Comparison of learning effects and stress between 3 different training methods (electronic training collar, pinch collar and quitting signal) in Belgian Malinois Police Dogs

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SUMMARY

Application of aversive stimuli in training, in particular via electronic training collars, is a highly controversial issue. The aim of the present study was to evaluate stress and learning effects of 3 different training methods, i.e. electronic training collar, pinch collar and a conditioned quitting signal in dog training organized in 3 sessions. In order to assess stress effects of the training methods, salivary cortisol concentrations and behavioural reactions of 42 police dogs of the breed Malinois were measured. The electronic training collar induced less stress and had stronger learning effect in comparison to the other methods in a training situation which required high motivation in case that proficiency of dog trainer is proved. It was also noted that quitting signal was markedly stressful in dogs. In the present study, however, theoretical and practical knowledge of each dog trainer could not be achieved during the assessment of pinch collar as well as quitting signal. Therefore, the findings of the study lead to the conclusion that debates over effectiveness of training methods should include not only the training aids but also the qualification of the trainer.

Keywords: Dog training, Malinois, electronic training collar, pinch collar, quitting signal, learning, behavioural reaction, stress, salivary cortisol.

RÉSUMÉ

Comparaison de 3 méthodes d'entrainement (collier électrique d'entrainement, collier d'étranglement et signal d'abandon) sur l'apprentissage et le stress chez les chiens de police malinois

Durant l'entrainement, l'application d'un stimulus de répulsion, notamment par le biais d'un collier électrique, est une méthode hautement controversée. Le but de cette étude a été d'évaluer les effets de 3 méthodes différentes d'entrainement, collier électrique, collier d'étranglement et signal d'abandon, sur l'apprentissage et le stress durant un exercice d'entrainement de chiens de police organisé en 3 sessions. Pour déterminer le niveau de stress induit, les concentrations de cortisol salivaire et les réactions comportementales ont été mesurées sur 42 chiens de police de race malinois. Dans le cas où l'efficacité du dresseur est certifiée, le collier électrique a induit un stress moins important et un meilleur apprentissage que les autres méthodes durant un exercice d'entrainement requérant une forte motivation. Il est à noter aussi qu'un signal d'abandon s'est avéré particulièrement stressant chez les chiens. Cependant, dans l'étude présente, les connaissances théoriques et pratiques de chaque propriétaire n'ont pas pu être évaluées lors de l'utilisation du collier d'étranglement ou de la mise en œuvre du signal d'abandon. Cette étude conduit à la conclusion que l'évaluation globale des méthodes d'entrainement doit tenir compte non seulement des outils utilisés mais aussi de la qualification de l'entraineur.

Mots clés : Chien, entrainement, Malinois, collier électrique, collier d'étranglement, signal d'abandon, apprentissage, réaction comportementale, stress, cortisol salivaire.

Introduction

In recent years, a controversial debate has emerged over the use of punishment in dog training. On one hand, some authors claim that with respect to producing physical damage to the skin and/or the body, electronic training collars are relatively safer than the mechanical training aids [9, 12] and, further, they have no adverse effects at all [4]. Opponents, on the other hand, argue that the use of electronic training collar is painful, unethical and unnecessary regardless of the severity of the training situation or problem behaviour [3, 13]. There are some scientific researches examined effects of electronic training collars in the area of dog training. The studies conducted by SCHILDER and VAN DER BORG [17] and SCHALKE *et al.* [16] conclude that electronic training collars can be used in accordance with animal protection principles if only the following criteria are met: The user must have sufficient practical and theoretical knowledge of these devices and must have undergone a test showing his capability to use them. Nevertheless, even if these criteria are met, the devices can only be used in specifically designed training situations [16, 17]. All in all, both scientific studies conclude that alternative training methods imply less stress on the animal, thus they comply with animal protection policies. Up until now, however, no scientific research has been conducted which could prove this hypothesis. Therefore, a comparative statement about the stress arising from training methods considering animal welfare has not yet been made.

There are different examples in the literature studying salivary cortisol values and behavioural indicators for the assessment

of acute stress in animals [1, 11]. According to BEERDA [1], non-invasive sampling methods must be used to assess stress in animals since those methods have minimal influence on the results. He further emphasized the necessity of using a physiological parameter concomitant with behavioural parameters in order to support the interpretation of the behavioural data when assessing stress. Therefore salivary cortisol values and direct behavioural reactions of the dogs were evaluated as stress parameters in the present study. Several researchers reported a number of different behavioural indicators of acute stress in dogs, which comprise lowering and arching of the body [1, 7, 18], flattening ears [1, 7, 18] and lowering the tail and/or holding the tail tightly between the legs [1, 18] when the dogs are confronted with the aversive situation. In the present study, the aim of the test design was to determine acute stress arising from the training methods. Thus, above mentioned behavioural elements were evaluated as acute stress parameters.

