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PSYCHO-EMOTIONAL STATE OF DOGS WITH DIFFERENT TEMPERAMENT CHARACTERISTICS UNDER THE INFLUENCE OF AN ACOUSTIC STIMULUS

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Summary. This study aimed to assess the psycho-emotional state of German Shepherd dogs with different temperament characteristics under acute stress and anxiety conditions. A modified five-point FAS-M (Fear, Anxiety, Stress) scale, adapted from the original eight-point system (Gatehouse et al., 2025), was applied. The experiment was conducted on 30 male dogs aged 3.9 ± 0.2 years, tested under open-field conditions for five consecutive days. On days 2–3, acute stress was induced by an acoustic stimulus (thunder, 90–100 dB), whereas on days 1, 4, and 5, the anxiety state was evaluated without stimulus exposure. Temperament traits were assessed using the C-BARQ questionnaire, allowing the classification of dogs by aggression, fear and anxiety, excitability, trainability, and obedience. It was established that acute stress caused a significant increase in psycho-emotional scores compared with baseline levels ($p < 0.001$), with the most pronounced reaction observed on the second experimental day. On non-stress days, gradual score reduction indicated adaptation to the testing environment. Highly aggressive and overexcitable dogs exhibited the strongest reactions to the stressor (up to 3.45 a. u.), whereas obedient and calm dogs showed the lowest reactivity and the fastest behavioral stabilization. Correlation analysis revealed a strong positive relationship between excitability and psycho-emotional state ($r = 0.80$; $p < 0.001$) and between aggression and excitability ($r = 0.68$; $p < 0.001$). Conversely, trainability and obedience were significantly negatively correlated with psycho-emotional state ($r = –0.65$; $p < 0.001$), confirming their protective role against stress development. These findings indicate that individual temperament traits determine the level of stress resistance in dogs and can be used to predict behavioral reactivity in veterinary practice, training, and animal welfare assessment

Keywords: stress, anxiety, aggression, excitability, obedience, FAS-M

Introduction. In contemporary veterinary behavioral science, the study of emotional and physiological responses of dogs to stressful stimuli is crucial for understanding mechanisms of adaptation, welfare, and the effectiveness of human–animal interaction. Psycho-emotional disturbances caused by chronic or acute stress can affect not only behavior but also neuroendocrine regulation, immune reactivity, and overall animal health (Beerda et al., 2000; Koolhaas et al., 2011). Clinical and experimental observations indicate that dogs respond sensitively to environmental changes, acoustic stimuli, social isolation, or unfamiliar surroundings, which manifest as increased anxiety, excitability, or aggression (Stanford, 1981; Döring et al., 2009). In veterinary practice, psychogenic stress is recognized as one of the main causes of behavioral disorders, examination difficulties, and reduced welfare (Hekman, Karas and Sharp, 2014; Hauser et al., 2020).

Stress responses in dogs exhibit both individual and typical components related to temperament, learning history, and socialization experience (Stephen and Ledger, 2005; Somppi et al., 2022). Behavioral indicators such as body posture, facial expression, vocalization, or avoidance, combined with physiological markers (cortisol level, heart rate), reflect the animal's emotional state (Flint et al., 2024; Mârza et al., 2024). Assessing these parameters forms the basis for developing scientifically grounded methods of stress control and prevention. Some studies have demonstrated the effectiveness of standardized scales such as FAS (Fear, Anxiety, Stress) for quantifying fear and anxiety during veterinary procedures (Mercier et al., 2023; Gatehouse et al., 2025). The use of such instruments enables correlation of behavioral responses with physiological changes, increasing the accuracy of emotional state assessment (Kim et al., 2022; King et al., 2022).

Recent works also emphasize the importance of interpreting 'frustration' as a distinct emotional response that can significantly affect the performance of working and search-and-rescue dogs (Dickinson and Feuerbacher, 2025). Similarly, chronic stress exposure can alter behavioral lateralization, indicating profound neurophysiological reorganization (Salgirli Demirbas et al., 2023). Moreover, McMahon, Youatt and Cavigelli (2022) highlight the significance of an animal's physiological profile as an indicator of individual behavioral differences: combining heart rate parameters, hormonal levels, and behavioral traits allows for more accurate interpretation of temperament's functional role. Collectively, these findings underscore that studying stress in dogs requires integrating neuroendocrine, cardiovascular, and behavioral indicators to achieve a comprehensive understanding of emotional regulation and adaptation mechanisms. Therefore, the complex assessment of stress-related behavioral and physiological traits in dogs, taking into account their temperament, is essential for developing scientifically grounded methods for evaluating adaptive responses. This has both theoretical and practical relevance — improving animal welfare, enhancing veterinary procedure efficiency, and strengthening the quality of human–dog interactions (Teo et al., 2022).

The study **aimed** to investigate the behavior of dogs, their level of psycho-emotional reactivity, trainability, and obedience under the influence of stress reactions in accordance with individual temperament traits, using an open field model with an acoustic stimulus.

Materials and methods. The study was conducted on 30 healthy male German Shepherd dogs aged 3.9 ± 0.2 years and weighing 34.0 ± 3.1 kg. The animals were kept at the Police Cynological Center in Kyiv and the 'vom Yambwelle Hof' kennel. All manipulations with experimental animals were carried out in accordance with the 'European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes' (CE, 1986) and Council Directive 2010/63/EU (CEC, 2010), and under Art. 26 of the Law of Ukraine No. 3447-IV of 21.02.2006 'About protection of animals from cruel treatment' (VRU, 2006) and basic bioethical principles (Simmonds, 2017). Under the current procedure, the research program was reviewed and approved by the Bioethics Committee of the State Biotechnology University (protocol No. 3, April 22, 2025).

Temperament traits were assessed using the standardized C-BARQ (Canine Behavioral Assessment & Research Questionnaire) method recommended by the University of Pennsylvania (2023). Standard questionnaires completed by the owners were analyzed (Serpell, 2015). Among 14 behavioral criteria, four were selected as most indicative of individual reactivity differences: aggression, fear and anxiety, excitability, and trainability and obedience. Each trait was divided into three expression levels.

For aggression:

Calm dogs — did not display aggression toward people or other animals;

Moderately aggressive — reacted aggressively only in specific threatening or competitive contexts;

Aggressive — showed pronounced aggression (growling, biting, or attack attempts).

For fear and anxiety:

Brave dogs — showed no signs of fear or avoidance;

Moderately anxious — exhibited short-term alertness or mild worry;

Fearful dogs — displayed pronounced fear responses, avoided contact, trembled, or hid.

