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Human-Animal Interactions (2023) 11:1
https://doi.org/10.1079/hai.2023.0038

CABI Human – Animal Interactions

RESEARCH

An exploratory randomised controlled trial comparing the effectiveness of different duration of canine-assisted interventions in higher education students

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Abstract

The aim of this study was to explore whether different durations of canine-assisted intervention (CAI) influenced the beneficial effects of CAI on anxiety, stress, depression, and the well-being of higher education (HE) students. Eighty-eight participants took part in an exploratory randomised control trial (RCT) and were assigned to the 2, 5, and 10-min CAI groups who interacted with a canine, or a control group who watched an unrelated slideshow. Pre- and post-intervention anxiety, stress, depression, and well-being levels were measured. Additionally, the type of interaction between humans and canines was recorded as well as participants' views of the canines' neoteny (juvenile features) to explore whether interaction activity and canine features have an impact on the beneficial positive effects of CAI. The results showed no differences in the duration of CAI in reducing anxiety, stress, and depression, meaning a 2-min CAI session was as effective as a 10-min session. The results also found individual intervention activities between humans and canines did not predict a reduction in anxiety, stress, depression, or an increase in general well-being. Additionally, a negative correlation was found between the cuteness of the canine and anxiety, and between the cuddliness of the canine and stress, although these results should be interpreted with caution due to high canine trait scores. Overall, this study used a CAI and control group to explore the differences between a single 2, 5, and 10-min CAI sessions in HE students and demonstrated a 2-min CAI session was as effective as a longer 10-min CAI session in supporting the mental health of HE students, by reducing anxiety, stress, and depression levels in the treatment group.

Keywords: animal-assisted activities, canine-assisted intervention, HE students, mental health, anxiety, stress, depression

Introduction

Mental health issues in higher education (HE) students are not uncommon (Kwong *et al*., 2021; Pierce *et al*., 2020; Broglia *et al*., 2021). Many universities and colleges offer CAI (canine-assisted intervention), with Gee *et al*. (2021) discussing the benefits of CAI for certain mental disorders as well as therapy dogs in an educational context. Specifically, there have been a number of studies on the HE population that identify the benefit of CAI on mental health using a range of specific interaction timings. These include both short durations, (e.g., [5–15 min] Buttelmann and Römoke, 2014; Lass-Hennemann *et al*., 2014; Crossman *et al*., 2015; Fiocco and Hunse; 2017; Rothkopf and Schworm, 2021; Binfet *et al*., 2022), and longer durations (e.g., [20–75 min] Adamle *et al*., 2009; Shearer *et al*., 2016; Binfet, 2017; Grajfoner *et al*., 2017; Kivlen *et al*., 2022). However, a systematic review carried out by Manville *et al*. (2022a) found that no studies have directly compared specific interaction timings in one study therefore, there is a lack of detail as to how long a single CAI intervention must last to be effective.

Alongside identifying an optimal duration of CAI, it is also important to explore whether the physical relationship or the level of interaction between humans and canines has a positive impact on CAI. However, most studies exploring CAI tend to focus on the benefit of interaction with a canine per se, without identifying the type or level of interaction (e.g., Muckle and Lasikiewicz, 2017; Trammell, 2017) and participants are free to decide how they

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Submitted: 17 May 2023. Accepted: 05 October 2023. Published: 07 November 2023

interact with the canine (e.g., Dell *et al*., 2015; Wood *et al*., 2018; Spruin *et al*., 2020). This makes it impossible to determine whether the level of interaction with the canine is a contributing factor towards effective CAI.

Another factor that may impact the effectiveness of CAI is the canine itself, in particular its features. Neoteny refers to the retention of juvenile features in adult animals (Beck, 2014). Research demonstrates a preference towards this juvenile appearance in animals that display baby schema, round face, large eyes, small nose, and mouth (e.g., Archer and Monton, 2010; Estren, 2012; Piazza *et al*., 2018). For example, Fridlund and MacDonald (2015) found that passers-by were more likely to stop and approach a younger puppy compared to an older puppy. Additionally, Borgi *et al*. (2014) demonstrated that participants spent more time gazing at images of babies, dogs, and cats that had been adapted to take on more baby schema or neotenous features which may be linked to the natural response in humans to be interested in and take care of babies. To the authors' knowledge, there is no current research exploring the influence of canine features on the effectiveness of CAI.

The main aim of this study is to identify whether the duration of the CAI influences the effectiveness of CAI in reducing anxiety, stress, and depression, while also improving the well-being of HE students. In addition to measuring anxiety, stress, depression, and well-being, participants will be video-recorded during the CAI sessions. In an effort to encourage engagement between participant and canine, a ball will be introduced as part of the CAI sessions. This can be used to simply throw the ball for the dog to retrieve or play with. The ball adopts the form of an instrument participants can use to engage with the dog which will encourage participants to feel more comfortable and have something to focus on (see VanFleet *et al*., 2015). The use of the ball is not compulsory, rather this will be left for the participant to use or not. Recording these interactions will allow exploration into the timings of six interaction activities, (1) no interaction with the canine (no interaction), (2) only watching the canine without any physical or vocal interaction (watching only), (3) petting the canine without any vocal interaction (pet no vocal), (4) petting the canine with vocal interaction (pet vocal), (5) playing with the canine with a toy without any vocal interaction (play toy no vocal), or (6) playing with the canine with a toy and vocal interaction (play toy with vocal). It will also support the second aim; identifying whether interactions that allow for physical contact between humans and canines (pet no vocal, pet with vocal, play toy no vocal, play toy with vocal) will predict the effectiveness of CAI in comparison to those with no physical contact (no interaction, watching only). The final aim will be to determine whether the canine features (juvenile or adult in appearance, cute, friendly, loveable, playful, good-natured, and cuddly) will have a positive impact on the effectiveness of CAI.

Participants will be randomly assigned to one of four groups: CAI with a duration of 2, 5, or 10-min, or a no-canine control group. The durations of 2, 5, and 10-min have been selected based on previous research demonstrating that CAI session of 5-min (e.g., Buttelmann and Römoke, 2014) and 10-min (e.g., Fiocco and Hunse, 2017) have a positive effect on mental health in HE students. Direct comparison of these durations within one study will determine whether there is an optimum duration required for effective CAI. The group with a shorter duration of CAI (2-min) is important because if it is found to be as effective as 5 or 10-min, universities may be more willing to consider CAI as a form of intervention, as a briefer intervention arguably has a lower financial and resource impact.

Methods

PARTICIPANTS

Based on Cohen's (1988) recommended power of 0.80, power calculations suggested a sample size of 88 participants was adequate to detect a medium effect size with the primary outcome being to investigate the impact of CAI on the mental health of HE students, specifically anxiety, stress, depression, and well-being. All HE students (75 females and 13 males) were recruited from Middlesex University (current Middlesex University student ratio female to male 58:42, Times Higher Education, 2023). Participants were randomly assigned to one of four groups: 2, 5, and 10-min CAI, or a 10-min control group using a computer-generated random sequence. Stratification was not employed as the study did not focus on the benefit of CAI on different populations. The study recruited undergraduate HE students only, therefore participants' ages ranged between 18 years and 24 years (M = 19.70 years, SD = 1.50: female M = 19.61 years, SD = 1.40, male M = 20.23 years, SD = 1.79). Twenty participants reported having a canine at home. Exclusion criteria included having a fear of canines, allergies towards animals, and whether the participant had purposely harmed an animal. Participants' responses were taken at face value, however, the researcher stayed in the room to monitor all sessions. No participants were excluded from this study. All participants took part individually, provided signed written consent to take part in the study, and were entered into a competition to win one of two £20 Amazon vouchers.

