True or false?

Differentiating negative responses in trained detection dogs

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ROYAL CANIN KNOWLEDGE AND RESPECT

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Medical Detection Dogs (also known as Cancer and Bio-detection Dogs)

Overview

Cancer *(William et al. 2004)*

Conservation dogs *(Engerman et al. 2002)*

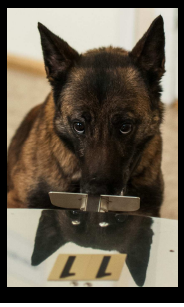
Water search dog *(Osterkamp, 2011)*

Drugs *(Lorenzo et al. 2003)*

Explosives *(Gazit and Teckel, 2003)*

Clostridium difficile (Bomer et al. 2012)

Human remains *(Komar ,1999)*



Detecting hidden corrosion (Schoon et al. 2014)

False Positive

The system detects the target odour as present when it is absent

Kurz et al. 1996; Bach and Mc Lean, 2003; Lit et al. 2011

False Negative

The target odour is present but the system fails to detect it

Wasser et al. 2004; Lasserter et al. 2013

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True Positive

False Positive

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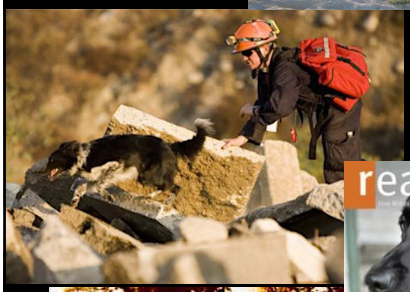

True Negative

False Negative

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Sniffing Behaviour

Controlled and modulated during investigatory behaviour

(Sobel et al. 2000; Verhagen et al. 2007; Wachoviak 2011)

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Sniffing Behaviour

- ✓ Sniffing frequency during search 140-210 sniffs min *(Steen et al. 1996)*
- ✓ Match scent of a suspect in a line up range from 6.4 to 23.7 s. *(Jezierski et al. 2008)*
- ✓ Dog can reliably detect a track and determine its direction in 3 to 5 s *(Thesen et al. 1993)*
- ✓ Following physical activity the sniffing frequency decreases, panting and duration of the search increases. Reducing the detection rate *(Gazit and Terkel, 2003)*

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Aim

To investigate whether the sniffing behaviour of detection dogs differs in response to true positives, true negatives, false positives and false negatives during a single scent detection task

Sniffing duration and the number of sniffing episodes

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Methods : Subjects

- 10 detection dogs
- 4 females and 6 males
- 30 to 138 months (mean ± SD: 64.3 ± 38.52 months)

Methods: Odour samples

Amyl acetate diluted in mineral oil

Fjellanger et al. 2002; Sargisson and Mc Lean 2010)

The position of the target in the carousel was determined using a computer target selector software

Methods: Training procedure

- Three concentrations of amyl acetate were presented daily for each dog.

- Dogs were paired on the basis of their performance.
- The order in which dogs worked (first or second) was counterbalanced during each session over different target concentrations.

- The dogs were exposed to a range of concentrations from 1:700,000 to 1:1,500,000,000 (amyl acetate: mineral oil)

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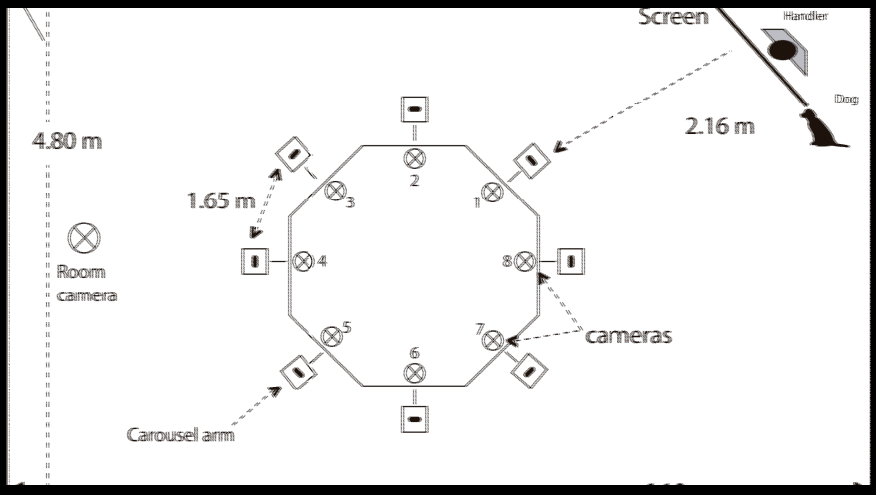
Methods: Training procedure



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Methods: Data analysis

Sniffing duration and the number of sniffing episodes

- 200 videos
- 20 videos for each dog including 5 of each of the four response types.
- Frames from the selected videos (with a frame rate of 25 fps) were converted to individual JPEG images using Free Studio 3 (version 5.0.28).