For excitability:

Calm — stable behavior, low reactivity;

Moderately excitable — transient periods of increased activity under stimulation;

Highly excitable — hyperreactive, excessive motor activity, poor behavioral control.

For trainability and obedience:

Obedient — easily trainable, promptly responded to commands;

Occasionally disobedient — responded selectively or required repetition;

Disobedient — had training difficulties, often ignored the trainer's cues.

These behavioral profiles were used to form experimental groups and to compare responses of dogs with different temperament traits during acute stress modeling. This approach enabled assessment of how individual temperament features influence behavioral and physiological reactivity intensity under standardized testing conditions.

Acute stress modulation was performed using the open-field test. A 16 m^2 test arena was equipped with a video camera for behavioral monitoring. Testing was performed over five consecutive days between 9:00 and 10:00 a. m. *Day 1:* the dog was left alone for 10 minutes for environmental adaptation. *Days 2–3:* the dog was left alone for 9 minutes — the first 3 minutes in silence, then 3 minutes with a thunder sound (90–100 dB), followed by 3 minutes of silence. *Days 4–5:* the dog was left alone for 5 minutes in silence to record anxiety-related behavior.

Behavioral responses were scored using a modified FAS-M (Fear, Anxiety, Stress) scale adapted from the original eight-point system (Gatehouse et al., 2025) to a five-point format. Two independent experts observed and rated each dog to minimize subjectivity. 0 points: no visible behavioral changes; calm and relaxed; 1 point: mild tension or concern without aggression or excessive movement; 2 points: fearfulness or agitation without aggression, frequent movements, or avoidance; 3 points: pronounced arousal with high mobility, vocalization, moderate aggression; 4 points: strong aggression — attack or active defense attempts. Additionally, typical signs of acute stress were recorded, including trembling, yawning, tongue protrusion, tail tucked between legs, avoidance of eye contact, and reactions toward the handler and experimenter (Gutiérrez et al., 2019; Kartashova et al., 2021). This combination of quantitative and qualitative assessments enabled a comprehensive characterization of behavioral responses to stress stimuli.

Statistical analysis was performed using MS Excel 2025 with the built-in 'Data Analysis' tool. Descriptive statistics, correlation, and one-way ANOVA were applied. Differences between means were tested using Student's *t*-test, with significance levels set at $P \leq 0.05$, $P \leq 0.01$, and $P \leq 0.001$.

Results and discussion. Modern research in canine neurophysiology confirms that stress responses are closely linked not only to individual temperament traits but also to early-life experiences and the quality of human–dog interactions. Buttner, Awalt and Strasser (2023) demonstrated that dogs exposed to early-life stressors show altered physiological and behavioral responses during social stress-buffering paradigms in adulthood, including reduced ability to mitigate stress through social contact (Buttner, Awalt, and Strasser, 2023). These findings are consistent with Höglin et al. (2021), who reported that long-term stress in dogs correlates with the quality of their relationship with the owner and certain personality traits such as emotional stability and anxiety level (Höglin et al., 2021).

Table 1 presents baseline results of the emotional and psychological state evaluation of German Shepherd dogs using the modified FAS-M (Fear, Anxiety, Stress) scale during a five-day experimental period. Measurements were taken before and after the dogs' exposure to the testing arena ('open-field' conditions), where acute stress (acoustic stimulus) and anxiety states were modeled. It was found that on the first experimental day, the mean pre-exposure score was 1.2 a. u. (ranging from 0 to 2), while after exposure, it significantly increased to 2.0 a. u. ($p < 0.001$), indicating the development of a mild stress response associated with environmental novelty and isolation.

Table 1 — Emotional and psychological state of German Shepherd dogs under acute stress and anxiety conditions (n = 30; a. u.)

Study period		Statistical indicators				
		M *(min.–max.)*	SD	SEM	S2	CI (95%)
Day 1	Before arena	1.2 *(0–2)*	0.79	0.14	0.63	0.3
	After arena	2 *(0–3)****	0.81	0.15	0.65	0.3
Day 2	Before arena	1.2 *(0–2)*	0.71	0.13	0.51	0.27
	After arena	2.6 *(2–4)****	0.67	0.12	0.46	0.25
Day 3	Before arena	1.6 *(1–3)*	0.67	0.12	0.45	0.25
	After arena	2.7 *(2–4)****	0.76	0.14	0.57	0.28
Day 4	Before arena	1.8 *(1–3)*	0.65	0.12	0.42	0.24
	After arena	2.3 *(1–3)***	0.66	0.12	0.44	0.25
Day 5	Before arena	1.8 *(1–3)*	0.68	0.12	0.46	0.25
	After arena	2.1 *(1–3)**	0.63	0.11	0.4	0.23

Notes: significant differences between pre- and post-exposure values: * — $P \leq 0.05$; ** — $P \leq 0.01$; *** — $P \leq 0.001$.

On the second and third days, when the dogs were exposed to an auditory stimulus (recorded thunder sound), emotional arousal scores increased significantly after exposure compared to baseline. Specifically, on day 2, the mean value rose from 1.2 to 2.6 a. u. ($p < 0.001$), and on day 3 — from 1.6 to 2.7 a. u. ($p < 0.001$), indicating a pronounced response to acute stress. On the fourth and fifth days, when anxiety was assessed without external stimuli, there was still a significant increase after arena exposure. The mean score increased from 1.8 to 2.3 a. u. on day 4 ($p < 0.01$) and from 1.8 to 2.1 a. u. on day 5 ($p < 0.05$).

The obtained results demonstrate that the modified FAS-M scale is a sensitive tool for detecting changes in the dogs' psycho-emotional state under the influence of acute stress and situational anxiety in open-field conditions. A significant increase in post-exposure scores was already observed on the first day of testing, despite the absence of a sound stimulus, reflecting a response to the novel environment and social isolation. Similar findings regarding the stressogenic effects of unfamiliar surroundings, isolation, and the veterinary environment were reported by Stanford (1981), Döring et al. (2009), and Hekman, Karas and Sharp (2014), who showed marked increases in anxiety levels and behavioral disturbances even in the absence of additional stressors. These observations confirm that testing conditions themselves can act as a significant source of psychogenic stress.

Fig. 1 presents the differences (Δ) between emotional and psychological state scores (according to the FAS-M scale) recorded before and after the dogs' exposure to the testing arena under acute stress conditions (days 2–3, with sound stimulus) and anxiety conditions (days 1, 4, and 5, without external stimuli).

