen et al., 2007) which is rarely found in relationships with insecure attachments. Physical contact in combination with emotional support is most effective in reducing stress responses (Demakis & McAdams, 1994; Ditzen et al., 2007)."

For the purpose of this study, we use the World Health Organization's (2004) definition describing mental health as "a state of wellbeing in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully and is able to make a contribution to his or her community." As argued by Dodd and colleagues (2021, p. 2) in their scoping review of wellbeing conceptualization and measurement for university students, "There is also recognition that measurement of wellbeing must be relevant for specific groups (e.g., age, health condition) as well as the level of interest (individual, community, population; for example, Huppert, 2017)." Taking these factors into consideration, we used self-report measures that captured participants' perceptions of wellbeing (e.g., happiness, life satisfaction, positive affect) and illbeing (e.g., stress, loneliness, and negative affect). Collectively, the measures chosen for this study reflect aspects of students' psychological health known to impact their ability to thrive within a campus community environment. In alignment with other researchers, we have used a 1-item statement to measure stress (e.g., Barker et al., 2016; Ward-Griffin et al., 2018).

Methods

University human (H19-02182) and animal (A18-0222) ethics approval were obtained prior to the study and participants provided informed, written consent prior to participation in the study.

Participants

Canine Handlers

A recruitment e-mail, including a description of the study, was sent to the entire pool of 60 handlers working in the on-campus canine therapy program titled Building Academic Retention through K9s (B.A.R.K.; barkubc.ca). Twenty-seven volunteer handlers responded and participated in this study (85% female, 93% Caucasian, $M_{age} = 41.5$ years, $SD = 13.9$, range = 21–69, mean prior canine therapy experience = 3.32 years, $SD = 3.46$).

Therapy Canines

Chosen from the larger pool of 61 therapy dogs working in the B.A.R.K. program, 24 participated in this study (75% female, $M_{age} = 5.65$ years, $SD = 2.81$, range = 15 months–13 years, prior canine therapy experience = 2.10 years, $SD = 0.18$). Participating dogs included 6 Golden Retrievers, 3 Labradors, 9 other pure breeds (including Wheaton Terrier, Border Collie, Nova Scotia Duck Toller, Husky, and Great Dane), and 6 mixed breeds (including a Shih Tzu/Bichon, Lab/Pit Bull, and Chihuahua/Boston Terrier).

Student Participants

Participants were drawn from a mid-size, western Canadian university (student population 9,120), were predominantly female (77%, 21% male, 2% non-binary), and their age ranged from 17 to 36 years ($M = 20.4$ years, $SD = 2.38$). Most were in their first (39%) or second (36%) year of study, with a minority in their third (13%), fourth (11%), or beyond (2%). Participants lived alone (23%) with one other person (35%), or with at least two others (42%). Of the participants, 62% self-identified as Caucasian, 10% as South Asian, 10% as mixed race, and 7% as Chinese. Participants identified their home countries as Canada (82%), China (4%), India (4%), the USA (2%), or one of 18 other countries each representing no more than 1% of the sample. In addition, 30% of the participants lived with pets. Among the participants living with pets, most reported having a dog (62%), cat (52%), or fish (11%), with other pets including rats, mice, snakes, snails, guinea pigs, parrots, bunnies, lizards, and geckos. When asked to rate their consumption (i.e., low, medium, or high) of the existing CAI program offered on campus, 89% self-identified as low consumers.

Participants were eligible to participate if they were 17 years of age or older and fluent (able to read at a Grade 12 level) in English. In addition, participants had to be current undergraduate students at the university and enrolled in a psychology course offering bonus credit for participating in research studies. As such, students may have been taking a psychology course as an elective or a requirement were at varying points in their degree and may have been full- or part-time students. Students who were severely allergic to or anxious around dogs were asked not to participate.

Procedure

Participants were recruited from undergraduate psychology classes via a posting on an online portal accessible to students. They were offered modest course credit for their time participating in the study, which amounted to 1.5 h in total. Research assistants

attended an orientation session prior to the study to familiarize themselves with study protocols and to ensure consistency across conditions. The assessment of dog–handler teams was done by B.A.R.K. program personnel and is outlined in Binfet and Struik (2020). As the protocols for this study were similar to the standard protocols used in the on-campus program, handlers did not receive additional training in preparation for participation in this study. Therapy dog welfare and signs of distress were monitored during each session by both handlers and by an experienced research assistant trained in the recognition of signs of canine distress. No incidents of canine distress were reported.

After providing written informed consent, participants were assigned an anonymized identification number and provided a survey package containing paper copies of the measures. They completed the pre-test survey which was read aloud by the lead author to ensure consistent timing across conditions. Each of the survey packages distributed to participants contained a randomly assigned color code which was used to randomly assign participants to one of three experimental conditions: (1) a treatment condition in which participants interacted with therapy dogs and were asked to engage in direct physical contact (e.g., caressing or petting the dog); (2) a treatment condition in which participants were in the immediate proximity of a therapy dog but engaged in no physical contact with the dog; and (3) a handler-only condition in which only the canine handler (no dogs) were present (see Figure 1). The ratio of participants-to-handler was 3–6:1 across all three conditions ($M_{group} = 4.35$ participants). To ensure consistency across conditions, the distance between the handler and each of the participants was pre-determined, with participants seated on the floor on markers indicating where to sit and the distance between dog–handler stations set at 213 cm (see Figure 2). The seating arrangements (including the type of chair and central mat) for all conditions were identical. Further, all conditions were held in strictly controlled settings.
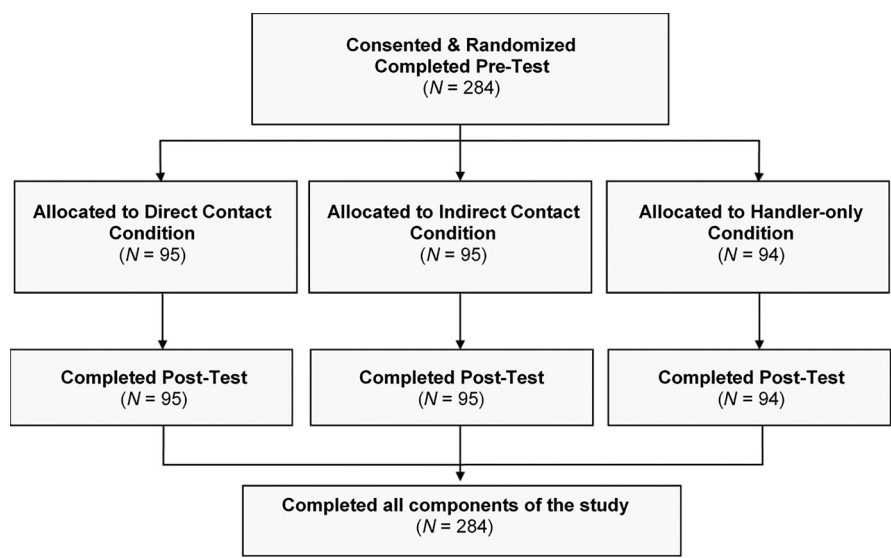

