Spatial Working Memory

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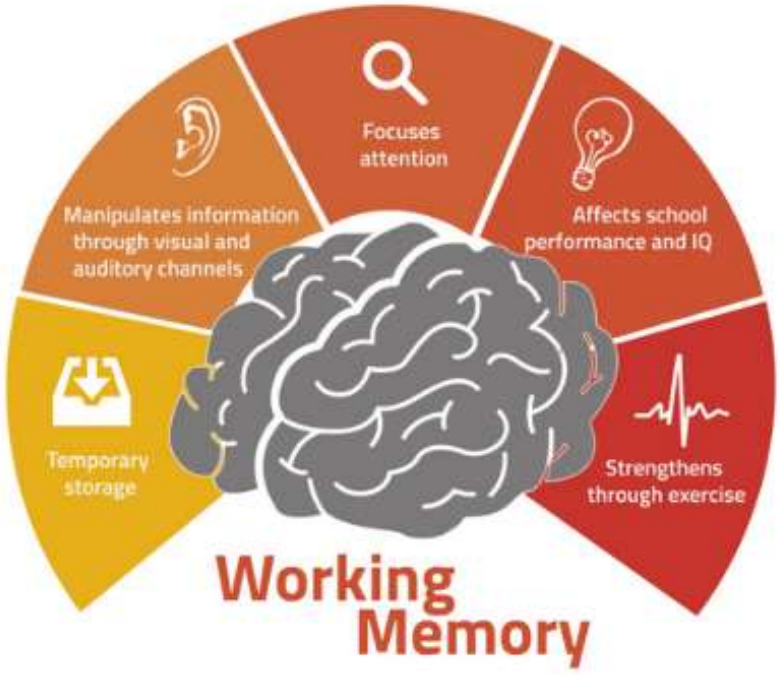
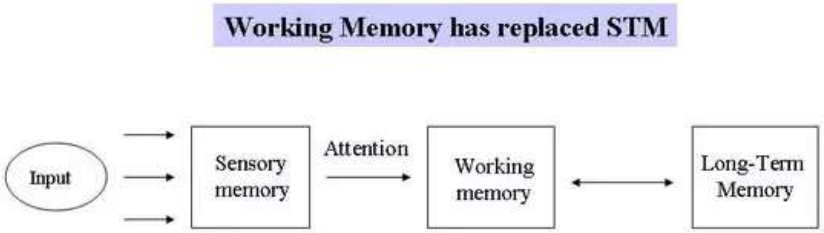
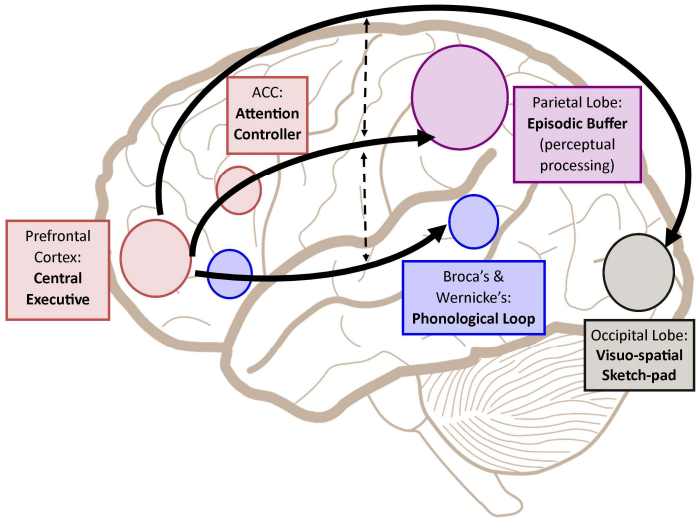
Working Memory