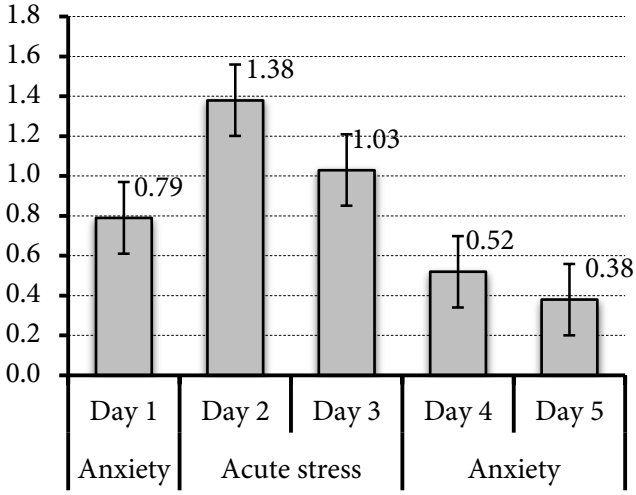

Figure 1. Difference (Δ) in emotional and psychological state scores of dogs under acute stress and anxiety conditions before and after exposure in the arena (n = 30; arbitrary units).

The largest difference between pre- and post-exposure scores was recorded on day 2 (acute stress) — 1.38 a. u. ($p < 0.001$), indicating a pronounced response of dogs to the sound stimulus. On day 3, also under acute stress, this difference slightly decreased to 1.03 a. u., suggesting partial desensitization or early adaptation to the repeated stimulus. On the days when only anxiety was assessed (without targeted stress exposure), the difference was less pronounced — 0.79 a. u. on day 1, 0.52 a. u. on day 4, and 0.38 a. u. on day 5, reflecting a gradual reduction in reactivity and partial habituation to the testing environment over the course of the experiment.

Thus, the highest psycho-emotional responses were registered on the second and third days of the experiment, during exposure to the auditory stimulus

(thunder sound), which was accompanied by a sharp rise in FAS-M scores and the greatest pre-/post-test difference. This pattern aligns with the concept of acute stress as a rapid adaptive response characterized by activation of behavioral and neuroendocrine mechanisms (Koolhaas et al., 2011; Beerda et al., 2000). Comparable findings were reported by Flint et al. (2024) and Gobbo and Zupan Šemrov (2021), who observed pronounced changes in behavioral and cardio endocrine indicators in dogs exposed to intense sensory or social stimuli. The reduction in Δ between days 2 and 3 (from 1.38 to 1.03 a. u.) in this study may reflect initial adaptation or partial habituation to the repeated stressor, consistent with earlier observations of habituation to recurring stimuli while maintaining general physiological tension (Beerda et al., 2000; Hauser et al., 2020).

On the non-stimulus days (1, 4, 5), a lower intensity of stress response and a progressive decrease in pre-/post-exposure differences were observed, indicating habituation of the animals to the arena and testing procedures. These findings correlate with results by King et al. (2022), Mercier et al. (2023), and Gatehouse et al. (2025), who demonstrated that standardized testing conditions, repeated exposure, and predictable environments reduce fear and anxiety in dogs during clinical visits. Hence, the dynamics of mean FAS-M values confirm the validity of the applied acute stress model, illustrating both stress-induced and adaptive components of behavioral responses.

Furthermore, Gobbo and Zupan Šemrov (2021) showed that aggressive reactivity in dogs is accompanied by activation of neuroendocrine and cardiovascular mechanisms, including increased cortisol levels and heart rate, emphasizing the tight coupling between emotional and physiological regulation. Similarly, Grigg et al. (2022) established that dogs' emotional states mirror those of their handlers, as synchronization of behavioral and cardiovascular parameters reflects emotional contagion within the human–dog dyad.

Fig. 2 presents the dynamics of the psycho-emotional state of dogs with varying degrees of aggressiveness (calm — n = 9, moderately aggressive — n = 12, aggressive — n = 9) under acute stress and anxiety conditions throughout the five-day experiment, according to the modified FAS-M scale (a. u.). Calm dogs exhibited the lowest baseline psycho-emotional scores (0.78–1.67 a. u.). Their reactivity increased markedly on the second and third days, reaching peaks of 2.56 and 2.44 a. u., respectively, indicating a moderate yet distinct response to acute auditory stress. Under anxiety-only conditions (days 4 and 5), their emotional state remained relatively low (1.67–2.11 a. u.), demonstrating good adaptability.

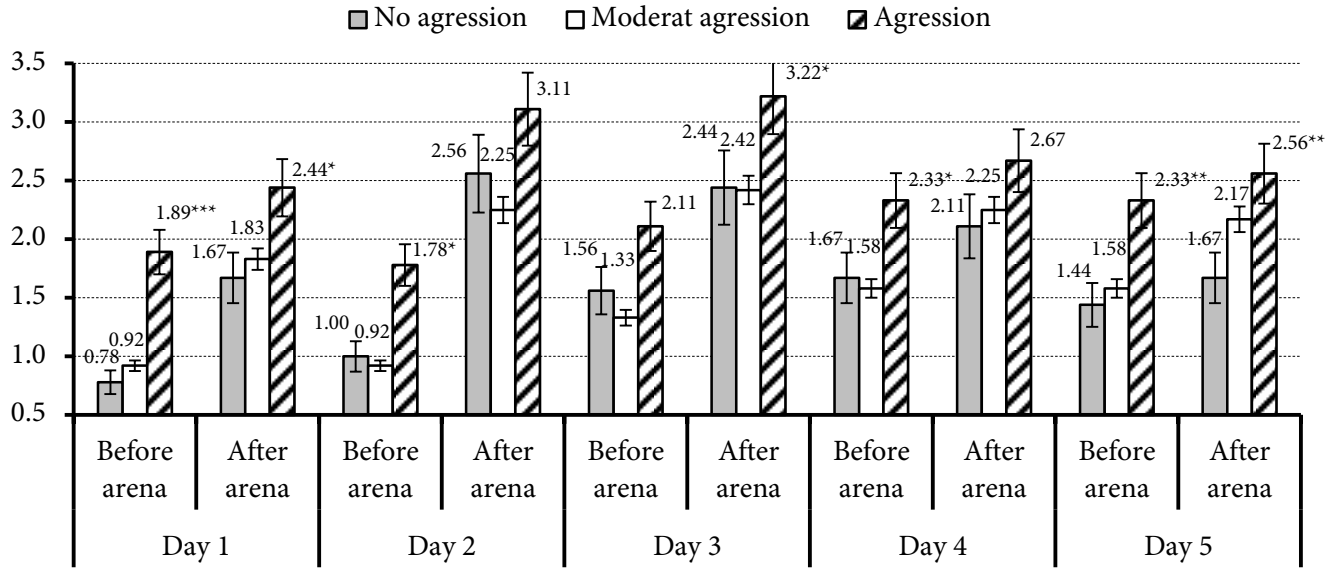

Figure 2. Dynamics of the psycho-emotional state of dogs with different levels of aggressiveness under acute stress and anxiety during the experiment (a. u.). Significant differences compared to calm dogs: * — P < 0.05; ** — P < 0.01; *** — P < 0.001.

