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Research

A test for the evaluation of emotional reactivity in Labrador retrievers used for explosives detection

Barbara L. Sherman [a,*], Margaret E. Gruen [a], Beth C. Case [a], Melanie L. Foster [b], Richard E. Fish [a], Lucia Lazarowski [b], Venita DePuy [c], David C. Dorman [b]

[a] Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina
[b] Department of Molecular and Biomedical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina
[c] Bowden Analytics, 104 Strawthorne Court, Apex, North Carolina

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ABSTRACT

The United States Marine Corps (USMC) uses Labrador retrievers as improvised explosive device detection dogs (IDDs). Of critical importance is the selection of dogs that are emotionally suited for this highly specialized application. The goal of our study was to develop an emotional reactivity test (ERT) as a screening tool for the selection of IDDs. The ERT included a series of subtasks that expose each dog sequentially to visual, auditory, and experiential stimuli with an associated grading scale used by trained observers to rate individual dog responses. In this study, 16 Labrador retrievers that met initial selection criteria as candidate IDDs were assessed using the ERT, measurement of plasma and salivary cortisol concentrations (pre- and post-ERT), and an independent open-field test of anxiety in response to sound stimuli. Based on the sum of its responses, each dog was assigned an aggregate ERT score. Aggregate ERT scores from independent trained observers were highly concordant [Shrout-Fleiss's intraclass correlation (2,1) = 0.96] suggesting excellent inter-rater reliability. The aggregate ERT scores were also negatively correlated with the dogs' scores on the open-field anxiety test (Spearman rank correlation, n = 16, r = −0.57, $P = 0.0214$). In addition, there were significant increases in salivary (Wilcoxon signed rank, n = 16, S = 38.5, $P = 0.0458$) and plasma (Wilcoxon signed rank, n = 16, S = 68, $P < 0.0001$) cortisol levels after the ERT, compared with baseline, suggesting that exposure to the ERT test elements produced a physiological stress response. We conclude that the ERT is a useful pre-training screening test that can be used to identify dogs with a low threshold of emotional reactivity for rejection, and dogs with a high threshold of emotional reactivity for entry into the IDD training program.

Introduction

Dogs used for the detection of explosives require a high standard of performance, as their success or failure may have profound repercussions. One specialized group is the improvised explosive device detection dog (IDD) used by the United States Marine Corps (USMC). Candidate IDDs are selected from adult Labrador retrievers bred for field trial and hunt competition. The goal of the IDD program is to produce a dog that can work with a USMC handler to conduct directed off-leash searches for improvised explosive devices (Crawford, 2012). To meet this goal, candidate IDDs are sent to a military contractor facility where they undergo a rigorous, approximately 70-day training program that includes physical conditioning, scent training, and behavior modification protocols. Dogs that successfully complete this program are paired with a USMC handler. Each dog/handler team undergoes an intensive 5-week training program at the training facility, followed by further off-leash explosives detection training in desert terrain at a military facility in the United States. Then, each fully trained IDD/handler pair is deployed overseas for active combat duty.

Selecting suitable dogs for the program is critically important. Unsuitable behavioral traits may negatively influence training and contribute to impaired dog/handler team performance. For example, the emotions of fear and anxiety may affect the ability

* Address for reprint requests and correspondence: Barbara L. Sherman, PhD, DVM, DACVB, DACAW, Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, 1060 William Moore Drive, Raleigh, NC 27607, USA. Tel.: +1-011-919-513-6141; Fax: +1-001-919-513-6464.
E-mail address: barbara_sherman@ncsu.edu (B.L. Sherman).

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of individual dogs to learn new tasks and to perform at optimal levels (Haverbeke et al., 2010). Fear responses may alter environmental perception by focusing attention on fear-inducing stimuli, and weakening attention to other salient environmental features, thereby impairing a dogs' ability to work (Blackwell et al., 2013). Anxiety, the anticipation of fear-inducing events, may lead to increased vigilance and avoidance (Araujo et al., 2013). There is compelling evidence that behavioral traits, more so than sensory or physiological capacity, may influence performance in dogs (Beerda et al., 1998, 1999). Selecting dogs that are resistant to debilitating emotional responses, such as fear and anxiety, is an important prerequisite for training dogs for explosives detection. Ideal dogs for training would exhibit modest and transient "emotional reactivity" that would not impair their ability to function under combat or other work situations.

A number of studies support the finding that "personality," "temperament," or "performance" tests may be used to predict behavior (Diederich and Giffroy, 2006; Jones and Gosling, 2005; Swartberg, 2005; Wilsson and Sundgren, 1997). Provocative tests in dogs have been used to elicit behavioral and physiological fear responses (Hydbring-Sandberg et al., 2004). More specific screening tests developed for German shepherd and Malinois breeds reliably predict the outcome for military working dog training test performance at Lackland Air Force Base in the United States (Sinn et al., 2010).