The aim of this study was to investigate whether any stress is caused by the use of specific conditioned signal, quitting signal, and/or pinch collars and if they do so, whether the stress produced in the process is comparable to the one with electric training collars. Corrections made by pinch collar and electronic training collar were considered as representatives of the positive punishment while correction made by the quitting signal was considered as the application of the negative punishment. In this context, positive punishment refers to an application of an aversive stimulus as a consequence of an undesired behaviour and negative punishment connotes the prevention or withholding of the delivery of an appetitive stimulus in case that the undesired behaviour occurs [15]. We set out to investigate the direct behavioural reactions and salivary cortisol values of the dogs upon administration of above mentioned training methods. We were especially interested in finding out which method leads to less stress in dogs during training with high level of arousal. Furthermore, this study examined the learning effects of the electronic training collar, the pinch collar and the quitting signal. Thus, the compatibility of the learning effect of ''negative punishment'' method with the ''positive punishment'' method, in a training with high level of arousal and motivation were also be assessed.

Material and Methods

SUBJECTS AND TEST PERSONS

Forty-two adult police dogs of both genders (33 males and 9 females) and varying ages (3-10 years old) of the breed Malinois (Shorthaired Belgian Sheepdog) served as subjects for this study. All dogs in the study were official police service dogs and recruited from two different police departments in Germany. The decision to use only Belgian Malinois was employed in an attempt to avoid the variability due to breed characteristics. During the study, dogs participated the sessions with their own handlers.

All tests were conducted on open air training grounds which were also used for routine police dog training. In order to obtain the standardization in respect to the test area, each dog was tested on the same place where it started to be tested during the entire experiment.

Two test instructors were present during the entire experiment. The main responsibilities of the test instructors were the observation and control of the test sessions. Additionally, two experienced canine officers who were also professional dog trainers took part in the study as decoys. The main responsibility of the decoys was provoking the dogs during the test sessions in order that the dogs make a mistake. Another responsibility of the decoys during this study was the administration of the electronic training collar. During the sessions in which the electronic training collar was tested, they held the receiver of the collar and gave the electric impulse whenever the dog made the mistake. Each of the helpers provoked one group during the whole experiment. The aim of using the same person as decoy for all dogs in the same group was to minimize the variability arising from the provocation style and, also, to the decoy himself.

Each training method used in this research required a proper training aid. Dogtra 600 NCP/2® electronic training collar, Klickstachelhalsung® pinch collar, the standard normal collar and the 5 m long leash were used as training aids.

EXPERIMENTAL DESIGN AND TESTS

In the current literature, it was cited that there are differences in response to aversive stimulus between individuals [8, 19]. LINDSAY [12] additionally suggested that in order to amplify the statistical results in studies in which the electronic training collar was tested, "within subject design" must be applied since individual variables can cause incorrect data. Therefore, in the present study ''within subject design'' was applied as experimental design for comparison of stress and learning effects of the different training methods. Namely, each training method was tested on each dog on different days during the research. In order to eliminate the effects of the administration orders of the training methods on the results, six subgroups, A, B, C, D, E, F, were established, to each of them a different administration order of the training methods was applied (randomized cross-over design, Table 1).

Subgroups	1st test day	2nd test day	3rd test day
A	Q	E	P
B	Q	P	E
C	E	Q	P
D	E	P	Q
E	P	Q	E
F	P	E	Q

Q: Quitting signal, P: Pinch Collar, E: Electronic Training Collar.

TABLE I: Cross-over design of the study conducted in order to compare 3 different learning methods (electronic training collar, pinch collar and quitting signal) in Belgian Malinois police dogs.

Prior to the main experiment, since 7 dogs had never been trained with the electronic training collar before, an adaptation phase, which lasted six weeks, was conducted for them. For the adaptation phase, the dogs carried the electronic training

collars during the normal daily training routine. The same procedure was applied for the rest of the dogs for a week since they were already familiar to the electronic training collar. This procedure was conducted in order to achieve habituation of the dogs to the device again since the electronic training collars are forbidden in Germany since 2006.