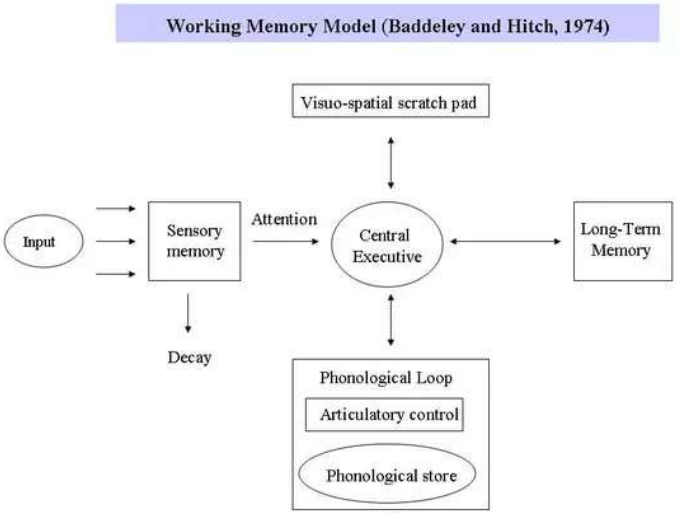
Working Memory: system that enables the temporary maintenance of limited information, where that information is kept on-line or available for immediate access by other cognitive processes



Multicomponent Working Memory Model



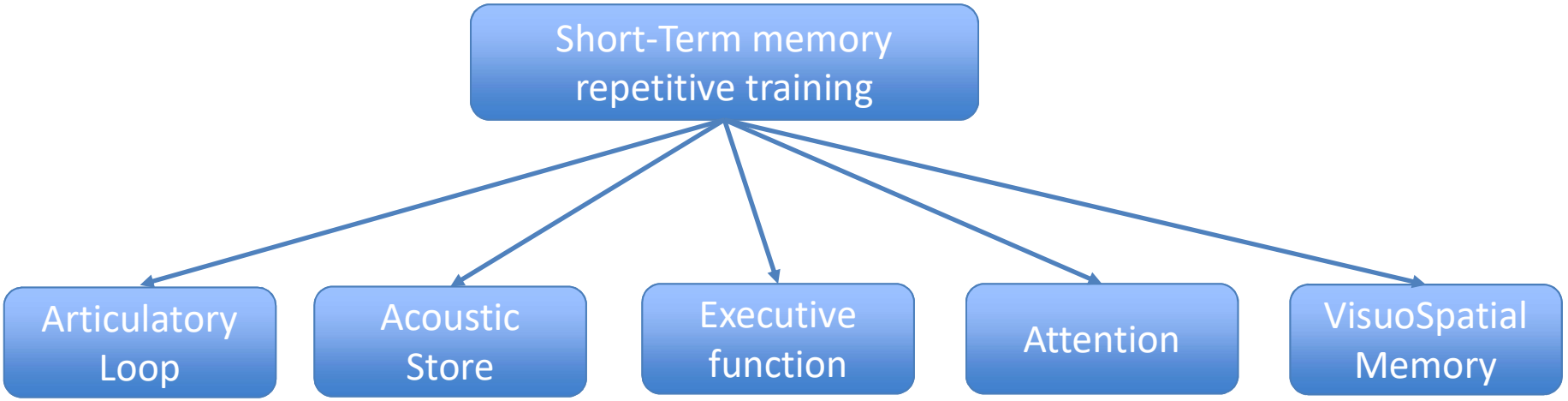




(Chai, Abd Hamid, & Abdullah, 2018)