MATERIALS

The study was carried out using Qualtrics, and an Amazon Fire 8 tablet, OS 5.6.4.0 was used to complete data collection. The control group watched a 10-min powerpoint with neutral images from the British Vocabulary Scale such as a boat or chair. All images were in colour and randomly presented. Two canines, Elvis (Fig. 1), a small Dachshund-Jack Russell cross, and Dahlia (see Fig. 2), a small Chihuahua, Yorkshire Terrier cross were used in the intervention groups. Both are pets and have received formal obedience training, frequently travel by tube with the researcher and are comfortable with other commuters. The handler also received training from Canine Consulting. This took place in a public space in London as there were many examples of external elements that may cause anxiety for a dog, and ensured the handler was able to recognise signs of distress in the canines. The handler was in the laboratory at all times to monitor both canines for fear or distress. Both canines did not provide CAI for more than four sessions each

Fig. 1. Elvis the dog.

Fig. 2. Dahlia the dog.

day, and received regular 20–25 min breaks between sessions where they were able to rest in a private space or walk around the outside spaces on campus. They were also made accustomed to the surroundings every day data collection was due to take place. This was done prior to data collection commencing.

OBSERVATION SOFTWARE

Observer XT software (Noldus, Version 11) was used on a MacBook Air, OS X 10.9 as the observational software, as it allowed for coding and custom analysis design. The videos recorded the six pre-set interactions used to identify the interaction activity between the participant and the canine. Recording started at the beginning of each participant session and each time the interaction changed the start/stop time was recorded, meaning that for each participant (2, 5, and 10-min) there is the relevant duration of coding.

1. No interaction – no interaction between participant and canine.
2. Watching only – participants only watch the canine.
3. Pet no vocal – participants pet the canine without talking to the canine.
4. Pet with vocal – participants pet while talking to the canine.
5. Play toy no vocal – participants use a toy while interacting with the canine without talking to the canine.
6. Play toy with vocal – participants use a toy while interacting and talking to the canine.

QUESTIONNAIRE MEASURES

To measure levels of anxiety, stress, depression, and well-being, four standardised questionaries were used alongside three visual analogue scales (VAS) measuring anxiety, stress, and depression. All VAS were represented by a 100 mm scale with, for instance, *extremely anxious* at one end and *not at all anxious* at the other. A further eight VAS were used to measure participants' perceptions of canine traits (VAS-CT) with *very* at one end to *not at all* at the other end. The eight traits measured were juvenile or adult in appearance, cute, friendly, loveable, playful, good-natured, and cuddly. The juvenile and adult traits were based on Fridlund and MacDonald's (2015) study with older and younger dogs. The other six traits were based on a number of sources (e.g., Nittono *et al*., 2012; Friedmann *et al*., 2015; Bognár *et al*., 2021; Fawcett and Gullone, 2021; Olson and Oney, 2022). This is the first time the VAS-CT was used therefore it was difficult to check for validity. Only participants in the three CAI groups who interacted with a canine completed the VAS-CT. The control group did not complete the VAS-CT as they had no interaction with a canine.

State Trait-Anxiety Inventory (STAI: Spielberger *et al*., 1983).

The STAI measures both state and trait anxiety, however, only the state questionnaire was used to identify the difference between pre- and post-subjective anxiety. Consisting of 20 questions with a 4-point scale, responses ranged from *not at all* to *very much so.* The STAI has a range score between 20 and 80, and internal consistency was high pre-intervention, Cronbach's alpha (*a*) = 0.92, and post-intervention, *a* = 0.93.

Becks Depression Inventory (BDI, Beck *et al*., 1996).

The BDI was used to measure depression and uses a Likert scale ranging from 0 to 3. It is comprised of 21 questions with a score ranging between 0 and 63. Internal consistency was high pre-intervention, Cronbach's *a* = 0.88, and post-intervention, *a* = 0.88.

Perceived Stress Scale (PSS, Cohen *et al*., 1983).

The PSS was used to measure perceptions, and the degree to which participants found their life stressful. Consisting of 10 questions on a 5-point scale ranging from 0 to 4, responses ranged from *never* to *very often.* Cronbach's alpha was acceptable at pre-intervention, *a* = 0.73, and post-intervention, *a* = 0.75.

Warwick-Edinburgh Mental Well-being Scale (WEMWBS, University of Warwick, 2015).

Used to measure well-being, the WEMWBS consists of 14 questions on a 5-point scale. Answers range from *none of the time* to *all of the time*. Cronbach's alpha was high pre-intervention, *a* = 0.92, and post-intervention *a* = 0.94.

PROCEDURE

Through individual pre-arranged appointments, participants were tested in a lab at Middlesex University. Randomly allocated to one of four CAI groups (2, 5, 10-min, or a no-canine control group), the duration of the study ranged from 25 to 40-min depending on the intervention group. The study took place after ensuring participants met all inclusion criteria participants, had completed a demographics questionnaire and had given their consent to participate.

- *Pre-intervention:* All measures were completed in the same order (VAS-Anxiety, VAS-Stress, VAS-Depression, BDI, STAI, PSS, WEMWBS), by all four groups (2, 5, 10-min CAI groups, and the control group). The canine was not present during pre-measures.
- *Intervention:* Participants were randomly assigned to one of four groups: 2, 5, 10-min CAI groups, or the control group. Participants were told the level of interaction was for them (the individual participant) to establish, and that the researcher would stay in the room in sight of both the canine and participants to monitor the timing of the session and the canine, but not take part in the intervention. Participants in the control group were given a neutral task involving watching a powerpoint with unrelated (non-animal) neutral images for 10-min and received no CAI.
- *Post-intervention:* The measures were presented for a second time in the same pre-intervention order (VAS-Anxiety, VAS-Stress, VAS-Depression, BDI, STAI, PSS, WEMWBS). All CAI groups (2, 5, and 10-min) were also presented with the VAS-CT. Participants were given the opportunity to ask any questions at the end of the study and received a full debrief.

Results

STATISTICAL ANALYSIS

Correlation analyses were first conducted to check concordance between measures pre-intervention (Table 1) and post-intervention (Table 2). To explore whether CAI reduced anxiety, stress and

Table 1. Correlation between all measures at pre-intervention.

Variables	VAS-Anxiety	VAS-Stress	VAS-Depression	BDI	STAI	PSS	WEMWBS
VAS-Anxiety	–						
VAS-Stress	0.59**	–					
VAS-Depression	0.50**	0.60**	–				
BDI	0.47**	0.44**	0.63**	–			
STAI	0.66**	0.53**	0.62**	0.73**	–		
PSS	0.32**	0.38**	0.47**	0.64**	0.65**	–	
WEMWBS	−0.36**	−0.33**	−0.57**	−0.75**	−0.72**	−0.47**	–

*p < 0.05.
**p < 0.01.
***p < 0.001.

Table 2. Correlations between all measures at post-intervention.

