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Abstract

While students are increasingly struggling with anxiety and depression, the effects of therapy dogs on student stress has only recently been explored. This study was conducted to investigate whether therapy dogs can improve student affect and to determine if these benefits extend to cognition in the form of enhanced ability to remember information. Forty-four college students were randomly assigned to interact with a therapy dog or not during both learning (session 1) and testing (session 2) in a paired-associates procedure. Arousal, stress, and mood were measured at the beginning and end of each session. As predicted, therapy dogs increased happiness and decreased stress and arousal. However, there was no difference in recognition memory for the paired associates between the therapy dog and control conditions. Mood was a significant predictor of memory, such that decreased happiness in session 2 predicted better recognition performance. These findings indicate that the benefits of therapy dogs are primarily affective and not cognitive

Keywords: affect, AAI, human–animal interaction, memory, stress

Therapy Dogs Improve Affect but not Memory

In the last few years there has been mounting recognition that mental health concerns are increasing among adolescents and college-aged students. For instance, there was a 33% increase in depressive symptoms and 31% increase in suicide deaths among US teenagers between 2010 and 2015 (Twenge, Joiner, Rogers, & Martin, 2018). Similarly, US colleges and universities have recently reported large increases in the number of students utilizing mental health services (Beiter et al., 2015; CCMH, 2017; Novotney, 2014). While the exact cause of the aforementioned increase is unknown and likely multifaceted, increased engagement in non-screen activities is linked to lower rates of depression and suicide (Twenge et al., 2018) while increased homework load is associated with stress, decreased health, and decreased time for stress-buffering pursuits (Galloway, Conner, & Pope, 2013).

In addition to homework, examinations are another frequent source of student stress and have been associated with sleep deprivation, anxiety, depression (Gilbert, Stunkard, Jensen, Detwiler, & Martinko, 1996), poor immune function (Marshall et al., 1998; Segerstrom & Miller, 2004), and increased levels of stress hormones (e.g., cortisol; Preuβ, Schoofs, Schlotz, & Wolf, 2010; Trueba, Smith, Auchus, & Ritz, 2013). Exam stress is also associated with poor academic expectations (Austin, Saklofske, & Mastoras, 2010) and performance (Ng, Koh, & Chia, 2003). These findings are consistent with well-established conclusions that stress at the time of retrieval impairs recall (Kuhlmann, Piel, & Wolf, 2005; Roozendaal, 2002; Schwabe & Wolf, 2014; Smeets, Otgaar, Candel, & Wolf, 2008).

Considerable research shows that animal-assisted interventions (AAIs) have positive outcomes on physical and mental health (Fine, 2015) and can reduce cardiovascular reactivity to both physical (cold water immersion) and mental (math test) stressors (Allen, Blascovich, &

Mendes, 2002). To combat the alarming increase in stress, anxiety, and mental-health concerns, many colleges and universities offer AAI. The few studies to date on AAIs in a college setting have shown that they reduce student stress (Barker, Barker, McCain, & Schubert, 2016; Crump & Derting, 2015; Trammell, 2017). However, evidence for whether AAIs could also enhance student performance has been mixed. In preschool-aged children, the presence of a dog aided object recognition speed and accuracy compared with the presence of a human (Gee, Belcher, Grabski, DeJesus, & Riley, 2012). Likewise, preschool-aged children made fewer errors (Gee, Church, & Altobelli, 2010) and had better restriction of attention (Gee, Gould, Swanson, & Wagner, 2012) in an object categorization task when a real dog was present compared with a stuffed dog or human. Performance on motor-skill tasks, however, was mixed: preschool-aged children were faster on a variety of these tasks in the presence, compared with the absence, of a dog, but accuracy was improved in some tasks and impaired in others with the presence of a dog (Gee, Harris, & Johnson, 2007). Similarly, preschool-aged children performed better on modeling-type motor tasks in the presence of a real dog (compared with a stuffed dog, human, or alone) but not with tandem or competition motor tasks (Gee, Sherlock, Bennet, & Harris, 2009).

In college-aged adults, performance in a stressful working memory task was worse when touching a dog compared with touching a human or not touching a dog or human (Gee, Friedmann, Cogliatore, Fisk, & Stendahl, 2015). Finally, the presence of a dog had no effect on long-term memory (examination performance) regardless of whether the dog was present before testing, immediately after learning, or was not present (Trammell, 2017). Several methodological differences could account for these conflicting results. While preschool-aged children generally showed performance improvements and college-aged adults did not, the type of task also varied widely, ranging from motor tasks to cognitive tasks, with several exploring either working

memory or long-term memory. The type of AAI may also be an important factor—the research involving actually touching a dog (Gee et al., 2015) showed impairment in performance compared with the presence of a dog. Finally, the stress level of the participants is likely an important factor as well; both Gee et al. (2015) and Trammell (2017) involved college students engaged in a stressful task and did not find benefits. This is particularly surprising given the stress-reducing benefits of AAIs, and the relationship between stress and memory described above. Thus, while it is apparent that stress during recall is harmful for memory, and that AAI can reduce stress, it is unknown if AAI can have a direct, positive impact on memory performance.

