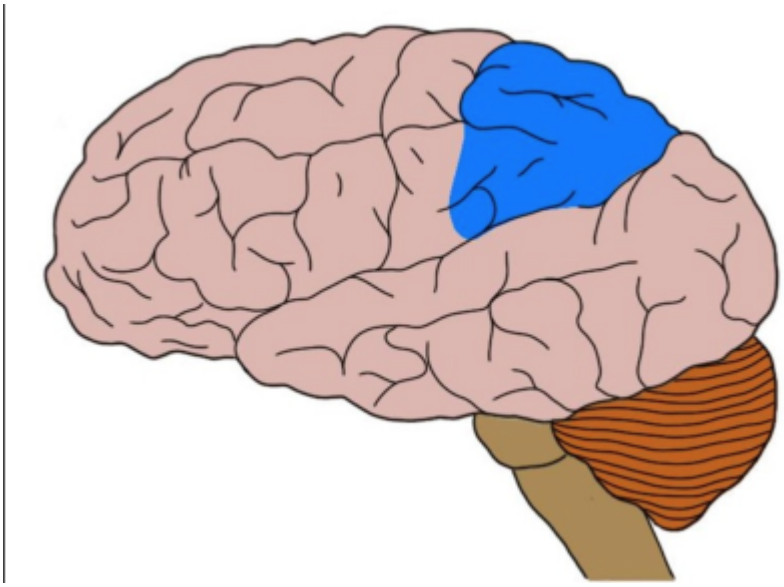
Posterior parietal cortex



The posterior parietal cortex can be subdivided into the superior parietal lobule (Brodmann areas 5 + 7) and the inferior parietal lobule (39 + 40), separated by the intraparietal sulcus (IPS). The intraparietal sulcus and adjacent gyri are essential in guidance of limb and eye movement, and—based on cytoarchitectural and functional differences—is further divided into medial (MIP), lateral (LIP), ventral (VIP), and anterior (AIP) areas.

The posterior parietal cortex (the portion of parietal neocortex posterior to the primary somatosensory cortex) plays an important role in planned movements, spatial reasoning, and attention.

Damage to the posterior parietal cortex can produce a variety of sensorimotor deficits, including deficits in the perception and memory of spatial relationships, inaccurate reaching and grasping, in the control of eye movement, and inattention. The two most striking consequences of PPC damage are apraxia and hemispatial neglect.

Pereira et al. from Geneva showed that perceptual consciousness and monitoring involve evidence accumulation. They performed single-unit recording in a participant with a microelectrode in the posterior parietal cortex, while they detected vibrotactile stimuli around the detection threshold and provided confidence estimates. They find that detected stimuli elicited neuronal responses resembling evidence accumulation during decision-making, irrespective of motor confounds or task demands. They generalized these findings in healthy volunteers using electroencephalography. Behavioral and neural responses are reproduced with a computational model considering a stimulus as detected if accumulated evidence reaches a bound, and confidence as the distance between maximal evidence and that bound. They concluded that gradual changes in neuronal dynamics during evidence accumulation relates to perceptual consciousness and perceptual monitoring in humans [1)]

Spatial remapping, the process of updating information across eye movements, is an important mechanism for trans-saccadic perception. The right posterior parietal cortex (PPC) is a region that has been associated most strongly with spatial remapping. The aim of a project of Ten Brink et al. was to investigate the effect of damage to the right PPC on direction specific transsaccadic memory. They compared trans-saccadic memory performance for central items that had to be remembered while making a left- versus rightward eye movement, or for items that were remapped within the left versus right visual field.

They included 9 stroke patients with unilateral right PPC lesions and 31 healthy control subjects. Participants memorized the location of a briefly presented item, had to make one saccade (either towards the left or right, or upward or downward), and subsequently had to decide in what direction the probe had shifted. We used a staircase to adjust task difficulty (i.e., the distance between the memory item and probe). Bayesian repeated measures ANOVAs were used to compare left versus right eye movements and items in the left versus right visual field.

In both conditions, patients with right PPC damage showed worse trans-saccadic memory performance compared to healthy control subjects (for the condition with left- and rightward gaze shifts, BF10 = 3.79; and when items were presented left or right, BF10 = 6.77), regardless of the direction of the gaze or the initial location of the memory item. At the individual level, none of the patients showed a direction specific deficit after leftward versus rightward saccades, whereas two patients showed worse performance for items in the left versus right visual field.

Damage in the right PPC did not lead to gaze direction specific impairments in trans-saccadic memory, but instead caused more general spatial memory impairments [2].

1)
Pereira M, Megevand P, Tan MX, Chang W, Wang S, Rezai A, Seeck M, Corniola M, Momjian S, Bernasconi F, Blanke O, Faivre N. Evidence accumulation relates to perceptual consciousness and monitoring. Nat Commun. 2021 May 31;12(1):3261. doi: 10.1038/s41467-021-23540-y. PMID: 34059682.
2)
Ten Brink AF, Fabius JH, Weaver NA, Nijboer TCW, Van der Stigchel S. Trans-saccadic memory after right parietal brain damage. Cortex. 2019 Jun 28;120:284-297. doi: 10.1016/j.cortex.2019.06.006. [Epub ahead of print] PubMed PMID: 31376588.