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ORIGINAL RESEARCH

Quantifying Search Dog Effectiveness in a Terrestrial Search and Rescue Environment

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Objective.—There is widespread and longstanding use of dogs in land search and rescue (SAR) operations, and their effectiveness is well accepted within the SAR community. However, very little published research exists that quantifies that effectiveness within a realistic SAR environment.

Methods.—This study included 25 experiments, conducted between October 2013 and February 2014 with 10 dog/handler pairs, using randomized target placement to calculate the ratio of hits, misses, and false positives per dog. Each dog was fitted with a GPS receiver to record their paths and ambient temperature. Wind strength and humidity were recorded throughout each run.

Results.—There was no identifiable correlation between humidity, temperature, or wind speed and effectiveness, but the age of the dog has a small positive correlation. Using a standard effectiveness formula, basic descriptive statistics were generated, which showed that the dogs tested were 76.4% successful overall, with an effectiveness of 62.9%. Dogs covered a mean distance 2.4 times greater than their human handlers but travelled at roughly average human walking speed.

Conclusions.—This work represents a first attempt to quantify and understand levels of performance in lowland search dogs, and these results need to be understood within that context. A repeatable experimental framework has been demonstrated and provides a foundation for further work in this area.

Key words: search and rescue, search dogs, canine ergonomics, search effectiveness

Introduction

It is well accepted that St Bernard dogs were used by monks in the Alps to rescue lost and injured travelers as early as the 1600s,[1–3] and before the First World War, search dogs were used to locate incapacitated soldiers. But it was not until World War I (1914–18) that the use of search dogs was officially documented[4] with military dogs being used to locate the wounded and deliver first aid supplies. Today, much of the civilian search and rescue (SAR) training is centered on techniques used in the training of military dogs during World War I and World War II,[5] with dogs also frequently used to detect invasive species, contraband such as drugs or tobacco, explosives, DVDs, contamination in fish tanks, and even cancerous cells.[6–9]

The utilization of search dogs has been built on the advanced olfactory capability of dogs, which is somewhere in the region of 10 parts per billion.[10] There is an obvious desire for organizations to quantify the performance in detection, but restrictions on experimental effectiveness related to environmental and biological factors result in this not being carried out as often or as systematically as possible.

The biological factors relate to the fact that the dog is not an electronic or mechanical sensor that can be relied on to perform with the same characteristics over a large number of tests. Simply put, sometimes dogs have "bad days" or may miss a target for an unknown reason.

Environmental factors arguably have a greater impact when carrying out research into scent detection, especially when all environmental conditions cannot be completely controlled. It is reasonable to assume that wind direction and speed, humidity, and temperature have an impact on the way scent moves through the air, meaning that any miss may be attributable to a lack of constant scent rather than a detection error.[4,11,12] Furthermore, carrying out research in public spaces creates the risk of scent from other animals or other humans contaminating the scene and confusing the dog.

The long use of dogs in SAR supports their effectiveness and there have been notable successes[13]; however,

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there is currently no standardized method to evaluate the effectiveness of these dogs. Furthermore, there is speculation that the dogs may actually be demonstrating a form of "Clever Hans" phenomenon, in which the handler consciously or unconsciously gives cues to the dog about the location or existence of a target.[14]

The aim of this study was to create a structured test bed to evaluate 2 key points; the *success rate* and the *effectiveness* of search dogs used for lowland search and rescue. In the United Kingdom, the term *lowland SAR* concerns SAR work on land, not on coastal cliffs or in mountainous regions. In addition, a number of environmental factors were recorded to test any potential relationships with success or effectiveness.

Methods

The dogs used in this study are classed as air-scenting search dogs, as opposed to trailing and tracking dogs. This means that the dogs are trained to detect traces of human scent within the air and follow it to the source, where the scent is most concentrated. Owing to the nature of this technique, the search dogs must be able to stay on the scent's path despite varying atmospheric conditions.

Eight routes were identified on 2 sites (Figure 1), which represented a typical "route and path"[15–17] search route that a dog team could be asked to search in a real event. The routes were all originally designed to be approximately 1.1 km in length, although this varied slightly when alternative routes were used in case of impassable paths or navigation errors on the part of the research facilitators. Table 1 shows the full list of routes, route lengths, and locations.

Table 1. Location, route number and length of each test run

Site	*Route No.*	*Length (m)*
Bookham Commons, Surrey	1	1235
	2A	1021
	2B	911
	2C	1212
	3A	1212
	3B	1021
	3C	1364
	4	1251
Chobham Common, Surrey	5A	1282
	5B	1118
	6	1223
	7	1231
	8	1134

Ten dog and handler pairs were recruited from UK lowland search and rescue teams. Each pair was tested against a minimum of 2 routes, ideally over 2 different test days, with a maximum participation of 8 routes over 8 testing days (Table 2). Routes were assigned using a random number generator for each test run.

Live human targets were placed along each route, with their number, distance along the route, and position to the left or the right of the route randomly determined. Each target was placed between 25 and 30 m from the path edge using a surveying tape measure.

Humidity, as a percentage, temperature in degrees Celsius, and wind speed in meters per second were measured at the beginning, middle, and end of each route (Table 2), using a Kestrel 4000 pocket weather

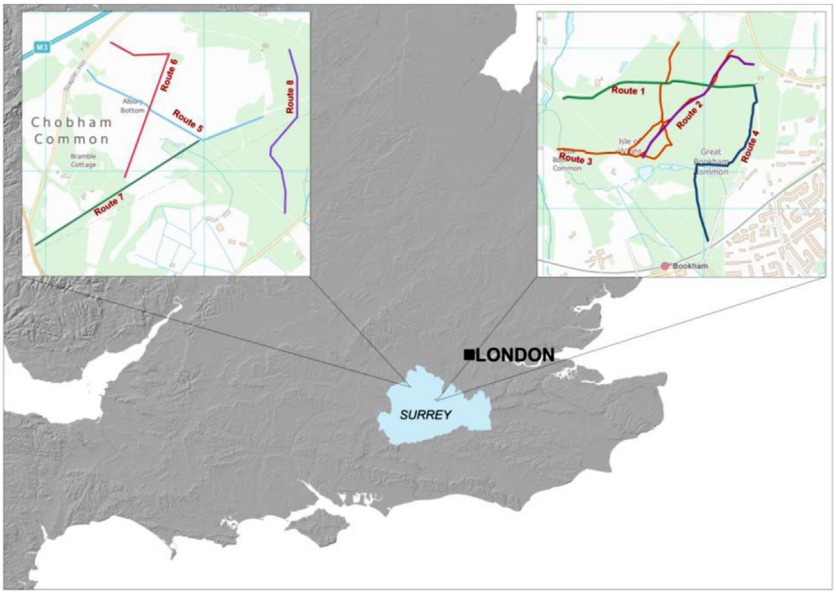

Figure 1. The routes and locations of the two sites.