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Behavioral and physiological reactions in dogs to a veterinary examination: Owner-dog interactions improve canine well-being

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A R T I C L E I N F O

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A B S T R A C T

In order to improve well-being of dogs during veterinary visits, we aimed to investigate the effect of human social interactions on behavior and physiology during routine examination. Firstly, we assessed the impact of a standardized veterinary examination on behavioral and physiological indicators of stress in dogs. Secondly, we examined whether the owner's tactile and verbal interactions with the dog influenced behavioral and physiological stress-associated parameters. A randomized within-subjects crossover design was used to examine behavior (n = 33), rectal temperature (n = 33), heart rate (HR) (n = 18), maximal ocular surface temperature (max OST) (n = 13) and salivary cortisol concentrations (n = 10) in healthy privately owned pet dogs. The study consisted of two experimental conditions: a) "contact" - owner petting and talking to the dog during the examination; b) "non-contact" - owner present during the examination but not allowed to interact with the dog. Our findings showed that the veterinary examinations produced acute stress responses in dogs during both "contact" and "non-contact" conditions, with significant increases in lip licking, HR, and max OST. A significant decrease in attempts to jump off the examination table ($p = 0.002$) was observed during the examination in the "contact" compared to the "non-contact" condition. In addition, interactions of owners showed an attenuating effect on HR ($p = 0.018$) and max OST ($p = 0.011$) in their dogs. The testing order (first vs. second visit) had no impact on behavioral and physiological parameters, suggesting that dogs did not habituate or sensitize to the examination procedure. Moreover, the duration of the owner-dog interactions had no significant impact on the behavioral and physiological responses of their dogs. This study demonstrates that owner-dog interactions improve the well-being of dogs during a veterinary examination. Future research may assist in further understanding the mechanisms associated with reducing stress in dogs in similar settings.

1. Introduction

Unpredictable and uncontrollable conditions during veterinary examination may lead to behavioral and physiological stress reactions, as reported for dogs [1–4], cats [5] and dairy cattle [6,7]. It has been documented, that 78.5% of dogs exhibited fearful behaviors during a veterinary clinical examination [3]. While recognizing and identifying signs of stress in dogs is beneficial to improve animal well-being and ensure the safety of the veterinary staff, proper management of stress is crucial for easier handling of the animal during the exam. It consequently also helps to increase thoroughness of examination along with diagnostic accuracy since it is well documented that stress responses may affect baseline physiological parameters such as temperature, pulse rate, blood pressure, respiration, glucose level and endocrine system, which in turn increases the likelihood of medical misdiagnosis [1,8].

Cognitive perception of the stimulus, in terms of uncontrollability and/or unpredictability, is central in the definition of a stress reaction [9]. Activation of the sympatho-adrenomedullary (SAM) system is an initial rapid response to an immediate threat, known as fight or flight response, whereby increasing heart rate, rise in core temperature, release of catecholamines (epinephrine and norepinephrine), and increase in plasma glucose results in an alert physiological readiness state [10–13]. Slower, hypothalamic–pituitary–adrenal (HPA) axis activates adrenocorticotropic hormone (ACTH) which stimulates cells of the adrenal cortex to release cortisol or corticosterone [13,14].

Consequently, physiological, endocrinological and ethological indicators can be used to assess stress and monitor animal well-being and

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Table 1
Descriptive demographic of the population of dogs used in this study. F - female, M - male, FS - female spayed, MN - male neutered, group A - assigned to "contact" condition at the first visit, group B - assigned to "non-contact" condition at the first visit, * - owners participating with more than one dog.