Moderately aggressive dogs showed slightly higher baseline scores (0.92–1.58 a. u.) than calm ones. The most significant increases occurred under acute stress (days 2 and 3), when post-exposure scores reached 2.25 and 2.42 a. u., respectively. During anxiety evaluation (days 4 and 5), their psycho-emotional state remained somewhat elevated (2.17–2.25 a. u.) compared to calm dogs, indicating moderate susceptibility to stress reactions.

Dogs with pronounced aggressive behavior exhibited consistently high pre-exposure psycho-emotional levels (1.78–2.33 a. u.), which were significantly higher than those of the other groups. In response to acute stress (days 2 and 3), this group showed the highest scores, reaching peak values of 3.11 and 3.22 a. u., respectively. During the evaluation of anxiety without a stressor (days 4 and 5), the excitation levels of aggressive dogs

remained elevated (2.67 and 2.56 a. u.), indicating the lowest adaptive capacity among the studied groups.

Dogs without evident signs of fear or anxiety had the lowest and most stable baseline psycho-emotional scores (1.0–1.55 a. u.), showing only moderate reactions to the acute auditory stimulus (days 2 and 3), when post-exposure scores increased to 2.45 and 2.55 a. u., respectively (Fig. 3). On non-stimulus days (days 4 and 5), their anxiety levels remained low, ranging from 1.82 to 2.0 a. u., reflecting good adaptability.

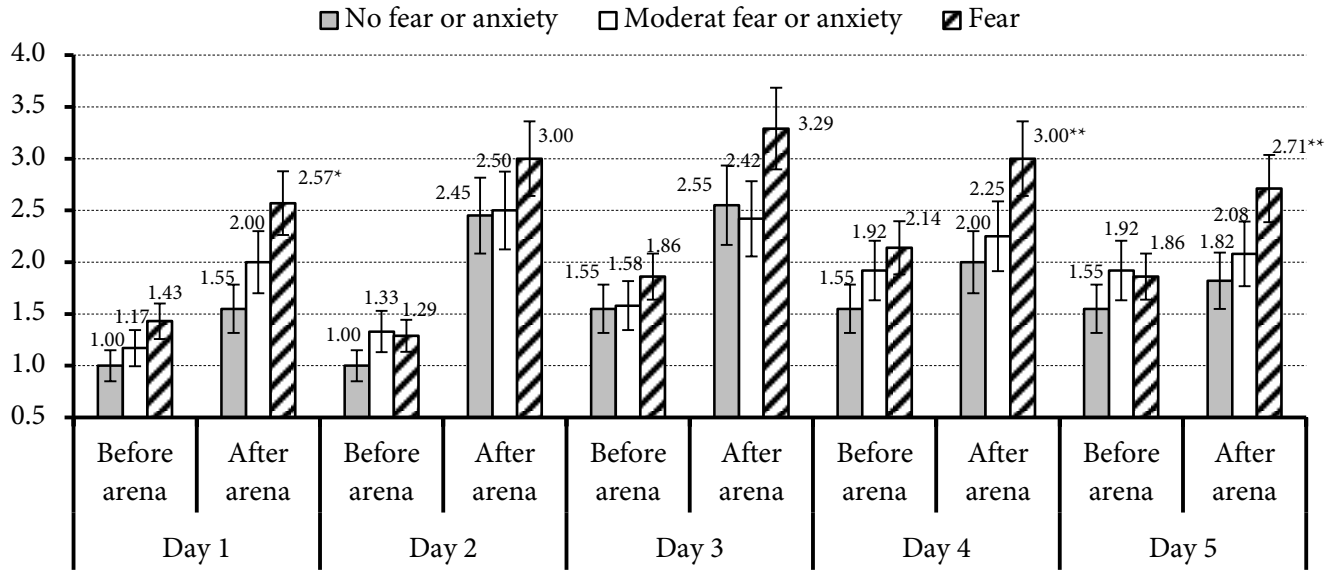

Figure 3. Dynamics of the psycho-emotional state of dogs with different levels of fear and anxiety throughout the experiment (a. u.). Significant differences compared to dogs without pronounced fear and anxiety: * — P < 0.05; ** — P < 0.01; *** — P < 0.001.

Animals with a moderate degree of fear and anxiety had slightly higher baseline scores (1.17–1.92 a. u.) and exhibited more pronounced increases in response to acute stress on days 2 and 3 (up to 2.5 and 2.42 a. u.). Under anxiety-only conditions (without the stressor), their post-exposure scores (2.08–2.25 a. u.) were somewhat higher than those of fearless dogs, indicating less effective adaptation.

Dogs with pronounced fear and anxiety showed the highest baseline psycho-emotional levels (1.29–2.14 a. u.) and the most intense reactions to acute stress, reaching up to 3.29 a. u. on day 3, which significantly exceeded the corresponding values in other groups. During the evaluation of ordinary anxiety (days 4 and 5), their emotional state remained elevated (2.71–3.0 a. u.), indicating a persistent predisposition to high anxiety levels and low adaptability.

Fig. 4 presents the dynamics of the psycho-emotional state of dogs with varying levels of excitability, assessed using the modified FAS-M scale under conditions of acute stress and anxiety throughout the five-day experiment. Dogs with calm behavior displayed the lowest baseline psycho-emotional levels (0.43–1.57 a. u.). Under acute stress (days 2 and 3), their scores increased significantly to 2.57 and 2.43 a. u., respectively, though remaining lower than in other groups. During anxiety evaluation days (4 and 5), the values stabilized at low levels (1.57–2.0 a. u.), reflecting good adaptive capacity to stressful situations.

