Examination of Doctoral thesis of Michal PIENIAK

It is my pleasure to examine this thesis, which is on a topic that is theoretically interesting and practically important. As each of the main parts of the thesis have been published, some in high impact journals, I have presented my revisions on each of these papers in relation to the 60 page opening part of the thesis – which I refer to as 'the summary'. My reason for doing this was to enable the candidate to insert comments/changes/reflections in this part of thesis, as this part could be changed.

Overall abstract of the thesis. An accurate overview of its content.

Introduction. Very clear introduction. I just note some typos here. The opening sentence on p11 needs to start with 'The human…'. On p12 what does 'novel ORNs' refer to?

NBR Paper (p14-19). This paper presents a review of the literature on olfactory training, with a focus on the impacts of COVID on olfactory function, which was a significant issue at the time of publication.

Comments on the summary: On p17, I did not understand fully why different control groups limit the comparability of evidence. Perhaps give some examples of where such a limitation is critical to interpretation. On p18, what is 'olfactory eloquence'?

Comments on the NBR paper. This was well written, comprehensive, and a significant scholarly achievement. There were a couple of issues that I would like the candidate to consider. The first is a point I make later in this examination, and that is the importance of considering psychological explanations of the impacts of olfactory training. It seems to me that one could explain many of the observed effects of olfactory training from an attentional perspective if one wanted to (and *brief* mention of this is made in the thesis). In such an attentional model, the odour sniffing procedure leads the participant to attend more to their olfactory sensorium, and it is this attentional shift – a psychological mechanism - that is beneficial. It would be good to see this, and indeed other psychological models discussed. For example, are there any findings which argue *strongly* for a primarily physiological explanation of olfactory training, and which *cannot* be encompassed within an attentional (or other psychological) account? I am not sure I could see any, but then I do not have the candidate's expertise in this domain. The second point, is that if exposure alone is so important to improving function (i.e., with no psychological component), then why does incidental exposure to odours, which every human being has in their day-to-day life, not result in a progressive return of olfactory function in most participants? Finally, I also found myself wondering whether an intriguing test of an attentional account vs. a physiological exposure account, would be to present odours either retronassally or orthonassally. Several authors have argued that there are substantial attentional differences between these modes of presentation (i.e., retronassal - attended less vs. orthonassal - attended more), but both result in roughly equal odour exposure. If increased attention is the key, then I suspect exposure via the retronasal route would not be very helpful.

Development of olfactory functions. A great summary of the developmental literature.

Aim of the project. On p23 two rather than 'twofold'.

EJP Paper. This paper explored the impacts of olfactory training in healthy children, finding an impact on odour identification.

Comments on the summary. It seems very possible that the observed identification benefit could be mediated via a psychological explanation, namely increased attention to olfactory stimuli. Is there any evidence for or against this possibility? Please discuss.

Comments on the EJP paper. This was a well-prepared paper with clear cut outcomes. It would have been interesting to know if the change in children's olfactory sensitivity correlated with the improvement in odour naming – was this examined for each group? Some discussion of mechanism would have been useful. Were the children asked what they *thought* they were doing? And what exactly did they verbally consent too? What is interesting here is to know what they were told, and how might this relate to what happened in the experiment.

BI Paper. This study examined the impacts of olfactory training on a paediatric mild-TBI group versus healthy controls. There were some impacts on olfactory sensitivity and some general effects on cognitive measures.

Comments on the summary. With the purported benefit of the low odour condition improving sensitivity – could this just have been a natural recovery which would have happened anyway? Is there anything in the design that would argue against this possibility? Relatedly, could then the high dose exposure condition actively impair or hinder recovery, hence no observed effect here? This possibility merits discussion, as the findings may indicate that for the developing brain the optimal treatment intensity is lower than say for the adult brain, and that high dose exposure may be delay improvement.

Comments on the BI paper. This paper would have benefitted from some additional pieces of information: More details about the causes of the mTBIs that the children sustained as this might impact benefits of olfactory training; Details about how compliance was measured, and the exact nature of the training regime; and whether this study was a component of any other study, and hence whether other cognitive testings, interventions or procedures were conducted on these samples – indeed, I thought the absence of a 'Procedure' section was unusual – was this an oversight? As this was a clinical trial, it would also have been useful to have undertaken a completer analysis, with those who dropped out being allocated 'no change' scores. Finally, was this trial registered and if so, where?

NR Paper. This study reported a null-result on the effects of olfactory training on various working memory measures.

Comments on the NR paper. Some more details about the study would have been helpful: Where were the schools that the children were recruited from? Did these children participate in any additional or related studies? What specifically were parents told as to the rationale for the study? Was there an incentive for participation for the parents given that policing this task involved quite a heavy load? What specifically led to the high rate of drop out for the olfactory working memory task? Finally, it was unclear what 'semi-random' meant.

JSS Paper. This study found a significant difference from the effects of olfactory training, on an emotion matching task in children.

Comments on the JSS paper. This study appears to use the same sample as the NR paper. There should be discussion of the potential for contamination between the measures/procedures reported separately in each of these papers. For example, the children who completed the olfactory working memory measure would have had more odour exposure than those who did not complete this task, which could have impacted performance on the emotion matching task. In addition, allocation in the NR paper involved 'semi-random' means, but allocation was reported as random in this paper – how could it be both? Some discussion of the problem of individually reporting findings from multi-component studies should be acknowledged, and the implications discussed. Finally, were any other cognitive tasks used beyond those reported in this paper and the NR paper? If yes, these should be identified and discussed, again in the light of the possible effects of cross-contamination of tasks, participant burden etc.

General discussion. Comments on the summary. On p34 what is 'low score resolution'? On p35, I do feel that the candidate has far too much faith in neuroimaging. If there are behavioural effects, then there must be alterations in brain structure and function. And if these are 'imaged' then it turns into an exercise of pinning labels on to brain parts. It seems to me more productive, and especially as we are psychologists, to focus on the psychological mechanisms that may account for the observed effects. An obvious and promising one is flagged on the top of p36, namely the effects of attention. But there are likely to be plenty of others. What might these be?

I congratulate the candidate on this body of work, which I enjoyed reading, and found to be thought provoking. They have undertaken a substantial amount of empirical work in hard to access groups, and completed a narrative synthesis of a large literature. In sum, this work, in my opinion, clearly merits award of a doctoral degree - following the revisions outlined above.

Yours sincerely,

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