Figure 1. Flow diagram illustrating randomization, intervention participation, and sample sizes per condition.
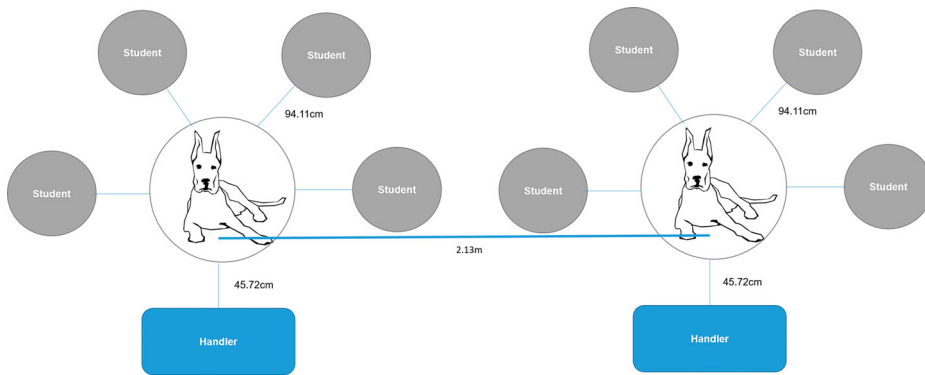
Figure 2. Illustration of seating arrangement per session.

The classrooms were in the same building and were almost identical in appearance, size, temperature, lighting, and flooring. Handlers drew from a bank of questions to initiate discussion with participants (see Appendix 1). A 20-min duration was chosen as this duration has strong ecological validity and has been used in previous on-campus CAI studies (Binfet, 2017; Grajfoner et al., 2017). Handlers were randomly assigned to conditions and participants. Once assigned to a condition, they were randomly assigned to the dog–handler or handler-only stations. There was thus randomization *to* condition and *within* conditions. Post-test measures were completed immediately following the intervention; again, measures were read aloud.

Self-Report Measures

Participants completed the measures in the form of pre-test and post-test surveys. With the exception of the demographic questionnaire (pre-test only), the engagement questionnaire (post-test only), and the open-ended prompts (post-test only), all measures were included in both survey packages. Total scores for each multi-item measure were created by taking the participants' mean of all items on that measure. Detailed descriptive statistics for each measure, including histograms of the distributions, and skew and kurtosis values, are available in an online supplement.

Demographic Questionnaire
Before participating in the intervention, participants were asked to provide their gender, age, ethnicity, hometown city and country, year of study, number of roommates, a description of any pets they had, and to indicate whether they were low, medium, or high consumers of the campus CAI program.

Measures of Wellbeing

Flourishing Scale (FS; Diener et al., 2009)
The Flourishing Scale is an 8-item scale measuring how individuals feel about their life (Cronbach's *α* of 0.87). Items are rated on a 7-point Likert scale, ranging from "strongly

disagree" (1) to "strongly agree" (7). Example statements include "My social relationships are supportive and rewarding" and "I am a good person and live a good life." A higher total score on this measure indicates greater psychological wellbeing. In the current sample, internal consistency Cronbach's αs at pre-intervention and post-intervention were 0.85 and 0.88, respectively.

Positive Affect Schedule-Short Form (Panas-SF; Thompson, 2007)

Administered as part of the PANAS-SF, the positive affect subscale of the PANAS is comprised of five items (e.g., "Indicate the extent to which this term describes you – Alert, Inspired, Determined, Attentive, and Active"; Cronbach's α is 0.75 for the positive affect subscale). Items are rated on a 5-point Likert-type scale, ranging from "very slightly or not at all" (1) to "extremely" (5). Cronbach's αs for each measurement occasion in this study were 0.72 and 0.77, respectively.

Social Connectedness Scale-Revised (SCS-R; Lee et al., 2001)

This 20-item scale measures the participants' level of social connectedness; that is, participants' sense of belongingness in their social surroundings or the quality of their interpersonal relationships. Example questions include "How often do you feel there is no one you can turn to?" and "How often do you feel outgoing and friendly?" This scale has a Cronbach's α of 0.92. Participants rate their connectedness using a 6-point Likert scale, ranging from "strongly disagree" (1), to "strongly agree" (6). Cronbach's αs for the measurement occasions were 0.94 and 0.91, respectively.

Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999)

The Subjective Happiness Scale is a 4-item scale measuring general happiness, with a Cronbach's α of 0.87. Items are rated on a 7-point Likert scale, ranging from "not at all" or "less" to "a great deal" or "more." Example statements include "In general, I consider myself:" and "Compared to most of my peers, I consider myself:" Evidence from an item-response theory analysis indicated that item 4 of the SHS is confusing and uninformative and that five response options are more appropriate than seven (O'Connor et al., 2015). As such, we used only items 1–3 of the SHS, with five response options. Cronbach's αs for each measurement occasion in this study were 0.84 and 0.83.

Integration into Campus Community

To assess participants' perception of their integration into campus life, a single-item question (How well have you integrated into the campus community?) was asked using a Likert-type response scale (1 = "Not very" to 5 = "Very").

Measures of Illbeing

Stress Scale

A single- item was used to assess participants' current stress level (How stressed do you feel right now?), with participants indicating their self-rating of stress using a 5-point Likert-type scale, ranging from "not at all stressed" (1) to "very stressed" (5).

Homesickness Scale

Using a 5-point Likert-type scale (1 = "Not very" to 5 = "Very"), a single-item (e.g., How homesick are you currently?) was used to assess participants' perceptions of the extent to which they felt homesick.

UCLA Loneliness Scale Version 3 (Russell, 1996)

A 20-item scale designed to measure participants' subjective feelings of loneliness (Cronbach's α ranging from 0.89 to 0.94). Participants rate each item on a 4-point Likert scale, ranging from "never" (1) to "often" (4). Example statements include "I fit in well in new situations" and "I feel like an outsider." Cronbach's αs for each measurement occasion in this study were 0.93 and 0.95.

Negative Affect Schedule-Short Form (Panas-SF; Thompson, 2007)

Administered as part of the PANAS-SF, the negative affect subscale of the PANAS is comprised of five items (e.g., "Indicate the extent to which this term describes you – Upset, Hostile, Ashamed, Nervous, and Afraid"; Cronbach's α is 0.76). Items are rated on a 5-point Likert-type scale, ranging from "very slightly or not at all" (1) to "extremely" (5). Cronbach's αs for each measurement occasion in this study were 0.74 and 0.80.

Analytic Plan

We preregistered our analysis plan prior to beginning data collection (https://osf.io/jvr23). The preregistered analysis plan includes the analyses for testing hypotheses 2 and 3, which were the study's primary focus. We also report on two tests that were not included in the preregistered plan but were added later to address hypotheses 1. Although these analyses were not preregistered, they were decided upon prior to viewing the results.

Hypothesis 1

Hypothesis 1 stated that each of the conditions would benefit participants' subjective wellbeing. We tested this hypothesis using paired samples t-tests comparing pre-to-post-intervention differences on measures of wellbeing and illbeing. We predicted that participants would show significant increases in each of the measures of wellbeing and significant decreases in the measures of illbeing.

Hypothesis 2 and Hypothesis 3

Hypothesis 2 was that the presence of a dog would improve the effectiveness of the intervention. Hypothesis 3 was that direct contact with a therapy dog would yield greater benefits than indirect contact with no physical touch. We tested these hypotheses by comparing post-intervention scores after controlling for scores pre-intervention. Comparisons were made from two planned contrasts. The first planned contrast assessed hypothesis 2 by comparing participants in the handler-only condition with those in

either the indirect or direct contact conditions. The second planned contrast assessed hypothesis 3; it compared participants in the indirect contact condition with participants in the direct contact condition. The presence of an effect was inferred from the significance of the planned contrasts.

Exploratory Analyses

We conducted exploratory analyses to assess whether the measures of wellbeing and illbeing could be considered as measuring a unidimensional construct. This included both reliability analysis and exploratory factor analysis. Based on the results of these analyses we created a composite measure using participant scores on a latent factor. We then conducted the tests of the three hypotheses using these factor scores.

Results

Participant demographics in the three conditions are presented in Table 1. The groups were similar on all demographic variables except pet ownership. There were a larger proportion of pet owners in the indirect (36.6%) and direct (32.3%) contact conditions than in the handler-only condition (22.3%).

Table 1. Demographic characteristics at baseline.

	Handler-only (*n* = 94) *n* (%)	Indirect (*n* = 95) *n* (%)	Direct (*n* = 95) *n* (%)
Mean age in years (SD)	20.5 (2.9)	20.4 (2.2)	20.3 (1.9)
Gender			
Female	74 (78.7%)	70 (74.5%)	75 (79.8%)
Male	19 (20.0%)	24 (25.3%)	18 (18.9%)
Non-binary	1 (1.1%)	1 (1.1%)	2 (2.1%)
Ethnicity			
Caucasian	53 (56.4%)	63 (66.4%)	60 (63.2%)
South Asian	11 (11.6%)	12 (12.8%)	6 (6.3%)
Mixed race	10 (10.5%)	9 (9.5%)	10 (10.5%)
Chinese	9 (9.6%)	4 (4.2%)	7 (7.4%)
Black	3 (3.2%)	2 (2.1%)	2 (2.1%)
Latin American	2 (2.1%)	2 (2.1%)	1 (1.1%)
Southeast Asian	2 (2.1%)	0 (0.0%)	2 (2.1%)
Aboriginal	1 (1.1%)	1 (1.1%)	1 (1.1%)
Filipino	2 (2.1%)	1 (1.1%)	0 (0.0%)
Korean	0 (0.0%)	0 (0.0%)	2 (2.1%)
Jewish	1 (1.1%)	0 (0.0%)	1 (1.1%)
Arab	0 (0.0%)	0 (0.0%)	1 (1.1%)
Japanese	0 (0.0%)	1 (1.1%)	0 (0.0%)
West Asian	0 (0.0%)	0 (0.0%)	1 (1.1%)
Italian	0 (0.0%)	0 (0.0%)	1 (1.1%)
Year of study			
First	38 (40.0%)	35 (37.2%)	38 (40.0%)
Second	29 (30.9%)	35 (36.8%)	38 (40.0%)
Third	14 (14.7%)	13 (13.8%)	9 (9.5%)
Fourth	11 (11.6%)	9 (9.5%)	10 (10.6%)
Fifth or more	2 (2.1%)	3 (3.2%)	0 (0.0%)
Pets in home	21 (22.3%)	34 (36.6%)	30 (32.3%)

Table 2. Means and standard deviations of repeated measures variables for each condition at each measurement occasion.