Moderately excitable dogs had higher baseline psycho-emotional scores (0.83–1.5 a. u.) compared to calm animals. Under acute stress (days 2 and 3), their reactions moderately intensified (2.0 and 2.08 a. u.), demonstrating average sensitivity to stress factors. During anxiety assessment (days 4 and 5), their scores remained stable at about 2.08 a. u., indicating moderate reactivity and sufficient adaptability. Highly excitable dogs exhibited the highest initial psycho-emotional levels (1.82–2.36 a. u.) and the most pronounced response to acute stress (days 2 and 3), reaching peak values of 3.27 and 3.45 a. u., respectively. Even during ordinary anxiety conditions (days 4 and 5), their psycho-emotional levels remained elevated (2.55–2.82 a. u.), reflecting poor adaptability to stressful environments. These findings indicate that the level of excitability significantly affects dogs' psycho-emotional responses and adaptive capacity under acute stress and anxiety. Dogs with excessive excitability exhibit high reactivity and low adaptability, whereas calm animals show minimal reactivity and strong stress resistance.

Fig. 5 illustrates the dynamics of the psycho-emotional state of dogs with different levels of trainability and obedience. Well-trained dogs (obedient) had the lowest baseline psycho-emotional scores (0.45–1.36 a. u.) and showed a moderate response to acute stress (day 2 — 2.09 a. u., day 3 — 2.0 a. u.). Under normal anxiety conditions, their scores remained low and stable (1.73–1.82 a. u.), indicating high adaptability and low reactivity.

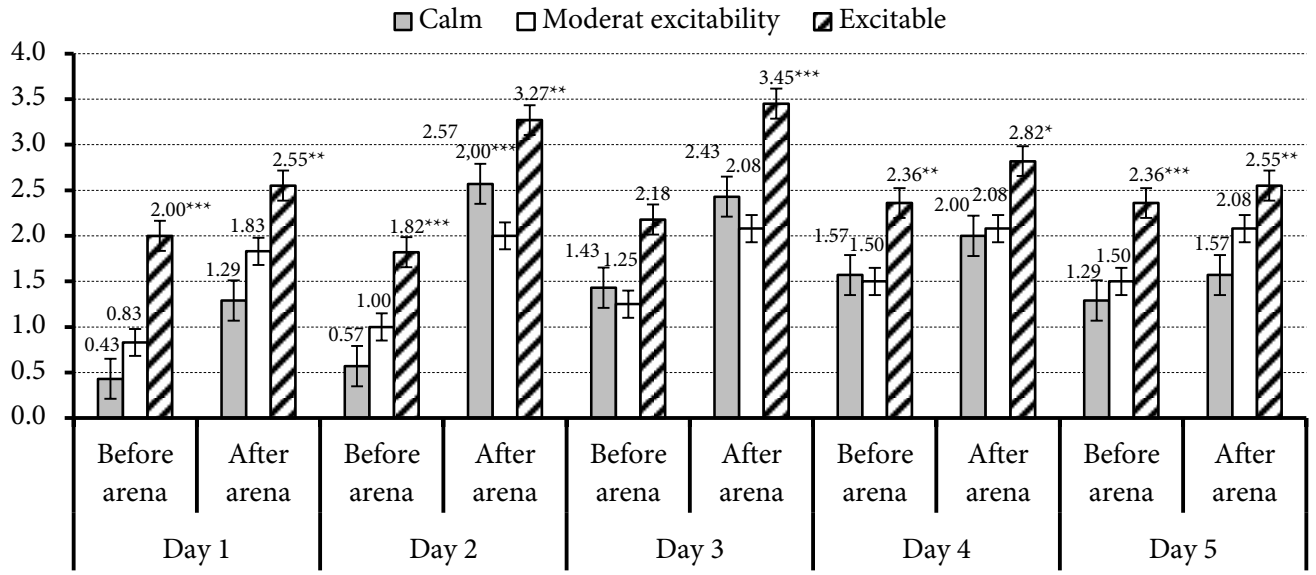

Figure 4. Dynamics of the psycho-emotional state of dogs with varying degrees of excitability during the experiment (a. u.). Significant differences compared to calm dogs: * — P < 0.05; ** — P < 0.01; *** — P < 0.001.

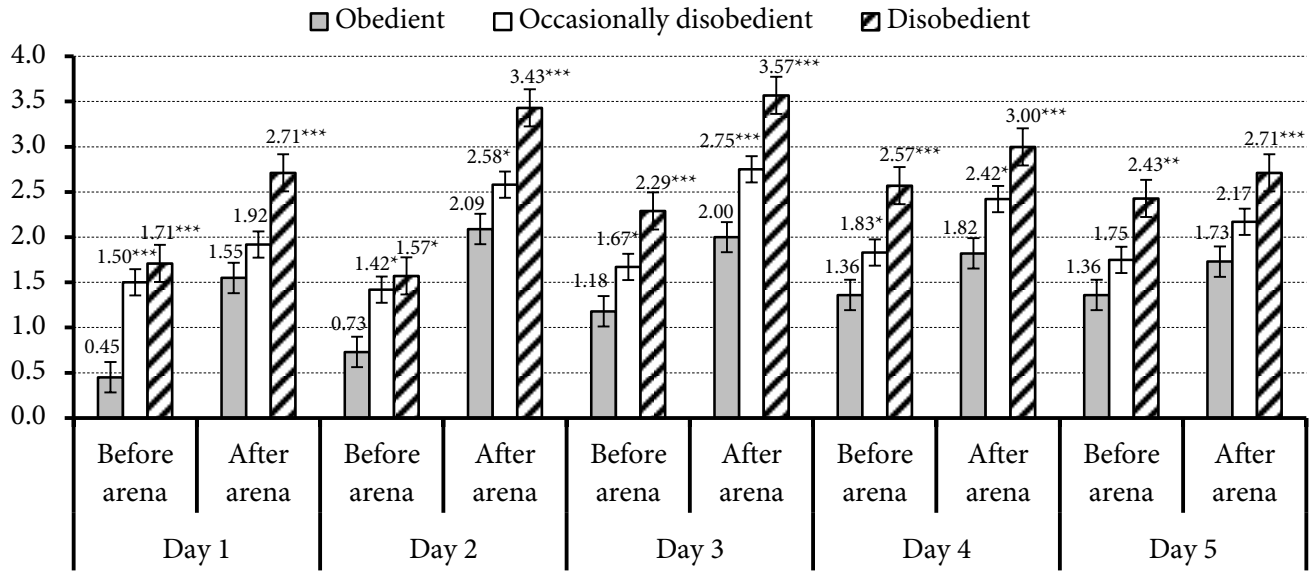

Figure 5. Dynamics of the psycho-emotional state of dogs with different levels of trainability and obedience during the experiment (a. u.). Significant differences compared to obedient dogs: * — P < 0.05; ** — P < 0.01; *** — P < 0.001.