Variables	VAS-Anxiety	VAS-Stress	VAS-Depression	BDI	STAI	PSS	WEMWBS
VAS-Anxiety	–						
VAS-Stress	0.79**	–					
VAS-Depression	0.59**	0.67**	–				
BDI	0.40**	0.43**	0.58**	–			
STAI	0.46**	0.34**	0.39**	0.45**	–		
PSS	0.19	0.26*	0.23*	0.36*	0.17	–	
WEMWBS	−0.27*	−0.34**	−0.45**	−0.64**	−0.56**	−0.28**	–

*p < 0.05.
**p < 0.01.
***p < 0.001.

depression levels, and improved well-being, separate two-way 4 (2-min CAI vs 5-min CAI vs 10-min CAI vs control) × 2(phase: pre vs post) mixed ANOVAs were carried out on all measures. Simple effects analyses followed up all significant interactions. Alpha = 0.05 was set as the rejection criterion in all analyses. Effect sizes are reported as partial eta-squared (η^2_p).

A hierarchal regression was carried out to explore whether all pre-measures of anxiety, stress, depression and well-being (model 1), and the five interaction activities (1) watching only, (2) pet no vocal, (3) pet with vocal, (4) play toy no vocal, and (5) play toy with vocal), were significant predictors of anxiety, stress, depression, and general well-being (model 2). The 6th predictor (no interaction) was removed from the analysis as this activity between humans and canines did not occur. Finally, correlation analyses were carried out to explore the relationship among canine traits and anxiety, stress, depression, and general well-being.

PRELIMINARY ANALYSES

Participants in the CAI groups were randomly allocated to interact with either Elvis or Dahlia. Initial analyses included canine (Elvis vs Dahlia) as an independent variable, however, there was no significant impact of canine on any of the measures, therefore it was decided to exclude this from the analysis. In addition, whether a participant lived with a canine was also factored into the analysis. Again, there were no significant differences between participants who lived with a canine and those who did not, therefore this was also excluded from reported analyses. Finally, a one-way ANOVA was performed on all pre-measure scores (VAS-Anxiety, VAS-Stress, VAS-Depression, BDI, STAI, PSS, and WEMWBS) across the groups to check for pre-existing differences before participants received their intervention. No significant pre-existing differences were identified.

CORRELATION ANALYSES

The results of the correlation analysis indicated a significant correlation between all measures pre-intervention (Table 1) and most post-intervention (Table 2). Positive correlations were found pre-intervention among the VAS-Anxiety, VAS-Stress, VAS-Depression, BDI, STAI, and PSS indicating that anxiety, stress, and depression measured across a breadth of measures were all highly related. In addition, a negative correlation was demonstrated among the WEBWMS and VAS-Anxiety, VAS-Stress, VAS-Depression, BDI, STAI, and PSS indicating that high levels of well-being were related to low levels of anxiety, stress, and depression. Post-intervention correlations differed slightly. No correlation was found between VAS-Anxiety and PSS or the STAI and PSS. All other measures were significantly correlated.

ANXIETY

Figure 3 displays the mean VAS-Anxiety scores, pre- and post-intervention in the 2, 5, 10-min CAI groups, and the control group. The graph shows a greater reduction in anxiety from pre- to post-intervention in all three CAI groups in comparison to the control group. Table 3 shows the 4×2 mixed ANOVA findings pre- and post-intervention for VAS-Anxiety, in the 2, 5, 10-min CAI groups, and the control group. The significant phase × group interaction demonstrates an effect of the intervention from pre- to post-intervention indicating a difference across the two groups. To follow up this significant interaction, simple effects analyses revealed a significant difference from pre- to post-intervention in the 2-min

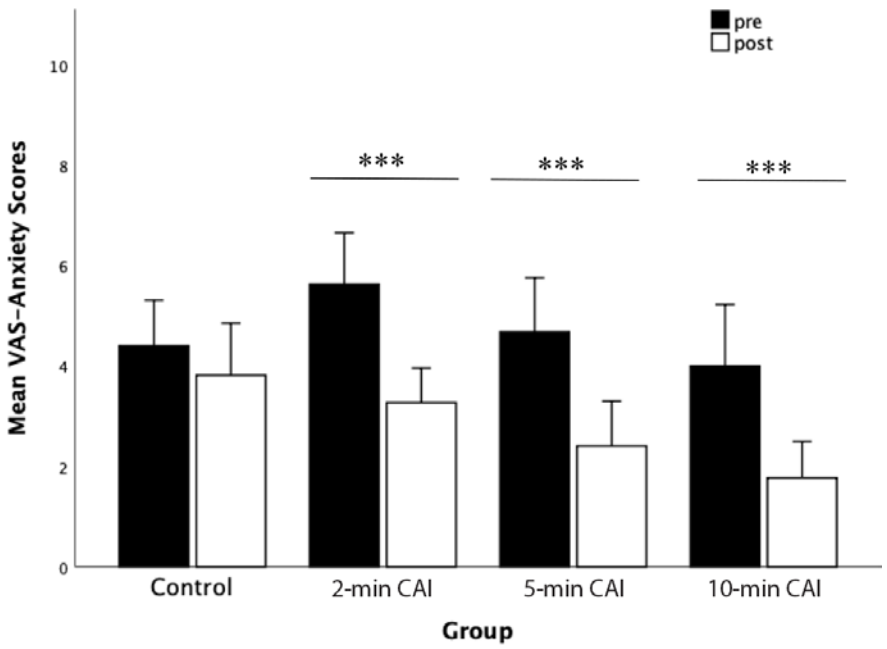

Fig. 3. Pre- and post-mean VAS-Anxiety scores (with SE bars) in the 2, 5, 10-Min CAI and control group. *p < 0.05, **p < 0.01, ***p < 0.001.

Table 3. Results of 4 × 2 mixed ANOVAs conducted on the VAS-Anxiety, STAI, VAS-Depression, BDI, VAS-Stress, PSS, and WEMWBS.

Measure	Main effects and interactions	*F*(1, 58)	η^2_p	95% CI
VAS-Anxiety	Phase	88.95***	0.51	[0.36, 0.62]
	Group	2.96	< 0.09	[0, 0.19]
	Phase × Group	0.4.63*	0.14	[0.02, 0.26]
STAI	Phase	118.71***	0.59	[0.45, 0.68]
	Group	2.23	0.07	[0, 0.17]
	Phase × Group	5.95***	0.18	[0.03, 0.30]
VAS-Depression	Phase	41.39***	0.33	[0.17, 0.46]
	Group	0.05	0.002	[0, 0.10]
	Phase × Group	1.53	0.05	[0, 0.14]
BDI	Phase	86.53***	0.51	[0.35, 0.61]
	Group	0.49	0.02	[0, 0.07]
	Phase × Group	3.80**	0.12	[0.01, 0.23]
VAS-Stress	Phase	132.08***	0.61	[0.48, 0.70]
	Group	0.49	0.69	[.0, 0.07]
	Phase × Group	6.25***	0.18	[0.04, 0.30]
PSS	Phase	16.05***	0.16	[0.04, 0.30]
	Group	2.56	0.08	[0, 0.13]
	Phase × Group	0.96	0.03	[0, 0.09]
WEMWBS	Phase	50.99***	0.38	[0.22, 0.50]
	Group	1.24	0.04	[0, 0.12]
	Phase × Group	1.54	0.05	[0, 0.14]

*p < 0.05.
**p < 0.01.
***p < 0.001.

group, *F*(1, 84) = 35.77, *p* < 0.001, *r* = 0.55, the 5-min group, *F*(1, 84) = 33.07, *p* < 0.001, *r* = 0.53, and the 10-min group, *F*(1, 84) = 31.76, *p* < 0.001, *r* = 0.52. However, there was no significant difference from pre- to post-intervention in the control group, *F*(1, 84) = 2.24, *p* = 0.14, *r* = 0.16. Findings, therefore, indicate that CAI, as measured by the VAS, was effective in reducing anxiety compared to the control group in the 2, 5, and 10-min CAI groups.