An open-field arena test is another model for measuring fear responses and anxiety states in animals (Prut and Belzung, 2003). In the open field, the animal may be subjected to provocative stimuli, such as relevant sounds, and its behavioral and physiological responses quantified. In dogs, the open-field model has been used to identify Beagles that suffer from thunderstorm anxiety and attenuate this state using pharmacologic and other means (Araujo et al., 2013; Landsberg et al., 2013). The aim of the present study was to validate an emotional reactivity test (ERT) as a screening (selection) tool for candidate IDDs using physiologic measures and an open-field model of anxiety We also evaluated the ERT with respect to inter-rater reliability and established convergent validity of this test to select dogs robust to "stress" effects.

Materials and methods

Dog procurement

A military working dog contractor (K2 Solutions, Inc. [hereafter K2], Southern Pines, NC) procured the dogs for training in the USMC IDD program.

To be considered for procurement, dogs had to be less than 24 months of age at the time of procurement, have started field trial training, and be in apparent good health. Dogs were not considered for procurement if they exhibited human-directed or dog-dog aggression, marked avoidance of the procurement officer, or pronounced submission to their handler. Procured dogs were collected throughout the Unites States and then transported by truck to south-central North Carolina. After a14-day quarantine at an off-site commercial boarding kennel, the dogs were transported to the K2 training facility. A K2 veterinarian performed a comprehensive physical evaluation, which included a retinal examination and evaluation of digital radiographs of the pelvis, lumbar-sacral spine, and elbows. Screening laboratory tests included comprehensive blood chemistry; complete blood count; urine and fecal analysis; tests to assess thyroid, heart worm, *Borrelia burgdorferi*, Ehrlichia, and Anaplasmosis exposure; and genetic testing for exercise-induced collapse. A subcutaneous microchip was placed for individual identification. Procured dogs that passed the veterinary assessment were held at the K2 facility where they were housed in individual kennels and received regular group exercise. The mean time in residence at K2 was 335 days (range: 225-411). Dogs were transported from K2 approximately 130 km to *North Carolina State University* (NCSU) on November 29, 2011. Additional details regarding housing conditions at K2 have been previously described (Lazarowski et al., 2014).

Experimental subjects and animal welfare oversight

The experimental subjects used for this study were drawn from the stock of candidate IDDs that were procured for the IDD program. They were 16 Labrador retriever dogs between 2 and 4 years of age; there were 8 intact males, 5 intact females, and 3 spayed females (Table 1). The coat color of 10 dogs was black and the coat

Table 1
Demographic information and result of ERT, physiologic, and open-field test assessment of Labrador retrievers (n = 16)

Dog Name	Sex[a]	Coat color[b]	Age (days)[c]	ERT score (max: 85)	Salivary cortisol (μg/dL)			Plasma cortisol (μg/dL)			Open-field anxiety Score
					Pre- ERT	Post-ERT	Δ salivary cortisol (post-pre)	Pre-ERT	Post-ERT	Δ plasma cortisol (post-pre)	
Ace	M	B	768	75	0.262	0.186	−0.079	1.42	1.63	0.21	0.0
Annie	F	Y	821	51	0.208	0.256	0.048	1.05	2.21	1.16	2.5
Baxter	M	B	1186	65	0.133	0.228	0.095	1.97	4.55	2.58	2.0
Bullet	M	Y	1347	75	0.119	0.115	−0.004	0.99[d]	2.50	1.51	1.75
Dakota	F	B	863	72	0.169	0.195	0.026	1.27	2.22	0.95	0.0
Honey	F	Y	829	48	0.089	0.166	0.007	2.22	4.15	1.93	2.75
Hunter	M	B	659	71	0.156	0.373	0.217	0.99[d]	1.46	0.47	1.0
Jimmy	FS	B	1025	73	0.110	0.245	0.135	1.68	3.70	2.02	1.5
Macks	M	B	872	63	0.065	0.192	0.127	0.99[d]	1.15	0.16	0.75
Mercy	FS	B	1012	74	0.413	0.103	−0.310	0.99[d]	1.83	0.84	−0.25
Piper	F	Y	741	36	0.049	0.240	0.191	1.05	5.41	4.36	1.0
Reno	M	Y	920	71	0.206	0.158	−0.048	0.99[d]	4.02	3.03	0.75
Rip	M	B	774	68	0.216	0.270	0.054	1.40	2.19	0.79	1.75
Ruby	FS	Y	805	74	0.116	0.139	0.023	1.39	1.83	0.44	0.75
Valentine	F	B	752	58	0.130	0.222	0.092	1.31	5.77	4.46	1.75
Wizard	M	B	821	71	0.090	0.156	0.066	1.28	2.37	1.09	0.5

ERT, emotional reactivity test.
[a] Sex: F = Female, M = Male, FS = Female, spayed; all males were intact.
[b] Coat color: B = black; Y = yellow.
[c] At time the ERT was administered.
[d] A value of 0.99 μg/dL was assigned when the sample concentration was below the limit of detection (<1.00 μg/dL).