ORIGINAL ARTICLE

Influence of gender, neuter status, and training method on police dog narcotics olfaction performance, behavior and welfare

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ABSTRACT

Objective: This study was carried out to study the influence of gender, neuter status, and training method on police dog narcotics olfaction performance, behavior, and welfare.

Materials and Methods: A total of 120 German Shepherds aged 1–3 years were used for this study. The dogs were separated into two experiments. The first experiment (32 dogs and 28 bitches) was used to study the influence of gender on olfaction and smell to narcotics in police dog performance and training methods with behavioral problems and welfare. The second experiment (30 dogs and 30 bitches) was used to study the influence of sexual status (entire or neutered) on the smelling of narcotics in police dog performance by comparing with intact dogs and bitches.

Results: We found that there were significant differences in sex in training to detect narcotics. Male German Shepherds were found to be significantly more trainable than females. Neutering causes a difference in trainability in male and female dogs. Gonadectomy had adverse effects on training. The intact male and female German Shepherds were found to be significantly more trainable than the neutered ones, and the reward-based method was found to be significantly more trainable than punishment. Dog training methods incorporated by punishment result in pain, suffering, emotional instability, symptoms of depression, aggression, unwanted barking, growling at other people, not under control all time, less trainability, increased problematic behavior, and decreased dog welfare.

Conclusion: Reward-based method is associated with lower lousy behavior and dogs with good behavior, such as, attachment attention behavior, dogs under the control of handler all times, higher trainability, less problematic behavior, and increased dog welfare.

Introduction

Trained dogs are used to detect the odor of narcotics for a long time. There are a few reports that have investigated the effect of canines on narcotics odor perception [1,2]. Domestic dogs (*Canis lupus familiaris*) are an essential tool for detecting narcotics due to the physical, behavioral, and olfactory understanding of dogs. Dogs used in the detection of scent marks are now used to detect narcotics [3]. Also, dogs are used for the determination of explosives [4–6]. The performance of dogs is well-known by the handlers and trainers without doing scientific experiments. The observed differences in determination of performance between individual dogs were related to behavioral

variations [6–9]. Interactions between handlers and dogs influence their welfare and performance [10].

The use of dogs is increasing rapidly for detection purposes [11]. The selection of working dogs depends on physical and behavioral abilities and performances in determining narcotics [7,10,12,13]. The differences between dog performances on detecting narcotics may be related to behavioral variations [7–10]. Castrated and uncastrated male dogs were compared on the effect of gonadectomy, but no relationship was found between neuter status and training [14,15]. Also, no variation was found in the training of neutered and uncastrated dogs, considering their excitability, fearfulness, and aggression.

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Uncastrated male dogs are calmer and more pleasant than neutered dogs [16–18].

A neutered male dog may show restlessness, abnormal, and aggressive behavior. Owners of castrated dogs frequently complain about their dogs showing fear behavior, pain, or more activity than those stated by the owners of uncastrated dogs. Intact dogs seemed to be calmer and less aggressive than neutered ones in certain aspects of behaviors. Flannigan and Dodman [19] and Zink et al. [20] reported that castrated dogs are highly excited and anxious than uncastrated ones. Most surveys and medical records illustrate that neutered dogs show separation anxiety and storms of fear than uncastrated dogs. Lorenz et al. [21] reported the relationship between dogs and humans, describing that castration depended on the choice preference to prevent reproductive diseases, and changing negative behavior. The objective of this research work was to study the impact of gender, neuter status, and training method on police dog narcotics olfaction performance, behavior, and welfare.

Material and methods

Ethical statement

This study was carried out in the Security and Guarding Dog Training Center, Cairo, Egypt. The protocol for the animal experiment was reviewed and approved by the Institutional Animal Care and Use Committee at Zagazig University.