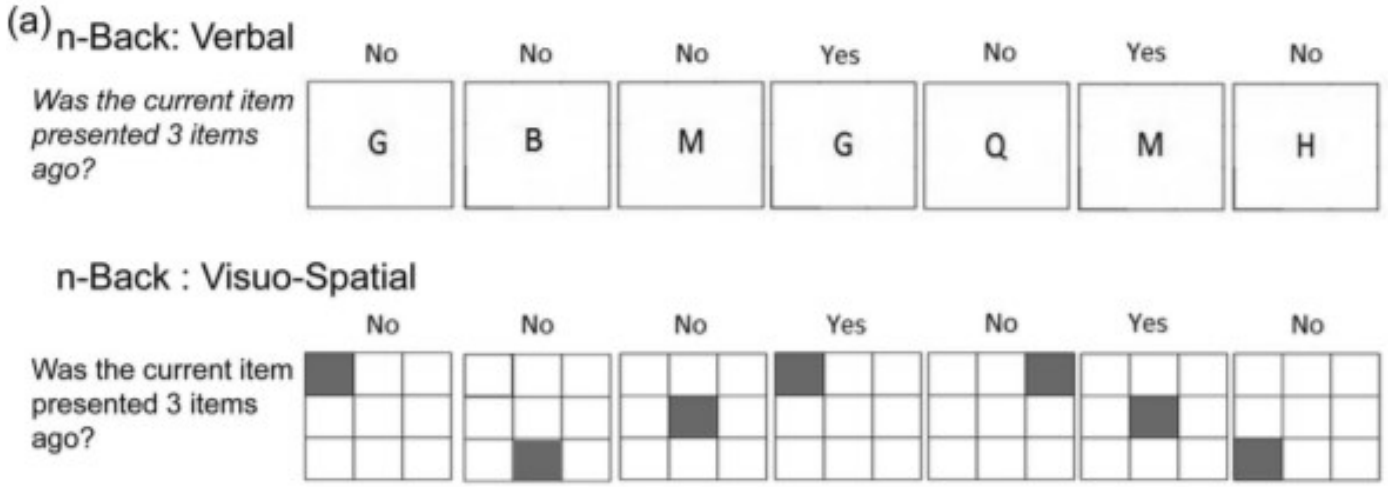
Visuospatial Working Memory Model in Cognitive Impairment

- Over 80% of patients with cognitive impairments represent with associated cognitive dysfunction.
- Cognitive dysfunctions cross different domains, including memory, language, attention, motor functions and visuospatial skills.



(Rodríguez-Blanco, Lubrini, Vidal-Mariño, & Ríos-Lago, 2017)

Sample Experiment in Working Memory Training

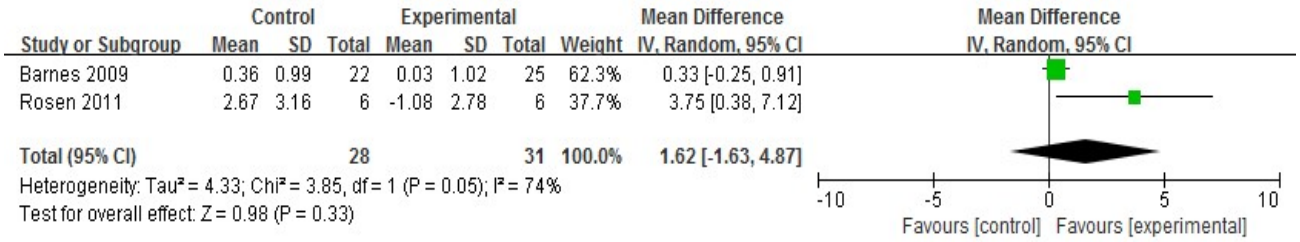


Problem Statement: Is working memory training effective ?

- Training programs may not increase working memory capacity
- Working Memory may not explain far transfer

Hypothesis

- Inconsistently measure near transfer with valid WM capacity tasks that differ from the method of training
- Not eliminate the use of no-contact control groups



The pool weighted standard mean difference score of Repeatable Battery for Assessment of Neuropsychological Status (RBANS) total score was 1.62

(Ge, Zhu, Wu, & McConnell, 2018)(Shipstead, Redick, & Engle, 2012)

Is Visuo-spatial working memory training measure near transfer with valid WM capacity tasks?

