

# Conscious perception and the frontal lobes: comment on Lau and Rosenthal

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The notoriously difficult problem of grounding conscious awareness in neuroscience was nicely illustrated in a recent review by Lau and Rosenthal [1]. The major discrepancies between the different theories referenced by the authors demonstrate how far we are from an agreed upon framework. As the authors correctly point out, more empirical data is dearly needed in order to make progress in this fascinating field. Related to this point, a number of studies cited by the authors as supportive of higher-order theories (e.g. [2]), are also compatible with first-order theories, and at least one study interpreted as consistent with higher-order theories of consciousness [3] is, in fact, inconsistent.

Starting with the latter point, Goldberg *et al.* [3] showed that frontal brain regions specialized for introspection and self-related processing actually reduce their activity under highly demanding sensory tasks. This result appears to contradict higher-order theories that argue for activation in such frontal areas as a pre-requisite for conscious perception. Lau and Rosenthal [1] argue that the reported reduction in frontal cortex activity actually supports their theory since: “subjects consciously saw the rapidly presented images with reduced detail”. However, the authors ignore a crucial aspect of the Goldberg *et al.* study: the activity in prefrontal areas was lower even when compared to the no-stimulus condition. Clearly such ‘task-negative’ responses cannot be explained by mere degradation of the sensory experience. Rather, these findings point to a specialized role for areas engaged in introspective, self-related (‘intrinsic’) cognition. These areas show functional complementarities, often antagonism, with the well known sensory areas which specialize in outwardly oriented (‘extrinsic’) information [4] (see also, e.g. [5,6]). To the extent that Lau and Rosenthal [1] define high order thoughts as including a self component: “mental states that represent oneself. . .” (first paragraph), the Goldberg *et al.* results appear to be incompatible with their theory.

Lau and Rosenthal cite the fascinating report of vivid visual hallucinations in a case of a unilateral absence of early visual cortex [2] as further support for higher-order theories. However, this case is also nicely compatible with local first-order theories that link visual experience to activity in non-retinotopic, high order, visual areas [7] that are bilaterally represented. Similarly, transcranial

magnetic stimulation (TMS) of high order visual cortex in a hemianopic patient has been shown to successfully elicit artificial posphenes in the blind field [8].

More generally, it is not clear how Lau and Rosenthal’s proposal relates to a range of mental states that can be loosely grouped under the term ‘absorption’. These are conditions in which tasks and stimuli are so engaging and attention-demanding (e.g. a highly engaging movie) that they appear to exclude high order meta-cognitive thinking. Under Lau and Rosenthal’s proposal, these most engaging sensory moments will most likely be deemed ‘unconscious’ given their apparent lack of high order thought content.

While these observations are certainly not decisive in favoring one theory over the others, it is fair to conclude that first-order theories, and even their local versions (that is, theories that emphasize the role of localized cooperative activity in subjective experience, e.g. [9,10]) are still compatible with available experimental data derived from the human brain.

## References

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