Dogs that were occasionally disobedient had higher baseline scores (1.42–1.83 a. u.) than obedient dogs. Their stress response was more pronounced (day 2 — 2.58 a. u., day 3 — 2.75 a. u.), and anxiety scores in non-stress conditions remained elevated (2.17–2.42 a. u.), reflecting lower adaptability compared to obedient dogs. Disobedient dogs displayed the highest initial psycho-emotional levels (1.57–2.57 a. u.) and maximum reactivity to acute stress (day 2 — 3.43 a. u., day 3 — 3.57 a. u.). Even on anxiety-assessment days, their emotional state remained high (2.71–3.0 a. u.), indicating poor adaptability and heightened stress sensitivity.

The dynamics of the influence of various temperament traits (aggression, fear and anxiety, excitability, trainability, and obedience) on the emotional and mental state of dogs over the five-day experiment are shown in Fig. 6, based on their relative effect strength. The 'aggression' trait exhibited the strongest influence on the first day of the experiment before exposure to the arena (0.55 a. u.; P < 0.001), followed by a significant decline in the subsequent days, reaching its minimum on day 3 after exposure (0.16 a. u.). However, by the end of the experiment (day 5), its influence increased again (0.46 a. u. after exposure; P < 0.01), indicating a gradual re-emergence of aggressive tendencies under prolonged

stress. The 'fear and anxiety' trait showed an initially low impact (0.09 a. u. on day 1 before exposure), but its significance gradually increased throughout the experiment, peaking on days 4 and 5 (0.42 a. u. before and after exposure; $P < 0.01$). Excitability had the highest impact on the psycho-emotional state at the start (0.86 a. u. before exposure on day 1; $P < 0.001$), followed by a gradual decline over the next days (0.27 a. u. after exposure on day 4). Despite the downward trend, excitability remained moderately significant at the end of the experiment (0.56 a. u. before exposure on day 5; $P < 0.001$). The 'trainability and obedience' trait maintained a consistently strong influence throughout the entire experiment, particularly pronounced on days 2 and 3 (0.75 and 0.86 a. u. after exposure; $P < 0.001$). This underscores the essential role of obedience and learning capacity in shaping dogs' responses to acute stress and anxiety-inducing conditions.

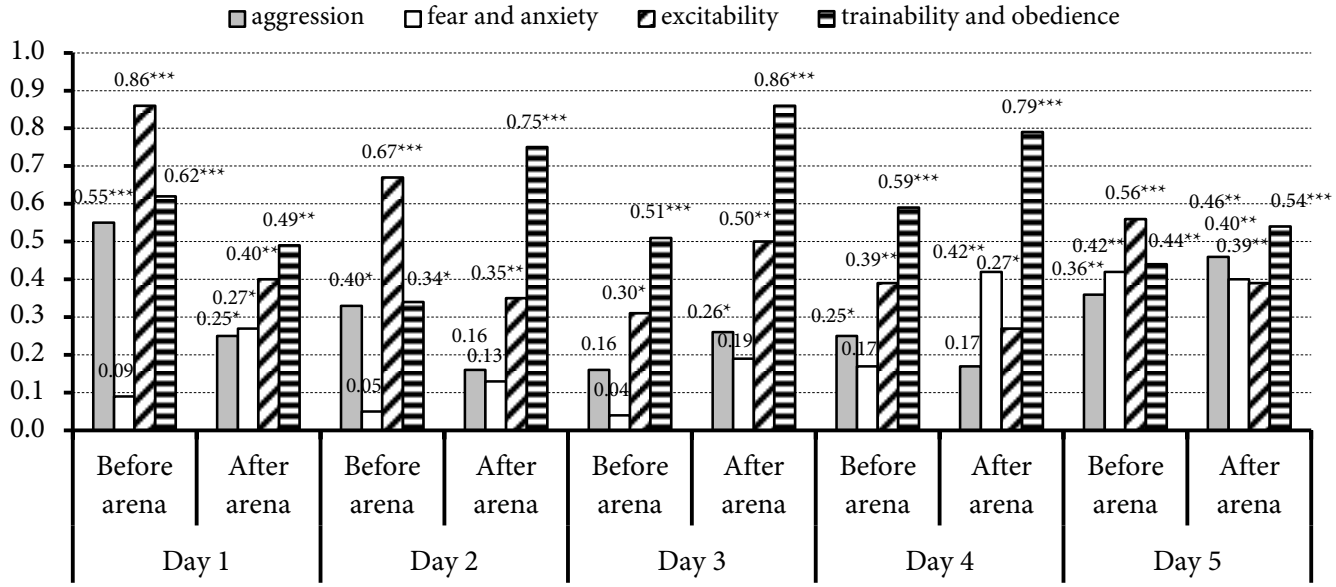

Figure 6. Dynamics of the influence of various temperament traits on the emotional and mental state of dogs during the experiment (η^2_χ; a. u.). Significant at: * — $P < 0.05$; ** — $P < 0.01$; *** — $P < 0.001$.

The temperament subgroup analysis revealed a clear differentiation of behavioral responses. Dogs with calm behavior, low aggressiveness, mild or absent anxiety, and high obedience had minimal baseline values and only moderate reactions to acute stress, followed by rapid state stabilization. In contrast, dogs with pronounced aggressiveness, high excitability, or persistent fear demonstrated elevated baseline scores, maximal reactivity to auditory stressors, and maintained high levels even on non-stress days. These findings align with McMahon, Youatt and Cavigelli (2022), who emphasized that an individual's physiological and behavioral profile (temperament) determines the functional significance of stress reactivity, as well as with Somppi et al. (2022) and Höglin et al. (2021), who found that dogs' personality traits and the quality of human–dog interactions are linked to long-term stress levels and emotional stability.

Table 2 presents the correlation analysis between the psycho-emotional state of dogs and key temperament characteristics. Aggression showed a strong positive correlation with excitability ($r = 0.68$; $p < 0.001$), indicating a close relationship between increased excitability and aggressive behavior. At the same time, aggression was negatively correlated with trainability and obedience ($r = -0.39$; $p < 0.05$), suggesting that aggressive dogs are less responsive to control and learning. Fear and anxiety showed a moderately negative correlation with trainability ($r = -0.43$; $p < 0.05$), implying that more anxious animals are less obedient and harder to train.

