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Neural plasticity and consciousness: Reply to Block

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We propose that perceptual quality can be explained by the way neural states figure in dynamic sensorimotor patterns [1–4]. Is this a version of functionalism, as Block [5] and Gray [6] suggest? No. First, our proposal is compatible with physicalism, that is, with the idea that phenomenology goes with brain state. We reject only a physicalism that holds that properties of cortical states activated by sensory input alone are sufficient for experience. In our view, the relevant neural substrates are dynamic and sensorimotor. Second, we do not hypothesize that function is (or determines) phenomenology. Rather, we propose that sensorimotor context *explains* the phenomenology. Even on the assumption that phenomenology correlates with neural states, it remains open whether one can bridge the explanatory gaps. One *can* bridge these gaps, we argue, by looking to dynamic sensorimotor context.

Our central claim is empirical: it is possible to explain and predict variations in phenomenology by reference to sensorimotor patterns. For example, applying TMS to V1 during Braille reading by early blind but not normal subjects produces tactile distortions; V1 gives rise to tactile experience because its activation mediates relevant patterns of sensorimotor contingency (e.g. patterns of change in stimulation of the fingers as they move). This point is untouched by Block's observations: (1) that somatosensory cortex is also active during Braille reading; and (2) that V1 may be active in other tactile tasks. Block concludes (3) that it is misleading to speak of visual or tactile cortex, because cortical areas are multi-sensory, and he challenges us (4) to explain the basis of our claim that the phenomenology of Braille is exclusively tactile and not spatial or visual.

As for (3), we agree that perceptual areas of the brain are multi-sensory. Activity in V1 is not intrinsically unimodal. Indeed, this is precisely our point: the phenomenology is determined by dynamic patterns of sensorimotor activity. As for (4), we need to be careful: First, there *is* reason to believe that Braille reading – using fingers to perceive letters and words – is tactile; the burden of proof is on one who claims that Braille readers do not have tactile phenomenology. (Block cannot appeal to the fact that V1 is active during Braille reading, precisely because of the multi-sensory character of neural activity in V1.) Second, a sensory modality isn't spatial *as opposed to* tactile or visual. Touch and vision are both modalities of spatial perception. But there are differences between the spatial content of touch and that of vision; vision but not touch presents spatial arrays at a distance. Crucially, the spatial content of Braille is that of touch, not vision.

This last point is relevant to Block's comments about our treatment of tactile–visual substitution systems (TVSS). We do not claim that the phenomenology of TVSS is exclusively visual, as Block suggests. We insist only that it is not exclusively tactile, and that its spatial content is visual, not tactile. The significance of Block's observation that subjects can concentrate on tactile sensations during TVSS is unclear. Perhaps attention can change the qualities experienced. In any event, the presence of tactile sensations does not make TVSS tactile, for the relevant experiences are not of those sensations.

What about the possibility of activity in V1 during TVSS? This would not be evidence against our claim that somatosensory cortex subserves non-tactile phenomenology, just as the existence of activity in somatosensory cortex during Braille reading does not invalidate the claim that V1 subserves touch. This suggests a new, parallel experiment: would TMS to somatosensory cortex in TVSS produce changes in the 'quasi-visual' phenomenology of TVSS users? We predict that it would.

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