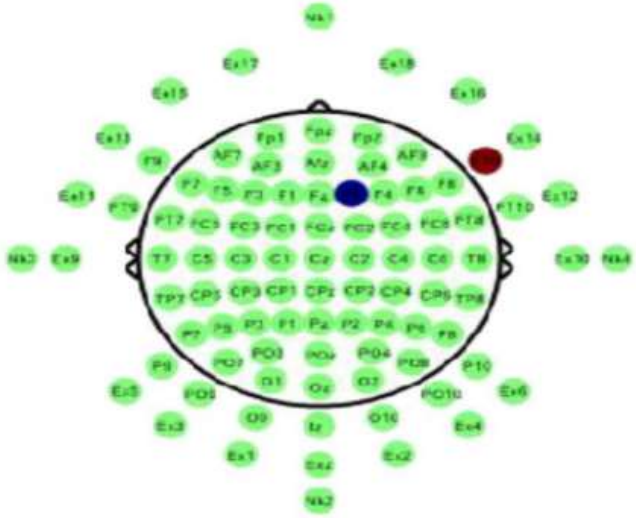
Is it possible there is an approach to further fractionate visual and spatial information, which separate stores for visual and spatial working memory?

Effects of Transcranial Direct Current Stimulation on Baseline and Slope of Prefrontal Cortex Hemodynamics During a Spatial Working Memory Task

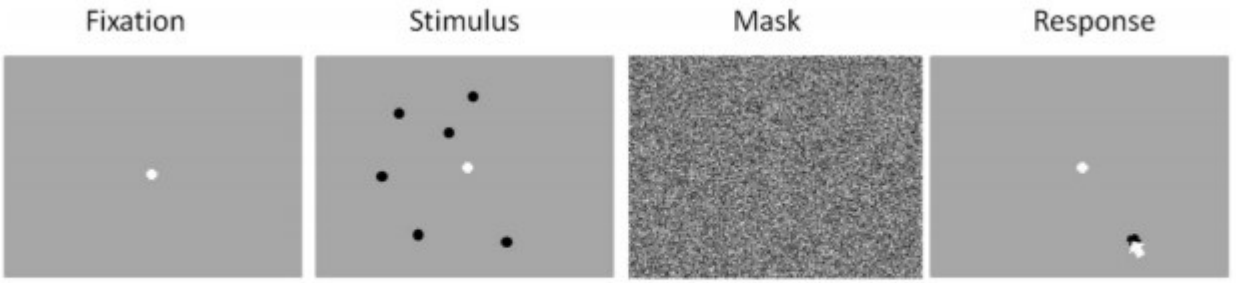
(McKendrick, Falcone, Scheldrup, & Ayaz, 2020)

Transcranial direct current stimulation (tDCS), is a non-invasive, painless brain stimulation treatment that uses direct electrical currents to stimulate specific parts of the brain

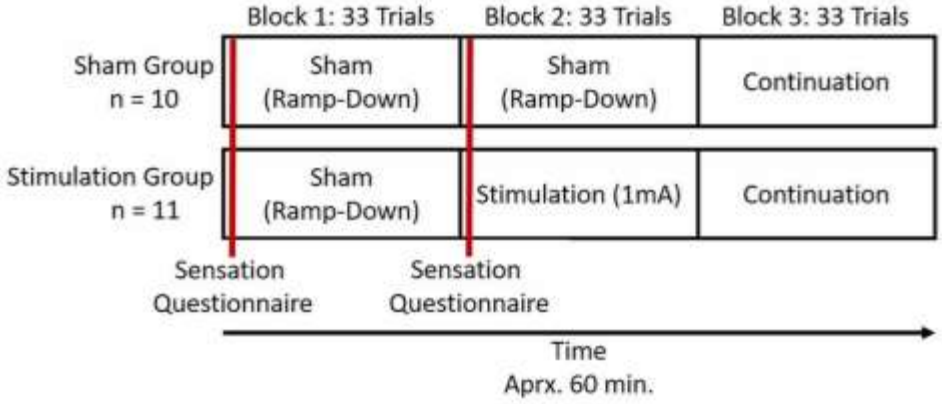
- TDCs was mounted on ventral PFC region which is generally considered as representation of spatial and feature information



