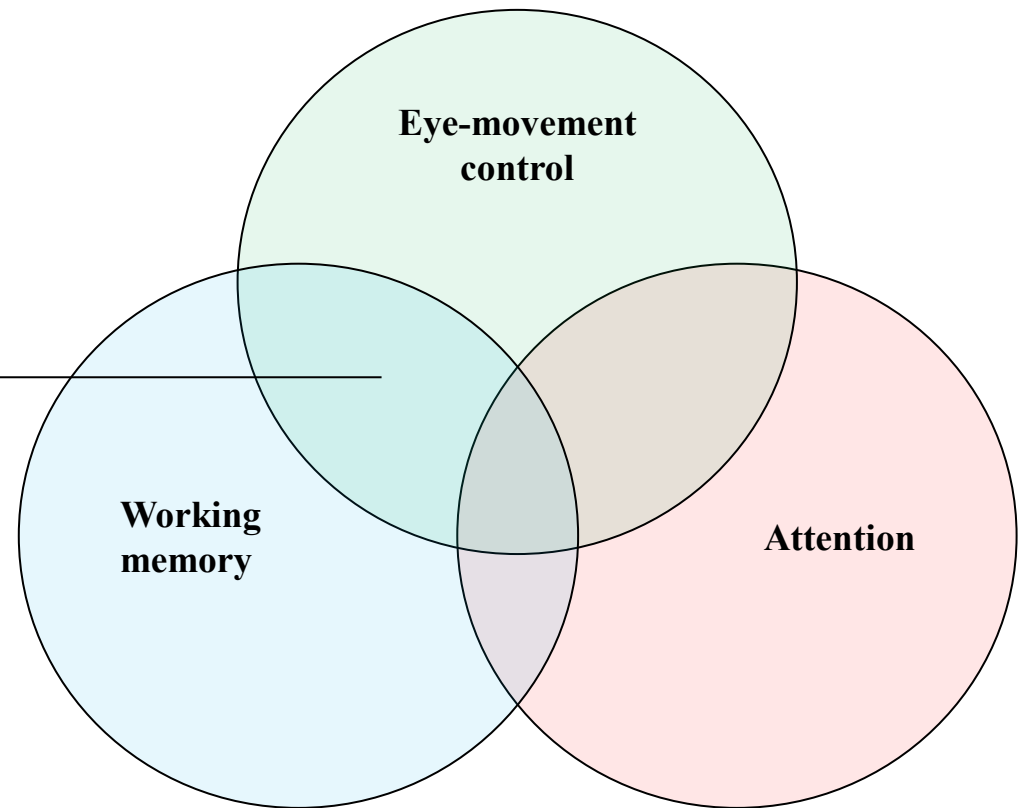


# Vertical gaze paralysis is associated with deficits of attention and memory: Evidence from Progressive Supranuclear Palsy

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**@AttentionLab**

# Background

- Tight coupling between visuo-spatial working memory and eye-movements
- Activate overlapping brain areas (Ikkai & Curtis 2011)
- Gaze directed to absent locations during STM tasks (Spivey & Geng 2001)
- Saccades dramatically reduce Corsi span (Pearson et al., 2001)
- Saccades biased away from locations in held WM (Belopolsky, & Theeuwes 2009).
- Improved recall accuracy at goal of planned but unexecuted saccades (Hanning et al., 2016)