Quitting signal is a conditioned signal which evokes feeling of frustration in dogs since it has a meaning of withdrawal of the reward. The main principle of the quitting signal is to condition a feeling of frustration, and thus, to abandon of a distinctive behaviour towards a specific signal. In order to participate in the experiment, the dog should withdraw itself from the toy immediately after the first instruction of the signal. Before the main experiment started, quitting signal training procedure was completed and the signal was tested on each dog.

The main experiment took three test days for each dog. The time interval between test days was one week. On each test day, a different training method was tested on the dog. Maximal three main test sessions were conducted for each dog per day to test the concerning training method. Learning effect of training methods was evaluated considering these three sessions. Regardless of which method was tested, each dog carried three collars around its neck, which were standard, pinch and electronic training collars, during the entire experiment in order to ensure the standardization among the training methods. The dogs were brought to the training area with a leash on standard collar and were kept on the leash throughout the entire experiment.

Before conducting the main test, two different sessions were performed with each dog, which were obedience and play sessions. During the obedience session, the dog did some obedience exercises for eighty seconds. This session brings the dog to a certain level of arousal, so that the optimal results could be achieved at the main test. After the obedience session, a standardized play session, which lasted for forty seconds, was carried on. In the play session, the handler played freely with his/her dog. The goal of performing the play session between the obedience- and test sessions was to avoid misevaluation of extra-stress caused by frustration. At the end of the two minutes, the dog and its handler came to the determined point at which they took up the heel position. After the dog and its owner took up the heel position with their backs turned to the entry of the test area, the decoy with a protection sleeve and a whip in his hand entered the test area. As soon as the handler took his position up at a distance of approximately 3 m from the dog and the handler, the owner gave the "Heel" command to his/her dog and started to walk by the decoy (figure 1). From that moment on, the decoy tried to provoke the dog in order that it made a mistake. As the dog made the mistake, the training method which would be tested was administered. As testing the quitting signal, the handler used a 5 m long leash. The first reason of using 5 m long leash for the quitting signal was to allow reaction time for the dog handler and also for the dog and, thus, to be able to evaluate clearly whether the dog stopped due to the influence of the collar or to the signal. The second reason was to be sure that the dog could not reach the decoy and, thus, it could not get rewarded by being able to catch him.

As mentioned before, the training method which would be tested was administered as the dog made the mistake. If the
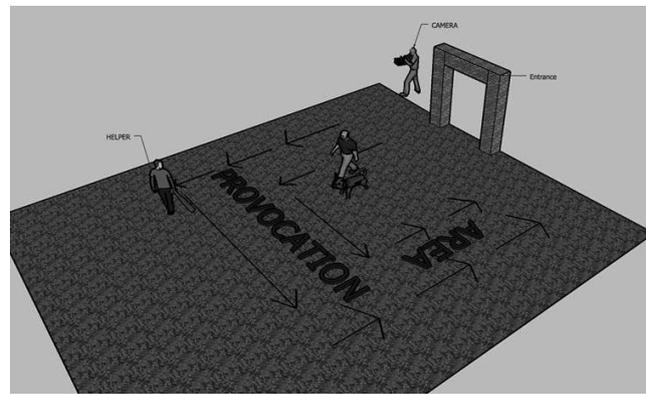

FIGURE 1: Test situation for comparing 3 different learning methods (electronic training collar, pinch collar and quitting signal) in Belgian Malinois police dogs.

dog abandoned the undesired behaviour reliably after the correction, the same test procedure was repeated after an hour in order to see whether the method had a learning effect. During the repetition of the test, the same procedure as in the first test was carried out. The decoy did exactly the same provocation against the dog. If the dog did not repeat the same mistake, the test session was terminated and it was noted that the method had a learning effect. In case that the dog showed a reaction against the decoy again, the test was repeated after an hour for the last time. If the dog did not abandon the undesired behaviour reliably after the first correction, the handler and the dog left the test area and no repetition session was conducted.