Animals and housing

A total of 120 German Shepherds aged 1–3 years were used in two experiments. The first experiment (32 dogs and 28 bitches) was used to study the influence of gender on olfaction and smell to narcotics in police dog performance and training method with behavioral problems and welfare. The second experiment (30 dog and 30 bitches) was used to study the influence of sexual status (intact or neutered) on the smelling of narcotics in police dog performance by comparing with intact dogs and bitches used in the first experiment. Dogs were housed in a kennel (3.0 m length, 2.0 m width, and 2.5 m height). The wall of the kennel was covered from inside with ceramic and opened from the upper side for favoring ventilation and light entry during the day time. An electric light (lamp 60 watts) was provided during the night, and the kennel was sheltered with asbestos. The height of the kennel door was 2.5 m, which opened in to a pass way (60.0 m length and 2.0 m width) and the pass way was opened with another door that opened in to a fenced green yard of 4,200 m² with swings and agility training. The kennel floor was covered with ceramic and provided with a slatted floor system with a height of 20 cm the during winter, but was removed during the summer so that the dogs could sleep on the floor directly. Dogs and bitches were fed 500 gm of fresh cooked minced cow meat with soup and 750 gm of cooked rice served in a clean bowl twice daily, at 6:00 a.m. and 6:00 p.m. and in between variable amounts of dry food moistened with water. The dogs and bitches were allowed to move freely in the kennel, but during walking, playing, and training, they were secured with head collars. The dogs received walks and training for social enrichment twice daily. Animal identification was made by metal pieces on the dogs, which had the bitch or dog's name written on the head collar. The odor ID test procedure outlines 10 multiple-choice tests for determining the odor of narcotics used by dog practitioners and research scientists in multiple agencies all over the world. This set-up requires a handler and dog to walk down a line of numbered identical stainless-steel sample containers, which contain either an "interferent" odor that the dog must ignore or a "target" odor. There was a time limit of 10 min for the search dogs. After each test, to decrease the test time, all containers with non-target odors were collected together during testing, and two tins were placed randomly into the line. Any non-target odor was falsely detected, withdrawn, and changed by new non-target odors in a clean container. All containers were washed at the start and end of the tests.

Scoring

The mean frequency was evelauated for true sitting, false sitting, successfully detecting target material, failure to detect target material, good locomotor behavior, poor locomotor behavior, good sniffing and failure of sniffing (Fig. 1).

