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HUMAN-DOG INTERACTION IN EMOTION REGULATION: ANIMAL-ASSISTED INTERVENTIONS VS. CLASSICAL PSYCHOTHERAPEUTIC INTERVENTIONS

Ionel PAPUC[1], Vasile COZMA[1], Emoke PALL[1], Ioan Ştefan GROZA[1]

[1]University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca,
Faculty of Veterinary Medicine, 3-5 Calea Mănăştur, 400372, Cluj-Napoca, Romania

Corresponding author email: ionel.papuc@usamvcluj.ro

Abstract

Animal-assisted therapies, particularly those based on human-dog interaction, have attracted increasing scientific interest due to their potential to influence emotional processes through specific psychophysiological mechanisms. Emotion regulation is a fundamental process for mental health and individual adaptation, and a major transdiagnostic factor in anxiety and affective disorders. The present experimental study compared the effectiveness of dog-assisted therapy (AAT) with cognitive-behavioural therapy (CBT) in a sample of 60 university students (aged 19-25) with moderate anxiety. Participants were randomly assigned to six weekly sessions of either AAT or CBT. Assessments included psychological measures of emotion regulation, anxiety, and affect, as well as psychophysiological markers: salivary oxytocin and cortisol, heart rate, and heart rate variability. Results showed significant increases in oxytocin and heart rate variability, and greater reductions in heart rate and cortisol in the AAT group compared to the CBT group. Oxytocin was positively correlated with heart rate variability and negatively with difficulties in emotion regulation. Limitations include the short-term design, small sample size, lack of blinding, and possible uncontrolled expectancy effects.

Key words*: human-dog interaction, oxytocin, emotional regulation, animal-assisted therapies, heart rate variability.*

INTRODUCTION

Emotion regulation is an essential psychological process for an individual's adaptation to environmental demands, being closely linked to mental health and optimal social functioning, and constituting a central transdiagnostic mechanism in anxiety disorders, depression, and vulnerability to stress (Gross, 2015).

Many contemporary models of psychopathology conceptualize emotion regulation difficulties as a key factor in the development and maintenance of anxiety and affective disorders (Thayer & Lane, 2009), although the strength and direction of these relationships may vary across contexts and populations. Anxiety is conceptualized as the result of sustained hyperactivation of stress response systems, associated with difficulties in processing and accepting emotions (Spielberger et al., 1983).

The relationship between anxiety and emotional dysregulation is bidirectional: high levels of anxiety increase the use of maladaptive strategies, while deficient regulation maintains symptomatology (Gross, 2015).

Interaction with animals is associated with stress reduction and the activation of social affiliation systems (Friedmann & Son, 2009).

In this context, human-dog interaction has attracted considerable scientific interest, being regarded as a particular form of human-animal interaction with high psychotherapeutic potential (Rusu, 2012; Papuc et al., 2013). Contact with dogs leads to increased oxytocin levels and reduced cortisol levels (Odendaal & Meintjes, 2003; Uvnäs-Moberg et al., 2015). Beetz et al. (2012) suggest that the psychophysiological effects of human-animal interaction are mediated through oxytocinergic mechanisms, contributing to emotion regulation and anxiety reduction.

Dogs are frequently used in animal-assisted interventions due to their ability to respond to human emotional signals and to facilitate secure attachment relationships (Beetz et al., 2012). Difficulties in emotional regulation are associated with persistent negative affect, increased autonomic activation, and inefficient

use of cognitive strategies (Brosschot et al., 2006).

While dog-assisted interventions are typically evaluated in terms of human psychological outcomes, increasing attention has been directed toward the welfare and physiological responses of the animals involved, highlighting the importance of considering human-animal interaction as a bidirectional process rather than a unidirectional therapeutic tool. Factors such as the dog's temperament, training, and stress levels may influence both the effectiveness and ethical implementation of such interventions. Although previous research suggests beneficial effects of human-dog interaction on stress-related outcomes, there is a lack of controlled experimental studies directly comparing dog-assisted interventions with established psychotherapeutic approaches such as cognitive-behavioural therapy, particularly using combined psychological and psychophysiological measures (e.g., oxytocin, heart rate variability) within the same design. (Barker & Wolen, 2008; Rodriguez et al., 2020). Cognitive-behavioural therapy is a form of psychotherapy that aims to identify and modify dysfunctional thoughts and behaviors in order to improve emotional well-being and individual adaptation (Beck, 2011). Animal-assisted therapy is a planned therapeutic intervention in which animals are used as an integral part of the treatment process to support individuals' physical, emotional, or psychological recovery (Fine, 2010). The present study aimed to compare the effects of cognitive-behavioural therapy (CBT) and dog-assisted therapy on emotional, cognitive, and physiological outcomes in students with moderate anxiety. Based on this objective, it was hypothesized that dog-assisted therapy would be associated with higher oxytocin levels, lower heart rate, and increased heart rate variability compared to CBT.