MEASUREMENTS

Salivary cortisol measurements

Salivary cortisol concentration was measured as one of the stress parameters. The saliva samples were obtained from the dogs with cotton buds manufactured by Salivettten® der Firma Sarstedt AG & C. Each dog handler took the saliva sample from his/her own dog. In order to stimulate the secretion of saliva, citric acid (Amos Vital Vitamin C Pulver der Firma Amos Vital GmbH) had been put into the dogs' mouths before the saliva samples were collected. Following samples were measured during the research:
- Resting samples: Two samples were taken with one hour interval in a home environment.
- Basal samples: The same procedure as in the main experiment without any intrusion of the decoy was conducted. The dogs were brought to the training ground. The decoy stood still at a distance of approximately 3 m from the dog and its owner. However, the owner was not allowed to apply any punishment to the dog if it made any mistake. The saliva samples were collected at 5, 10 and 15 minutes after the dogs leaving the training ground and the cortisol values were recorded as basic values.
- Experimental samples: The saliva samples were collected at 5, 10 and 15 minutes after the administration of the concerning training method. The investigation of the samples was carried out in the laboratory of pharmacology and toxicology

at the University of Veterinary Medicine Hanover. For the measurement, enzyme-linked immunosorbent assay (ELISA) kits (IBL®) were used.

Behavioural observations

The entire experiment was filmed on DVDs using a video camera. The recorded DVDs were reviewed later in order to analyze the direct behavioural reactions of the dogs after the administration of the training methods. The direct reactions of the dogs were evaluated using an extensive ethogram. One-zero sampling method was used in order to assess the direct behavioural reaction of the dog upon the administration of the above mentioned methods.

STATISTICAL ANALYSIS

Data analysis was performed with SPSS 16.0 Inc. software. Two significance levels were set at the levels 95% (*P<0.05***) and 99% (*P<0.01**). Kruskal-Wallis tests were used for the comparison of the learning effect of the training methods between groups and subgroups. Learning effects between the training methods as well as the saliva cortisol concentrations were analyzed by paired-sample t-tests. Frequency analyses have also been used for the detection of direct behavioural effects of training methods.

Results

LEARNING EFFECTS

As shown in figure 2, with electronic training collar, the method had learning effect on 39 of 42 dogs. In other words, at the end of the experiment the wrong behaviour was abandoned in 39 out of 42 dogs. With pinch collar, learning effect was obtained on 32 of 42 dogs, that is, 32 dogs abandoned the misbehaviour at the end of pinch collar part of the experiment. Four dogs could be tested for the learning effect of the quitting signal since the other 38 dogs did not reliably quit the behaviour after the instruction of the signal. In fact, the signal had learning effect on only 3 dogs out of 42 subjects. The learning effect was maximal with electronic training collar, not significantly compared to the pinch collar (*P = 0.160*) but significantly compared to the quitting signal (*P < 0.0001*). In parallel, the learning effects of the pinch collar were also significantly higher than those obtained with the quitting signal (*P < 0.0001*). Considering learning effect of the training methods, no significant difference was found between subgroups.

DIRECT BEHAVIOURAL REACTIONS

In order to determine the direct effects of the training methods, the reactions of the separate ear, tail and joint parts as well as the vocalizations of the dogs were considered. Considering the behavioural reactions against the methods, no statistically significant difference was found between the subgroups.

In reaction to the electronic training collar, 38.1% of the dogs showed "maximum backward ear position" whereas
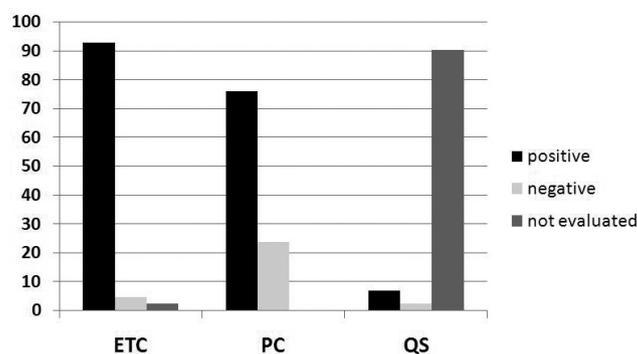

FIGURE 2: Learning effects of the 3 different learning methods (electronic training collar (ETC), pinch collar (PC) and quitting signal (QS)) in Belgian Malinois police dogs.