	Handler-only M(SD)		Indirect M(SD)		Direct M(SD)	
	Pre	Post	Pre	Post	Pre	Post
FS	5.71 (0.80)	5.72 (0.77)	5.67 (0.69)	5.73 (0.70)	5.65 (0.86)	5.78 (0.86)
PANAS-PA	3.28 (0.75)	3.24 (0.82)	3.34 (0.57)	3.29 (0.81)	3.24 (0.72)	3.36 (0.73)
SCS-R	4.47 (0.81)	4.49 (0.87)	4.37 (0.79)	4.47 (0.93)	4.42 (0.88)	4.64 (0.79)
SHS	3.32 (0.89)	3.44 (0.89)	3.29 (0.87)	3.51 (0.79)	3.32 (0.88)	3.66 (0.78)
Engagement	2.71 (1.08)	2.81 (1.14)	2.82 (1.02)	2.69 (0.97)	2.80 (1.05)	2.44 (0.93)
Stress	3.27 (1.04)	2.76 (1.08)	3.21 (0.90)	2.53 (0.100)	3.15 (0.98)	1.84 (0.76)
Homesick	2.22 (1.29)	2.10 (1.24)	1.97 (1.14)	1.92 (1.14)	2.07 (1.18)	1.67 (0.92)
Lonely	2.02 (0.55)	1.96 (0.57)	2.06 (0.48)	1.96 (0.52)	2.05 (0.56)	1.82 (0.51)
PANAS-NA	1.99 (0.75)	1.76 (0.75)	1.95 (0.67)	1.66 (0.74)	2.00 (0.71)	1.42 (0.45)

For descriptive purposes, means and standard deviations of the repeated measures variables for each condition across the two measurement occasions are presented in Table 2.

Hypothesis 1: Did the Interventions Benefit Wellbeing?

The first set of hypotheses concerned the efficacy of the interventions for improving participants' immediate subjective wellbeing. These results are presented in Table 3 and Figure 3. Results were generally consistent with our hypotheses. That is, in each of the three conditions, participants reported statistically significant improvements in subjective wellbeing across several self-report variables.

Wellbeing Indicators

For participants in the handler-only condition, results indicated no significant improvement in flourishing; significant improvement in subjective happiness; and no statistically significant changes in positive affect, social connectedness, or engagement. Participants in the indirect condition reported significant improvements in social connectedness, happiness, and engagement, with non-significant results for flourishing and positive affect. Participants in the direct condition reported statistically significant improvements on all measures of wellbeing.

Illbeing Indicators

Participants in all three conditions reported significant pre-to-post-intervention reductions in stress, loneliness, and negative affect. Participants in the handler-only and direct contact conditions also reported significantly lower homesickness. Participants in the indirect contact condition did not report a significant reduction in homesickness.

Hypothesis 2 and Hypothesis 3: Effects of Canine Contact

These sets of hypotheses concerned differences in the effect of the intervention between the three experimental conditions. The results are presented in Table 4 and Figure 4.

Table 3. Results of paired samples *t*-tests of pre-to-post-intervention change in wellbeing and illbeing.

Measure	t	p	d_z	95% CI for d_z	
				LL	UL
Handler-only[a]					
FS	0.22	0.414	0.02	−0.18	0.22
PANAS-PA	0.92	0.821	−0.10	−0.30	0.11
SCS-R	0.63	0.531	0.06	−0.14	0.27
SHS	3.06	0.001	0.32	0.11	0.52
Integration	1.26	0.209	−0.13	−0.33	0.07
Stress	5.42	< 0.001	−0.56	−0.78	−0.34
Homesick	1.71	0.045	−0.18	−0.38	0.03
Lonely	2.78	0.003	−0.29	−0.49	−0.08
PANAS-NA	5.21	< 0.001	−0.54	−0.75	−0.32
Indirect[b]					
FS	1.76	0.041	0.18	−0.02	0.38
PANAS-PA	0.82	0.793	−0.08	−0.29	0.12
SCS-R	2.32	0.023	0.24	0.03	0.44
SHS	5.02	< 0.001	0.52	0.30	0.73
Integration	2.16	0.033	0.22	0.02	0.42
Stress	7.12	< 0.001	−0.73	−0.96	−0.50
Homesick	0.63	0.266	−0.06	−0.27	0.14
Lonely	4.10	< 0.001	−0.42	−0.63	−0.21
PANAS-NA	5.91	< 0.001	−0.61	−0.82	−0.39
Direct[b]					
FS	3.39	0.001	0.35	0.14	0.55
PANAS-PA	2.31	0.011	0.24	0.03	0.44
SCS-R	5.54	< 0.001	0.57	0.35	0.78
SHS	7.88	< 0.001	0.81	0.57	1.04
Integration[a]	5.00	< 0.001	0.52	0.30	0.73
Stress	15.40	< 0.001	−1.58	−1.88	−1.28
Homesick	4.01	< 0.001	−0.41	−0.62	−0.20
Lonely	9.71	< 0.001	−1.00	−1.24	−0.75
PANAS-NA	10.17	< 0.001	−1.04	−1.29	−0.79

Note: CI = confidence interval; LL = lower limit; UL = upper limit; FS = Flourishing Scale; PANAS-PA = Positive affect sub-scale of the Positive and Negative Affect Schedule-Short Form; SCS-R = Social Connectedness Scale-Revised; SHS = Subjective Happiness Scale; stress = single-item stress measured on a scale of 1–5; integration = single-item measure of integration to campus community; homesick = single-item homesickness measured on a scale of 1–5; Lonely = UCLA Loneliness Scale; PANAS-NA = the negative affect subscale of the Positive and Negative Affect Schedule-Short Form.
[a]$df = 93$. [b]$df = 94$.

