



IRONDOG: Canine Warfighter

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Introduction

Detection canines serve critical roles to support the military, homeland security and border protection. Little is understood regarding variables which impact their olfactory performance. Within the military, some explosive detection tasks are physically demanding for dogs, and prior research suggests this can lead to a reduction in olfactory detection sensitivity. Decrements in performance can have implications for any military working dog mission. Therefore, to meet the objective of further evaluating the effect of exercise intensity on olfactory sensitivity, researchers developed a novel olfactory paradigm that allowed the measure of olfactory detection thresholds. This mechanism automatically provides odor and records responses to odor while dogs exercised on a treadmill at two different exercise intensities. This model of assessment has the potential to be utilized to study the many other variables which are believed to impact olfaction in working dogs.

Methods

This work was conducted using three privately owned dogs who were trained to detect a target odor (1-bromooctane) and to walk and trot on a treadmill equipped with an olfactometer, microphone, and cameras (figure 1). The dogs were also trained to indicate detection via pressing their nose into the port of an olfactometer (figure 2). This port automatically recorded whether the alert was accurate. Each assessment lasted approximately 30 minutes, and each dog had a maximum of two sessions per day. During the sessions, dilutions of odor presented varied from 10⁻² to 10^{-6.5}. Each session included walk and trot in equal proportions based on a randomized block design. Dogs were rewarded for both correct indication on odor and ignoring a blank odor at a variable rate which started at 100% and gradually decreased to 40% reinforcement. Heart rate (via Polar HR monitor), respiration (via microphone), dilution of odor, latency (time from odor to alert), were all collected and used for correlation with alert rate of the dogs. For statistical analysis, hit rate (number of alerts to target/ number of trials) was calculated. Correlations with exercise intensity were compared with trials at 4km/h (walk/low intensity) and at 8km/h (trot/moderate intensity).



Figure 1. Dog indicating odor
Detection dog indicating the presence of target odor by pressing nose into port of olfactometer.



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Figure 2. Canine Performance Assessment Treadmill
Outfitted with cameras, microphones, and an olfactometer to assess canine olfactory performance via machine learning to predict behavior, endurance, and performance under physical stress. Arrow is indicating a schematic of the olfactometer mechanism on how odor is delivered to the dogs via the odor port.

Results

Heart rate remained the same and did not increase as expected with steady state exercise. It also did not increase with trial of odor detection. However, heart rate was higher at the trot compared to the walk (Figure 4). Hit rate for the lowest concentration dropped from 0.87 ± 0.04 when walking(low intensity) to below 0.45 ± 0.06 at the trot (moderate intensity) (Figure 3). This decline had an interaction with the duration of the session at the trot, whereby dogs performed near 100% detection in the first 10 min of the trot session, but showed 0% detection after 20 min. Hit rates for high odor concentrations were relatively stable at both low (1 ± 0.00) and moderate (0.91 ± 0.04) exercise intensities. (Figure 4, A). Additionally, latency showed a similar trend, with increased time between odor and alert for both decreased concentration and increased pace (Figure 4, B)