Spatial Memory Task



Spatial Span Task



Result

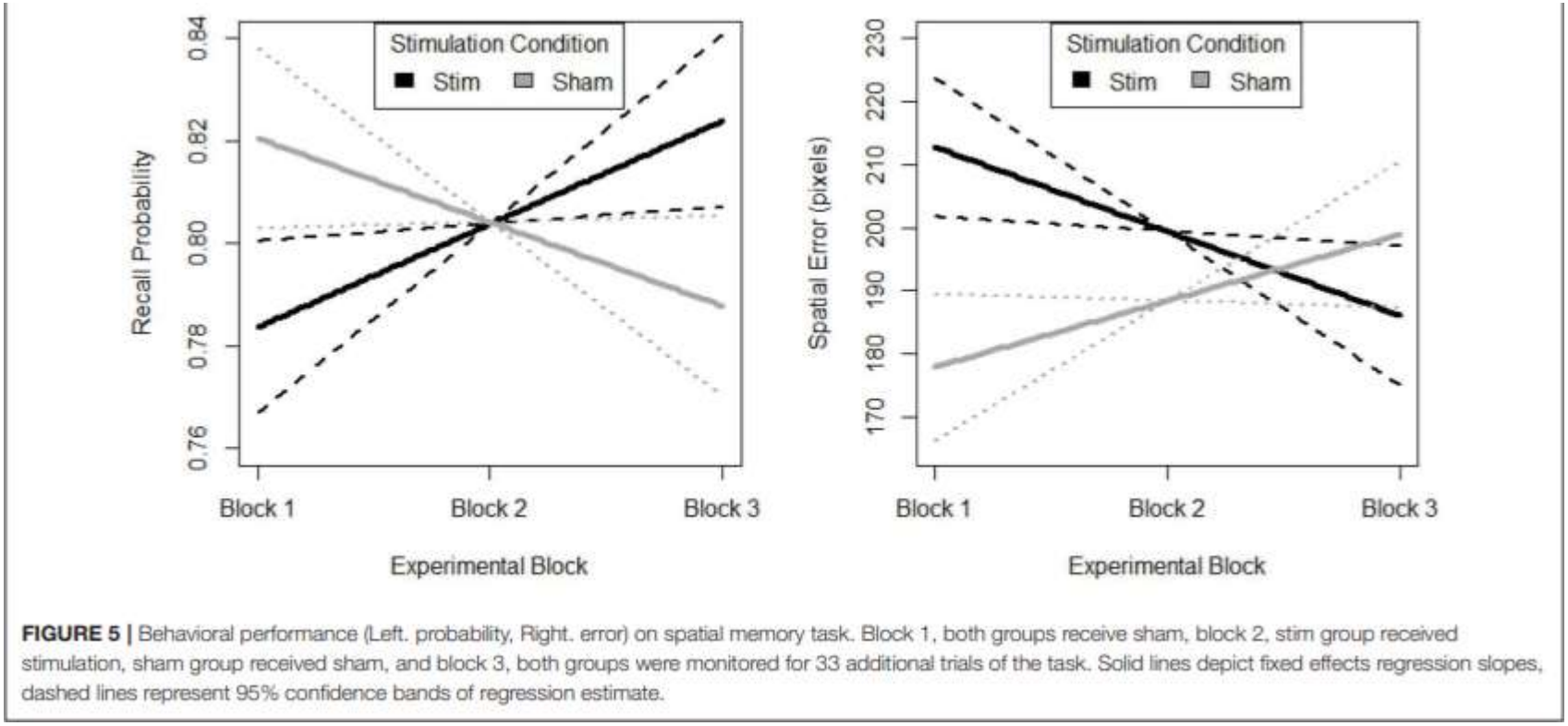


FIGURE 5 | Behavioral performance (Left. probability, Right. error) on spatial memory task. Block 1, both groups receive sham, block 2, stim group received stimulation, sham group received sham, and block 3, both groups were monitored for 33 additional trials of the task. Solid lines depict fixed effects regression slopes, dashed lines represent 95% confidence bands of regression estimate.