Presence of a Dog

Contrast 1 tested the effect of the presence of a dog with or without physical contact. Results were not significant for the benefit of the dog's mere presence compared with the handler-only condition for flourishing or positive affect; the presence of a dog did yield significant benefits for social connectedness, happiness, and integration with campus community. For measures of illbeing, the dog's presence was associated with greater reductions in stress, loneliness, and negative affect. There was no significant benefit of the dog's mere presence for reducing scores on the measure of homesickness.

Contact with a Dog

Contrast 2 tested the effect of physical contact with the dog by comparing the indirect and direct conditions. With the exception of flourishing – for which results were non-significant – results related to contrast 2 corroborated all our hypotheses. That is, compared
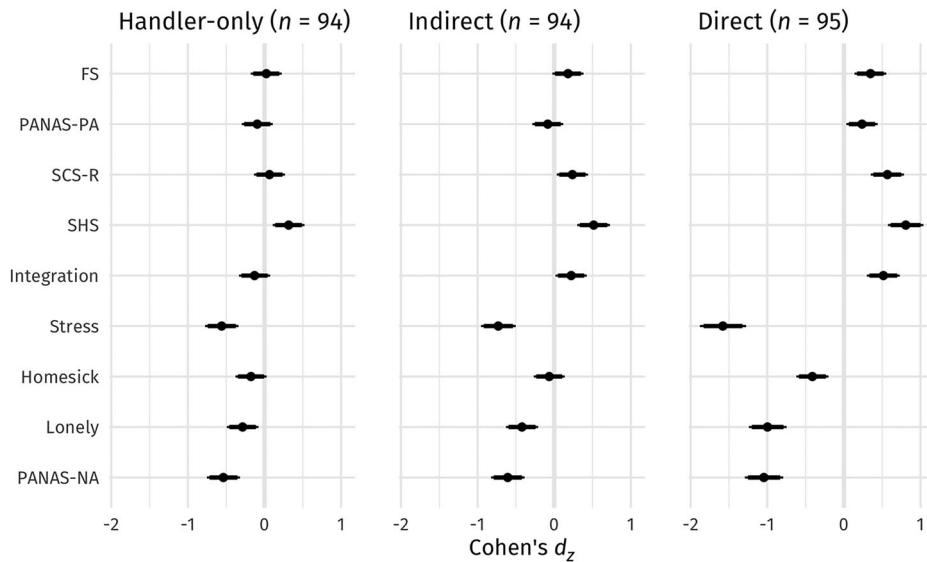
Figure 3. Cohen's d_z for paired t-tests comparing pre-intervention with post-intervention. Note: Thin lines represent 95% confidence intervals (CI) for d_z. Thick lines represent the 90% CI for d_z. Post-intervention comparisons on measures of wellbeing and illbeing used directional tests; therefore, an effect is significant if the 90% CI does not cross 0 and d_z is in the hypothesized direction.

Table 4. Results of planned contrasts comparing the effect of the intervention between conditions.

Measure	B	SE	$t_{(280)}$	p	d	95% CI for d LL	UL
Handler vs. indirect and direct							
FS	0.05	0.03	1.83	0.068	0.22	−0.02	0.45
PANAS-PA	0.05	0.04	1.24	0.215	0.15	−0.09	0.38
SCS-R	0.09	0.03	2.75	0.006	0.33	0.09	0.56
SHS	0.10	0.03	3.30	0.001	0.39	0.16	0.63
Integration[a]	0.21	0.06	3.77	< 0.001	0.45	0.21	0.69
Stress	−0.35	0.07	5.01	< 0.001	−0.60	−0.84	−0.36
Homesick	−0.11	0.06	1.78	0.075	−0.21	−0.45	0.02
Lonely	−0.06	0.02	3.56	< 0.001	−0.43	−0.66	−0.19
PANAS-NA	−0.13	0.04	3.66	< 0.001	−0.44	−0.67	−0.20
Indirect vs. direct							
FS	0.03	0.02	1.18	0.238	0.14	−0.09	0.38
PANAS-PA	0.08	0.04	1.97	0.050	0.24	0.00	0.47
SCS-R	0.06	0.03	2.14	0.034	0.26	0.02	0.49
SHS	0.06	0.03	2.32	0.021	0.28	0.04	0.51
Integration[a]	0.12	0.04	2.85	0.005	0.34	0.10	0.58
Stress	−0.32	0.06	5.88	< 0.001	−0.70	−0.94	−0.46
Homesick	−0.16	0.06	2.78	0.006	−0.33	−0.57	−0.10
Lonely	−0.07	0.02	4.20	< 0.001	−0.50	−0.74	−0.26
PANAS-NA	−0.14	0.03	4.23	< 0.001	−0.51	−0.74	−0.27