Table 2 — Correlations between the psycho-emotional state of dogs and various temperament characteristics (n = 30; r, a. u.)

Parameters		Degree of manifestation			
		Aggression	Fear and anxiety	Excitability	Trainability and obedience
Degree of manifestation	Fear and anxiety	0.23	–	–	–
	Excitability	0.68***	0.03	–	–
	Trainability and obedience	–0.39*	–0.43*	–0.37*	–
Psycho-emotional state index		0.55***	0.21	0.80***	–0.65***

Notes: significant differences: * — $P < 0.05$; ** — $P < 0.001$.

Excitability demonstrated a very strong positive relationship with the psycho-emotional state ($r = 0.80$; $p < 0.001$), confirming that high excitability is the primary factor amplifying emotional responses in stressful conditions. Similar associations between heightened emotional excitability, aggressive behavior, and increased neuroendocrine activation were reported by Beerda et al. (2000), Gobbo and Zupan Šemrov (2021), and Stephen and Ledger (2005). The observed positive correlations between overall psycho-emotional state and aggression ($r = 0.55$; $p < 0.001$) and a trend toward association with anxiety support the concept that aggression in some animals has a frustration–anxiety basis and may represent maladaptive coping strategies under stress.

Moreover, the psycho-emotional state exhibited a strong negative correlation with trainability and obedience ($r = –0.65$; $p < 0.001$). The negative associations of obedience with aggression and anxiety confirm that a high level of trainability and behavioral control plays a protective role in mitigating stress-related behavioral reactions. These findings are consistent with Mercier et al. (2023) and Grigg et al. (2022), who highlighted the importance of structured owner–dog interaction, predictable cues, and training in reducing emotional dysregulation. The results also correspond with the social stress-buffering hypothesis, emphasizing the role of stable social bonds in lowering stress reactivity (Teo et al., 2022; Buttner, Awalt and Strasser, 2023).

The observed increase in the role of fear and anxiety, along with the partial restoration of aggression significance at the end of the experiment, may indicate that under repeated environmental influences, some animals transition to a more stable yet less adaptive response pattern characteristic of chronic anxiety or frustration. This shift in the balance between active and passive coping strategies aligns with modern stress models, which emphasize the risk of transitioning from adaptive to maladaptive responses under prolonged or repeated exposure to stressors (Koolhaas et al., 2011; Salgirli Demirbas et al., 2023).

Thus, the obtained results indicate the dominant influence of excitability and aggressiveness on the psycho-emotional state of dogs, as well as the key role of trainability as a factor that reduces anxiety and stress response levels.

Conclusions. Overall, the study results demonstrate that: the open-field model with an auditory stimulus is an effective tool for standardized induction of acute stress in dogs; the level of psycho-emotional reactivity is largely determined by individual temperament traits, primarily excitability and aggressiveness; high trainability and obedience are associated with lower stress indicators and can be considered markers of better adaptive capacity. These findings are consistent with leading research in veterinary behavioral medicine and emphasize the importance of integrating standardized behavioral scales with temperament assessment in the development of stress prevention and correction protocols in dogs.

References

Beerda, B., Schilder, M. B. H., van Hooff, J. A. R. A. M., de Vries, H. W. and Mol, J. A. (2000) 'Behavioural and hormonal indicators of enduring environmental stress in dogs', *Animal Welfare*, 9(1), pp. 49–62. doi: 10.1017/s0962728600022247.

Buttner, A. P., Awalt, S. L. and Strasser, R. (2023) 'Early life adversity in dogs produces altered physiological and behavioral responses during a social stress-buffering paradigm', *Journal of the Experimental Analysis of Behavior*, 120(1), pp. 6–20. doi: 10.1002/jeab.856.

CE (The Council of Europe). (1986) *European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes*. (European Treaty Series, No. 123). Strasbourg: The Council of Europe. Available at: https://conventions.coe.int/treaty/en/treaties/html/123.htm.

CEC (The Council of the European Communities) (2010) 'Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes', *The Official Journal of the European Communities*, L 276, pp. 33–79. Available at: http://data.europa.eu/eli/dir/2010/63/oj.

Dickinson, S. and Feuerbacher, E. N. (2025) 'Frustration and its impact on search and rescue canines', *Frontiers in Veterinary Science*, 12, p. 1546412. doi: 10.3389/fvets.2025.1546412.

Döring, D., Roscher, A., Scheipl, F., Küchenhoff, H. and Erhard, M. H. (2009) 'Fear-related behaviour of dogs in veterinary practice', *Veterinary Journal*, 182(1), pp. 38–43. doi: 10.1016/j.tvjl.2008.05.006.

Flint, H. E., Weller, J. E., Parry-Howells, N., Ellerby, Z. W., McKay, S. L. and King, T. (2024) 'Evaluation of indicators of acute emotional states in dogs', *Scientific Reports*, 14(1), p. 6406. doi: 10.1038/s41598-024-56859-9.

Gatehouse, E., Bremhorst, A., Denenberg, S. and Loftus, L. (2025) 'Assessment of a behavioral scale for the measurement of fear, anxiety and stress in dogs visiting the veterinary practice', *Journal of Veterinary Behavior*, 81, pp. 58–70. doi: 10.1016/j.jveb.2025.08.008.

Gobbo, E. and Zupan Šemrov, M. (2021) 'Neuroendocrine and cardiovascular activation during aggressive reactivity in dogs', *Frontiers in Veterinary Science*, 8, p. 683858. doi: 10.3389/fvets.2021.683858.

Grigg, E. K., Liu, S., Dempsey, D. G., Wong, K., Bain, M., Sollers, J. J., Haddock, R., Kogan, L. R., Barnhard, J. A., Tringali, A. A., Thigpen, A. P. and Hart, L. A. (2022) 'Assessing the relationship between emotional states of dogs and their human handlers, using simultaneous behavioral and cardiac measures', *Frontiers in Veterinary Science*, 9, p. 897287. doi: 10.3389/fvets.2022.897287.

Gutiérrez, J., Gazzano, A., Pirrone, F., Sighieri, C. and Mariti, C. (2019) 'Investigating the role of prolactin as a potential biomarker of stress in castrated male domestic dogs', *Animals*, 9(9), p. 676. doi: 10.3390/ani9090676.