Updating spatial working memory in a dynamic visual environment

(Boon, Theeuwes, & Belopolsky, 2019)

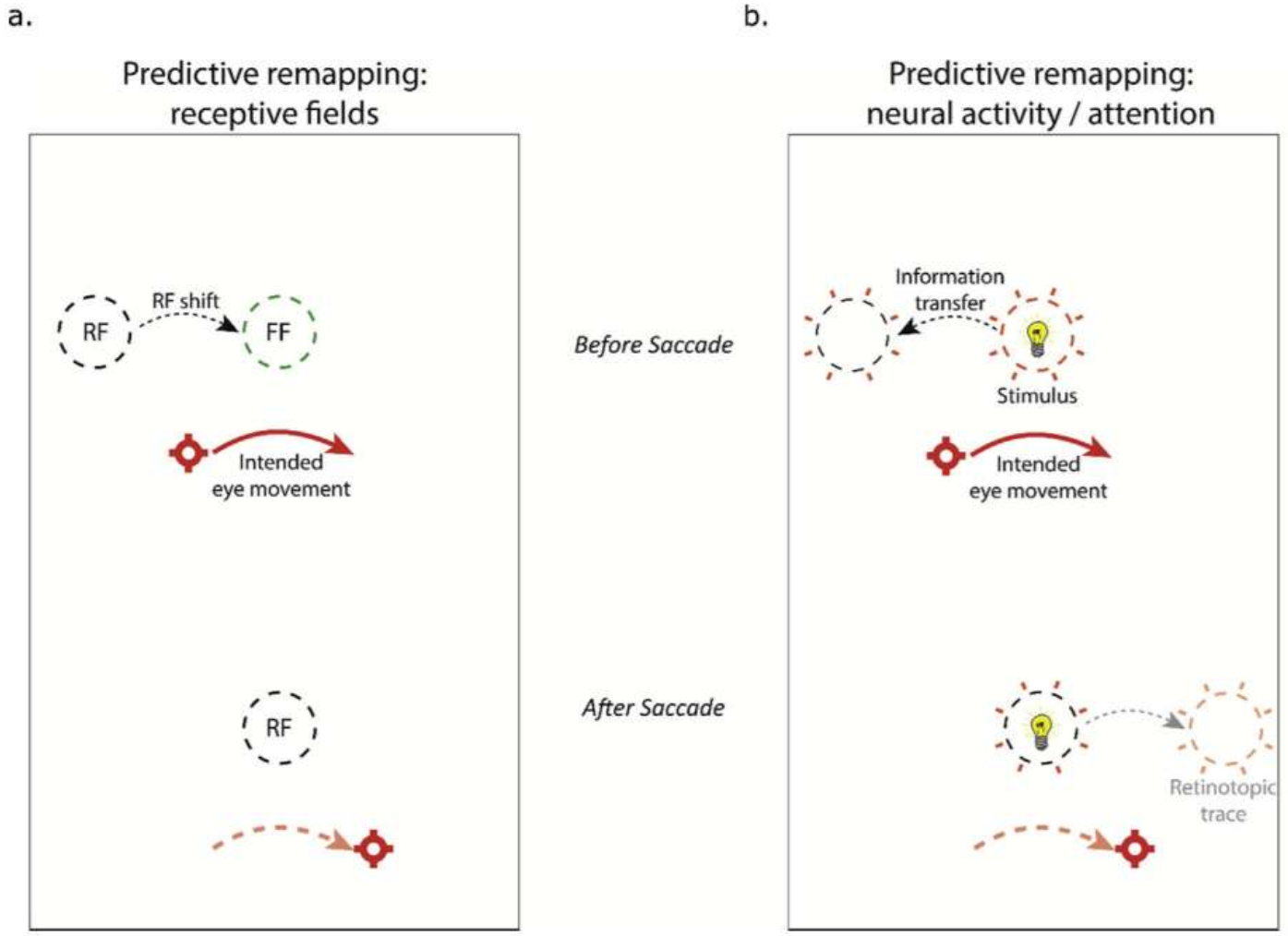
- Most notably, observers fail to notice large changes in the visual scene if they are timed to coincide with short interruptions of viewing.

