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Canine Olfactory Detection of Parkinson's Disease from Sebum Samples: Longitudinal Modelling of Training Performance in the PrOCRI Study

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INTRODUCTION

Parkinson's disease (PD) diagnosis remains mainly clinical and may be challenging in early disease stages. Previous observations suggest that patients with PD may have a distinctive skin odour, possibly related to volatile organic compounds present in sebum. A preliminary step is therefore to assess whether trained dogs can learn to recognize PD-associated sebum samples under controlled training conditions.

OBJECTIVES

To pilot canine olfactory learning during the preliminary PrOCRI training phase, assessing recognition of sebum samples from patients with PD versus healthy controls and changes in performance across increasing training complexity.

METHODS

We analysed 4,364 training trials performed by three dogs, including positive-target and blank trials. The primary outcome was a correct response, defined as correct identification of a positive sample or correct rejection of a blank trial. Overall accuracy was decomposed into sensitivity and specificity.

The training pathway was progressive: the first two kits represented imprinting/familiarization, subsequent kits a softer learning phase, and from the 13th kit onward a higher-complexity phase aimed at approximating more realistic recognition conditions through greater sample mixing and task difficulty.

Multivariable logistic regression models included dog identity, training phase, target identity, and dog-by-phase interaction. Generalized additive models with binomial link were used to describe non-linear learning trajectories over training days. The model was trained using data up to the 21st kit and then used to forecast performance on the last two kits, corresponding to kits 22–23. These were considered an internal holdout phase. Uncertainty was assessed using simulation-based prediction intervals and bootstrap resampling.

RESULTS

The transition to the higher-complexity training phase, starting from the 13th kit, was associated with reduced odds of a correct response for Dylan, the reference dog (OR=0.63; 95% CI 0.50–0.80; p<0.001), reflecting increased task difficulty. Performance changes differed across dogs. The dog-by-phase interaction was not significant for Kappa, whereas Olivia showed a significant positive interaction (OR=1.86; 95% CI 1.35–2.57; p<0.001), suggesting preserved or improved performance despite increased training complexity. Olivia's model-based accuracy increased from approximately 0.65 in the early phase to approximately 0.78 in the higher-complexity phase. GAMs confirmed dog-specific learning trajectories, with higher odds of correct detection for Olivia (OR=1.73; p=0.006). In the internal holdout phase, observed performance exceeded predictions for Dylan in both trial types, Olivia in positive trials, and Kappa in both trial types (Δ range: 0.101–0.262; p≤0.040), suggesting that increased training complexity did not produce a measurable performance decline.

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CONCLUSIONS

This pilot analysis suggests that canine olfactory recognition of PD-associated sebum samples is feasible within a structured and progressively complex training setting. However, these findings should be interpreted as evidence of learning and preliminary recognition ability, not as clinical diagnostic validation. Further studies using independent, previously unseen samples from new patients and controls are required before any diagnostic application can be considered.

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