No.	A/B group	Age (in years)	Sex	Breed	Age of the owner	Gender of the owner	Days between two visits
1	A	9	FS	Poodle	74	F	15
2	A	3	MN	Golden retriever	25	F	11
3	A	8	MN	Blue spaniel of Picardie	50	F	14
4	A	4	F	Shetland sheep dog	50*	F*	14
5	A	2	FS	Akita inu	23	F	16
6	A	4.5	FS	Yorkshire terrier	44	F	17
7	A	3	FS	Yorkshire terrier	44*	F*	17
8	A	0.8	M	Spanish water dog	25	F	15
9	A	1.3	MN	Border collie	52	M	11
10	A	0.5	F	Mix	26	F	10
11	A	3	M	Bearded collie	63	F	14
12	A	8	F	Mix	21	F	10
13	A	1.7	FS	Beauceron	41	F	7
14	A	5	M	Siberian husky	32	F	12
15	A	5.3	M	German shepherd	45	F	10
16	A	11.5	FS	Labrador retriever	65	F	7
17	B	2.5	MN	Australian sheepdog	22	F	10
18	B	1.7	F	Netherland sheep dog	61	F	15
19	B	2	FS	Pyrenees sheep dog	58	F	14
20	B	12	F	Mix	58*	F*	14
21	B	3	MN	Australian sheep dog	52	F	15
22	B	10	FS	Yorkshire terrier	44*	F*	17
23	B	1.3	F	Mix	60	F	17
24	B	2.5	MN	German shepherd	61	F	12
25	B	2	M	Australian cattle dog	23	F	13
26	B	1.1	F	Border collie	25	F	11
27	B	8	FS	Mix	52*	M*	11
28	B	4.5	MN	Mix	63	F	14
29	B	2.1	M	Labrador retriever	23	F	9
30	B	2.6	FS	Staffordshire bull terrier	44	F	14
31	B	2	F	Staffordshire bull terrier	41	F	7
32	B	9	MN	Mix	32*	F*	12
33	B	1.3	M	Cane corso	30	F	7

welfare. Heart rate (HR) represents a relatively easily accessible physiological measure. Measuring changes in HR has long been used to measure psychophysiological arousal in dogs [15–18]. Infrared thermography (IRT) is a non-contact and rapid imaging method, measuring the surface temperature by detecting electromagnetic radiation [19]. IRT records infrared region of the electromagnetic spectrum, emitted by all objects with a temperature above absolute zero [20]. It is a useful method to indirectly measure changes in blood flow by detecting small differences in surface temperature that are related to physiological and psychological stressors during acute and chronic stress, both in human [21,22] and animals [23–25]. Eye region temperature is frequently used to detect a stress response [4,21,26,27]. Increases in core body temperature due to stress induced hyperthermia is found in a large variety of species encountering various stressful stimuli [28]. Rectal temperature seems to be the most accurate method for measuring core body temperature both in humans and animals [29,30]. Salivary cortisol level testing has become a well-established method for studying both psychological and physical stress responses [16,31–33] and welfare in canine species [34–36] due to pronounced HPA axis activation. Salivary cortisol correlates well with plasma cortisol values [31,37]. When the saliva samples are collected within 4 min from the start of collection, there should be no significant effect of handling on measured cortisol concentration [38].

Physiological reactions to stressors are often accompanied by behavioral manifestations [15,16]. Even though there is a high inter-individual variability in stress–related behaviors, increased locomotor activity, panting, lip licking, tongue flicking, yawning, paw lifting, shaking, vocalization and lowered body posture have been identified as potential indicators of stress in dogs [15,16,32,33,39,40].

Interactions between humans and dogs involve various types of sensory stimulation such as tactile, auditory, visual and olfactory stimuli. Several studies provide evidence for a positive effect of human social interactions on the physiology, behavior, and welfare of dogs by moderating the SAM and HPA response. It has been shown, that tactile stimulation alone is sufficient to decrease cardiovascular response [18,41–43] and cortisol levels [44] while petting and talking increase oxytocin levels [45–47] in dogs. Moreover, affiliative interactions in a form of petting, talking, playing and obedience training have been found to reduce physiological and behavioral stress responses in both short [44,48,49] and long-term shelter-housed dogs [50,51].

In this context, the aim of the present study was twofold. Primarily, we aimed to investigate whether designed experimental conditions represented a stressful experience for dogs. We hypothesized that measured behavioral and physiological indicators of stress in dogs would increase during the veterinarian examination. Therefore, we compared behavioral and physiological stress indicators in dogs before, during and after a clinical examination. Secondly, we aimed to explore whether owner-dog affiliative interactions (petting and talking) affected behavioral and physiological indicators of stress in dogs during the examination. We expected that this interaction during the examination would attenuate the physiological and stress behavior responses in their dogs. Furthermore, we examined the effect of testing order on the behavior and the physiology of the dogs, to control the impact of sensitization or habituation. In addition, we investigated whether the duration of owners' tactile and verbal interactions affected the behavioral and physiological indicators of stress in their dogs. We anticipated that the duration of owner-dog interactions would positively affect the behavioral and physiological stress responses in dogs.