Behavioral observation

The observation was carried out visually by recording for 4 h per week (1-min interval per one-hour observation for each animal) using the focal sample technique, observation sheet, and stopwatch. The following behavioral patterns were observed for studying the effect of training method in the form of (a) reward (play, food, and praise) and (b) punishment (physical, vocal, and tugging back at the lead in heel training) on the occurrence of problematic behavior. The mean frequency of barking, aggression toward people, nipping, growling at dogs, fear in a few and many situations, excitement in a few and many situations, separation-related behavior,
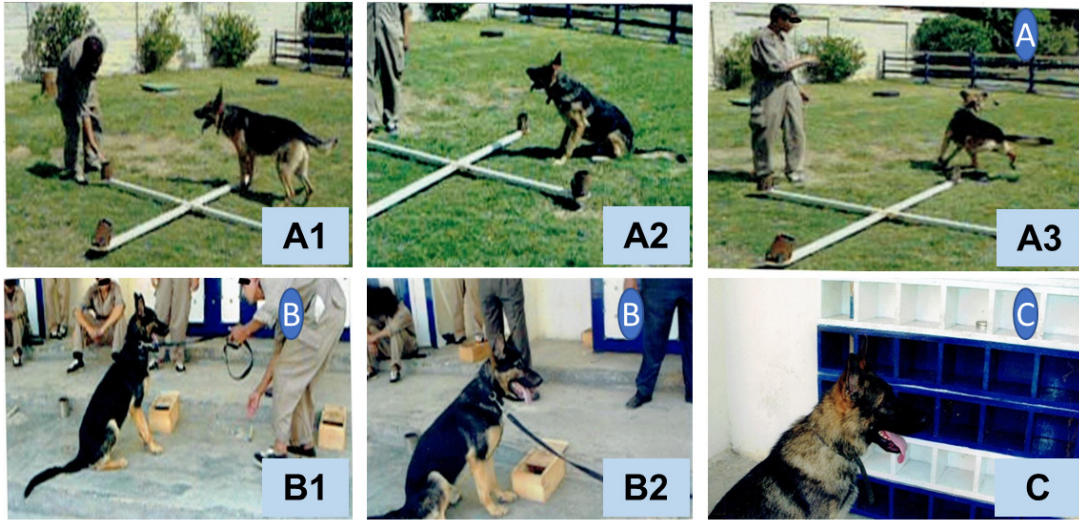
Figure 1. (A1) A handler ordering a police dog to search. (A2) The dog sniffs the odor of the target material and sits beside it. (A3) The handler throws the ball for the dog to retrieve it as a reward. (B1) The dog searches for narcotics inside the plastic pipe. (B2) The dog searches for narcotics inside a wooden box. (C) The bitch searches for narcotics inside the wooden box.
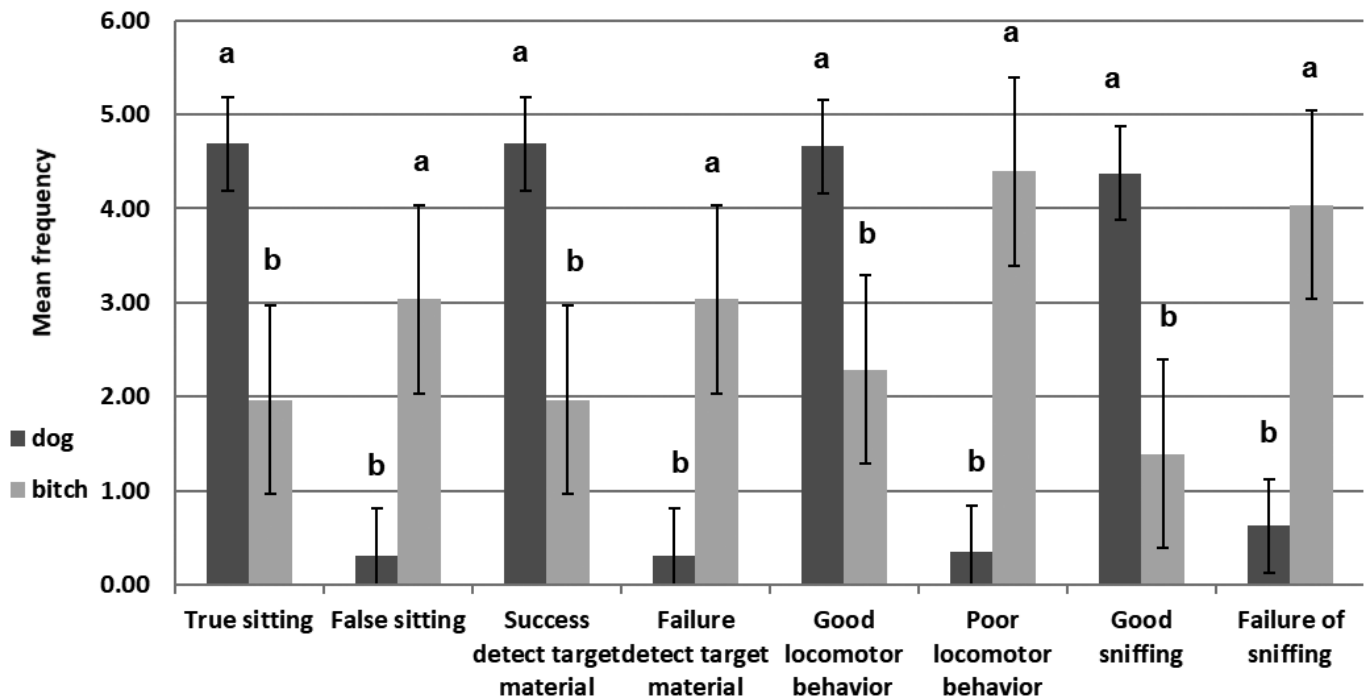

Figure 2. Influence of gender olfaction and smelling on narcotics in training detector police dog performance.

inappropriate mounting, repetitive behavior, and eating non-foodstuffs.

