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  Dynamic Retinotopic Coding

  If the brain stores visual space in a stable headcentric (retinal error + eye position) frame, short-term visual memory should be independent of subsequent eye movements. However, if the brain uses a retinotopic frame then remembered visual space would have to a re-mapped during saccades, and this re-mapping could lead to behavioural errors. To test between these models, eye and arm orientations were recorded while 7 head-fixed subjects (Ss) looked and pointed toward lights flashed briefly in the dark. The paradigms were: (1) control, where Ss both looked and pointed toward remembered targets; (2) static, where Ss pointed to remembered targets flashed in their visual periphery (with eye fixed); and (3) dynamic, where Ss looked directly at the briefly flashed target before looking away and then pointing at it. Control pointing was relatively accurate in the horizontal direction, but systematic overestimation of retinal error (indicated by pointing) was observed in the static condition (2.01 deg +/- .77). The headcentric hypothesis suggested that pointing should be as accurate in the dynamic condition as in the control (since Ss would compute target re:head while fixating the target) whereas the retinocentric hypothesis predicted inaccuracies similar to the static condition (since pointing would be based on target representations that were shifted on a retinotopic map during eye movement). As predicted by the latter, dynamic pointing errors (2.55 deg +/- 1.04) were quantitatively indistinguishable from static pointing errors (r = 0.79, slope = 0.97). Further, by varying target locations and fixation directions we confirmed that these errors were a function of retinal error, not eye position. We conclude that visual space is remembered relative to current visual gaze, such that it must be shifted within a retinotopic map during each eye movement.

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  Denise Henriques, D.Lowey, and J.D. Crawford
  York University