64.3% of the dogs exhibited this typical reaction after corrected by the pinch collar, but the difference between the 2 methods was not statistically significant. No statistically significant difference was found in comparison for the tail reactions (lowering) between the electronic training collar and the pinch collar (t-test, *P = 0,165*). Comparing the first joint reactions of the dogs to the pinch- and the electronic training-collar, it was found that the correction applied by the pinch collar caused lower body posture than the one applied by the electronic training collar (figure 3). Moreover, 4.8% of the dogs exhibited "extreme lowering of body posture" as a reaction to the pinch collar, while this reaction was observed in none of the dogs using the electronic training collar. Dogs elicited vocalizations more frequently as a reaction to the electronic training collar than to the pinch collar (*P < 0.0001*) (figure 4). As mentioned above, only 4 dogs out of 42 subjects abandoned the behaviour after receiving the quitting signal during the first session. Therefore, only the reactions of these 4 dogs were tested. Consequently, it was observed that 2 dogs showed "backward ear position" and 1 dog showed "extreme lowering of body posture" together with the "crouching" after getting the correction.
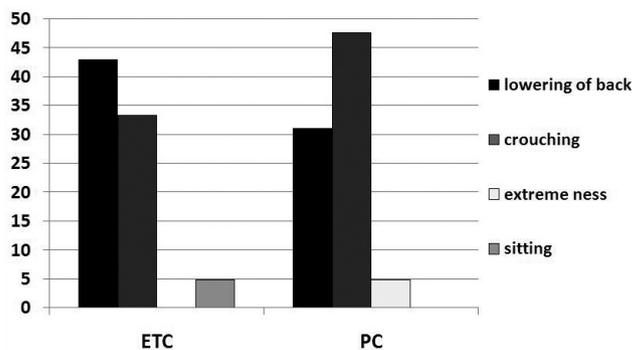

FIGURE 3: Comparison of the first joint reactions to the electronic training collar (ETC) and the pinch collar (PC) in Belgian Malinois police dogs.

SALIVARY CORTISOL MEASUREMENT

The highest cortisol concentration was evaluated in each dog after the administration of the each training method. A

total of 17 dogs showed maximal cortisol values after the instruction of the quitting signal, while 15 and 10 dogs exhibited maximal hormone concentrations after administration of signal with electronic training collar and with pinch collar, respectively (figure 5). To have a better comparison, relative cortisol values established as difference between maximum cortisol values and resting cortisol values were compared. Both relative cortisol values after the administration of the pinch collar (*P = 0.0004*) and the electronic training collar (*P = 0.0065*) were significantly lower than the relative basal value. No statistically significant difference was found between the relative basal cortisol value and the relative cortisol value after the instruction of the quitting signal. However, no significant difference was found between electronic training collar and pinch collar or quitting signal (*P = 0.2006* and *P = 0.1782*, respectively) while the relative cortisol value after the application of quitting signal was significantly higher than after the application of pinch collar (*P = 0.0294*). As a result, the highest cortisol concentrations were measured after the instruction of the quitting signal (figure 5). In addition, considering the relative cortisol values, no significant difference was found between the subgroups.

Discussion

The results of the present study showed that the electronic training collar as well as the pinch collar was convenient as training aids to cease the unwanted behaviour. The electronic training collar was, however, found to be more effective in comparison to the pinch collar. By contrast, the desirable learning effect could not be achieved in application of the quitting signal. The reason of obtaining high learning effect with electronic training collars might be due to the fact that the device fulfils the essential punishment criteria such as timing and sensitive adjustment, which the learning theories require [1, 6, 14, 16, 20]. In case an appropriate device is chosen, the electronic training collar gives possibility of making a sensitive adjustment for the level of punishment. In the present study, the dose of the stimulus was reliably adjusted for each dog by two proficient dog trainers. These dog trainers were also responsible for administration of the electronic training collar. Thus, the correct timing was obtained. On the other hand, while using

pinch collar, it is difficult to achieve a sensitive adjustment, as factors such as strength and motivation of the handler are essential for the effectiveness of the mechanical training devices [10, 12, 20]. In addition to that, the pinch collar had to be administered by the dog handlers themselves. That obligation might also cause different results since the ability of each dog handler in timing and application of the method was different. An explanation for the low learning effect of quitting signal is similar to that of pinch collar. Since the dog handler applied the method, the optimal timing could not be achieved for each dog. Moreover, as using the conditioned quitting signal, feeling of frustration upon application of the signal might not be as strong as the feeling arised during the provocation of the decoy in most of the dogs.

One of the goals of the present study was to compare the direct behavioural reactions of the dogs to three different training methods. Considering the body posture and ear positions, pinch collars seem to induce more behavioural reactions, in the form of distress, than the electronic training collar However, the maximal cortisol values after the administration of electronic training collar were higher, but not significantly, than that after application of pinch collar. This contradiction between physiological and behavioural measures support the hypothesis that behavioural responses are not always concomitant to physiological parameters in case of exposing to stress [5, 21]. Furthermore, it might also support the claim that in a study involving highly exciting training sessions such as police dog training, the behavioural data is more reliable than the physiological measures such as cortisol concentrations and heart-rate frequency [17].