Statistical analysis

Data were analyzed statistically using t-test, with a value set at $p < 0.01$, as described by Tamhane and Dunlop [22].

Results

The results in Figure 2 show a significant sex difference in the detection of narcotics. Male German Shepherds were found to be significantly more trainable than females. The scores recorded for dogs were true sitting (4.69 ± 0.08),

false sitting (0.31 ± 0.08), successfully detecting target material (4.69 ± 0.08), failure to detect target material (0.31 ± 0.08), good locomotor behavior (4.66 ± 0.08), poor locomotor behavior (0.34 ± 0.13), good sniffing (4.38 ± 0.13), and failure of sniffing (0.63 ± 0.13). On the other hand, the scores for bitches were true sitting (1.96 ± 0.12), false sitting (3.04 ± 0.12), successfully detecting target material (1.96 ± 0.12), failure in detecting target material (3.04 ± 0.08), good locomotor behavior (2.29 ± 0.10), poor locomotor behavior (4.39 ± 0.09), good sniffing (1.39 ± 0.14), and failure of sniffing (4.04 ± 0.12).

The results in Figure 3 show that there were significant differences in sexual status on the trainability of police dog performance. The intact German Shepherd was found to be significantly more trainable than a neutered dog. The scores for the intact dogs were true sitting (4.63 ± 0.08), false sitting (0.36 ± 0.08), successfully detecting target material (4.63 ± 0.08), failure to detect target material (0.36 ± 0.08), good locomotor behavior (4.00 ± 0.13), poor locomotor behavior (1.00 ± 0.13), good sniffing (4.00 ± 0.13), and failure of sniffing (1.00 ± 0.11). On the other hand, the scores for the neutered dogs were true sitting (1.40 ± 0.10), false sitting (3.60 ± 0.10), successfully detecting target material (1.40 ± 0.09), failure to detect target material (3.60 ± 0.09), good locomotor behavior (1.83 ± 0.13), poor locomotor behavior (3.16 ± 0.09), good sniffing (0.36 ± 0.13), and failure of sniffing (4.63 ± 0.08).

The results in Figure 4 show that there were significant differences in sexual status on the trainability of police dog performance. The intact German Shepherd bitches were found to be significantly more trainable than neutered bitches. The scores of intact bitches were true sitting (4.06 ± 0.09), false sitting (5.36 ± 0.09), successfully detecting target material (3.30 ± 0.1), failure to detect target material (1.70 ± 0.1), good locomotor behavior (3.03 ± 0.13), poor locomotor behavior (1.96 ± 0.13), good sniffing (3.00 ± 0.11), and failure of sniffing (2.00 ± 0.11). The scores of neutered bitches were true sitting (0.63 ± 0.1), false sitting (4.36 ± 0.11), successfully detecting target material (0.63 ± 0.11), failure to detect target material (3.20 ± 0.13), good locomotor behavior (1.20 ± 0.07), poor locomotor behavior (3.80 ± 0.07), good sniffing (0.40 ± 0.09), and failure of sniffing (4.60 ± 0.09).

The results in Table 1 show a significant increase in problematic behavior in the case of dogs with training techniques under punishment compared to dogs with training techniques under reward.