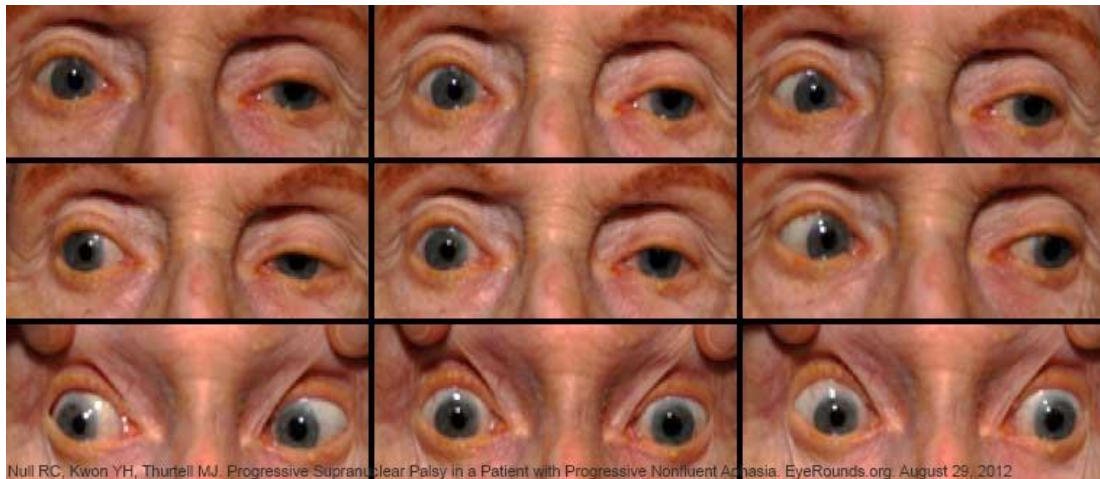
# Background

- What is the functional role of oculomotor system in VSSTM?
- Baddeley (1986) proposed “Oculomotor loop” as rehearsal mechanism in visuospatial STM
- Predicts that disrupting saccade planning will impair VSSTM
  - [This is exactly what we observed spatial STM](#) (Pearson et al., 2013; Ball et al., 2014) [LINK TO SLIDE 13-15]
- Can the same effects be observed in neuropsychological patients?
  - Oculomotor deficits associated with impaired covert attention (Rafal et al., 1989; Craighero et al., 2002; Smith et al., 2005; Gabay et al., 2010).
  - No equivalent studies of VSSTM
- We tested this hypothesis in Progressive Supranuclear Palsy



# Progressive Supranuclear Palsy

- PSP a rare (~6/100000), degenerative brain disease
  - Brainstem, basal ganglia, spreads to frontal lobes, cerebellum
  - Postural instability leading to falls, akinesia and rigidity in the neck.
  - Cognitive impairments (e.g. communication problems & dysexecutive syndrome),
  - Characterised by **slowed and hypometric vertical saccades**
    - Eventually affects all eye-movements



Null RC, Kwon YH, Thurtell MJ. Progressive Supranuclear Palsy in a Patient with Progressive Nonfluent Aphasia. EyeRounds.org. August 29, 2012

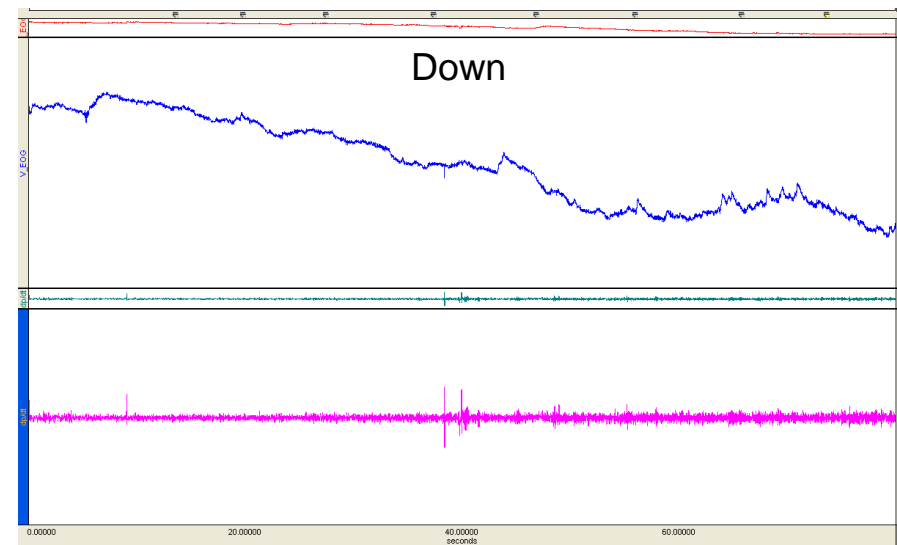
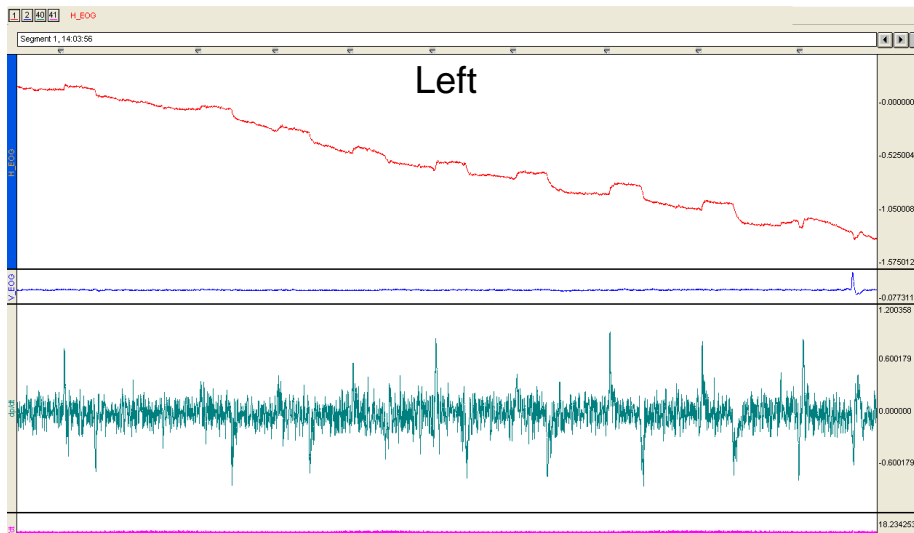
# Participants