- We need to determine where to move the eyes next, which locations remain relevant while moving our eyes elsewhere, and refrain from inspecting the same location over and over again.

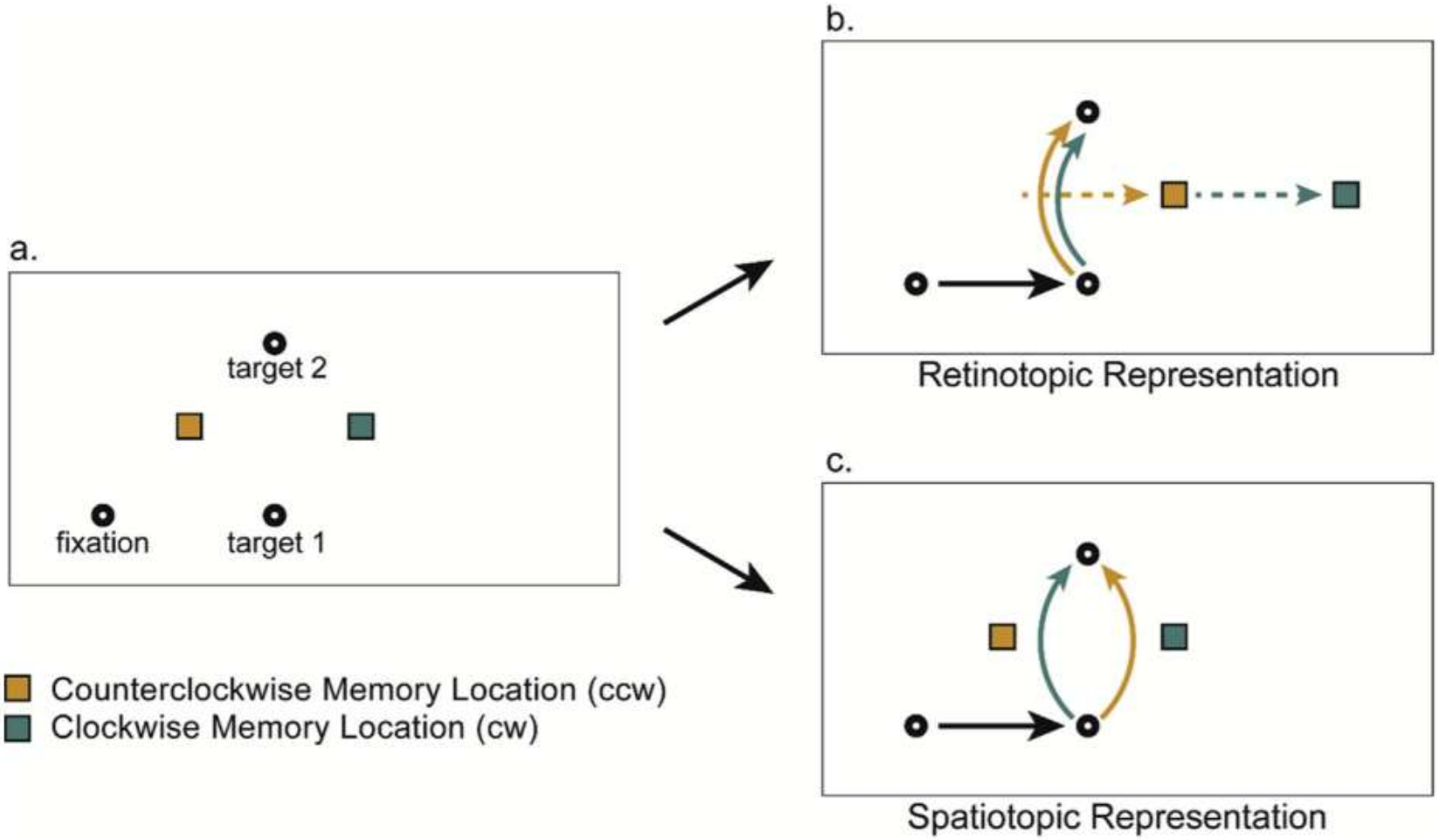
- Whether it is the planning of a future eye movement, memorizing a location of an object, or simply refraining from revisiting already inspected objects - any of these tasks would not be possible if this information would be computed anew with every fixation.