To extend and further explore AAI effects on college students' stress, as well as other measures of affect (mood and arousal), and to build on Trammell (2017), which utilized AAI either before testing or after learning of examination material, this study utilized an AAI *during* both learning and testing of paired-associates. Consistent with prior research (see Barker et al., 2016; Crump & Derting, 2015; Fine, 2015; Trammell, 2017), those who interact with therapy dogs should show reduced stress and increased happiness. Further, stress at the time of recall (during the paired associates task) is expected to predict performance: high stress should result in decreased performance (e.g., Roozendaal, 2002). Given that AAIs are expected to reduce stress and that stress is expected to predict performance, those who interact with therapy dogs should show better recognition performance than those who do not interact. In contrast, however, given that prior research (Gee et al, 2015; Trammell, 2017) found no memory benefit for AAIs, there is also reason to expect no benefit to performance. Therefore to verify the effects of AAIs on performance their direct effects on memory were assessed.

Method

Ethical Approval

This research was approved by Pepperdine University's IACUC (Institutional Animal Care and Use Committee) and IRB (Protocol # 17-10-628).

Participants and Procedure

Students in an introductory psychology class were informed via email of the study and the requirement that they must like and enjoy interacting with dogs. Potential participants answered two questions: "How much do you like dogs?" (on a scale of 1 [strongly dislike] to 7 [strongly like]) and "How enjoyable do you find interacting with dogs?" (on a scale of 1 [very unenjoyable] to 7 [very enjoyable]). Participants were given course credit in exchange for participation.

At session 1, 44 participants who scored between 4 and 7 on these measures completed informed consent, followed by the Perceived Stress Scale (PSS) and the first set of affect measures. They were then randomly assigned to either the control group or the therapy dog group (see Table 1 for participant demographics and responses on the eligibility, PSS, and affect measures). Participants in the therapy dog group, a maximum of four at a time (or two per dog), were escorted to another room in which two therapy dogs were waiting. Participants were instructed that their primary focus should be on the learning task and the laptop in their laps but that they could pet, rest their hand on, or simply sit next to, their preferred dog as they wished. A researcher remained in the room to insure participants attended to the task. In the control condition, also with a maximum of four students at a time, participants were taken to a similar room but with no dogs present. To motivate participants to score well on the recognition test, they were told that the top three scorers would receive a $15 Amazon gift card. The participants then completed the learning phase followed by the second set of affect measures.

During session 2, exactly one week later, participants were escorted to either the therapy dog room or the control room according to the condition assigned during session 1. Participants then completed the third set of affect measures, followed by the recognition test, and lastly filled in the fourth set of affect measures. Participants were then debriefed and thanked for their participation

Materials

Two therapy dogs, a 2-year-old neutered male pug and an 11-year-old neutered female dachshund, interacted with the participants in the therapy dog group. Both dogs were certified therapy dogs from the Love on a Leash organization. They had constant access to water and breaks after every group of participants.

Paired Associates Test: On a laptop computer running Eprime 2.0, participants saw 100 5-letter-word pairs (e.g., ONION-BANJO), for 2 seconds each, three times each, in random order during session 1. The word pairs were selected from a list of 200 established word pairs (Underwood, 1982) and ranged from easy to moderately difficult. Three undergraduate-student raters independently selected word pairs that did not carry any emotional or especially memorable connotation and that they and their fellow students would know. The top 100 pairs agreed upon by all three raters were selected. During session 2, participants were shown 200 words in random order, 100 of which were old (presented as part of a word pair in session 1), and 100 of which were new. Participants indicated which words they had seen in session 1 by pressing a key corresponding to “old” or “new.”

Affect Measures: Participants answered a three-question affect measure (Trammell and Clore, 2014), designed to assess current mood, stress, and arousal, at the beginning and end of both

sessions. The three questions were “How aroused are you feeling right now?” (on a scale of 1 [very calm/relaxed/unaroused] to 7 [very stimulated/activated/aroused]), “How stressed are you right now?” (on a scale of 1 [very relaxed] to 7 [very stressed]), and “What is your current mood?” (on a scale of 1 [very unhappy] to 7 [very happy]). Additionally, participants completed the 14-item Perceived Stress Scale (Cohen, Kamarck, Mermelstein, 1983) at the beginning of session 1. The PSS has consistently been shown to have acceptable to high validity and reliability (see Lee, 2012).

