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Scent-matching of olfactory samples via proxy by domestic dogs Canis lupus familiaris

McKay, Shannon

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Commentary sheet

Dissertation title: Scent-matching of olfactory samples via proxy by domestic dogs *Canis lupus familiaris*

Name: Shannon McKay
Student number: 403231

I have taken into account the comments of both the examiners' reports and pdf annotations.

Examiner 1

Page i, paragraph 3 - Examiner writes: *"Her analyses of these data are also clear, however she may have benefitted from slightly more complex statistical analyses (multi-variate or AIC to look at different components differentially) to tease apart co-variates in her study"*.

I agree with the examiner that a more complex statistical test, such as the Akaike information criterion, could have highlighted possible variable influences. However the relatively small sample size in my study made the use of this test problematic but will be considered in future studies with a larger sample size.

Examiner 2

Page iii, paragraph 1 - Examiner writes: *"The fundamental theoretical background of signal detection theory is completely lacking"*.

I agree with the examiner that the broad field of signal detection theory could certainly be applied to scent-matching, especially in studies that concentrate on the internal mechanics of the signal-detecting organism and have thus added information to this end.

Page 11: Earlier Studies - 1.4.8 Signal Detection Theory

"Signal detection theory considers measurement of stimuli over behaviour (Davison & Tustin, 1978). In the application of scent-matching, the stimulus (e.g. scent presented to the

dog) can be measured in terms of the dog's trained response (behaviour) to that stimulus. While signal detection theory is pertinent to scent-matching, it has not been a major area of focus in previous studies on scent-matching by dogs. This is possibly due to the focus being on the data generated from scent-matching as opposed to the mechanisms involved in scent-matching.

Signal detection theory has a concise set of terminology relating to the whether the stimulus is present or absent and whether or not a response occurred. This terminology is used as follows: stimulus present with a response is a "hit"; stimulus present with a non-response is a "false rejection/miss"; stimulus absent with a response is a "false alarm" and stimulus absent with a non-response is a "correct rejection" (Davison & Tustin, 1978). In previous studies of scent-matching by dogs, a variety of terminology is used, e.g. a "hit" is described as a "correct choice" (Settle et al, 1994), "correct response" (Jezierski et al, 2010) and "correct recognition" (Schoon, 2005)."

Page 16: Proposed Modifications – 1.5.5 Signal Detection Theory

"Due to the variety of terminology used in previous studies and the fact that my study did not involve a "stimulus absent" treatment – thereby negating the possibility of a "correct rejection" or "false alarm" – I chose to use simpler terminology of "match" or "non-match"."

Page iii, paragraph 1 - Examiner writes: *"Had the author studied and used this theory, she could have stuck to the common terminology of 'hit' or 'correct indication' (instead of 'first attempt match'); 'miss' (not even defined); 'false alarm' (instead of 'non-match'), 'correct rejection' (also not defined)".*

I disagree with the examiner that common terminology exists in this specific field. A "hit" is described as a "correct choice" (Settle et al, 1994), "correct response" (Jezierski et al, 2010) and "correct recognition" (Schoon, 2005). In my study I chose to use a simple one word ('match") to describe a correct choice/response/recognition, which is defined as "Subject correctly matched the reference proxy to the matching target proxy in the line-up" in Table 4, page 25. My study did not incorporate any trials where a matching sample was not present, so

there was never the possibility of a "correct rejection" or a "false alarm" and thus no need to use these terms.

Page iii, paragraph 2 – Examiner writes: *"Her 'success rate' is more commonly called 'sensitivity', and there is no talk about 'specificity' at all which should definitely be part of the theoretical background"*.

I agree with the examiner that my study focused on sensitivity and excluded specificity. I did not however overtly state this and agree that this was an omission on my part. Statements to this end have now been included.