- thalamic and frontoparietal lesions have been shown to lead to similar deficits in the updating of spatial content.

Hypothesis

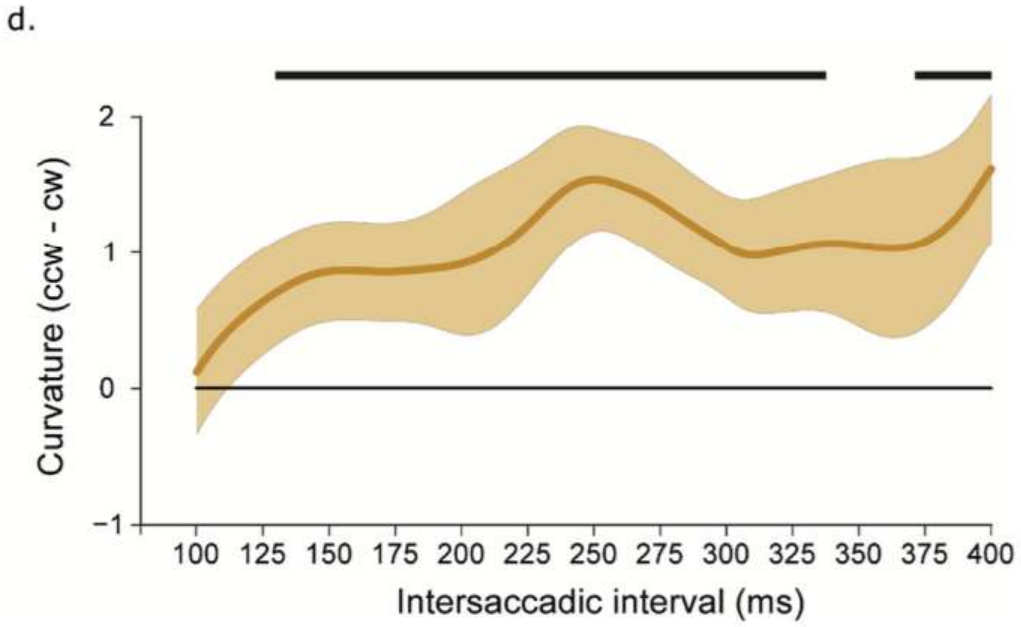

a.
Predictive remapping:
receptive fields
RF
RF shift
FF
Intended
eye movement
RF
b.
Predictive remapping:
neural activity / attention
Information
transfer
Stimulus
Intended
eye movement
Retinotopic
trace
Before Saccade
After Saccade

Experiment Prediction



Result

spatial information is likely to be represented in the effector systems that facilitate a suitable response towards the object of interest, most prominently the eye movement system. This information is continuously updated as we move through a dynamic environment and move our eyes to locations of interest.



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