Hauser, H., Campbell, S., Korpivaara, M., Stefanovski, D., Quinlan, M. and Siracusa, C. (2020) 'In-hospital administration of dexmedetomidine oromucosal gel for stress reduction in dogs during veterinary visits: A randomized, double-blinded,

placebo-controlled study', *Journal of Veterinary Behavior*, 39, pp. 77–85. doi: 10.1016/j.jveb.2020.05.002.

Hekman, J., Karas, A. and Sharp, C. (2014) 'Psychogenic stress in hospitalized dogs: Cross species comparisons, implications for health care, and the challenges of evaluation', *Animals*, 4(2), pp. 331–347. doi: 10.3390/ani4020331.

Höglin, A., Van Poucke, E., Katajamaa, R., Jensen, P., Theodorsson, E. and Roth, L. S. V. (2021) 'Long-term stress in dogs is related to the human–dog relationship and personality traits', *Scientific Reports*, 11(1), p. 8612. doi: 10.1038/s41598-021-88201-y.

Kartashova, I. A., Ganina, K. K., Karelina, E. A. and Tarasov, S. A. (2021) 'How to evaluate and manage stress in dogs — a guide for veterinary specialist', *Applied Animal Behaviour Science*, 243, p. 105458. doi: 10.1016/j.applanim.2021.105458.

Kim, S. A., Borchardt, M. R., Lee, K., Stelow, E. A. and Bain, M. J. (2022) 'Effects of trazodone on behavioral and physiological signs of stress in dogs during veterinary visits: A randomized double-blind placebo-controlled crossover clinical trial', *Journal of the American Veterinary Medical Association*, 260(8), pp. 876–883. doi: 10.2460/javma.20.10.0547.

King, T., Flint, H. E., Hunt, A. B. G., Werzowa, W. T. and Logan, D. W. (2022) 'Effect of music on stress parameters in dogs during a mock veterinary visit', *Animals*, 12(2), p. 187. doi: 10.3390/ani12020187.

Koolhaas, J. M., Bartolomucci, A., Buwalda, B., de Boer, S. F., Flügge, G., Korte, S. M., Meerlo, P., Murison, R., Olivier, B., Palanza, P., Richter-Levin, G., Sgoifo, A., Steimer, T., Stiedl, O., van Dijk, G., Wöhr, M. and Fuchs, E. (2011) 'Stress revisited: A critical evaluation of the stress concept', *Neuroscience & Biobehavioral Reviews*, 35(5), pp. 1291–1301. doi: 10.1016/j.neubiorev.2011.02.003.

Mârza, S. M., Munteanu, C., Papuc, I., Radu, L., Diana, P. and Purdoiu, R. C. (2024) 'Behavioral, physiological, and pathological approaches of cortisol in dogs', *Animals*, 14(23), p. 3536. doi: 10.3390/ani14233536.

McMahon, E. K., Youatt, E. and Cavigelli, S. A. (2022) 'A physiological profile approach to animal temperament: How to understand the functional significance of individual differences in behaviour', *Proceedings of the Royal Society B: Biological Sciences*, 289(1966), p. 20212379. doi: 10.1098/rspb.2021.2379.

Mercier, P., Honeckman, L., Jokela, F., Dunham, A. E. and Overall, K. L. (2023) 'Using standardized scales to assess fear at veterinary visits — intra- and inter-rater reliability', *Journal of Veterinary Behavior*, 62, pp. 12–17. doi: 10.1016/j.jveb.2023.02.004.

Salgirli Demirbas, Y., Isparta, S., Saral, B., Keskin Yılmaz, N., Adıay, D., Matsui, H., Töre-Yargın, G., Musa, S. A., Atilgan, D., Öztürk, H., Kul, B. C., Şafak, C. E., Ocklenburg, S. and Güntürkün, O. (2023) 'Acute and chronic stress alter behavioral laterality in dogs', *Scientific Reports*, 13(1), p. 4092. doi: 10.1038/s41598-023-31213-7.

Serpell, J. A. (2015). *The C-BARQ Questionnaire*. Available at: https://kenneltocouch.org/wp-content/uploads/2021/05/dog-aggression-questionnaire.pdf.

Simmonds, R. C. (2017) 'Chapter 4. Bioethics and animal use in programs of research, teaching, and testing', in Weichbrod, R. H., Thompson, G. A. and Norton, J. N. (eds.) *Management of Animal Care and Use Programs in Research, Education, and Testing*. 2nd ed. Boca Raton: CRC Press, pp. 35–62. doi: 10.1201/9781315152189-4.

Somppi, S., Törnqvist, H., Koskela, A., Vehkaoja, A., Tiira, K., Väätäjä, H., Surakka, V., Vainio, O. and Kujala, M. V. (2022) 'Dog–owner relationship, owner interpretations and dog personality are connected with the emotional reactivity of dogs', *Animals*, 12(11), p. 1338. doi: 10.3390/ani12111338.

Stanford, T. L. (1981) 'Behavior of dogs entering a veterinary clinic', *Applied Animal Ethology*, 7(3), pp. 271–279. doi: 10.1016/0304-3762(81)90083-3.

Stephen, J. M. and Ledger, R. A. (2005) 'An audit of behavioral indicators of poor welfare in kenneled dogs in the United Kingdom', *Journal of Applied Animal Welfare Science*, 8(2), pp. 79–95. doi: 10.1207/s15327604jaws0802_1.

Teo, J. T., Johnstone, S. J., Römer, S. S. and Thomas, S. J. (2022) 'Psychophysiological mechanisms underlying the potential health benefits of human–dog interactions: A systematic literature review', *International Journal of Psychophysiology*, 180, pp. 27–48. doi: 10.1016/j.ijpsycho.2022.07.007.

University of Pennsylvania (2023) *The C-BARQ (Canine Behavioral Assessment & Research Questionnaire)*. Available at: https://vetapps.vet.upenn.edu/cbarq/.

VRU (Verkhovna Rada Ukrainy) (2006) 'Law of Ukraine No. 3447-IV of 21.02.2006 'About protection of animals from cruel treatment' [Zakon Ukrainy № 3447-IV vid 21.02.2006 'Pro zakhyst tvaryn vid zhorstokoho povodzhennia'], *News of the Verkhovna Rada of Ukraine [Vidomosti Verkhovnoi Rady Ukrainy]*, 27, art. 230. Available at: https://zakon.rada.gov.ua/laws/3447-15. [in Ukrainian].

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