Figure 4 shows the mean anxiety scores as measured by the STAI indicating a reduction in anxiety levels in the 2, 5, and 10-min CAI groups and a much smaller reduction in the control group, pre- to post-intervention. Findings of the 4×2 mixed ANOVA can be found in Table 3. The phase × group interaction was significant, with simple effects revealing a significant difference from pre- to post-intervention in the 2-min group, *F*(1, 84) = 40.48 , *p* < 0.001, *r* =

0.57, the 5-min group, $F(1, 84) = 50.06$, $p < 0.001$, $r = 0.61$, and the 10-min group, $F(1, 84) = 42.70$, $p < 0.001$, $r = 0.58$. However, there was no significant difference from pre- to post-intervention in the control group, $F(1, 84) = 3.30$, $p = 0.07$, $r = 0.19$. In line with the results from the VAS, the STAI demonstrated a reduction in anxiety in the 2, 5, and 10-min CAI groups in comparison to the control group.

STRESS

Figure 5 shows the mean VAS-Stress scores demonstrating a larger reduction in stress in all CAI groups compared to the control group. Results of the 4×2 mixed ANOVA (see Table 3) revealed a significant phase × group interaction. Simple effect analyses indicated a significant difference from pre- to post-intervention in the 2-min group, $F(1, 84) = 31.79$, $p < 0.001$, $r = 0.52$, the 5-min group, $F(1, 84) = 62.64$, $p < 0.001$, $r = 0.65$, and 10-min group, $F(1, 84) = 51.20$, $p < 0.001$, $r = 0.62$, but no significant difference from pre- to post-intervention in the control group, $F(1, 84) = 5.18$, $p = 0.03$, $r = 0.24$. These results indicate CAI was effective in reducing stress as measured by the VAS-Stress in the 2, 5, and 10-min CAI groups when compared to the control group.

Figure 6 displays the PSS scores, pre- and post-intervention, in the 2, 5, and 10-min CAI and control group showing a small reduction in all groups including the control group. Table 3 presents the results of the 4×2 mixed ANOVA no significant phase × group interaction therefore regardless of group, participants experienced a small reduction in stress post-interaction compared to pre-interaction, even in the control group.

DEPRESSION

Figure 7 shows the mean VAS-Depression scores indicating a reduction in depression levels pre- to post-intervention in all groups; however, there is a greater reduction in the CAI groups compared to the control group. A 4×2 mixed ANOVA (see Table 3) found no significant phase × group interaction, therefore, regardless of group, participants experienced a reduction in depression post-intervention from pre-intervention.

Figure 8 displays the mean BDI scores. Like the VAS-Depression scores, there was a reduction in depression from pre- intervention to post-intervention in all groups, with a larger reduction in the CAI groups compared to the control group. The 4×2 mixed ANOVA (see Table 3) demonstrated a significant group × phase. Simple effect analyses showed a significant difference from pre- to post-intervention in the 2-min group, $F(1, 84) = 23.41$, $p < 0.001$, $r = 0.47$, the 5-min group, $F(1, 84) = 46.84$, $p < 0.001$, $r = 0.60$, and 10-min group, $F(1, 84) = 23.03$, $p < 0.001$, $r = 0.46$, but no significant difference from pre- to post-intervention in the control group, $F(1, 84) = 4.51$, $p = 0.04$, $r = 0.23$. Therefore, CAI was effective in reducing depression as measured by the BDI in the 2, 5, and 10-min CAI groups but not the control group.

WELL-BEING

Figure 9 shows mean WEMWBS scores pre- and post-intervention in the 2, 5, 10-min CAI groups, and the control group. Levels of well-being pre- and post-intervention increased by a small amount in the 2, 5, and 10-min CAI groups. There was also a slight increase in well-being in the control group. Table 3 shows the results of a 4×2 mixed ANOVA demonstrated no significant phase × group interaction. Therefore regardless of group, participants demonstrated an increase in well-being post-interaction compared to pre-interaction.

INTERACTION STYLE

Using the enter method, a two-stage hierarchal regression was carried out to explore whether pre-measures and the five interaction activities (watching only, pet no vocal, pet with vocal, play toy no vocal, and play toy with vocal) were significant predictors of post-measures. The equations for all measures resulted in high VIF scores in the interaction activities, especially in pet no vocal (VAS-Anxiety, *Tolerance < 0.001, VIF = 3674.56; STAI, Tolerance < 0.001, VIF = 4218.39;* VAS-Stress, *Tolerance < 0.001, VIF = 3705.22;* PSS*, Tolerance < 0.001, VIF = 3932.23*; VAS-Depression, *Tolerance < 0.001, VIF = 3782.92*; BDI, *Tolerance < 0.001, VIF = 3976.3*; WEBWBS, *Tolerance < 0.001, VIF = 3828.78*). These results indicated concerns over multicollinearity. Based on this, pet no vocal was removed from model 2 in all measures resulting in acceptable VIF scores greater than 1.

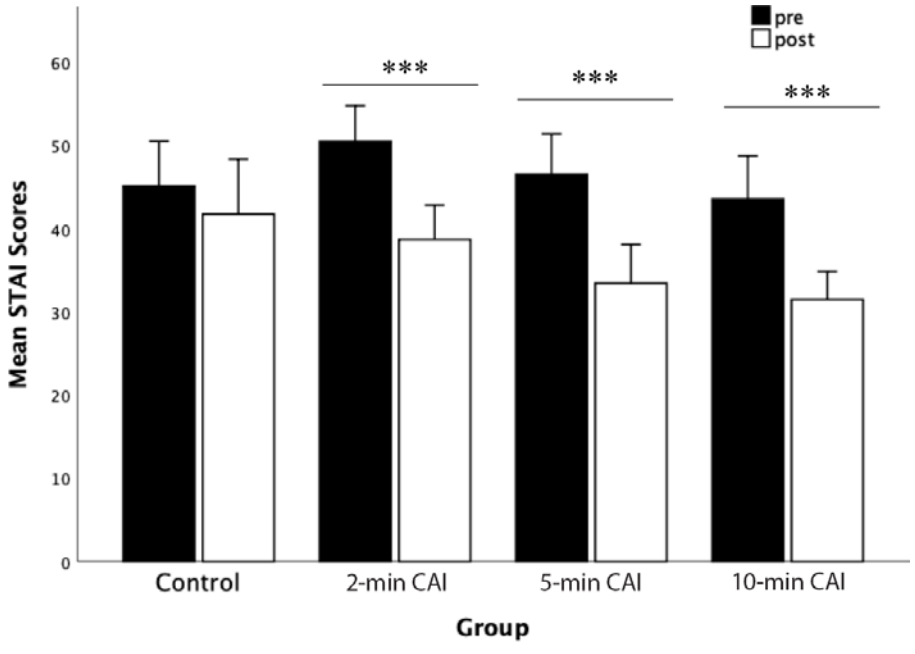

Fig. 4. Pre- and post-mean STAI scores (with SE bars) in the 2, 5 , 10-min CAI and control group. *p < 0.05, **p < 0.01, ***p < 0.001.