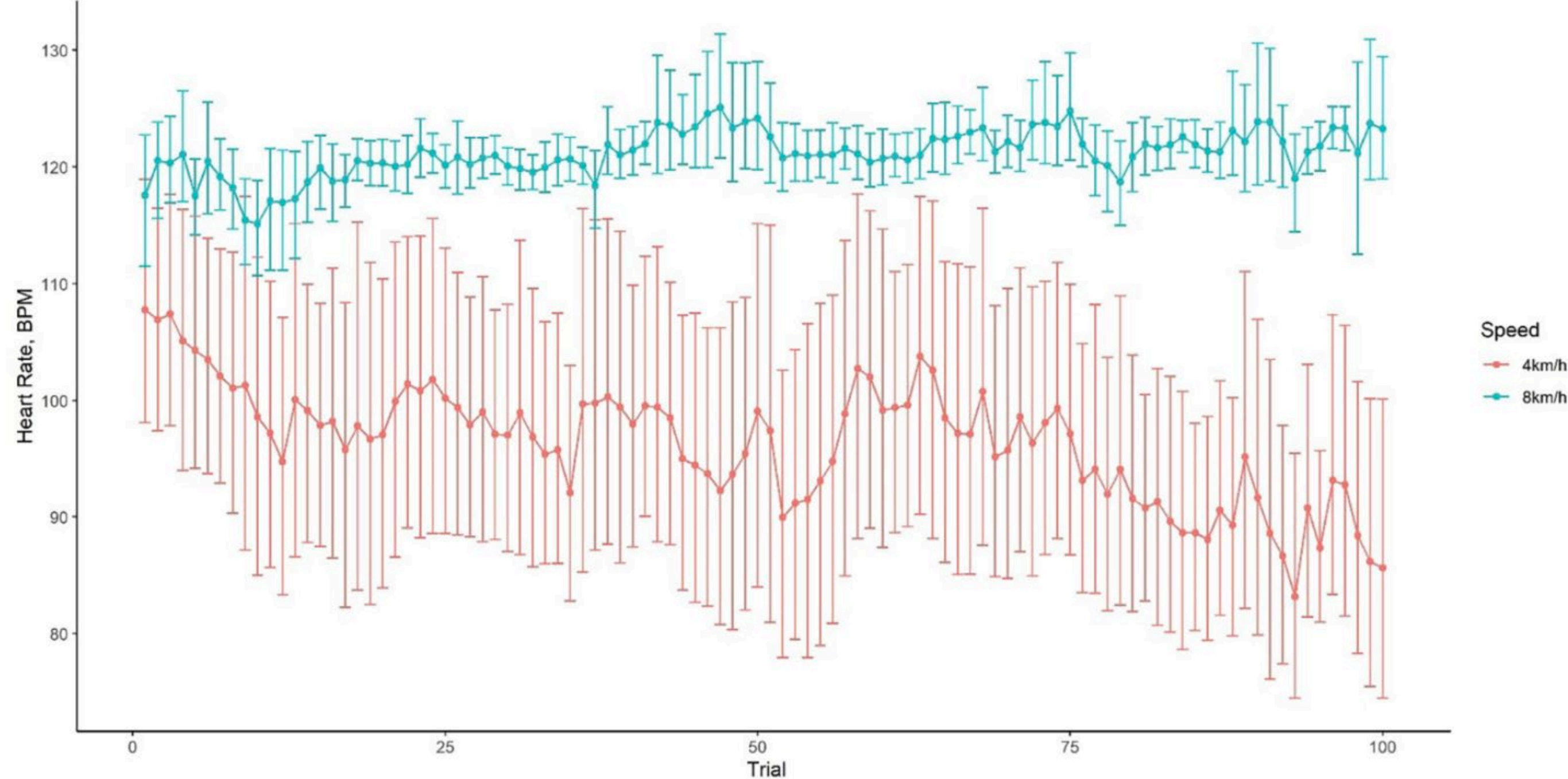


Figure 3. Heart Rate at Walk and Trot
Heart rate and 95% confidence intervals for dogs at walk (4km/h) and at trot (8km/h). As published in Aviles, et al., 2024.

