AUTHOR QUERY FORM

ELSEVIER	**Journal:** TICS **Article Number:** 1537	**Please e-mail your responses and any corrections to:** **E-mail:** corrections.esnl@elsevier.thomsondigital.com

Dear Author,

Please check your proof carefully and mark all corrections at the appropriate place in the proof (e.g., by using on-screen annotation in the PDF file) or compile them in a separate list. Note: if you opt to annotate the file with software other than Adobe Reader then please also highlight the appropriate place in the PDF file. To ensure fast publication of your paper please return your corrections within 48 hours.

For correction or revision of any artwork, please consult http://www.elsevier.com/artworkinstructions.

Please note that the figure resolution in these proofs is lower than the original figures to avoid problems with emailing large file sizes. The figure resolution in the final publication will be equivalent to the original figure submission.
Any queries or remarks that have arisen during the processing of your manuscript are listed below and highlighted by flags in the proof. Click on the 'Q' link to go to the location in the proof.

Location in article	Query / Remark: click on the Q link to go Please insert your reply or correction at the corresponding line in the proof
Q1 Q2 Q3	for consistency, please provide the zip code for each postal address. Please confirm that given names and surnames have been identified correctly. Please check for correctness relevant online publication date and complete DOI number
	Please check this box or indicate your approval if you have no corrections to make to the PDF file ☐

Thank you for your assistance.

Letter

No-Report and Report-Based Paradigms Jointly Unravel the NCC: Response to Overgaard and Fazekas

Naotsugu Tsuchiya,[1,2,*] Stefan Frässle,[3] Melanie Wilke,[4,5,6] and Victor Lamme[7]

In their recent letter to *Trends in Cognitive Sciences* [1], Overgaard and Fazekas provide constructive criticisms of our proposal to use no-report paradigms to extract the true neural correlates of consciousness (NCC) [2]. Here, we clarify our claims that are slightly misrepresented in their comments. Specifically, we re-emphasize that: (i) no-report paradigms should be combined with report-based paradigms; (ii) no read-out of perception is likely to generalize over all conditions; and (iii) theoretical approaches are a viable alternative to simply relying on the scientists' intuitions. Furthermore, we agree with their suggestion of a refinement of post-NCC processes and offer some existing examples.

Overgaard and Fazekas claim that no-report paradigms are no better than report-based paradigms because both are confounded 'in similar ways but for different reasons'. We acknowledge that, when used in isolation, no-report paradigms can indeed overestimate the NCC due to its potential inclusion of unconscious pre-NCC processes. Report-based paradigms typically avoid that (although see Table 1 in [2]), but run into the risk of including post-NCC processes, related to cognitive demands, such as attention, working memory, decision making, and action planning. Therefore, we propose that the combination of both paradigms will provide us with a framework to unravel the 'true' NCC at the intersection of the differently obtained NCCs. We argue that the inclusion of no-report control conditions in future experiments can bring us an important step closer to finding and disentangling the neural mechanisms leading up to, producing, and finally reporting conscious experience.

Overgaard and Fazekas further critique our advocacy of alternative ways to 'read out' subjects' phenomenology in the absence of report. We highlighted the use of eye movements (and pupil size) to gauge perceptual switches in binocular rivalry [2]. Overgaard and Fazekas counter that these may be unreliable measures of perceptual switches, that perception without reports may in fact differ from reported percepts, and that omitting explicit reports do not entirely avoid post-NCC processes, such as attention. Indeed, a read-out that works for all tasks and situations is unlikely to exist. Thus, while we do not believe that one type of autonomous measure by itself will provide a reliable perceptual readout for all stimulus and task configurations, it may be possible to combine multiple physiological measures to develop more reliable methods that match with phenomenology under specific stimulus conditions [3].

It is furthermore possible that phenomenology differs depending on whether a report is given, particularly in the case of near-threshold stimuli. Therefore, caution should be applied when combining near-threshold stimuli with no-report paradigms. By contrast, when using clearly visible stimuli, perception is typically cognitively 'impenetrable' [4]. The neural signature of Kanizsa illusions in visual cortex, for example, is not different for reported or not reported stimuli [5]. In such cases, it is more important to effectively exclude large post-NCC confounds than to worry about subtle (if any) changes in phenomenology when reports are taken away [6].

To avoid any and all post-NCC confounds, we have argued to use inattention paradigms, where a potential NCC can be fully dissociated from cognitive access and attention. In that case, the risk of including unconscious processes is, obviously, even larger, and combining such paradigms with report-based paradigms is even more important.