- 7 people with PSP (aged 55-77, mean 69; 4 female)
  - 1 withdrew
- 7 aged matched controls (64-80, mean 69, 4 F)
- 5 people with Parkinsons Disease (64-77, mean 67, 3 F)
  - 1 withdrew
  - 1 took medication right before testing



# Methods

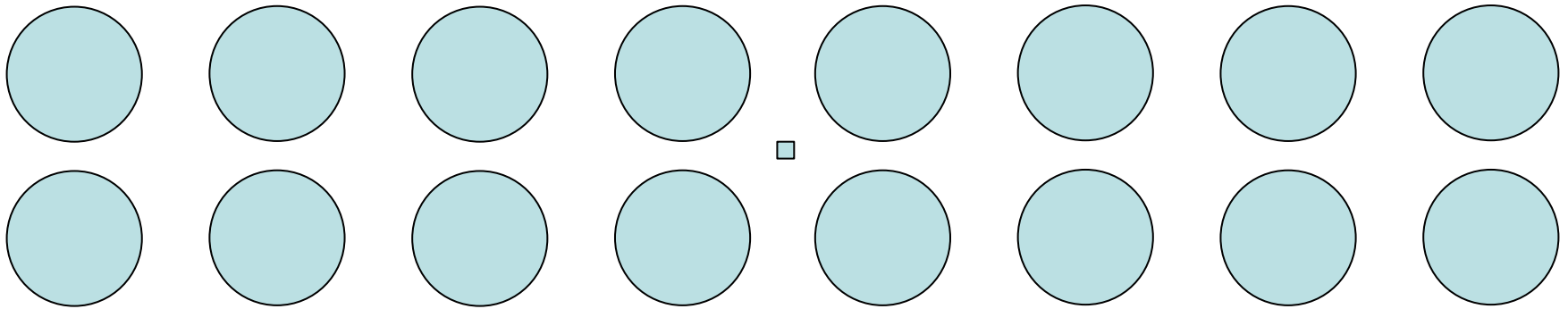
- Recorded eye-movements with EOG
  - Saccadometry procedure to estimate Effective Oculomotor Range
  - Follow dot as it jumps from centre to periphery ( $1^\circ$  increments, max  $11^\circ$ )



- All patients had complete vertical gaze palsy
- 5/7 also had some hypometria / slowing of horizontal saccades