Discussion

The use of dogs in police service has decreased the time and increased the frequency of finding narcotics. The police dog is a highly useful tool used in more than 30 different tasks [23,24], for example, the ability of dog to detect narcotics by its olfactory ability. However, there is a wide variation
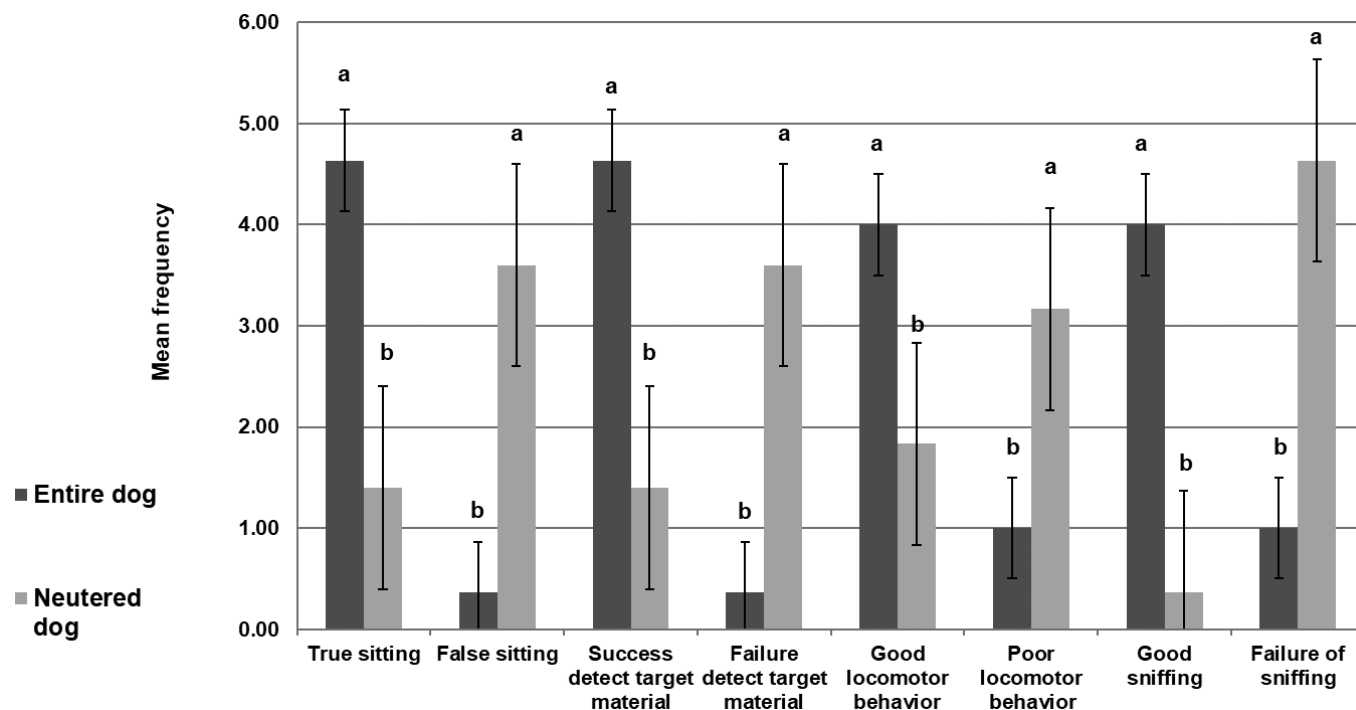