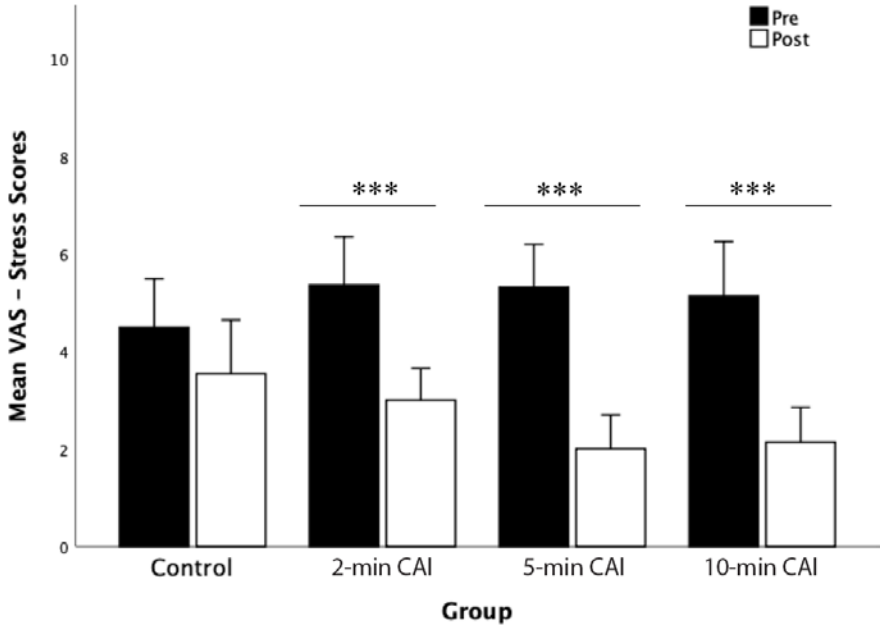

Fig. 5. Pre- and post-mean VAS-Stress scores (with SE bars) in the 2, 5, 10-min CAI and control group. *p < 0.05, **p < 0.01, ***p < 0.001.

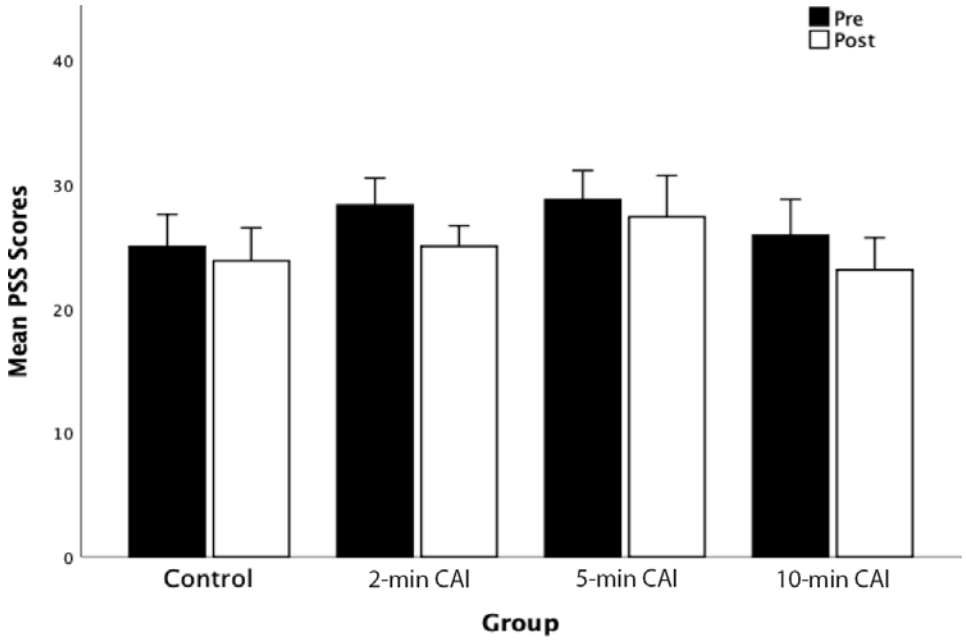

Fig. 6. Pre- and post-mean PSS scores (with SE bars) in the 2, 5, 10-min CAI and control group. *p < 0.05, **p < 0.01, ***p < 0.001.

Anxiety

Table 4 presents the results from the two-stage hierarchal regression. At the first step of the regression to predict post-anxiety, pre-anxiety was entered resulting in pre-anxiety making a significant unique contribution to model 1, $F(1, 64) = 80.80$, $p = < 0.001$ and explained 56% of variance in post-anxiety. After the four intervention activities (watching only, pet with vocal, play toy no vocal, and play toy with vocal) were entered into model 2, the total variance explained by the model as a whole was 56%, $F(5, 60), = 15.50$, $p = < 0.001$. The introduction of the four intervention activities explained an additional 0% of variance in post-anxiety. After controlling for pre-anxiety, this change in R^2 was not significant $F(4, 60) = 0.20$, $p = 0.94$. These results indicate that the four interaction activities (model 2) did not significantly predict post-VAS-Anxiety.

Following the hierarchical regression used in VAS-Anxiety above, the same process was followed for the STAI, VAS-Stress, PSS, VAS-Depression, BDI, and WEMWBS. Based on the results (see Table 4), it was concluded that none of the four interactions activities (see model 2) were significant predictors of post-STAI, VAS-Stress, PSS, VAS-Depression, BDI, or the WEMWBS.

The overall findings indicate that while pre-scores (anxiety, stress, depression, and well-being) predicted corresponding post-scores,

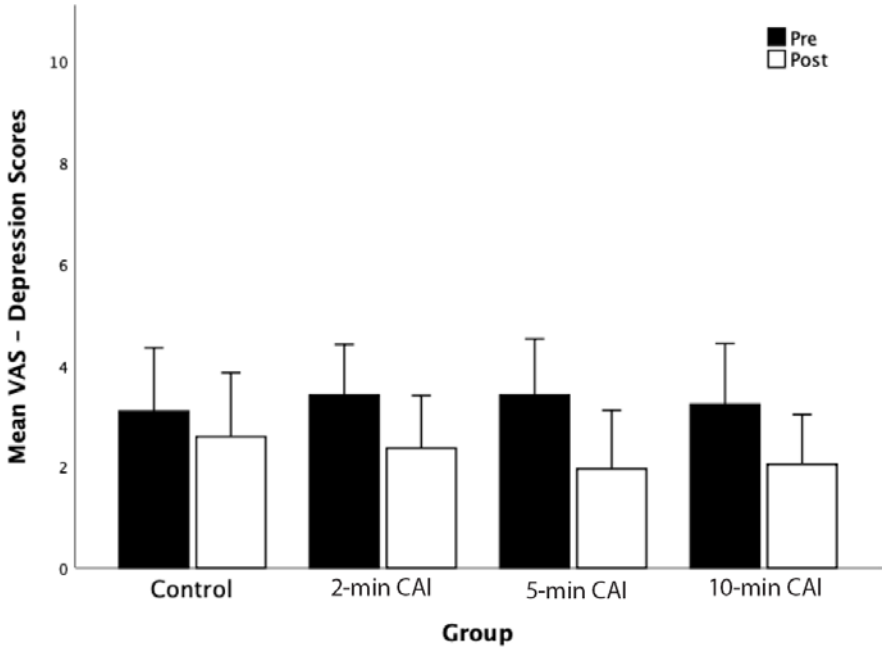

Fig. 7. Pre- and post-mean VAS-Depression scores (with SE bars) in the 2, 5, 10-min CAI and control group. *p < 0.05, **p < 0.01, ***p < 0.001.

