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Human–animal interface: The effects of handler's stress on the performance of canines in an explosive detection task

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ABSTRACT

The handler–dog interaction is significantly important for the canine performance. The handler error may mislead the dog into false identification, and the probability to commit such an error is altered often by the handlers' stressful state. In the current study we have focused on stress characteristics and the handler–dog interface effects on the canine detection performance. For baseline evaluation, the handlers were tested for attention performance and anxiety level utilizing pre-pulse inhibition and startle response tests, respectively. Following this, the handlers were randomly assigned into three stress conditions (relevant or/and irrelevant to the detection task) and to a control condition. The dogs were videotaped during explosive detection task and the latency of detection as well as activity and velocity were measured using a custom-made computerized algorithm. Finally, post detection task, the handlers were re-tested for attention performance and anxiety level. Our results revealed that all stress conditions decreased the handlers' attention and elevated their anxiety level. However, stress improved the dogs' latency to detect the explosive, and likewise, increased the dogs' locomotor activity. Specifically, when exposing the handlers to stress that is irrelevant to the detection task, we were surprised to find that the dogs showed a superior performance across all measures. Focusing on the handler–dog interface, we found that when the handlers' anxiety level is elevated, the dog performance is improved. We postulate that since the handlers' exposure to stress elevated anxiety level and impaired their attention, it may have led to less control over the dog. Consequently, it allowed the dogs to 'take control' and manifest their training outcomes. This alleged locus of control transfer may explain the improved performance of the dogs, and further emphasizes the importance of the handler–dog interface.

1. Introduction

The psychologist Pfungst (1911) investigated in 1911 a horse named 'clever Hans', that was capable of exhibiting various mental abilities (e.g.; counting). Pfungst verified that 'clever Hans' was responding to unintentional postural and facial cues of individuals. Similarly, the trust of dogs on human cues has been shown to prevail over both olfactory and visual indications for the location of food (Szetei et al., 2003), thus emphasizing the crucial role of the handler on the dogs' performance. Specifically, scent detection dogs search an area according to their

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handlers' commands, exhibiting operant response toward their trained scent. Therefore, the ability of a dog to detect a target scent is not merely depends on olfactory perception. For example, the characteristics of the detection task together with the designated training paradigm, can also affect the dog's performance (Lit, 2009). Nevertheless, Furton and Myers (2001) in their detailed review, presented a comparison between instrumental (i.e. mechanical device) and dog detection abilities and showed aspects in which detector dogs are still superior compared with available instrumental devices. Specifically, dogs showed a better sampling, being less problematic in interfering odors, and best mobility as well as tracking ability.

Noteworthy, handler error was observed to mislead the dog into false identification, by forcing the dog to obey rather than to detect according to previous learning process and training procedures (Curran et al., 2010). Moreover, the dog might respond to unintentional human cues aimed at a desired target scent (Wasser et al., 2004). Thus, a blind experiment design is mandatory.

The handler–dog interaction is subjected to the handlers' skills and bonding. It has been observed that the ideal system for optimal detection of explosives appears to be the use of single dog – single handler team, as it has been shown that changing handlers invariably resulted in lower percentage of correct detection (Nolan and Gravitte, 1977). However, since it has been shown that the dog's behavior is further affected by the handler personality (Kotrschal et al., 2009), a specific handler–dog matching may be beneficial to form an optimal 'dog-handler interface'. The latter is postulated to be affected by the dog behavior as well as by the affective (i.e. stress) and cognitive (i.e. attention) traits of the handler.

Madsen and Persson (2013) showed that dogs yawned contagiously (regardless of the emotional closeness with the model), and support the notion of a developmental increase in dogs' attention to others and identification of others' emotional states However, the handler's traits as well as the characteristics of a possible stressful event that the handler needs to cope with, may all exert different effects on the handler–dog interface, and eventually on the dogs' performance in a scent detection task.

In the current study, we have focused on the 'handler–dog interface' by exposing the handler to qualitatively different stressors, and examining their separate as well as interactive effects on the dog's detection performance. Specifically, first we aimed to examine the effects of the exposure of the handler to 'external stress' (i.e. irrelevant to the task) or to 'internal stress' (i.e. relevant to the task), on the performance of the canine dogs in an explosive detection task. Secondly, we aimed to examine the interaction between the two stress conditions on the performance of the canine.

2. Methods

2.1. Dogs and handlers

Five canine male dogs (average age 18 ± 2 months), Belgian Shepherd Dog (Malinois) and their handlers at the Israeli air-force military were participated in each of the four experimental conditions. Specifically, utilizing a within-subject design, every handler/dog team fulfilled each condition, with a two days interval. Moreover, each handler/dog team allocated to the various conditions in a counterbalanced manner (Fig. 1). In order to exclude possible habituation to search pattern (i.e. finding 2 items on a search), a routinely training sessions (4–8 sessions between each test day) were conducted, containing randomly 1, 3, 4, 5 or 6 items on a search. Conducting the pre-pulse inhibition (PPI) test before and after the exposure to stress allowed us to take into consideration any baseline change. Thus, we calculated in each condition, the change (post/pre training) in PPI measure. All tests were conducted at the same time window during the day, avoiding unwanted circadian effects on the PPI measurements and on the dog's behavior. Within each experimental condition, the 1st PPI test (takes a ~22 min) was immediately followed by the exposure to stress (~3 min conversation with the unit commander, in the case of 'external stress') and thereafter the performance in detection task was recorded. Following, with no delay, the handler was re-tested in the PPI task.

The dogs had received training to detect explosive (TNT) 6 months prior to the experiment. This training maintained four times a week, 1 h per day. While staying in their home kennels (W2 × L3 × H2m), the dogs had free access to water and they were fed once a day. Each dog had its own personal handler who had at least 12 months experience with the dog before the experiment. All procedures as well as housing conditions were utilized inside the unit facility, were approved and under the supervision of a full-time veterinarian. All handlers signed a consent form to participate in the experiment. The handlers were blind to the experiment conditions and objectives. Likewise, they were blind to the placement and number of explosives before each trial. The handlers were highly motivated to detect all possible explosives. A summary of the studys' results was presented to the participants upon the end of the study.

2.2. Detection task

All dogs worked on-leash and each dog was continuously encouraged vocally to search by using phrases such as "where is it?". Upon detection the dog sat next to the "hot spot" for several seconds before being reinforced by a playing ball. The same was for each "hot spot".

Five different "clean sites" were used in order to hide the explosives. The PI hides the explosives, so the handlers and the other staff of the unit were blind to the location of the explosives. The two hides were placed up to 10 min before the dogs worked. To disable the dogs to track from the first to the second hide, during the total 20 tests the PI positioned the first and the second hides in different order, relative to the exploration direction of the dogs. In each experimental condition, the handler/dog team explored different site. Therefore, all teams were exploring the different sites in a counterbalances order (to control possible contamination). The location of the hidden explosives remained constant between the different test days. A detection made by the dog sitting near the hotspot and nose poke toward the exact location of the hotspot.