MATERIALS AND METHODS

The study was approved by the Ethics Committee of USAMV Cluj-Napoca (Decision no. 552, March 10, 2026) in accordance with national and European legislation on the ethics of scientific research.

All participants provided written informed consent prior to participation. Participants were recruited from the university student population.

Inclusion criteria included age between 19 and 25 years, moderate anxiety (scores between 40-59 as measured by STAI), university student status, and the availability to participate in therapy sessions.

Exclusion criteria also comprised medical or psychological conditions that could interfere with participation or bias the results, such as neurological disorders (e.g., epilepsy, traumatic brain injury), severe or unstable medical conditions (e.g., uncontrolled diabetes, significant cardiovascular disease), substance use disorders, severe depression, psychotic symptoms, or cognitive impairments affecting comprehension and engagement in therapy. Participants were randomly assigned to one of two groups (dog-assisted therapy vs. cognitive-behavioural therapy). During the study period, participants did not receive any other psychological treatments or psychotropic medications**.**

The study included 60 students (N = 60) of both genders, aged between 19 and 25 years (M = 21.8, SD = 1.9), diagnosed with moderate levels of anxiety. The participants were randomly assigned to two groups of 30 students each. One group received dog-assisted therapy (AAT) (n = 30), while the other group received cognitive-behavioural therapy (CBT) (n = 30).

The research instruments were selected in accordance with the study objectives. Emotion regulation was assessed using the Difficulties in Emotion Regulation Scale (DERS) ($\alpha = .91$), an instrument with high validity and reliability in both clinical and non-clinical populations (Gratz & Roemer, 2004).

The DERS is a 36-item self-report measure designed to assess multiple dimensions of emotion regulation difficulties. Respondents are asked to indicate the extent to which each statement applies to them "in general," using a 5-point Likert scale (1 = almost never; 5 = almost always). In this study, the DERS was administered in a self-report format under standardized conditions, ensuring anonymity and informed consent. The average completion time was approximately 7-10 minutes.

Trait anxiety was assessed using the trait subscale (Form Y-2) of the State-Trait Anxiety Inventory (STAI) (α = .88) (Spielberger et al., 1983). The STAI-T is a 20-item self-report instrument designed to measure relatively stable individual differences in proneness to anxiety. Participants indicate how they generally feel in relation to environmental stress using a 4-point Likert scale (1 = almost never; 4 = almost always). After reverse-coded items are recorded, a total score is calculated by counting score responses, with higher scores indicating higher levels of trait anxiety.

The possible score range for each answer is set between 20 and 80 points. Positive and negative affect were assessed using the Positive and Negative Affect Schedule (PANAS) (α = .86) (Watson et al., 1988). The PANAS is a 20-item self-report instrument measuring two distinct affective dimensions: positive affect and negative affect, each subscale containing 10 items.

Participants rate the extent to which they have experienced each affective state using a 5-point Likert scale (1 = very slightly or not at all; 5 = extremely), with responses referring to a specified time frame (e.g., "in general," "during the past week," or "at this moment").

Subscale scores are obtained by the sum of relevant items, with higher values indicating higher levels of positive or negative affect, respectively.

The two dimensions are conceptualized as relatively independent.

Statistical analyses were performed using SPSS v27 (IBM Corp.). Data were initially screened for missing values, outliers, and normality using the Shapiro-Wilk test, as well as visual inspection of histograms and skewness and kurtosis indices.

Between-group differences over time were analysed using a repeated-measures ANOVA (2 × 2: Group × Time) to examine main and interaction effects. To assess pre-post changes within each group, pairwise comparisons were conducted using paired-sample t-tests.

Effect sizes were calculated using Cohen's d for pairwise comparisons and partial eta squared (η^2) for ANOVA. The level of statistical significance was set at $p < .05$. To control for Type I error in the case of multiple comparisons, Bonferroni corrections were applied.