Results

Affect Measures: Independent samples two-tailed *t*-tests revealed no differences between conditions in PSS, arousal, stress, or mood at the start of session 1 (see Table 1). As predicted, independent samples one-tailed *t*-tests revealed that those who interacted with therapy dogs showed significantly lower arousal ($t_{(40)} = –1.89$, $p = 0.03$, $d = 0.56$), lower stress ($t_{(40)} = –4.34$, $p < 0.001$, Cohen’s $d = 1.34$), and more happiness ($t_{(40)} = 4.51$, $p < 0.001$, $d = 1.40$), at the end of session 1. In addition, the change in affect was significant in some of the measures: those in the therapy dog group, compared with the control group, showed a larger (non-significant) reduction in arousal ($t_{(40)} = 1.61$, $p = 0.06$, $d = 0.50$), a significantly larger reduction in stress ($t_{(40)} = 4.75$, $p < 0.001$, $d = 0.47$), and a significantly larger increase in happiness ($t_{(39)} = –2.11$, $p = 0.02$, $d = 0.65$).

Independent samples two-tailed *t*-tests revealed no differences between conditions in stress or mood at the start of session 2. However, those in the control condition were significantly less aroused than those in the therapy dog condition ($t_{(39)} = 2.50$, $p = 0.02$, $d = 0.79$). As predicted, independent samples one-tailed *t*-tests revealed that those who interacted with therapy dogs showed significantly lower stress ($t_{(39)} = –1.89$, $p = 0.03$, $d = 0.60$) and significantly

more happiness ($t_{(39)} = 2.04$, $p = 0.02$, $d = 0.63$) at the end of session 2, but there were no significant differences in arousal. Lastly, those in the therapy dog condition, compared with the control condition, showed a significantly larger reduction in both arousal ($t_{(39)} = 3.82$, $p < 0.001$, $d = 1.20$) and stress ($t_{(39)} = 2.78$, $p < 0.01$, $d = 0.88$).

Recognition. The ability to discriminate between "old" and "new" was measured by *d'* (*z* of Hit Rate minus *z* of False Alarm rate). Hit rate was calculated as the proportion of old items correctly identified as old, and False Alarm rate was calculated as the proportion of new items incorrectly identified as old. A two-tailed independent samples *t*-test revealed no significant differences between conditions ($t_{(39)} = –0.98$, $p = 0.34$, $d = 0.31$). To test the hypothesis that affect would predict performance, Pearson's correlations were conducted between affect measures and *d'*. Only lower arousal at the start of session 1, lower happiness at the end of session 2, and a (non-significant) decrease in happiness during session 2 predicted better recognition performance (see Table 2).

Discussion

As predicted, interacting with a therapy dog decreased arousal and stress and increased happiness compared with the control group. These results provide further support for the growing use of therapy dogs to combat stress and enhance wellbeing in undergraduate students. For undergraduate students, even occasional interaction may be a useful non-screen activity (e.g., Twenge et al., 2018), with protective effects against mental health concerns. Interestingly, those in the therapy dog group experienced higher arousal at the beginning of session 2. This is likely because this group (which also experienced increased happiness in sessions 1 and 2) was anticipating a pleasurable interaction. The beneficial effects on affect did not extend to memory, however. While this lack of benefit could be due to distraction for those in the presence of a dog,

researchers monitored the interaction and took care to insure that participants' attention did not greatly wander from the task. Also, participants were allowed to touch, pet, and interact with the dog as they wished. Touching a dog has been shown to negatively impact performance compared with when a dog is simply present (Gee et al., 2015). It is possible that had participants refrained from touching the dogs they might have shown increased performance. The exact impact of touching versus not touching a dog during an AAI is an important topic for future consideration.

A third reason for the lack of positive effect on memory may be that the small sample size (n = 44) did not allow for differences in recognition performance to be detected. However, while not significant, the trend (see Table 1) was actually for the control group to have better recognition than the therapy dog group, which suggests that an increased sample size would not have resulted in finding recognition benefits for the therapy dog group. Thus, consistent with other research finding no benefit of AAIs on working memory (Gee et al., 2015) or academic performance (Trammell, 2017), these findings indicate that the benefits of AAIs are primarily affective and not cognitive in a college-aged sample.