Figure 3. Influence of dog sexual status olfaction and smelling on narcotics in training detector police dog performance.
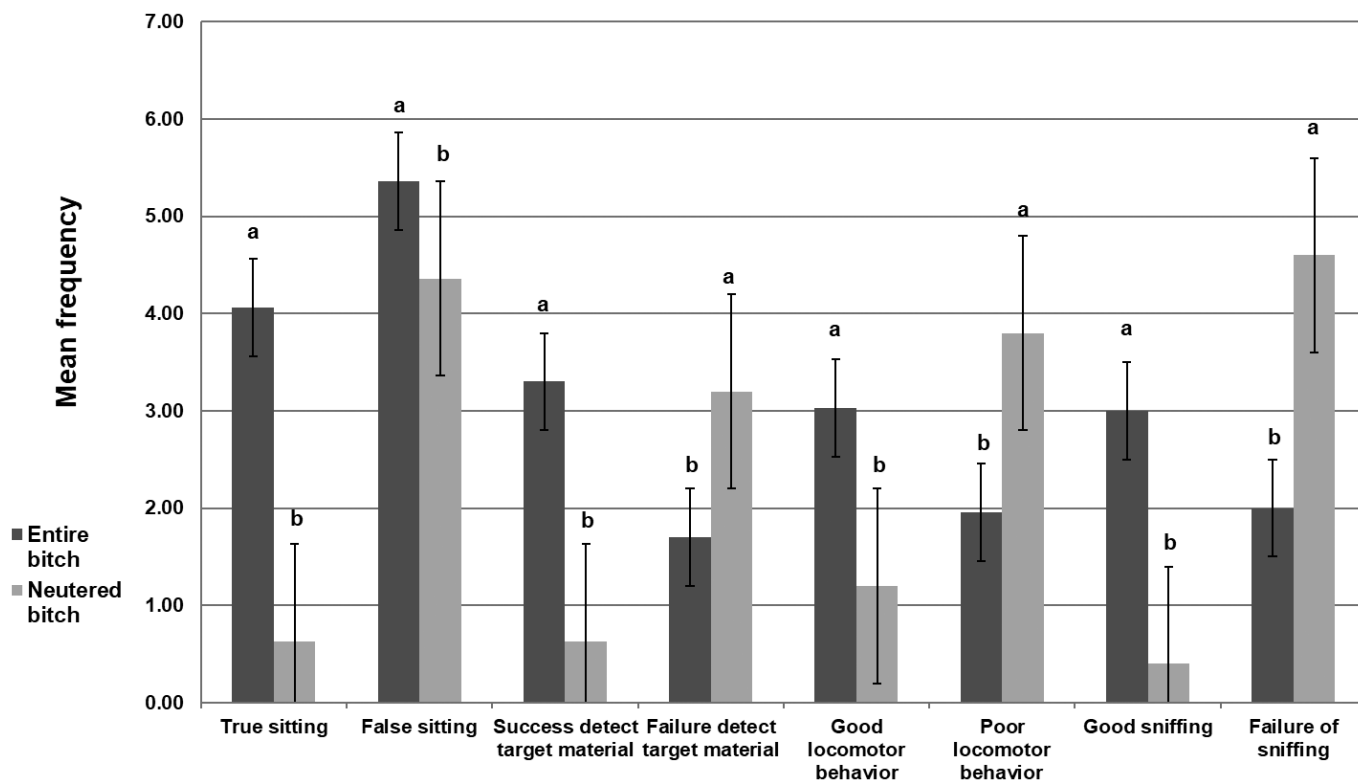
Figure 4. Influence of bitch sexual status on olfaction and smell to narcotics in training detector police bitch performance.

Table 1. Influence of training methods with problematic behavior and welfare on olfaction and smell of narcotics in police dog performance.

Problematic behavior	Training techniques	
	Reward	Punishment
Barking at people	1.50 ± 0.13b	10.40 ± 0.15a
Barking at dogs	1.70 ± 0.16b	12.46 ± 0.17a
Aggression toward people	1.43 ± 0.11b	10.80 ± 0.13a
Nipping	1.30 ± 0.08b	4.13 ± 0.13a
Growling at dogs	1.96 ± 0.14b	11.36 ± 0.15a
Fear in a few situations	1.33 ± 0.08b	10.83 ± 0.07a
Fear in many situations	1.46 ± 0.11b	7.83 ± 0.14a
Excitement in a few situations	1.53 ± 0.11b	11.23 ± 0.17a
Excitement in many situations	1.46 ± 0.09b	11.13 ± 0.16a
Separation-related behaviors	1.33 ± 0.08b	11.40 ± 0.22a
Inappropriate mounting	1.26 ± 0.08b	12.06 ± 0.14a
Repetitive behavior	1.26 ± 0.08b	14.53 ± 0.25a
Eating non-food stuffs	1.20 ± 0.07b	12.26 ± 0.18a

Means in the same row with different superscripts are significantly different at $p \leq 0.05$.

in performance. This difference is associated with gender, neuter status, and training method of dogs [25]. Males scored higher than females on trainability performance, in

which sex differences were related to particular traits, like aggression and cooperative behavior [26,27].