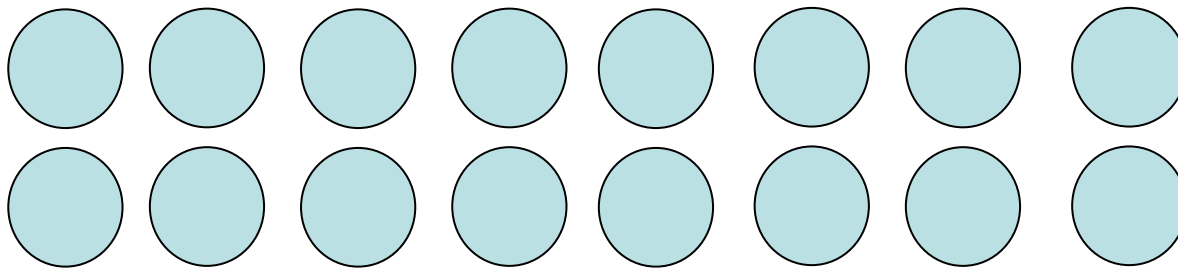
# Corsi Blocks task

- Begin with 1 item, add 1 if 2/3 sequences correct
- Participants touched screen with a stylus
- 3 spans for each array orientation

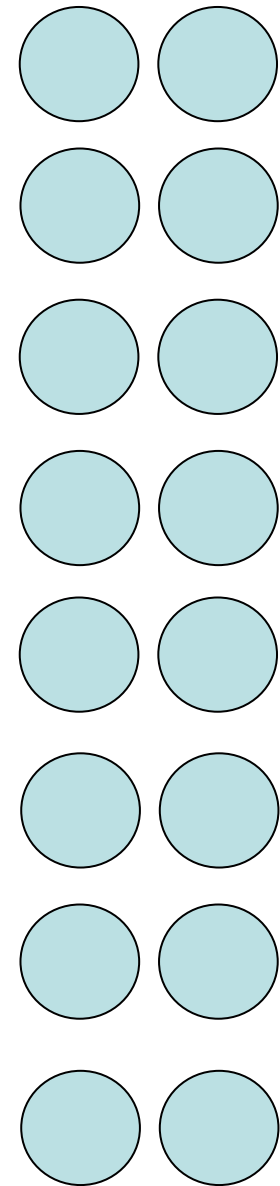


# Corsi Blocks task

- Begin with 1 item, add 1 if 2/3 sequences correct
- Participants touched screen with a stylus
- 3 spans for each array orientation
- Redo trials with eye-movements (very rare)