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Methods: Statistical analysis

- GLMM (R 2.15.2)

The sniffing duration before a choice is made differed according to the olfactory parameters.

Differences between response choices in the number of sniffing episodes

Sniffing episode " when the dog's nose was put over the hole of the carousel arm, and the end point was when the dog's nose moved away from it"

- Pearson's correlations

To analyze intra-observer agreement

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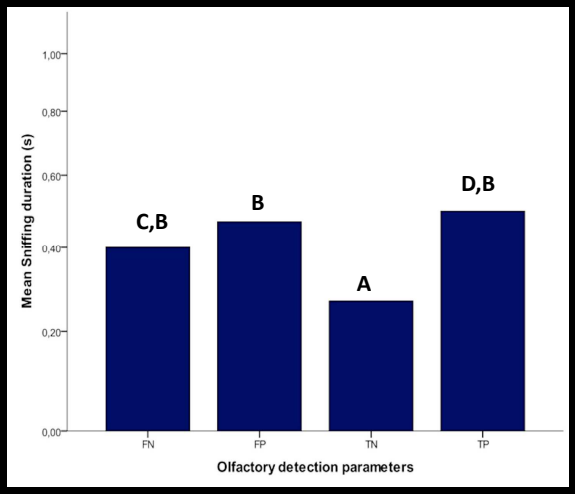
Results: Sniffing duration differed significantly between the four response choices



Olfactory parameters with a different letter differ significantly from one another
(A,B $p < 0.001$; C,D $p < 0.05$)

N=50 for each parameter.

Mean± SD

TP : 0.498 ± 0.239
TN: 0.268 ± 0.118
FP: 0.468 ± 0.223
FN: 0.408 ± 0.714

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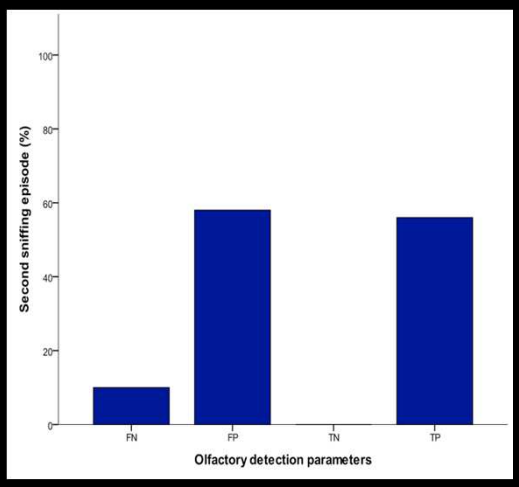
Results: Sniffing episodes



One sniffing episode was observed towards true negatives

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Results: Inter-observer agreement

There was a significant level of inter-observer agreement between the two independent raters

- Sniffing duration

r = 0.721, n = 20, p < 0.001

- Sniffing episodes

r = 0.923, n = 20, p < 0.05

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Discussion and conclusions

- The initial encoding of the presence-absence of a stimulus is rapid with discrimination determined with a single sniff *(Wesson et al. 2009; Kepecs et al. 2007; Mainland and Sobel, 2006; Uchida and Mainen, 2003.*
- The longer sniffing duration has been observed when determination that the target odour was present occurred *(Stonick, 2007)*
- The longer sniffing towards true and false positives might reflect the engagement of higher-order pathways associated with the recognition of the odour itself

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Discussion and conclusions

- Sniffing behavior can be used alongside the trained alert response.
- Future work is ongoing to further investigate sniffing behaviour in complex odours.
- Develop technology to evaluate sniffing behaviour in real time during search tasks under field conditions

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Acknowledgements

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Daniel Mills
Tom Pike
Helen Zulch

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Claire Guest
Rob Harris

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Dr. Alexandre Feugier

Thank you

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