Note: CI = confidence interval; LL = lower limit; UL = upper limit; FS = Flourishing Scale; PANAS-PA = Positive affect subscale of the Positive and Negative Affect Schedule-Short Form; SCS-R = Social Connectedness Scale-Revised; SHS = Subjective Happiness Scale; stress = single-item stress measured on a scale of 1–5; integration = single-item measure of integration to campus community; homesick = single-item homesickness measured on a scale of 1–5; Lonely = UCLA Loneliness Scale; PANAS-NA = the negative affect subscale of the Positive and Negative Affect Schedule-Short Form.
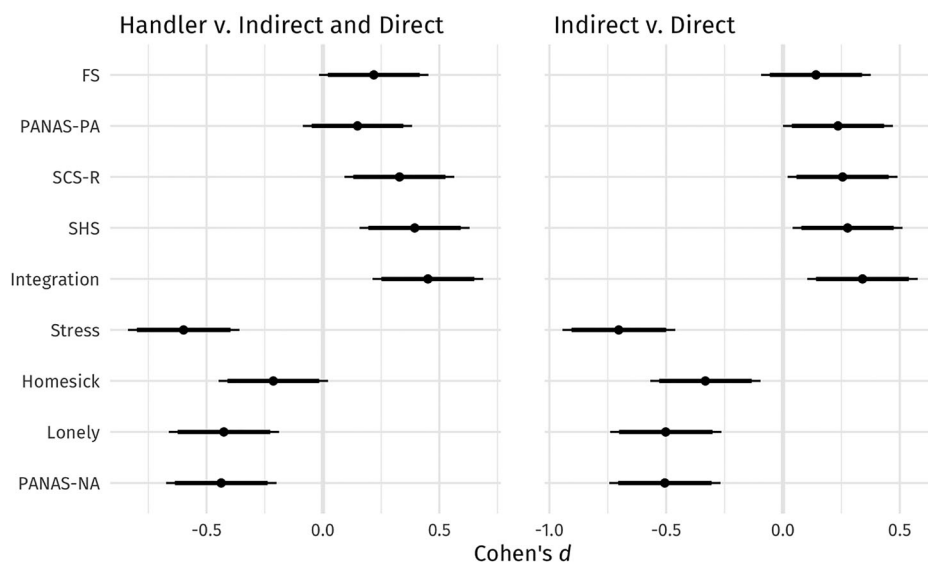[a]$df = 279$.

Figure 4. Cohens *d* for the effect of the dog's presence and physical contact with the dog on post-intervention scores after controlling for pre-intervention scores. Note: The first contrast assessed the effect of the dog's presence by comparing the handler-only condition with both the indirect and direct conditions using the contrast codes −1, 0.5, and 0.5, respectively. The second contrast assessed the effect of physical contact with the dog by comparing the indirect and direct conditions using the contrast codes 0, −1, and 1 for the three respective conditions. Thin lines represent 95% confidence intervals (CI). 95% CIs not inclusive of 0 indicate a statistically significant effect of the contrast. Thick lines represent 90% CIs.

with the indirect condition, participants in the direct contact condition reported greater increases in positive affect, social connectedness, and subjective happiness; and greater decreases in stress, homesickness, loneliness, and negative affect.

Exploratory Analyses

Although participants were randomly assigned to each group, the groups were imbalanced on the proportion of pet owners. Pet owners were more prevalent in the indirect and direct contact conditions – conditions for which a dog was present. Because this is an animal intervention, pet owners could experience greater benefits. To ensure that the between-group differences we observed were not being driven by differences in the proportion of pet owners, we conducted the analyses of hypotheses 2 and 3 with pet ownership included as a categorical covariate. Pet ownership was not a significant predictor in any of these models, and adjusting for pet ownership did not appreciably change the results. The results of these analyses are available at: https://osf.io/q29ad/

We conducted exploratory analyses to assess whether the wellbeing and illbeing items were measuring a unidimensional construct. Inter-item correlations at each measurement occasion are shown in Table 5. The three single-item measures (those measuring homesickness, stress, and integration with campus community) had mostly weak associations with the other measures.

Table 5. Inter-item correlations at pre-intervention and post-intervention.

Variable	M	SD	1	2	3	4	5	6	7	8	9
Pre-intervention											
FS	5.68	0.78									
PANAS-PA	3.29	0.68	0.52***								
SCS-R	4.42	0.82	0.73***	0.39***							
SHS	3.31	0.88	0.68***	0.36***	0.63***						
Integration	3.22	1.05	0.28***	0.23***	0.44***	0.26***					
Stress	3.21	0.97	−0.23***	−0.16**	−0.23***	−0.30***	−0.03				
Homesick	2.09	1.20	−0.21***	−0.07	−0.22***	−0.20**	−0.09	0.08			
Lonely	2.04	0.53	−0.59***	−0.31***	−0.89***	−0.58***	−0.42***	0.21***	0.28***		
PANAS-NA	1.98	0.70	−0.50***	−0.20**	−0.52***	−0.47***	−0.21***	0.31***	0.12*	0.55***	
Composite	−0.08	0.96	0.76***	0.40***	0.99***	0.69***	0.44***	−0.25***	−0.25***	−0.93***	−0.58***
Post-intervention											
FS	5.74	0.78									
PANAS-PA	3.30	0.79	0.47***								
SCS-R	4.53	0.87	0.69***	0.35***							
SHS	3.53	0.82	0.65***	0.32***	0.61***						
Integration	3.35	1.03	0.29***	0.17**	0.48***	0.30***					
Stress	2.37	1.03	−0.24***	−0.16**	−0.24***	−0.31***	−0.16**				
Homesick	1.89	1.11	−0.14*	−0.00	−0.21***	−0.22***	−0.06	0.20**			
Lonely	1.91	0.53	−0.62***	−0.31***	−0.87***	−0.59***	−0.50***	0.30***	0.28***		
PANAS-NA	1.61	0.67	−0.36***	−0.09	−0.43***	−0.38***	−0.22***	0.44***	0.20**	0.44***	
Composite	0.10	0.98	0.74***	0.37***	0.99***	0.67***	0.49***	−0.28***	−0.24***	−0.92***	−0.48***