To explore HRV as the potential mechanisms underlying the intervention effects, a mediation analysis was conducted using linear regression and a bootstrap approach (5,000 samples) to estimate indirect effects and their 95% confidence intervals. Group was the independent variable while the dependent variable was the change in DERS scores. Heart Rate and Heart Rate Variability (HRV) Heart rate (HR) and heart rate variability (HRV) were recorded via electrocardiography (ECG) and analysed according to international standards (Task Force of the European Society of Cardiology, 1996; Shaffer & Ginsberg, 2017) ECG signals were acquired using a 3-lead system (limb leads) with a sampling rate of 1,000 Hz and electrodes placed on standard limb positions. Signal preprocessing included band-pass filtering (0.5-40 Hz), artifact correction, and visual inspection RR intervals were extracted for HRV computation.

Time-domain HRV parameters measured were SDNN (standard deviation of NN intervals), RMSSD (root mean square of successive differences), and pNN50 (percentage of successive NN intervals differing by >50 ms) Frequency-domain parameters included LF (low-frequency power, 0.04-0.15 Hz), HF (high-frequency power, 0.15-0.40 Hz), and the LF/HF ratio HRV analysis was performed using Kubios HRV Premium v3.5 (Kubios Oy, Finland) with standard settings for artifact correction and detrending.

Salivary oxytocin was measured using a commercial ELISA kit (Cayman Chemical, Ann Arbor, MI, USA; catalog no. 500440) with an analytical sensitivity of 15 pg/mL, intra-assay variation of 6,5%, and inter-assay variation of 7,8%, following the manufacturer's instructions and current methodological recommendations (MacLean et al., 2019).

Salivary cortisol was measured using a commercial ELISA kit (Salimetrics, State College, PA, USA; catalog no. 1-3002) with an analytical sensitivity of 0.003 µg/dL (≈0.03ng/mL), intra-assay variation of 3.5%, and inter-assay variation of 5.1% (Hennessy et al., 2009).

All saliva samples were collected at 08:00 a.m. to control for diurnal variation using passive drool into sterile tubes and stored at –80°C until analysis.

Pre-intervention assessments were conducted one day before therapy, and post-intervention assessments one day after therapy completion.
Therapy lasted 6 weeks, consisting of one 60-minute session per week Participants were randomly assigned to dog-assisted therapy (AAT) or cognitive-behavioural therapy (CBT)

RESULTS AND DISCUSSIONS

Both interventions led to significant improvements across psychological and physiological outcomes.
DERS scores at pre-test and post-test for both CBT and AAT are presented in Table 1 and Figure 1.

Table. 1. Effects of CBT and AAT on Emotion Regulation (DERS)

Measure	Group	Pretest M (SD)	Posttest M (SD)
Biomarker (pg/mL)	CBT	12.4 (3.5)	13.8 (3.2)
Biomarker (pg/mL)	AAT	12.1 (3.7)	18.9 (3.5)
Resting HR (bpm)	CBT	78.5 (6.2)	74.2 (5.7)
Resting HR (bpm)	AAT	79.1 (6.5)	70.3 (5.1)

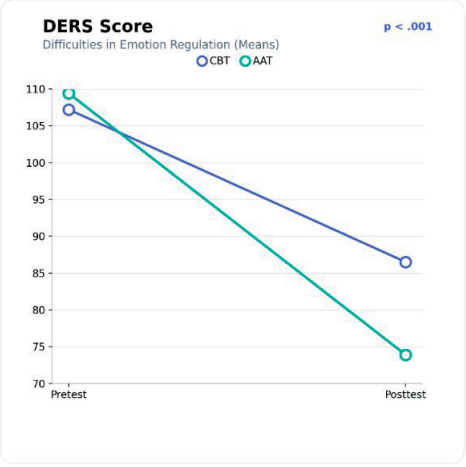


Figure 1. Group changes in emotional regulation

Both CBT and AAT were associated with significant reductions in emotion regulation difficulties, with large effect sizes (CBT: d = 1.63; AAT: d = 2.21). A repeated-measures ANOVA revealed a significant Group × Time interaction, F (1.58) = 10.87, p = .002, η^2 = .16, indicating that changes over time differed between groups, with a greater reduction observed in the AAT condition.
A significant Group × Time interaction was observed for anxiety scores, F (1.58) = 6.44, p = .014, indicating differential reductions across interventions, with larger decreases in the AAT group.
For negative affect, the Group × Time interaction was significant, F (1.58) = 8.01, p = .006, with greater reductions observed in the AAT group.
For positive affect, a significant interaction effect was also found, F (1.58) = 6.21, p = .015, with greater increases in positive affect in the AAT group compared to CBT.
Heart rate variability (HRV) and heart rate values are presented in Table 2 and Figure 2.