On the other hand, It was reported that dogs scored higher in activity levels than bitches [28,29]. The general activity incidence due to differences in traits correlated with the motor activity, such as searching for narcotics [14,19]. Male German Shepherds were found to be significantly more trainable than bitches [30]. On the contrary, bitches were easier to control, which might be due to their small size, and less aggressive behavior [31,32]. This was important if the dog lived in a home or kennel environment, where contact with other dogs is inevitable [9,31]. While there were many parameters for choosing the sex of the dog in training, it is essential to note that individuals may not have the characteristics that resemble their sex. Regardless of sex, breeding is not intended; dogs should be de-sexed [31]. DeGreeff et al. [33] reported that narcotics detection performance of dogs differed on an individual basis. However, the abilities may differ based on the differences in training method, experience, breed, gender, and other many factors.

Male dogs scored higher than females for defense drive and hardiness. On the contrary, females scored higher in cooperation and lower levels of aggression toward other dogs [34]. Male German Shepherds gain more abilities to defense- and prey-driven activities and courage [34,35]. In this study, male German Shepherds scored significantly higher in training and

performances as compared to females. Also, intact male dogs are more useful for performing task as compared to neutered male dogs. This might be due to the castration that has negative influence on the behavior of dogs.

The dogs showed more anxious behavior after neutering than intact ones because they are denied their ability to discover their surroundings and destroying objects. Zlotnick et al. [36] suggested an effect of dog castration on behavior, health, and training of service dogs. In another study, it was found that gonadectomy of trained male dogs caused them to become more aggressive than a trained female dog [37]. Matos et al. [38] found that the castration of trained dogs caused them to show more aggressiveness toward trainers; especially, trained male dogs showed more aggressiveness toward trainers. On the other hand, intact trained male and female dogs were lower in showing aggression and biting during training than castrated trained dogs [39]. Lorenz et al. [21] illustrated that castrated trained dogs were less confident and highly anxious than uncastrated trained dogs during contact with other trained dogs and more anxious toward intact female trained dogs. Punishment is not only painful but also causes frightening behavioral problems of dog [40,41]. Giving training to dogs is difficult for the trainer when force is used for controlling their behavior by exerting harmful, physical, and psychological effects [42,43]. Punishment can badly influence the dog's performance by affecting problem-solving behaviors, increasing pain and sufferings, causing emotional instability, showing symptoms of depression, aggression, unwanted barking, and growling at other people [44–47]. Dogs with reward training are more willing to put in a novel task and are successful at problem-solving.

On the other hand, the dogs that received punishment during their training period engaged easily in the novel task and turned to their handler quickly with a novel situation. The dogs trained by giving rewards showed minimum undesirable behaviors. As a result, the dogs showed positive behavior and good attentions toward their handlers [48–52]. A successful dog and handler team found that the training method by reward made dogs more trainable than punishment [53]. The narcotics detection by the dog through rewarding during training, but not punishment, increases the incidence of success, which is also made by the team's relationship between dog and handler [34,54]. In the current study, we found behavioral problems as a result of giving punishment to the dogs during training.

The influence of training on dog behavior has been studied by several authors [55–57], who found a negative influence of training methods on the behavior of trained dogs, leading to behavioral problems and obeying commands with less behavioral problems. The dogs with aggression toward owners respond less to the commands of their trainer [57,58]. Podberscek and Serpell [58] found a link between the type of training method and the appearance of undesirable behavior in dogs. Blackwell et al. [57] and Arhant et al. [59] found a negative correlation between training and unfriendly behavior toward both familiar and unfamiliar persons. It was found that giving punishment and reward technique would have resulted in the highest mean frequency of aggression due to the inconsistency technique.

Conclusion

It is concluded that gender has significant differences in narcotics detection trainability performance. Male German Shepherds are significantly more trainable than females. Intact dogs and bitches of German Shepherd breed are significantly more trainable than neutered dogs and bitches. The reward-based method is significantly more advantageous than punishment. The reward-based method is accompanied by less bad behavior, more good behavior, and an alert character at all time with attention behavior, correlated, obedient toward the handler, more trainable, lower lousy behavior, and more dog welfare. It is recommended to avoid gonadectomy of dogs used for the detection of narcotics. Using an odor ID test is useful to increase dogs' ability (good or poor) to detect narcotics and to decrease incorrect trail (pass or fail).

Conflict of interest

The authors have declared that no competing interest exists.

Authors' contribution

Both the authors contributed equally to this work.

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