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Research

The use of an open-field model to assess sound-induced fear and anxiety-associated behaviors in Labrador retrievers

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ABSTRACT

Previous studies have shown that the playing of thunderstorm recordings during an open-field task elicits fearful or anxious responses in adult beagles. The goal of our study was to apply this open-field test to assess sound-induced behaviors in Labrador retrievers drawn from a pool of candidate-improvised explosive devices (IEDs)-detection dogs. Being robust to fear-inducing sounds and recovering quickly is a critical requirement of these military working dogs. This study presented male and female dogs, with 3 minutes of either ambient noise (days 1, 3, and 5), recorded thunderstorm (day 2), or gunfire (Day 4) sounds in an open-field arena. Behavioral and physiological responses were assessed and compared with control (ambient noise) periods. An observer blinded to sound treatment analyzed video records of the 9-minute daily test sessions. Additional assessments included measurement of distance traveled (activity), heart rate, body temperature, and salivary cortisol concentrations. Overall, there was a decline in distance traveled and heart rate within each day and over the 5-day test period, suggesting that dogs habituated to the open-field arena. Behavioral postures and expressions were assessed using a standardized rubric to score behaviors linked to canine fear and anxiety. These fear/anxiety scores were used to evaluate changes in behaviors after exposure to a sound stressor. Compared with control periods, there was an overall increase in fear/anxiety scores during thunderstorm and gunfire sound stimuli treatment periods. Fear/anxiety scores were correlated with distance traveled and heart rate. Fear/anxiety scores in response to thunderstorm and gunfire were correlated. Dogs showed higher fear/anxiety scores during periods after the sound stimuli compared with control periods. In general, candidate IED-detection Labrador retrievers responded to sound stimuli and recovered quickly, although dogs stratified in their response to sound stimuli. Some dogs were robust to fear/anxiety responses. The results suggest that the open-field sound test may be a useful method to evaluate the suitability of dogs for IED-detection training.

Introduction

Fear and anxiety are debilitating conditions that can negatively affect the functionality and well-being of working dogs. Fear is the awareness of immediate danger, whereas anxiety is the anticipation of future danger usually from prior experiences or unknown or imagined origin (Overall, 2013). Fear and anxiety may be difficult to differentiate behaviorally in animals; the terms are often used interchangeably to describe a constellation of behavioral and physiological responses to external stimuli. Although in some cases, fear and anxiety may be adaptive and enhance survivorship, in other cases, fear and anxiety may impair an animal's function and inhibit learning (Passalacqua et al., 2013). In severe cases or in stressful environments, an exaggerated maladaptive response may occur, leading to behavioral debilitation.

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Fearful or anxious dogs may be hypervigilant even in the absence of specific stimuli and may startle easily; assume low posture (Haverbeke et al., 2008); or show more subtle signs such as yawning, tongue flicking, or lip licking (Scaglia et al., 2013). With specific stimuli, fear-induced physiologic responses resulting from enhanced activation of the hypothalamic-pituitary-adrenal axis, such as release of cortisol, epinephrine, and norepinephrine, may occur (Part et al., 2014). Acute physiological responses may include tachycardia, tachypnea, and increased body temperature (Beerda et al., 1997).

Inappropriate fear or anxiety responses could impair the function of military working dogs (MWD) in a combat situation. Behavioral problems, many resulting from stress effects, were the most common cause of early discharge in MWDs aged younger than 5 years in 1 study (Evans et al., 2007). Identifying dogs susceptible to elevated fear or anxiety response and rejecting them for further training is critically important for MWDs. A standardized behavioral assay to evaluate such dogs before training and deployment would improve MWD effectiveness and welfare.

Recently, an open-field test (OFT) that used recorded thunderstorm sounds was shown to be a robust model of noise-induced fear and anxiety in laboratory beagle dogs (Araujo et al., 2013). The present study modified this OFT model to evaluate physiological and fear-/anxiety-related behavioral responses to loud sounds by Labrador retrievers selected for training as improvised explosive device detection dogs (IDDs). The IDDs are specifically trained to detect improvised explosive devices in combat zones. As such, they need to be resilient to loud sounds, including rapid gunfire, explosives, and other military noise. Our objective was to expose candidate IDDs to the sounds of thunderstorms and gunfire in an OFT, and to use physiologic measures, activity data, and assessment of sound-induced behaviors to evaluate the strengths and limitations of this model for screening candidate IDDs.