Table 2. Heart rate variability (HRV) and heart rate values

Group	Pretest M (SD)	Posttest M (SD)	t (df)	p	d
CBT	107.2 (14.2)	86.5 (12.4)	8.91 (29)	< .001	1.63
AAT	109.4 (15.0)	73.9 (10.8)	12.14 (29)	< .001	2.21

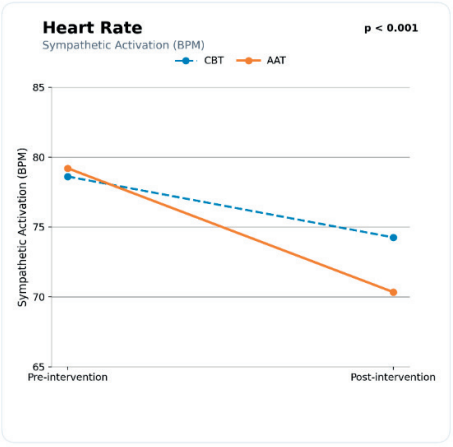


Figure 2. Heart Rate in CBT and AAT

Heart rate variability (HRV) increased in both groups, with a larger increase in the AAT group (24%) compared to CBT (10%), F (1.58) = 9.32, p = .003, η^2 = .14.
Resting heart rate decreased in both groups (CBT: t = 4.03, p < .001, d = 0.74; AAT: t = 8.76, p < .001, d = 1.61), with larger reductions in the AAT group.

Biomarker levels (pg/mL) increased in both groups, with a modest increase in CBT (t = 2.17, p = .038, d = 0.41) and a larger increase in AAT (t = 9.12, p < .001, d = 1.66).
Salivary oxytocin values are presented in Table 3 and Figure 3.

Table 3. Salivary oxytocin levels and heart rate pre- and post-intervention

Group	Pre-intervention (pg/mL)	Post-intervention (pg/mL)
CBT	12.4 (SD = 3.5)	13.8 (SD = 3.2)
AAT	12.1 (SD = 3.7)	18.9 (SD = 3.5)

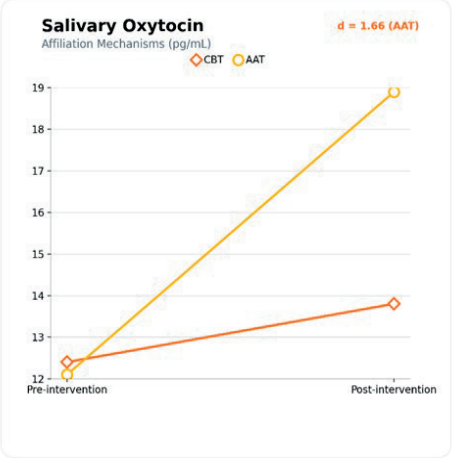


Figure 3. Salivary Oxytocin Levels in CBT and AAT

A mediation analysis (bootstrapped, 5,000 samples) examined whether HRV mediated the relationship between intervention type and changes in emotion regulation (DERS). The model is presented in Figure 5.
A significant indirect effect was observed, β = -. Salivary oxytocin increased significantly in both groups (t =2.17, p = .038, d = .41 for CBT, t = 9.12, p <.001, d = 1.66 for AAT), with a larger increase observed in the AAT group.
Salivary cortisol values are presented in Table 4 and Figure 4.
Both interventions were associated with reductions in salivary cortisol (CBT: t = 2.72, p = .008, d = .70, AAT: t =, p =, d =), with a greater decrease observed in the AAT group.
29, 95% CI [-.48, -.09], indicating partial mediation.

Significant correlations were observed between physiological markers and emotion regulation outcomes: oxytocin–DERS (r = -.54, p < .001), heart rate–DERS (r = .49, p < .001), and HRV–DERS (r = -.61, p < .001).