Within the frame of the study it was detected that more vocal reactions were elicited by the electronic training collar than by the pinch collars. The explanation of more vocalizations with electronic training collar might be that these vocal reactions are elicited as "startle reactions" [2] rather than "pain-induced vocalizations". Visibility of the punishment as in the application of the pinch collar can cause that the dog reacts in different ways according to the cues given by the handler subconsciously, such as facial expression, body language, holding style of the leash etc.. That is, the application of the pinch collar as well as of the quitting signal is directly linked to the handler since the correction made by the owner
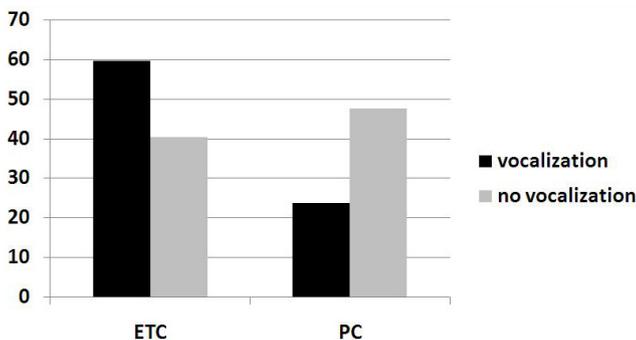

FIGURE 4: Vocal reactions to the electronic training collar (ETC) and the pinch collar (PC) in Belgian Malinois police dogs.
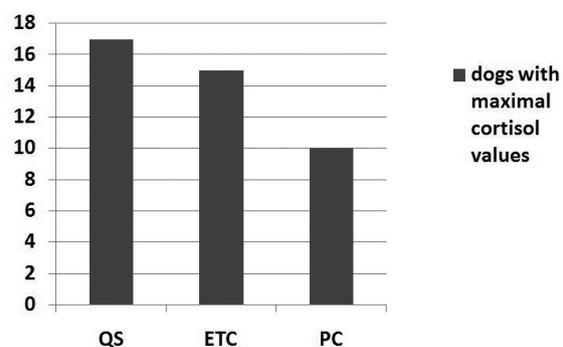

FIGURE 5: Number of the dogs with maximal cortisol values per learning method (electronic training collar (ETC), pinch collar (PC) and quitting signal (QS)).

is visible to the dog. Furthermore, the feeling of the leash on the pinch collar could be a signal for the dog as forthcoming punishment, whereas no signal could be perceived by the dog while testing the electronic training collar. All those associations the dog makes between the punishment and the owner are undesirable in training since the dog can show a submissive communication with its owner if it perceives that the punishment comes from him/her. On the other hand, as applying the electronic training collar, if exact timing is obtained, the dog makes association only between the situation and the effect. In fact, this might be another explanation of the high learning effect of the electronic training collar.

Considering the maximum cortisol concentrations, it was evaluated that most of the dogs exhibited maximal values after the instruction of the quitting signal. It was further detected that even the dogs on which the quitting signal had learning effect exhibited clear stress related behaviours. This point is noteworthy since this result raises an important question about whether the psychic stressors such as frustration and uncertainty produce more stress than the physical exposures in animals. The significant difference found between the quitting signal and the pinch collar supports this hypothesis, at least for the dogs of Malinois breed. Considering the relative cortisol values, the basal values were significantly higher than the values obtained using the electronic training collar and the pinch collar. As mentioned above, no correction was applied on dogs even though they made a mistake before the collection of basic value. This uncertainty might cause a high stress just as the feeling of frustration during the use of quitting signal.

As a conclusion, in the present study, it was found that the electronic training collar had higher learning effect and induced less stress to cease the unwanted behaviour in comparison to the other training methods in a situation with high motivation. However, for achieving this result, it is essential to prove the administrator's practical and theoretical knowledge. Overall, the debates over training methods should include not only the specific training aids but also their significance for animal welfare prospect should be covered. The qualifications of professional dog trainers such as practical and theoretical knowledge requirements that trainers must fulfil should also be considered in new discussions. Therefore, we strongly recommend to put more emphasize on qualification of the trainer when assessing the effectiveness of training methods. We finally recommend that further studies should be performed to investigate whether the same findings could be achieved with the dogs of other breeds.

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