Horizontal array

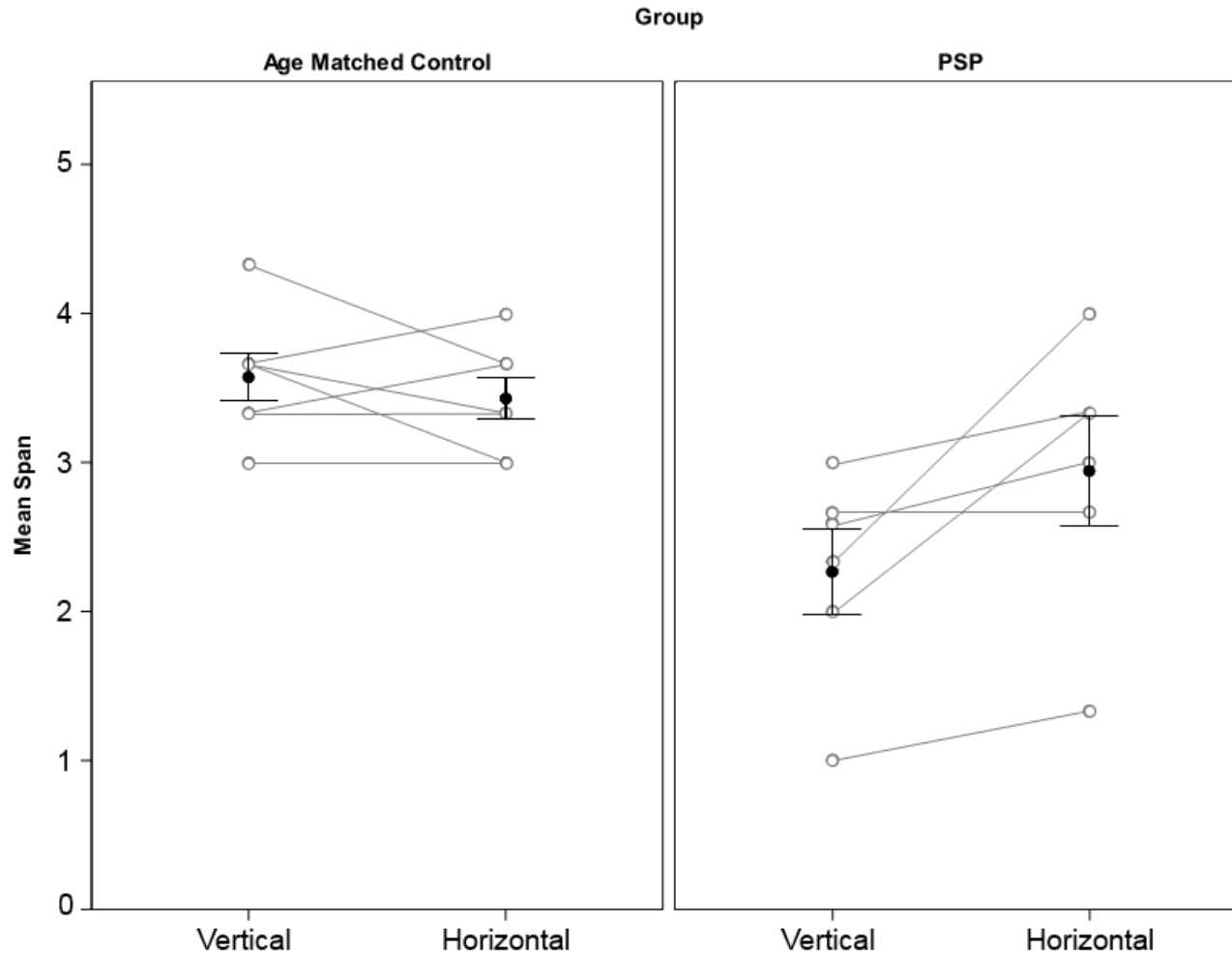


Vertical array



# Results: Corsi Blocks Task

- Main effect of Group ( $F= 8.2, p < 0.05$ )
- Group x Target Axis interaction ( $F=8.78, p < 0.05$ )



# Discussion

- Selective impairment of VSSTM on vertical axis of ~0.5 item
  - Deficit similar magnitude to eye-abduction (Pearson et al., 2014)
  - Need more data from Parkinson's Disease control group
- Impairment analogous to disrupting verbal STM with articulatory suppression
  - Oculomotor system serves rehearsal, not storage of VSSTM

# Conclusions

- Clear evidence for functional role of oculomotor system in visuospatial short-term memory
- Consistent with 'Oculomotor Loop' hypothesis of rehearsal in VSSTM
- People with PSP are hard to study!

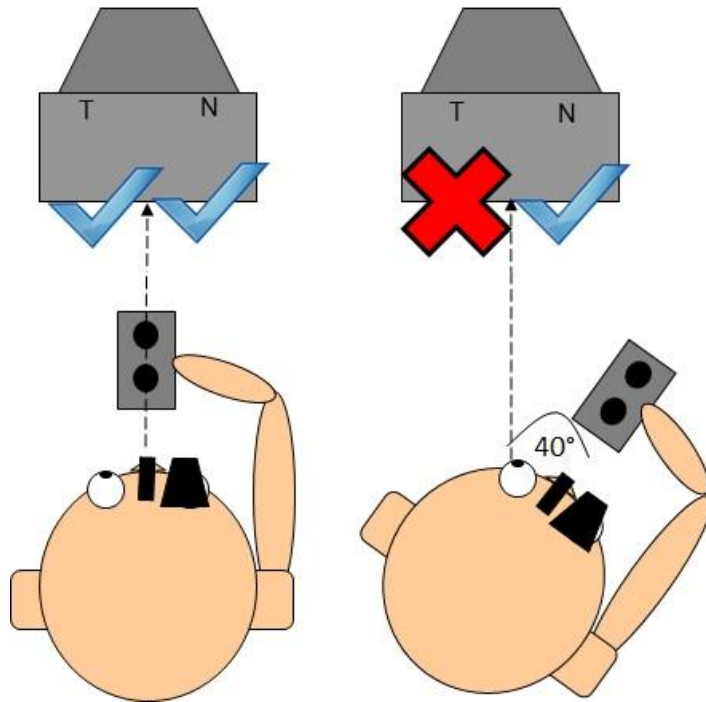


# Thanks

- Dr Neil Archibald
- James Cook University Hospital
- All the participants and their carers who travelled to Stockton to take part.