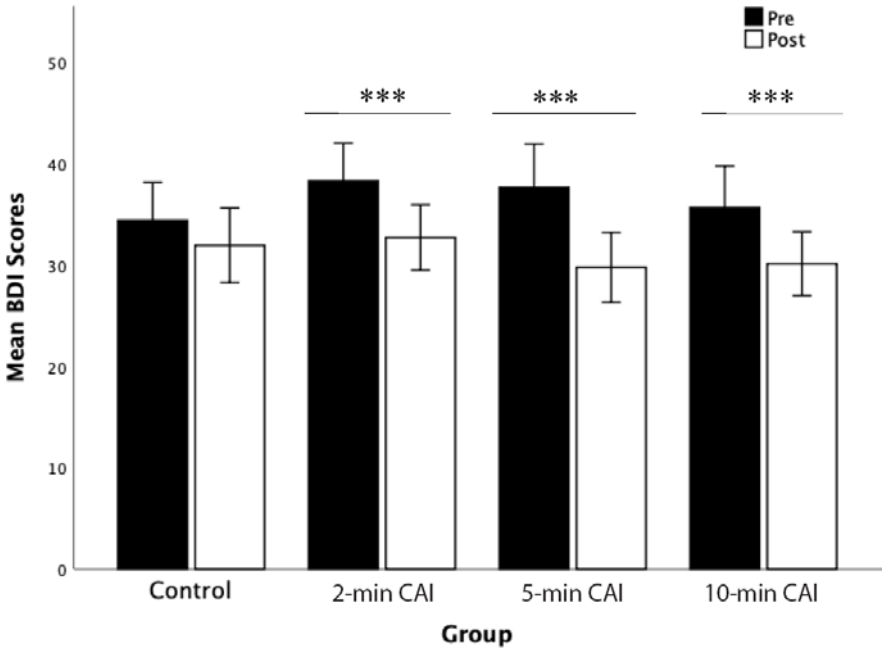

Fig. 8. Pre- and post-mean BDI scores (with SE bars) in the 2, 5, 10-min CAI, and control group. *p < 0.05, **p < 0.01, ***p < 0.001.

the four interaction activities (watching only, pet with vocal, play toy no vocal, and play toy with vocal) were not predictors of post-anxiety, stress, depression, or well-being scores. It was concluded that the interaction activities between humans and canines resulted in no positive impact on the effectiveness of CAI.

CANINE TRAITS

Correlation analyses were carried out using change scores (post-intervention measures minus pre-intervention measures) to explore whether there was a relationship between measures of anxiety, stress, depression, and well-being, and the canine traits (Table 5). There was no significant correlation between the VAS-Anxiety and any of the eight canine traits (juvenile, adult, cute, friendly, loveable, playful, good-natured, and cuddly). The same was true for the VAS-Depression, BDI, PSS, and WEMWBS. However, there was a significant negative correlation between the STAI and cuteness, $r\,(66) = -0.26$, $p = 0.001$ indicating that as the cuteness of the canine increased, anxiety levels decreased. There were no other significant correlations between the canine traits and anxiety as measured by the STAI. For stress, there was a significant negative correlation between the VAS-Stress and the cuddly canine trait $r(66) = -0.26$, $p < 0.001$ indicating that as the cuddliness of the canine increased stress levels decreased. No other significant correlations were found between the VAS-Stress and the remaining canine traits.

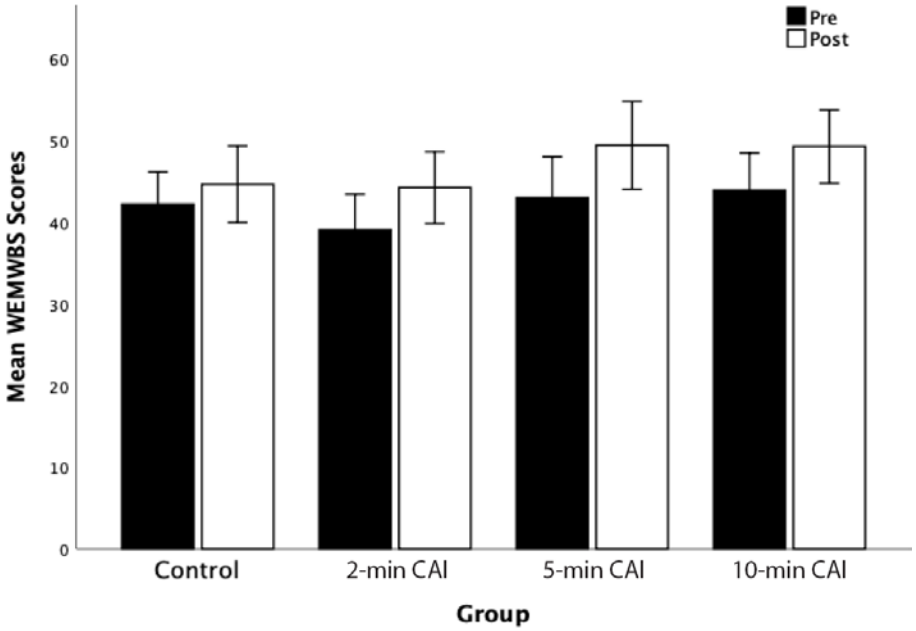

Fig. 9. Pre- and post-mean WEMWBS scores (with SE bars) in the 2, 5, 10-min CAI, and control group. * p < 0.05, ** p < 0.01, *** p < 0.001.

It is important to note that high mean scores were found in the cuteness of the canine (M = 9.36, SD = 1.15), and the friendliness (M = 9.09, SD = 1.34), lovableness (M = 9.36, SD = 1.52), and how good-natured they appeared (M = 9.38, SD = 1.13). In addition, the cuddliness of the canine (M = 8.36, SD = 2.02) and the playfulness of the canine (M = 7.71, SD = 2.31) were found to be moderately high. These results indicate the VAS as an instrument to measure canine traits may not be sensitive enough to detect whether canine traits have an impact or that saturation has been reached, thus ceiling effects are an issue.

Discussion

Having previously demonstrated CAI was a suitable short-term intervention that had a positive impact on anxiety and stress levels (Manville *et al*., 2022b), this study replicates the use of an exploratory RCT to examine the effectiveness of CAI by specifically exploring the influence of the length of time participants spent interacting with a canine. The main aim was therefore to identify whether the duration of CAI influences the effects of the intervention on the mental health of HE students.

In line with the previous studies that demonstrate the benefits of CAI on the mental health of HE students (e.g., Kwong *et al*., 2021; Pierce *et al*., 2020; Broglia *et al*., 2021; Rothkopf and Schworm, 2021; Manville *et al*., 2022b), the results of this study demonstrate there was a reduction in anxiety, stress, and depression levels in HE students which could indicate a benefit of CAI on the mental health of HE students. It is important to note that these are short-term changes meaning the translation of these to improved mental health requires more detailed and longitudinal measures. It is also possible that the short-term changes in anxiety, stress, and depression could dissipate over time but exploring this would require further research.

The results showed that (1) there were no differences in the effectiveness of reducing anxiety, stress, and depression across the different time durations, (2) the individual intervention activities during CAI did not predict a reduction in anxiety, stress, depression, or an increase in general well-being, (3) a negative correlation was found between the cuteness of the canine and anxiety, and (4) a negative correlation was found between the cuddliness of the canine and stress levels. In addition, this is the first study to challenge the limitations of previous work (e.g., Buttelmann and Römoke, 2014; Fiocco and Hunse, 2017; Rothkopf and Schworm, 2021; Manville *et al*., 2022b) by comparing a range of CAI session lengths alongside a control group, to identify the optimum length of a CAI session.