An alternative promising avenue for elucidating the presence or absence of perceptual states in the cases of full inattention and inability to report [7] are theoretical approaches, such as integrated information theory [8], that should in principle be able to predict the contents of consciousness without relying on report. While such theoretical approaches are still in their infancy, recent approaches have started to test such mathematical formulations against measured neuronal activity [9].

Finally, Overgaard and Fazekas propose to refine post-NCC through manipulation of introspection. We agree that this is a promising idea and we have already highlighted a few methods along this line: (i) varying sensory inputs in subtle ways, such as contrasting between forward versus backward masking at a comparable task performance [10]; (ii) manipulating the history of stimulus presentation using perceptual adaptation, prior exposure of a subset of stimuli, or the order of presentation [11]; and (iii) manipulating decision criterion to report independently of stimulus visibility to disentangle neural processes of perception, decision making, and report [12].

Overall, using no-report paradigms and contrasting them with report-based paradigms gives rise to promising experimental designs to study the NCC that control for some of the major confounds. Importantly, such approaches also ask scientists to pay closer attention to conscious experience or phenomenology itself, rather than taking what subjects report at face value. Without reports, do we really lose consciousness? Taking phenomenology seriously is the basic and first step towards identifying the neural basis of consciousness.

[1]School of Psychological Sciences, Faculty of Biomedical and Psychological Sciences, Monash University, Clayton, VIC, Australia
[2]Monash Institute of Cognitive and Clinical Neuroscience, Monash University, Clayton, VIC, Australia
[3]Laboratory for Multimodal Neuroimaging (LMN), University of Marburg, Germany
[4]Department of Cognitive Neurology, University Medicine Goettingen, Robert-Koch-Strasse 40,37075 Goettingen, Germany
[5]German Primate Center, Leibniz Institute for Primate Research, Kellnerweg 4, 37077 Goettingen, Germany
[6]German Research Foundation (DFG) Center for Nanoscale Microscopy and Molecular Physiology of the Brain (CNMPB), Georg-August-Universitaet Goettingen, 37073 Goettingen, Germany
[7]Amsterdam Brain and Cognition (ABC) and Department of Psychology, University of Amsterdam, Amsterdam, the Netherlands

*Correspondence: naotsugu.tsuchiya@monash.edu (N. Tsuchiya).

http://dx.doi.org/10.1016/j.tics.2016.01.006

References

1. Overgaard, M. and Fazekas, P. (2016) Can no-report paradigms extract true correlates of consciousness? *Trends Cogn. Sci.* Published online XXX, UU, 2016. http://dx.doi.org/10.1016/j.tics.2015.XXXX
2. Tsuchiya, N. *et al.* (2015) No-report paradigms: extracting the true neural correlates of consciousness. *Trends Cogn. Sci.* 19, 757–770
3. Frässle, S. *et al.* (2014) Binocular rivalry: frontal activity relates to introspection and action but not to perception. *J. Neurosci.* 34, 1738–1747
4. Firestone, C. and Scholl, B. (2015) Cognition does not affect perception: evaluating the evidence for 'top-down' effects. *Behav. Brain Sci.* Published online July 19, 2015. http://dx.doi.org/10.1017/S0140525X15000965
5. Vandenbroucke, A.R. *et al.* (2014) Seeing without knowing: neural signatures of perceptual inference in the absence of report. *J. Cogn. Neurosci.* 26, 955–969
6. Wilke, M. *et al.* (2009) Neural activity in the visual thalamus reflects perceptual suppression. *Proc. Natl. Acad. Sci. U.S.A.* 106, 9465–9470
7. Lamme (2010) How neuroscience will change our view on consciousness. *Cogn. NeuroSci.* 1, 1–57
8. Tononi, G. (2004) An information integration theory of consciousness. *BMC Neurosci.* 5, 42
9. Oizumi, M. *et al.* (2016) Measuring integrated information from the decoding perspective. *PLoS Comput. Biol.* Published online January 21, 2016. http://dx.doi.org/10.1371/journal.pcbi.1004654
10. Lau, H.C. and Passingham, R.E. (2006) Relative blindsight in normal observers and the neural correlate of visual consciousness. *Proc. Natl. Acad. Sci. U.S.A.* 103, 18763–18768
11. Aru, J. *et al.* (2012) Local category-specific gamma band responses in the visual cortex do not reflect conscious perception. *J. Neurosci.* 32, 14909–14914
12. Super, H. *et al.* (2001) Two distinct modes of sensory processing observed in monkey primary visual cortex (V1). *Nat. Neurosci.* 4, 304–310

Q3