Page 11: Earlier Studies – 1.4.9 Sensitivity and Specificity

"Previous studies of scent-matching via proxy addressed both sensitivity (can the dogs detect a human donor scent) and specificity (can the dogs discern or generalise human donor scents) (Settle, *et al*, 1994; Schoon, 2005; Jezierski *et al*, 2010)."

Page 16: Proposed Modifications – 1.5.6 Sensitivity and Specificity

Due to the fact that my study was unique (it was not known whether dogs could scent-match non-human scent donors via proxy) my study only considered sensitivity and not specificity because sensitivity needs to be established before specificity can be addressed."

Page iii, paragraph 3 – Examiner writes: *"The first hypothesis (that dogs will do better than chance) is clear, but a limitation should be that no generalisation has been tested to body odours from other individuals of the same species or to scat from other individuals… As such, the final conclusion (page 70 – 71) needs to be more limited"*.

I agree with the examiner, and while this point is noted in the Discussion on page 70, I have now reiterated this point by including a statement to this effect.

Page 72, "… noting that in this study specificity and generalisation of this scent-matching was not tested".

Page iii, paragraph 3 – Examiner writes: *"The second hypothesis (that the dogs would do better than computer simulated dogs) since this is essentially the same as the first: the digidog exercise exemplifies chance, so at best it is an illustration of the first hypothesis"*.

I disagree with the examiner. The second hypothesis provides a potential null model and as such is not a repetition of the first hypothesis.

Page iv, paragraph 1 – Examiner writes: *"For me it is unclear why wildlife odours have been chosen… The reason for this choice requires elucidation"*.

I disagree with the examiner. The reasons for selecting wildlife odours are stated on page 5 – 6. In summary I suggested that current research using wildlife samples could be made easier and more effective if the scent of these samples could be transferred to a proxy. This study was not about proxy scent-matching *per se*, but rather about whether current scent-related wildlife research could be conducted via proxy.

Page iv, paragraph 2 – Examiner writes: *"Also unclear is why the first 6 levels of training were done with a target human odour, as is the choice of method to switch to the wildlife odours"*.

I disagree with the examiner that the reasoning for the use of target human odour was unclear. The reason for starting the training with a human odour is outlined on page 32, i.e. "it was assumed that due to the familiarity of the handler's scent, the task at hand would thus be less demanding of the subject".

The reasoning behind switching to wildlife odours is covered in the previous comment.

Page iv, paragraph 2 – Examiner writes: *"I know it can be done, that is it no problem to first use one target odour to achieve a particular level of training and then switch to another target odour, but it is more common to switch using some kind of blocking procedure than changing modality as has been done here… This requires some comment, especially since the chosen setup opens up for a number of alternative strategies the dogs could have been following"*.

I agree with the examiner that the change of modality is not common. That was the essence of the training programme used in this study. I agree that alternative strategies could have been employed by the dogs and that this was not fully examined. The reason alternative strategies were not examined was because it first needed to be established if dogs were capable of scent-matching via proxy across species and this study was dedicated to that aim and not to the wide array of possible alternate strategies being used by the dogs in scent-matching. It is however worth mentioning that this is an area that should be considered for future studies, which I have now done in the Conclusion.

Page 72: "The possibility of the dogs employing alternative behavioural/learning strategies during the training of scent-matching was not considered in this study and hence this remains an area that should receive further attention ".

Page iv, paragraph 2 – Examiner writes: *"McKay's conclusion that the change of modality had no adverse effect (page 64) is not supported by the evidence, given the longer duration of levels 2 and 5".*

I agree with the examiner that the change in modality did have an effect, based on the longer duration of levels 2 and 5. However my statement was that the overall effect, i.e. final scent-matching competence, did not appear to be hindered. I have clarified my statement by adding that while overall competence did not appear to be hindered, the change of modality did temporarily slow the learning process.

Page 65: "While bimodal stimulus use in training of scent-matching did temporarily slow the learning process, it did not appear to hinder the subjects in this study with regard to overall scent-matching success."