Table 4. Salivary cortisol changes pre- and post-intervention

Group	Pre-intervention	Post-intervention	% Change
CBT	18.5 (SD = 4.1) pg/mL	15.5 (SD = 3.8) pg/mL	-16%
AAT	18.7 (SD = 4.3) pg/mL	12.3 (SD = 3.5) pg/mL	-34%

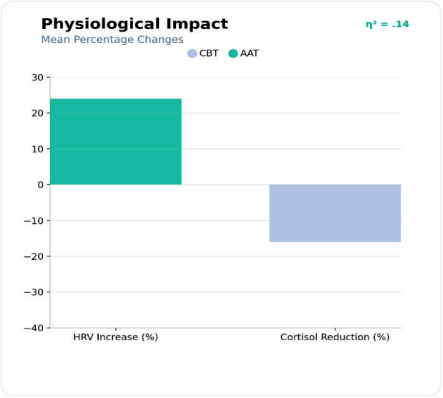


Figure 4. Salivary Cortisol Levels in CBT and AAT

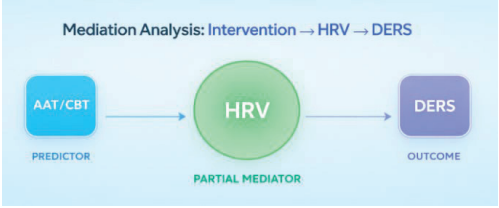


Figure 5. Mediation analysis between the two types of intervention

The present study examined the comparative effects of cognitive-behavioural therapy (CBT) and animal-assisted therapy (AAT) on emotional, affective, and physiological outcomes in students with moderate anxiety. Both interventions were associated with significant improvements across all domains, supporting the view that emotion regulation is a modifiable process through structured psychological interventions.

Across outcomes, AAT was associated with larger changes compared to CBT, including greater reductions in emotion regulation difficulties, anxiety, and negative affect, as well as greater increases in positive affect and heart rate variability. These findings are consistent with previous research suggesting that human-animal interaction may facilitate stress reduction and emotional adjustment (Beetz et al., 2012; Uvnäs-Moberg et al., 2015).

The observed increase in HRV in the AAT group is consistent with models linking vagal regulation to emotional flexibility and adaptive responding (Thayer et al., 2012; Porges, 2007). Higher HRV has been associated with improved regulatory capacity and reduced vulnerability to anxiety (McCraty & Shaffer, 2015), suggesting that autonomic regulation may represent one pathway through which AAT exerts its effects.

Similarly, the increase in salivary oxytocin and the reduction in cortisol levels observed in the AAT group align with evidence indicating that human-dog interaction may influence affiliative and stress-related neuroendocrine systems (Odendaal & Meintjes, 2003; Hennessy et al., 2009). These physiological changes are consistent with the hypothesis that AAT engages bottom-up regulatory processes related to stress attenuation and social bonding.

In contrast, CBT is typically conceptualized as operating through top-down mechanisms, including cognitive restructuring and reappraisal processes associated with prefrontal regulation of emotional responses (Gross, 2015; Thayer et al., 2012). The present findings suggest that these approaches may rely on partially distinct mechanisms, with CBT emphasizing cognitive control and AAT engaging autonomic and neuroendocrine pathways.

The mediation analysis provides preliminary support for the role of HRV as a potential mechanism linking intervention type to improvements in emotion regulation. However, given the study design, these findings should be interpreted cautiously and do not establish causal mediation.

From a theoretical perspective, the results support integrative models of emotion regulation that incorporate both cognitive and physiological processes. From a clinical perspective, they suggest that AAT may represent a useful complementary intervention, particularly in contexts where experiential or relational engagement may enhance treatment response.

Several limitations should be acknowledged. The sample consisted exclusively of students, limiting generalizability. The study employed a short-term pre-post design without follow-up, preventing conclusions about long-term effects. The absence of blinding introduces the possibility of expectancy and therapist effects, and the novelty of interacting with a dog may have influenced responses. In addition, only a limited set of physiological markers was assessed, and potential confounders such as prior experience with animals were not controlled.

Future research should include larger and more diverse samples, incorporate longitudinal designs, and employ more rigorous control of potential confounding variables. The inclusion of additional physiological and behavioural measures may further clarify the mechanisms underlying the observed effects. Given the number of outcomes assessed, future studies may also benefit from formal correction for multiple comparisons.

CONCLUSIONS

Dog-assisted therapy (AAT) was associated with greater improvements in emotional regulation among students compared to cognitive-behavioural therapy (CBT), as reflected by a reduction in DERS scores ($d = 2.21$). The results suggest that heart rate variability (HRV) may serve as a relevant biomarker of emotional regulation, and that increases in HRV could partially mediate reductions in emotional dysregulation through optimization of vagal control and attenuation of sympathetic activation. Psychological effects were accompanied by more pronounced positive neurophysiological changes. These findings support the potential of an integrative therapeutic model, in which multimodal interventions might produce synergistic effects. However, further controlled studies with larger samples are needed to confirm these associations and to establish the clinical and preventive relevance of AAT for students with moderate anxiety.

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