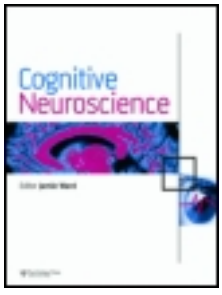

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Constructing priors in synesthesia

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Commentary

Constructing priors in synesthesia

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Abstract: A new theoretical framework (PPSMC) applicable to synesthesia has been proposed, in which the discrepancy between the perceptual reality of (some) synesthetic concurrents and their subjective non-veridicality is being explained. The PPSMC framework stresses the relevance of the phenomenology of synesthesia for synesthesia research —and beyond. When describing the emergence and persistence of synesthetic concurrents under PPSMC, it is proposed that precise, high-confidence priors are crucial in synesthesia. I discuss the construction of priors in synesthesia.

Seth (2014) addresses the interesting fact that synesthetic concurrents are perceptually vivid (at least for some synesthetes), while all synesthetes are aware that their synesthetic experiences are not "real," i.e., *subjectively non-veridical*. Existing theories of synesthesia do not explicitly account for this important phenomenological aspect. Since it is known that individual differences in the phenomenology of synesthetic concurrents impact the underlying neural mechanisms (e.g., van Leeuwen, den Ouden, & Hagoort, 2011), it is equally relevant that synesthesia models take into account both the perceptual *vividness* and the lack of perceptual *presence* of synesthetic concurrents.

Seth puts forward a Predictive Perception account of SensoriMotor Contingencies (PPSMC), in which he focuses on explaining the lack of subjective veridicality of synesthetic concurrents. One aspect of PPSMC is that strong, high-confidence priors are necessary during the initial emergence and later persistence of synesthetic concurrent sensations, because the hierarchical models underlying synesthetic perception need to resist prediction errors arising from the *absence* of stimuli directly representing the concurrent. Seth discusses possible associative mechanisms by which the inducers of synesthesia (e.g., letters) become linked with concurrents (e.g., colors) during development. After learning, strong priors could maintain a representation of the synesthetic concurrent even in absence of the actual associated stimulus.

However, it can be disputed whether (all) synesthesia develops exclusively via associative mechanisms. Cross-activation models of synesthesia propose that inducer-related activity immediately leads to activity in brain areas related to the concurrent experience through hyperconnectivity (Hubbard, Brang, & Ramachandran, 2011). Studies showing that visual cortex of synesthetes may be hyperexcitable (Terhune, Tai, Cowey, Popescu, & Cohen Kadosh, 2011), and very sensitive to color stimuli (e.g., van Leeuwen, Hagoort, & Händel, 2013), support an interpretation where perceiving the inducing stimulus leads to excess brain activity because neurons are easily excitable. When learning the neural representation of an inducer (e.g., a letter), the brain depends on the neural signal it "sees" in the cortex. Therefore, any sensory input or co-activation (e.g., activation in color areas, accompanied by a color percept) becomes naturally incorporated in the high-level representations of "which signal constitutes a letter." Thus, there is no "inexistent sensory input" of the concurrent, as Seth puts it. Instead, the concurrent stimulus is directly represented by the inducer by low-level brain activity, leading to an adapted high-order prior for the inducing stimulus. Which brain regions are co-activated may determine

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the perceptual vividness of the synesthetic concurrent (projectors/associators).

This is not to say that strong top-down predictions are not part of the synesthetic experience. Top-down predictions of concurrents are supported by the influence of context on synesthetic experiences (Ward, 2013). Jardri and Denève (2013) have proposed top-down predictions in synesthesia are strong compared to the weighting of sensory evidence. Indeed, if cortex is hyperexcitable, sensory evidence may be noisy. However, if synesthetic concurrents would become manifest via strong top-down influences alone, all synesthetes would be "associators." Synesthetic concurrents would resemble the retrieval of other previous knowledge about the inducer from memory (e.g., phonological properties of a letter, exemplar information (a*a*A)) or imagery: Both subjectively non-veridical, and lacking perceptual vividness. I propose that in order to explain both the perceptual vividness and subjective non-veridicality of synesthesia, we need to study how priors in synesthesia are shaped during development to incorporate the concurrent synesthetic experiences.

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