Note: $n = 284$. FS = Flourishing Scale; PANAS-PA = Positive affect subscale of the Positive and Negative Affect Schedule-Short Form; SCS-R = Social Connectedness Scale-Revised; SHS = Subjective Happiness Scale; integration = single-item measure of integration to campus community; stress = single-item stress measured on a scale of 1–5; homesick = single-item homesickness measured on a scale of 1–5; Lonely = UCLA Loneliness Scale; PANAS-NA = the negative affect subscale of the Positive and Negative Affect Schedule-Short Form; composite = wellbeing composite score derived using factor analysis.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Reliability Analysis

We further explored the relationships between these measures with a reliability analysis. Specifically, we calculated Cronbach's α to assess internal consistency of a composite measure and assessed the fit of each item in the composite measure by examining the change in total α associated with dropping the item from the composite measure and the item-whole correlation for the item against the scale with that item removed. We then removed the poorest performing item from the composite measure and computed the same statistics again. We repeated this until all items were performing adequately. These steps were done separately for both measurement occasions; however, because the results were similar, we present only the results for the first measurement occasion. The results for post-intervention are available at: https://osf.io/q29ad/.

Results of the reliability analysis are presented in Table 6. The first step included all wellbeing and illbeing measures, with the illbeing measures reverse-scored. Cronbach's α indicated relatively high internal consistency ($\alpha = 0.79$). The homesickness item was correlated weakly ($r = 0.22$), with the total scale with that item removed. We removed that item, which increased α to 0.82. We then removed the stress item from the composite measure ($r = 0.28$), increasing α to 0.84; followed by the measure of integration ($r = 0.39$) which increased α to 0.87. Finally, we removed the PANAS-PA ($r = 0.44$), which again increased α to 0.88. Cronbach's α would have been further increased by removing the PANAS-NA, but the item-whole correlation for that measure was moderate ($r = 0.58$) and α was already high. Therefore, we chose to retain that measure as an item in the composite wellbeing measure.

Exploratory Factor Analysis

We additionally conducted exploratory factor analysis, which also suggested that items we had removed based on the reliability analysis were poorly explained by a common

Table 6. Item-whole correlations at each step in reliability analysis of a composite wellbeing measure.

Item	Step				
	1	2	3	4	5
FS	0.72	0.73	0.75	0.80	0.76
PANAS-PA	0.42	0.44	0.44	0.44	–
SCS-R	0.78	0.80	0.83	0.81	0.83
SHS	0.66	0.68	0.66	0.70	0.70
Integration	0.34	0.36	0.39	–	–
Stress	0.27	0.28	–	–	–
Homesick	0.22	–	–	–	–
Lonely	0.75	0.75	0.77	0.76	0.78
PANAS-NA	0.54	0.56	0.53	0.55	0.58

Note: Item-whole correlations are the Pearson correlation between each item and the total scale score with that item removed. Total Cronbach's αs at each step were 0.79, 0.82, 0.84, 0.87, and 0.88. FS = Flourishing Scale; PANAS-PA = Positive affect subscale of the Positive and Negative Affect Schedule-Short Form; SCS-R = Social Connectedness Scale-Revised; SHS = Subjective Happiness Scale; integration = single-item measure of integration to campus community; stress = single-item stress measured on a scale of 1–5; homesick = single-item homesickness measured on a scale of 1–5; Lonely = UCLA Loneliness Scale; PANAS-NA = the negative affect subscale of the Positive and Negative Affect Schedule-Short Form.

factor. Parallel analysis indicated that – using all wellbeing and illbeing measures – only the first principal component eigenvalue was larger than random data eigenvalues. This suggests that a multidimensional factor solution was not warranted.

A maximum likelihood factor analysis with 1 factor explained 40% of the common variance in the nine variables. Consistent with the findings of the reliability analysis, factor loadings were weakest for the homesickness (−0.29), stress (−0.28), integration (0.46), and PANAS-PA (0.41). A separate factor analysis with these items removed explained 60% of the common variance in the five variables, with at least moderately strong loadings for all variables: FS (0.73), SCS-R (0.97), SHS (0.67), UCLA Loneliness Scale (−0.91), PANAS-NA (−0.53). Participants' factor scores were computed from these loadings and then used to conduct the analyses to test our hypotheses.

Analyses with Composite Measure

Directional paired samples t-tests indicated that participants' scores on the wellbeing factor increased significantly from pre-to-post-intervention in all three conditions: handler-only ($t_{(93)} = 1.76$, $p = 0.041$, $d_z = 0.18$, 90% CI [0.01, 0.35]); indirect ($t_{(94)} = 3.67$, $p < 0.001$, $d_z = 0.38$, 90% CI [0.20, 0.55]); direct ($t_{(94)} = 7.61$, $p < 0.001$, $d_z = 0.78$, 90% CI [0.59, 0.55]).

Planned contrasts showed a significantly greater improvement in pre-to-post-intervention wellbeing when a dog was present ($t_{(280)} = 3.70$, $p < 0.001$, $d = 0.44$, 95% CI [0.20, 0.68]), and a significant benefit of physical contact with the dog beyond what is offered by the dog's mere presence ($t_{(280)} = 3.06$, $p = 0.002$, $d = 0.37$, 95% CI [0.13, 0.60]).

Discussion

Recall that the aim of this study was to empirically assess the role that contact with therapy dogs within a CAI contributes to participants experiencing wellbeing outcomes. Our findings provide strong and consistent empirical support for the benefit of both the presence of a therapy dog and physical contact with a therapy dog. Across positive and negative dimensions of wellbeing, our findings indicate that participating in a CAI, with direct physical contact with a therapy dog, contributes to students experiencing boosts to their wellbeing, with benefits being most pronounced for happiness, stress, loneliness, and negative affect. Participating in the same intervention either with no dog present or without physical contact with the dog yields smaller, but still meaningful, benefits for those components of wellbeing; however, evidence for benefits to other measures of wellbeing was inconclusive. Our findings also indicate that greater wellbeing benefits are derived when a dog is present; especially when a student attending a CAI interacts with the therapy dog through touch. Situating our findings within the extant research conducted to date that has examined the role of touch between visitors to CAIs and therapy dogs, our results are in accord with the findings of Beetz et al. (2011) and Pendry and Vandagriff (2019), who established the important role of touch between a client and a therapy dog within a session. Conversely, our findings challenge the recent findings of Mueller et al. (2021) in which the role of touch was found to not play a significant role in eliciting a reduction in anxiety in participants. This inconsistency in findings

may perhaps be explained by differences in the participants studied (university versus high-school age students) and the dependent variables measured (positive and negative dimensions of wellbeing versus anxiety, autonomic reactivity, and cognitive performance).