Arguably, the most important finding in this study was that CAI had a positive impact on anxiety (as measured by the VAS-Anxiety and STAI), stress (as measured by the VAS-Stress), and depression (as measured by the BDI) levels in the 2, 5, and 10-min CAI groups but not in the control group. These results extend beyond previous limited research that found no significant effect of CAI on depression (Shearer *et al*., 2016; Hall, 2018) by demonstrating an impact of CAI on depression levels as measured by the BDI. That depression was found to decrease as a result of CAI based on one depression measure (BDI) and not another (VAS) may be related to the measures themselves. The BDI is a well-established standardised measure that has an abundance of research to support its effective use in measuring depression (e.g., Beck *et al*., 1996; Shearer *et al*., 2016; Ediz *et al*., 2017; Hart Abney *et al*., 2018; Sakellari *et al*., 2020). In comparison, the VAS is a one-component measure that asks participants to indicate their depression levels at one moment in time. Therefore, it may be that the BDI is a more reliable tool when measuring depression levels in HE students. Further research should investigate a range of depression measures to better understand this.

That there was no difference between groups is a significant and important finding. If students experience no differences in benefit with a 2-min CAI session compared to a 10-min CAI session, a greater number of students can take advantage of 2-min CAI session within a set time period (e.g., an hour) in comparison to taking part in CAI for 5 or 10-min. This has a positive impact on both financial and physical resources and may be the key to making CAI a more attractive form of support to universities.

That there was no effect of CAI on general well-being may be because the WEMWBS was not sensitive enough to identify differences in well-being as a result of CAI. It is also possible that well-being, as an undefined and general term for mood, lacks in specificity and definition thus making it difficult to measure (White, 2010). Alternatively, it may be that well-being is multi-faceted, and as such CAI only impacts certain elements of this. Indeed it may simply be the case that CAI does not have an impact on well-being.

Table 4. Results from the two-stage hierarchal regression conducted on the VAS-Anxiety, STAI, VAS-Depression, BDI, VAS-Stress, PSS, and WEMWBS.

VAS-Anxiety				
		B	***SE B***	***β***
Step 1				
	(Constant)	−0.05	0.32	
	Pre-VAS-Anxiety	0.53	0.06	0.75***
Step 2				
	(Constant)	−0.06	0.40	
	Pre-VAS-Anxiety	0.52	0.06	0.75***
	Pet with vocal	−0.001	0.008	−0.01
	Play toy with vocal	0.009	0.01	0.07
	Play toy no percentage	−0.001	0.009	−0.01
	Watching only	0.003	0.008	0.03
Note. R^2 = 0.56 for Step 1: ΔR^2 = 0.53 for Step 2				
STAI				
		B	***SE B***	***β***
Step 1				
	(Constant)	8.08	3.99	
	Pre-VAS-STAI	0.57	0.08	0.65***
Step 2				
	(Constant)	6.02	4.20	
	Pre-VAS-STAI	0.61	0.09	0.70***
	Pet with vocal	−0.08	0.05	−0.17
	Play toy with vocal	−0.03	0.07	−0.04
	Play toy no percentage	0.02	0.05	0.05
	Watching only	0.04	0.05	0.08
Note. R^2 = 0.42 for Step 1: ΔR^2 = 0.43 for Step 2				
VAS-Depression				
		B	***SE B***	***β***
Step 1				
	(Constant)	−0.38	0.31	
	Pre-VAS-Depression	0.75	0.08	0.78***
Step 2				
	(Constant)	−0.24	0.42	
	Pre-VAS-Depression	0.76	0.08	0.79***
	Pet with vocal	−0.007	0.01	−0.06
	Play toy with vocal	−0.004	0.01	−0.02
	Play toy no percentage	−0.009	0.01	−0.07
	Watching only	0.002	0.01	0.02
Note. R^2 = 0.60 for Step 1: ΔR^2 = 0.58 for Step 2				
BDI				
		B	***SE B***	***β***
Step 1				
	(Constant)	5.18	2.12	
	Pre VAS-BDI	0.69	0.06	0.84***
Step 2				
	(Constant)	5.20	2.30	
	Pre-VAS-BDI	0.70	0.06	0.85***

Continued

Table 4. Continued.

	BDI		
	B	**SE B**	**β**
Pet with vocal	−0.005	0.03	−0.01
Play toy with vocal	−0.04	0.04	0.07
Play toy no percentage	−0.02	0.03	−0.05
Watching only	0.01	0.03	0.03

Note. R^2 = 0.71 for Step 1: ΔR^2 = 0.69 for Step 2

	VAS-Stress		
	B	**SE B**	**β**
Step 1			
(Constant)	0.17	0.42	
Pre-VAS-Stress	0.42	0.07	0.59***
Step 2			
(Constant)	0.18	0.49	
Pre-VAS-Stress	0.43	0.08	0.59***
Pet with vocal	−0.004	0.009	−0.05
Play toy with vocal	−0.001	0.01	−0.005
Play toy no percentage	−0.007	0.009	−0.08
Watching only	0.004	0.009	0.06

Note. R^2 = 0.34 for Step 1: ΔR^2 = 0.30 for Step 2

	PSS		
	B	**SE B**	**β**
Step 1			
(Constant)	8.12	3.10	
Pre-VAS-PSS	0.62	0.11	0.58***
Step 2			
(Constant)	10.37	3.35	
Pre-VAS-PSS	0.60	0.11	0.56***
Pet with vocal	−0.02	0.03	−0.05
Play toy with vocal	−0.03	0.05	−0.07
Play toy no percentage	−0.03	0.04	−0.08
Watching only	−0.05	0.03	−0.16

Note. R^2 = 0.33 for Step 1: ΔR^2 = 0.32 for Step 2

	WEMWBS		
	B	**SE B**	**β**
Step 1			
(Constant)	11.87	3.12	
Pre-VAS-WEMWBS	0.85	0.07	0.83***
Step 2			
(Constant)	10.22	3.73	
Pre-VAS- WEMWBS	0.88	0.08	0.85***
Pet with vocal	0.03	0.04	0.07
Play toy with vocal	0.02	0.06	0.02
Play toy no percentage	0.11	0.04	0.19
Watching only	−0.06	0.04	−0.12

Note. R^2 = 0.68 for Step 1: ΔR^2 = 0.70 for Step 2

*p < 0.05.
**p < 0.01.
***p < 0.001.

Table 5. Correlation between all measures and canine traits.

Variables	VAS-Anxiety	VAS-Stress	VAS-Depression	BDI	STAI	PSS	WEMWBS
CT-Cute	−0.15	−0.08	0.09	−0.21	−0.26*	−0.06	0.02
CT-Juvenile	−0.06	0.05	0.05	−0.008	0.04	−0.11	0.01
CT-Adult	0.06	−0.09	0.07	−0.03	−0.23	0.20	−0.07
CT-Friendly	−0.07	−0.004	−0.11	0.03	0.14	0.006	−0.002
CT-Lovable	0.10	−0.03	0.06	0.05	−0.07	−0.02	−0.06
CT-Playful	−0.03	−0.10	−0.15	−0.14	−0.03	−0.05	0.18
CT-Good Natured	−0.006	0.07	0.04	0.13	−0.02	−0.04	0.06
CT-Cuddly	−0.13	−0.26*	−0.05	−0.09	−0.22	−0.07	0.15

*p < 0.05.
**p < 0.01.
***p < 0.001.