Surprisingly, affect was not a strong predictor of recognition performance. The lack of significant relationships between arousal or stress and memory may be attributed to them being in the mid-range of the scale (particularly at recognition; see Table 1). It is possible that having more extreme high and low levels would have allowed the predicted relationships to emerge, as memory and arousal/stress typically show an inverted-U relationship, wherein moderate (but not extreme high or low) arousal results in the best performance (e.g., Andreano & Cahill, 2006; Yerkes & Dodson, 1908). In addition, arousal effects on memory are typically stronger for arousing items (e.g., Abercrombie, Speck, & Monticelli, 2006; Cahill & Alkire, 2003; Cahill, Gorski, & Le, 2003), but the items here were purposefully kept neutral.

Decreased happiness at the end of session 2 was significantly correlated with better memory. According to Affect-as-Information theory (e.g., Clore, Gasper, & Garvin, 2001; Schwarz, 1990), a sad mood serves as a signal that something is wrong and thus typically results in more effortful, systematic processing—a strategy which would be consistent with enhanced performance on the paired associates task.

While the benefits of the therapy dogs on affect did not extend to memory, future research should investigate other measures of cognition that are known to be influenced by affect, such as attention or processing style. Further, as mentioned above, the duration of affective benefits has not been fully explored; while this research suggests such effects last less than one week, it is important to evaluate whether they are in the order of minutes, hours, or days when considering adoption of AAIs in any college or university setting. Despite no benefit to memory, AAIs are still valuable to enhance the wellbeing of students at colleges and universities, with clear benefits to stress and mood.

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Conflicts of Interest

The author declares that there are no personal, professional, or financial conflicts of interest.

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Table 1. Descriptive, affective, and recognition measures by condition.

	Therapy Dog (*N* = 23)		Control (*N* = 21)		
	N	**%**	**N**	**%**	***p***
Gender					.87
Male	6	26.09	5	23.81	
Female	17	73.91	16	76.19	
	Mean	**SD**	**Mean**	**SD**	***p***
Age	19.04	1.22	19.14	1.65	0.82
PSS	40.87	5.85	39.48	6.45	0.46
Like Dogs	6.96	0.21	6.71	0.72	0.13
Enjoy Dogs	6.48	1.73	6.29	1.52	0.70
Affect At Start of Session 1					
Arousal	3.00	1.13	3.29	1.31	0.44
Stress	5.39	1.16	5.10	1.18	0.41
Mood	5.48	1.12	4.90	1.51	0.16
Affect At End of Session 1					
Arousal	2.86	1.82	3.86	1.59	0.03*
Stress	2.57	1.63	4.67	1.49	<0.001***
Mood	5.95	0.92	4.52	1.12	<0.001***
Session 1 Change in Affect					
Arousal	0.19	1.69	-0.57	1.36	0.06.
Stress	2.86	1.93	0.43	1.33	<0.001***
Mood	-0.43	1.25	0.38	1.24	0.02*
Affect At Start of Session 2					
Arousal	3.86	1.88	2.58	1.30	0.02*
Stress	3.91	1.87	3.74	1.88	0.77
Mood	4.86	1.39	4.21	1.81	0.20
Affect At End of Session 2					
Arousal	3.18	2.06	3.42	1.39	0.34
Stress	2.95	1.99	4.05	1.68	0.03*
Mood	5.45	1.47	4.53	1.43	0.02*
Session 2 Change in Affect					
Arousal	0.68	1.36	-0.84	1.17	<0.001***
Stress	0.95	1.62	-0.32	1.25	<0.01**
Mood	-0.59	1.40	-0.32	1.63	0.28
d'	.43	.28	.51	.21	.34

Note. For affect, lower numbers indicate less arousal, stress, and happiness; for change in affect, positive numbers indicate a decrease in arousal, stress, and happiness.
Significance codes: 0.001 '***'; 0.01 '**'; 0.05 '*'; 0.1 '. '

Table 2. Correlations between affect measures and d'.

	r	*p*
Affect At Start of Session 1		
Arousal	-.33	0.04*
Stress	-.15	0.36
Mood	-.21	0.19
Affect At End of Session 1		
Arousal	-.20	0.23
Stress	-.24	0.14
Mood	-.18	0.28
Session 1 Change in Affect		
Arousal	-.02	0.89
Stress	.07	0.65
Mood	.01	0.95
Affect At Start of Session 2		
Arousal	.07	0.66
Stress	.15	0.36
Mood	-.05	0.74
Affect At End of Session 2		
Arousal	.08	0.63
Stress	.24	0.13
Mood	-.35	0.03*
Session 2 Change in Affect		
Arousal	-.01	0.97
Stress	-.12	0.46
Mood	.29	0.06.
d'	.43	.28

Note. Significance codes: 0.05 '*'; 0.1 '. '