Our findings also hold applied significance. The findings from the current study serve to inform our understanding of how to make the most out of CAI sessions and to help ensure that participants at sessions experience optimal wellbeing benefits. First, upon arrival to an on-campus CAI session, students should be informed that, in order to make the most out of their visit, they should spend their time interacting with the therapy dog through direct touch. For some students with limited prior experience interacting with dogs, this may require explicit instructions around how to pet the dog (e.g., do not pat but stroke from head to tail). This is especially important as we consider canine welfare and ensuring that the interactions within sessions are not stress-inducing for the dogs. Second, when CAI programs are introduced on campus, considerations around the number of participating dogs and the ratio of visitor-to-dog must be made. Therapy dogs must be accessible to students, and the number of students interacting with any given dog–handler team must allow for students to physically interact (i.e., pet) with the dog. Relatedly, the handlers overseeing these interactions must be suitably trained to facilitate such interactions between students and dogs. And last, our findings inform the screening and selection of therapy dogs for participation in on-campus CAIs. Therapy dogs working in sessions must be especially comfortable with hands-on interactions from multiple strangers and not find these interactions stressful. As summarized by Fredrickson-MacNamara and Butler (2010, p. 126), "The key is determining whether an animal has the capacity to recover from the encroachment of strangers, cope comfortably in the environment, and respond appropriately to interactions."

Strengths and Limitations

This study had strong implementation fidelity as reflected by the use of experienced dog–handler teams, the reading aloud of all measures, adherence to conversational guidelines by handlers across conditions, randomization of handlers and participants to conditions and the randomization of participants within conditions, the use of a seating template, and using a pre-determined dose intervention.

Despite best intentions, there were limitations to this study. First, as the participants in this study were undergraduate students, concerns may be raised about the generalizability of this population to broader audiences. University students are certainly a well-studied population (Hanel & Vione, 2016; Peterson & Merunka, 2014) and complexities in studying this group for the present investigation include the role incentives might play in influencing participation in studies and the role that self-report measures play in influencing outcomes. The incentive for this study was minimal (i.e., a modest participation grade for their undergraduate course); steps were taken to ensure anonymity. Nevertheless, we recognize the biases these factors introduce. Second, the inclusion of a wait-list control group, a condition in which participants had no exposure to a handler or to a dog–handler team, would have strengthened the study's

methodology by allowing comparison against a control when examining the effect of the intervention; however, the absence of a wait-list control has no bearing on the primary research questions (i.e., hypotheses 2 and 3), which compared levels of the intervention. Finally, with one exception, we used measures of theoretically stable traits to assess short-term changes in state wellbeing. Most measures instructed participants to report their general experiences. The exception to this was the measure of stress which instructed participants to report on their current feelings. Therefore, despite observing much larger effect sizes for stress than any of the other measures, we cannot conclude that the intervention was more effective at reducing stress than it was for any of the other components of wellbeing. Had the other constructs been measured differently, we may have observed a substantially larger effect. Future research should utilize valid measures of state wellbeing to better estimate the effectiveness of CAIs.

Conclusion

University students seeking to reduce their stress by participating in on-campus canine-assisted stress-reduction programs can best benefit from spending their time in sessions petting and directly interacting with therapy dogs through touch. Where this is not possible, merely being in the immediate presence of a therapy dog can also yield wellbeing benefits. Post-secondary administrators seeking to reduce student stress and bolster their wellbeing can support on-campus initiatives that provide opportunities for students to be both in the close proximity of therapy dogs and to engage in CAIs known to support their overall wellbeing.

Disclosure Statement

No conflict of interest has been reported by the authors.

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Appendix 1.

Canine handler discussion guidelines
    Session and Engagement Questionnaires
    Semi-structured Question Guide for Handlers
    This series of questions are designed to be a guide to the questions you may ask students and the conversations you can have. This does not need to be a script followed directly but acts as a guide to keep the conversations among groups consistent.
    To start the conversation, please introduce yourself and your dog to the group and ask the students to introduce themselves to one another. To facilitate conversation, there is a list below of the types of questions you may ask students:

1. Tell me, where is home for you? Where are you from?
2. What brought you here to the university?
3. What program are you studying?
4. Tell me about the courses you're taking. Which ones are you enjoying the most?
5. What are things you like to do outside of school? What is it you like about doing that?
6. What do you like about living in our city?
7. What are your favorite places to visit (e.g., parks, restaurants, cafes)?
8. What is something good that has happened this week?
9. What did you do over the weekend?
10. What are your plans for the next week?
11. What are your plans for the summer?
12. What is something you're looking forward to this month?
13. What kind of music do you listen to? Do you have a favorite song? Artist?
14. Have you been to see any shows or concerts recently? If so, what did you go and see? What did you think of the show?
15. What kind of podcasts do you listen to?
16. What books have you read recently? What genre do you like?
17. Have you ever met anyone famous? If so, who? What were they like?
18. Do you have any favorite things you like to cook?
19. Do you have any favorite actors/actresses/artists/comedians?
20. What is a special skill or talent that you have?

    Note: please do not discuss the University's dog therapy program, wellbeing or adjustment to campus, or their dogs at home.