Materials and methods

Subjects

The experimental subjects were 16 Labrador retrievers aged between 2 and 4 years. There were 8 intact males, 5 intact females, and 3 spayed females. The dogs had been selected from field trial stock as candidates for IDD training by a private MWD training firm (K2 Solutions, Southern Pines, NC). Additional details regarding their selection, housing, and welfare oversight have been described (Lazarowski et al., 2014). At the time of OFT, all dogs had been in residence for approximately 3.5 months in a dedicated indoor canine facility under veterinary supervision at the North Carolina State University College of Veterinary Medicine Laboratory Animal Resources Unit. They were individually housed in kennels separate from the test areas, and were maintained on a stable regime of feeding, exercise, and rest. The Laboratory Animal Resources Unit is accredited by the Association for Assessment and Accreditation of Laboratory Animal Care International. All procedures were approved by the North Carolina State University Institutional Animal Care and Use Committee and the United States Army Medical Research and Materiel Command Animal Care and Use Review Office.

OFT arena

The OFT arena (Figure 1) consisted of a room approximately 3 × 3 m, located in a dedicated free-standing building, maintained at an ambient temperature of approximately 20-25°C. The OFT arena had an epoxy-painted cement floor, and was constructed of 3 cement block walls and a fourth modular wall with a door and narrow viewing panel. The OFT arena was equipped with a hide (W61 × H76 × L91 cm), constructed of high-density polyethylene boards (King StarBoard; King Plastic Corporation, North Port, FL), into which the dogs could retreat. Two video cameras (ICD-49 B/W camera; Ikegami Tsushinki Company, Ltd., Japan) were mounted so that dogs could be visualized at all times while in the OFT arena, including the hide. One camera was mounted overhead in the center of the ceiling, whereas a second horizontal camera was mounted outside the arena, 0.6 m above the OFT floor. The horizontal camera was fitted with an infrared filter and illuminator (IR-ROOM Ultra-Covert 940 nm; Nightvisionexperts.com, Buffalo, NY) and was directed through a camera port in an opaque window to record each dog's behavior while in the hide and adjacent areas. During recordings, the cameras recorded digital video to a nearby computer equipped with EthoVision XT 7.1 (Noldus Information Technology, Leesburg, VA) dedicated behavioral analysis software. A sanitizing agent Virkon-S (Dupont, Fayetteville, NC) diluted to 0.25% strength was applied to the floor of the OFT arena and allowed to air dry following each dog's session.

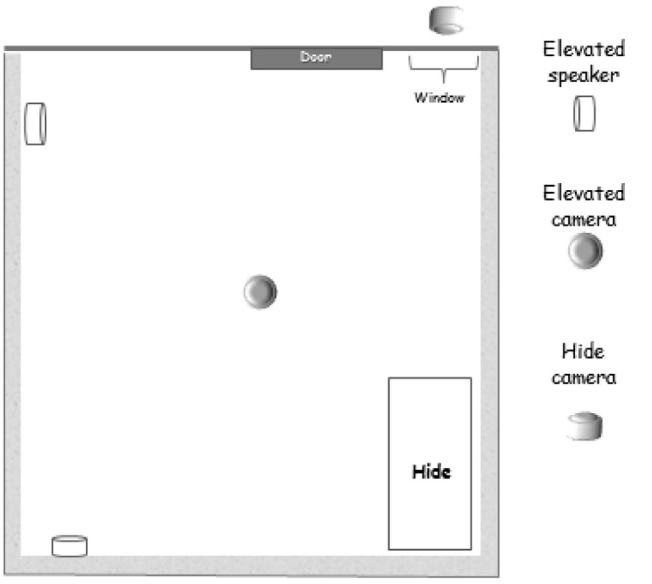

Figure 1. The open-field test arena (3 m × 3 m) with "hide." The schematic representation, not to scale, shows the approximate location of the door, 2 elevated speakers, and 2 cameras. One camera was positioned overhead in the center of the arena, and 1 camera was laterally positioned, 0.6 m above the floor level, at an opaque window with a port just large enough to accommodate the camera lens.

Sound stimuli and OFT procedures

Digital audio recordings of the sounds of a thunderstorm (CanCog Technologies, Toronto, Ontario, Canada) or simulated gun battle (K2 Solutions, Southern Pines, NC) were played through 2 overhead speakers in the OFT arena at standardized sound pressure levels (SPL), measured in decibels (dB). Background sound level (without a dog in the arena) was approximately 46-50 dB SPL. The mean thunderstorm sound level was 88.8 dB SPL; the peak level was 104-105 dB; the A-weighted sound exposure level was 110.9 dBA. The mean gun battle sound level was 95.2 dB; the A-weighted sound exposure level was 117.2 dBA.

The OFT was completed during a 2-week period (8 dogs/week). Testing was performed between 13:00 and 16:00 hours. None of the subjects had been exposed to the OFT arena before testing. Within each group of 8 subjects, males were evaluated before females. Otherwise, the order of the dogs was randomized for each group