Page iv, paragraph 3 – Examiner writes: *"Actually, only the last level L6 is truly a match to sample setup".*

I agree with the examiner. This point has been stated in my study.

Page 41: “Each subject underwent a minimum of 80 L6 training runs spread over a minimum of seven L6 sessions... The data gained from these testing runs as described were used to establish proficiency at scent-matching among donor species via proxy by trained dogs.”

Page 32: “Table 5. Levels of scent-match training via proxy by domestic dogs *Canis lupus familiaris* indicating the main objectives, modality use, absence/presence of decoys and target scent donor”

Page 33: “In the following three levels, L4 – L6, the same procedure was followed as L1 – L3 (no decoys, blank decoys, scented decoys) but with the target scent now unknown to the dog.”

Page iv, paragraph 3 – Examiner writes: *“Different dogs can follow different strategies, which would explain the variation between the dogs in progressing from one level to the other… Expanding this topic requires some more analysis and self-criticism on the part of the author on how effective the chosen training strategy actually was in achieving the desired end result”.*

I agree with the examiner, but this study was not aimed at analysing differences between the dogs during level progression. I did state that many variables could play a role in the training of scent-matching and have also added that consideration of alternative strategies needs to be considered in the future (underlined addition shown below)

Page 72: “More studies need to be conducted to assess the limitations of scent matching via proxy among species by domestic dogs. <u>The possibility of the dogs employing alternative behavioural/learning strategies during the training of scent-matching was not considered in this study and hence this remains an area that should receive further attention</u>. This study showed that breed, sex and training venues do not need to be controlled for whereas age of the subjects might need to be considered. Reproductive status of the subjects could not be assessed in this study because all subjects which completed training were sterilised, so this is an aspect that should be regarded in future studies.

Page iv, paragraph 4 – Examiner writes: *“I understand the logistic difficulties of working with such a large number of dogs, but the down side to not being able to optimize the*

training per individual has to be part of the data analysis and the discussion as well, and should perhaps be mentioned as a cautionary notes besides the 'low cost, relative ease and fairly short period of time' on page 71".

I agree with the examiner and have added that group training does not take individual advancement into account which may well hinder individual progress.

Page 72: "Group training sessions and "group promotion" could impede individual progress and it is possible that better results could be obtained if dogs were to be trained individually."

Page iv, paragraph 5 – Examiner writes: *"The 'first time new material is used' has been correctly taken out and presented separately on page 51. However, the material presented in this sub-section is a combination of levels 5 and 6. Since only level 6 is the true match to sample paradigm, this should be presented alone in my view".*

I disagree with the examiner. My intention in analysing the "first time new material used" was not to establish whether scent-matching was occurring, but to establish whether the dogs were somehow "marking" the proxy for later identification. With that intention in mind, it is not relevant whether other scented proxies were present (level 6) only that proxies were present (level 5 and level 6). This point has been clarified.

Page 46: "It was then necessary to establish whether the subjects were placing a mark on the unknown target proxy, i.e. on the first run with a new target proxy were the first number of match attempts random until the target proxy was found and then the target proxy somehow marked by the subject for identification on future runs? New proxy first runs were analysed for L5 and L6 because in many instances the new proxy was first used in L5 runs and then in L6 runs in the same session. This test was not used to measure scent-matching, but rather "new proxy marking".

Page iv, paragraph 6 – Examiner writes: *"The first run after a switch in target is in my view the only independent data, since the other runs are repetitions of the first one so whatever has been learned in this first run influences the decision making process in subsequent runs. Repetitions cannot be viewed as independent data for statistical purposes, and the way it has been used by the author has led to inflated 'success rates'".*

I agree with the examiner that repetitions of the same target could be interpreted as non-independent data. However, the target was changed at each session, no one target was used excessively and all testing trials per new target were kept to a relatively low number to minimise the effect of repetition.