The final aim of the current study was to explore whether particular canine traits are related to the effectiveness of CAI. If certain traits were found to have more of an influence on the effectiveness of CAI than other traits, using a canine who was for instance, cuter or more juvenile in appearance would ensure a greater impact of CAI compared to the use of a canine who was more adult looking. The results demonstrated a relationship between a reduction in anxiety and canine cuteness levels and a reduction in stress and canine cuddliness levels. This is important as it suggests the use of canines with cute and cuddly traits to be used in CAI. However, as both Elvis and Dahlia are small canines, they are frequently considered cute dogs and as such, six of the eight canine traits demonstrated a moderate to high ceiling effect. If the canines had been larger dogs with less juvenile features (e.g., Great Danes or Alsatians), this ceiling effect may not have occurred. As a result of this, interpretation of the results must be approached with the understanding that the results cannot be generalised to the application of any canine used in CAI due to the specific neotenous features of the canines these results are based on. It is also important to note here that while Brelsford *et al*. (2020) were consulted, and the canines met the recommended guidelines as set out by Pet Partners' (2022) *Standards of Practice in Animal Assisted Interventions,* neither canine received any formal animal therapy training.

Although the results showed no differences in the effect of CAI based on the length of the session, the study is not without its limitations. One limitation is that not all facets of mental health were factored into the regression model. Due to participant numbers, only six predictors could be used. This limits the results as they do not allow for the possibility to include all mental health facets. A second limitation is the time durations used in the study design. It could be argued that 2, 5, and 10-min are all considered shorter durations. By restricting the CAI intervention duration to a maximum of 10-min the results are limited to 10-min and there is no comparison of longer durations (e.g., 20 or 40-min) which may have allowed for a greater reduction in domains as participants had longer to interact with the canine.

In regard to measures, it is important to note that Richter *et al*. (1998) report the BDI to have shortcomings, one being the instability of scores over a short-time period, specifically over a period of 24-h. While this may impact the lasting effect of CAI on the mental health of HE students, this study does not explore, or make long-term recommendations, as to the benefit of CAI. An alternative depression measure is recommended alongside the BDI should a longitudinal study develop from this research.

One other point to consider is the impact of the animal, assuming that canines interacted with alternative participants during data collection. For instance, if Canine 1 interacted with a participant for 10-min, and Canine 2 for 2-min, Canine 1 had a shorter break between participants than Canine 2. While this would be the case if both dogs took part on each data collection day, our dogs worked on alternative days. However, there is a possibility that Canine 1 only had 2-min interactions whereas Canine 2 may have had only 10-min interactions giving them longer breaks between participants. It is difficult to determine if this would have made a difference as many factors would need to be considered such as individual interactions between canine and human, and all the interactions in 1 day as some may have been more active or boisterous than others. Even the canine's journey into the lab and external influences during this may have impacted how the canine behaved on the day. Future studies should endeavour to ensure that the canine's interactions times and breaks are mirrored to eliminate potential issues. Relating to the canines, it is also important to acknowledge the possible limitations of those that took part in this study. Results may differ if canines had been of a different breed, or had received formal therapy dog training. Based on this, it would be beneficial for CAI to determine whether a difference in canines breed and training has an impact on the effects of CAI on the mental health of HE students.

A further limitation to there being no effect could be the training received by the handler. Fredrickson and Howie (2000) state training received by the handler is important to ensure they are knowledgeable in areas such as their role and responsibility, animal stress, techniques for interactions, and conversation and listening skills. While the handler did not receive any formal therapy dog training which may have had an impact on the interaction and results, they did receive training to understand how to identify signs of canine distress and to better manage the canine. This included obedience training. However, it is important to note that one of Fredrickson and Howie's (2000) points is that the handler should understand conversation and listening skills. To ensure the benefit of CAI was limited to the impact of the canine and not the handler, the handler was instructed to not interact with the participant or canine during the data collection session (unless there was a safety issue) to limit any external effects. Therefore, it is arguable that handler training was not a contributing factor here. Interestingly, Grajfoner *et al*. (2017), in a study seeking to understand the impact of both canine and handler, found no significant difference between the dog-only group, and the dog and handler group suggesting the handler had no impact on the

benefit of CAI, and that it was the canine that was the contributing factor. The study also recorded mood and anxiety improved in the groups where the dog was present in comparison to the handler-only group. The gender imbalance in participants also warrants a mention as the sample consisted of a greater number of females than males. However, this is unsurprising given that Middlesex University's student ratio has more females to males (58:42, Times Higher Education, 2023). In addition, many participants were students from the psychology department which is often a female-dominated subject.

A final limitation relates to the interaction activities and the observation of these. One unexpected finding was that none of the activities between humans and canines were predictors of post-intervention anxiety, stress, depression, or well-being, meaning physical interaction was not necessary for a positive impact of CAI. One potential explanation for this may be that the effectiveness of CAI is not reliant on the type of interaction with a canine. Another possible explanation is that the interactions observed were too similar (e.g., playing with the canine with a toy and playing with the canine with a toy while talking to the canine). It is also possible it was difficult to measure difference between interactions as participants were allowed to interact naturally with the canine rather than rigidly or formally moving from one interaction activity to another. As the interactions were reliant on canine compliance rather than human compliance, during all data collection sessions, at times, the canine's interaction with the human was fleeting meaning the canine ran away from the human only to turn back 1–2 s later. This made it complicated to determine whether a specific interaction activity had stopped and another started. Based on this, it may have been more suitable to have given explicit instructions to individual participants as to what interaction activities they could take part in.

A strength of this study is the use of an exploratory RCT design. In addition, the finding of no differences in the effect of reducing anxiety, stress, and depression between the 2, 5, or 10-min CAI session has significant practical and financial implications. Demonstrating that CAI with a short duration (2-min) is as effective as a longer duration (10-min) has a positive impact on cost and resources as more students can take advantage of CAI in the same time period (e.g., 1 h). This may motivate universities to use CAI alongside more traditional forms of support and motivate students to take part as it is quick and can be fitted in between classes or on a lunch break.

In conclusion, the results of this study support the objectives which were to demonstrate that CAI has a positive impact on anxiety, stress, and depression. Additionally, there was no significant difference in the impact of CAI in time durations of 2, 5, or 10-min on the mental health of HE students. Finally, intervention activities between humans and canines did not predict CAI effectiveness. Regardless of whether students choose to spend short or longer lengths of time with a canine, and regardless of the intervention activity they prefer, they will still benefit from a positive impact of CAI. Importantly, these results are based on participants taking part in CAI individually and demonstrate that a 2-min CAI session is as effective as a longer 10-min CAI session.

CONFLICT OF INTEREST

No conflict of interest.

ETHICS STATEMENT

Ethical approval was granted by Middlesex University Psychology Research Ethics Committee, application number 2016. The authors confirm this study adhered to all relevant institutional guidelines, and all appropriate licences and permission were obtained. In addition, all participants consented to take part in this study and for their data to be used for publication purposes.

AUTHOR CONTRIBUTIONS

All authors were involved equally in the research, data collection, and analysis of this study. The primary author wrote the final manuscript.

FUNDING STATEMENT

Other than the two £20 Amazon vouchers for student participants, the authors received no funding for this study.

DATA AVAILABILITY

Data not publicly accessible, contact authors to discuss requests.

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