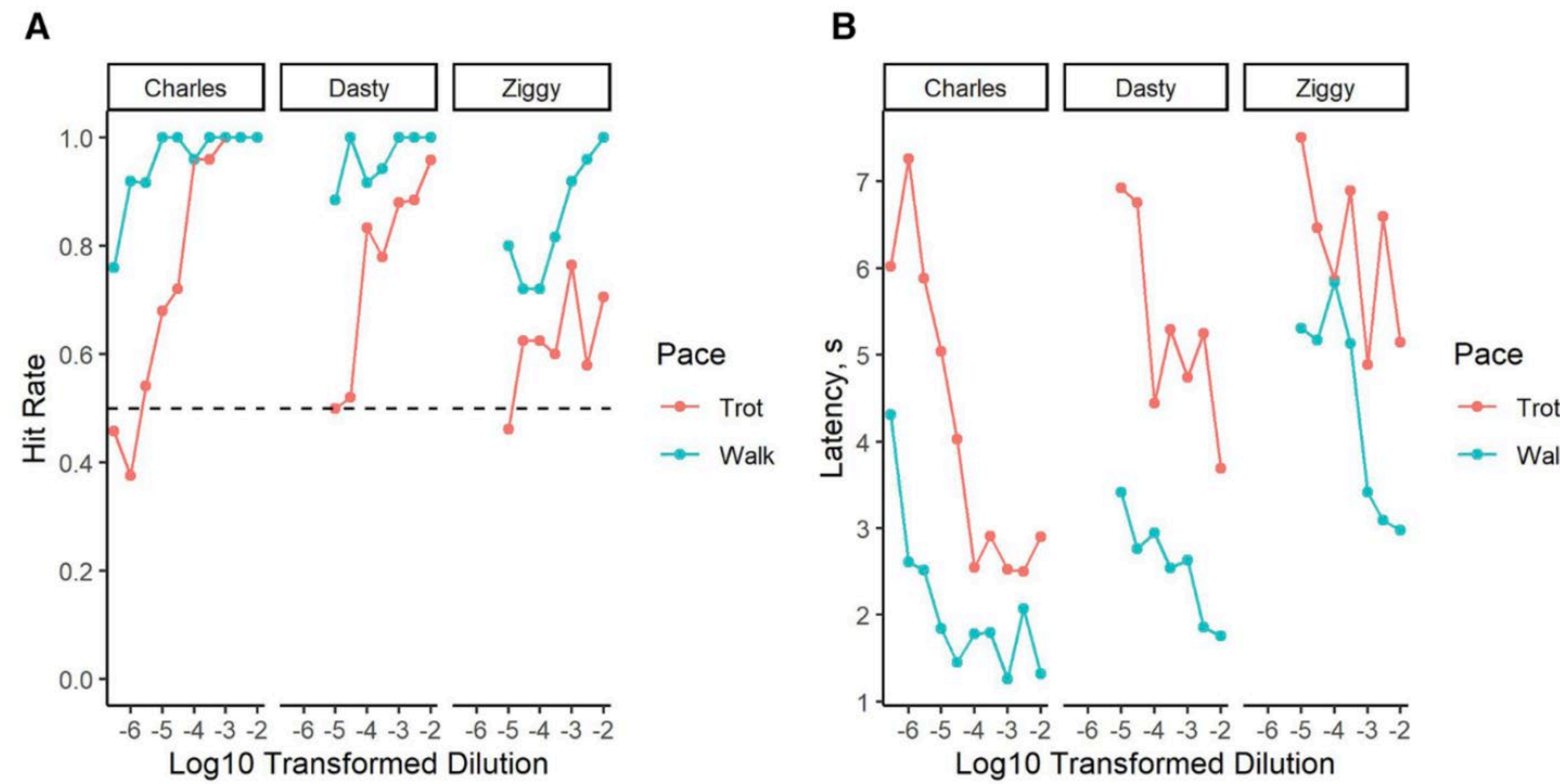


Figure 4. Hit rate and latency by pace and dilution of odor
Hit rate (A) and Latency (B) for dogs at walk (4km/h) and at trot (8km/h) at different dilutions of target odor. As published in Aviles, et al., 2024.

Discussion

This work confirmed that there is decreased olfactory performance associated with increased exertion as indicated by lower hit rate and increased latency at the trot over time. This effect appeared be exacerbated by decreasing odor concentration at the trot. As multiple organizations rely on the use of detection dogs as sensors, this information may provide insight to improve management and training techniques. As the canines maintained more than 80% accuracy (hit rate) for the first 10 minutes for both low and high concentrations of odor, but then declined to 0% at 20 minutes, interventions may be necessary to increase stamina. Detection dogs are frequently required to work in environments requiring exertion for more than 30 minutes while doing detection tasks. Therefore, methods for increasing thresholds for working dogs will be vital. In conjunction to intervention, additional work is required in breeds of dogs typically utilized as military working dogs (MWDs) to identify if similar decrements in performance may exist in the MWD population. It is also possible that common MWD breeds may have differing thresholds for odor and exertion. As MWD type breeds are bred to complete detection work, there may be increased thresholds in these breeds. Furthermore, other target odors may alter these findings, therefore further work should utilize this methodology on common target odors such as explosives to create a holistic model of detection thresholds in detection dogs.

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