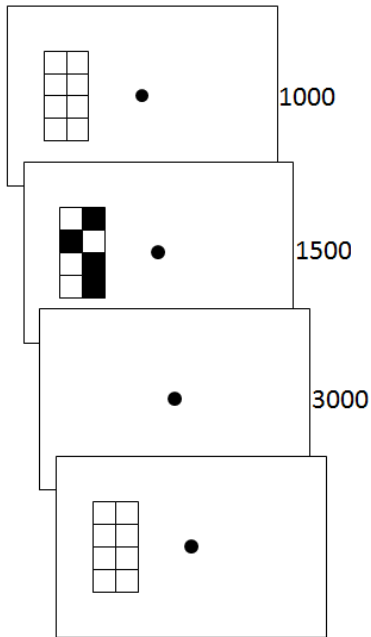
# Eye Abduction

- Eye abduction paradigm (Craighero et al., 2004)

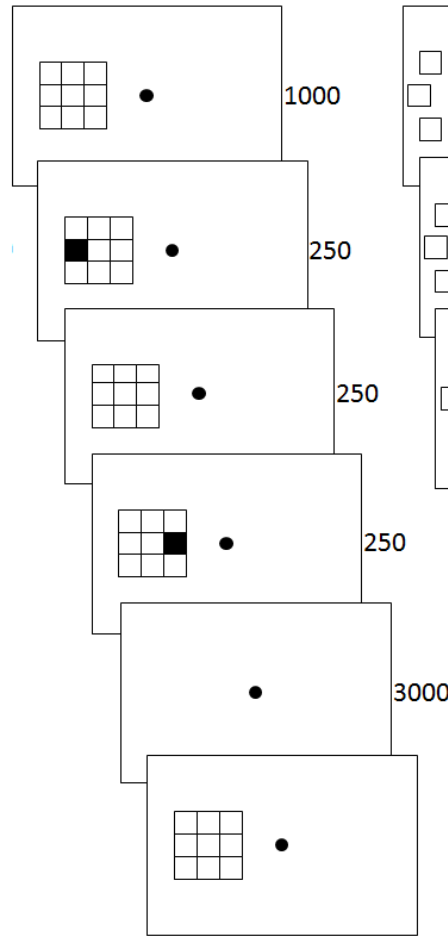


# Spatial Working Memory

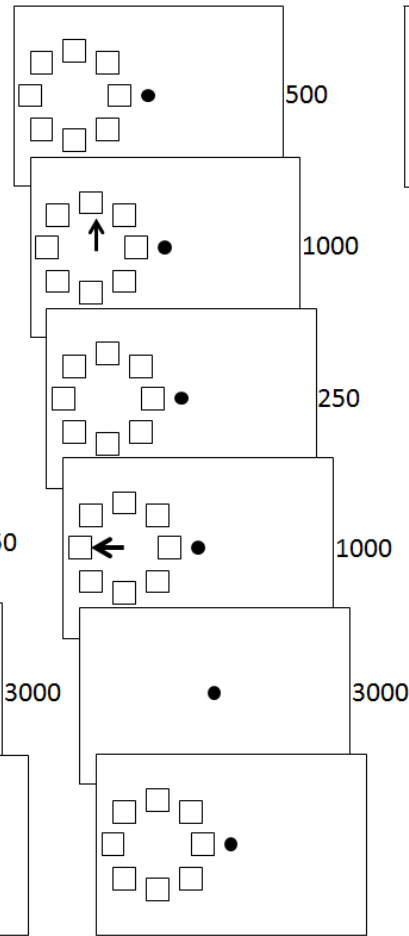
Visual Patterns



Corsi



Arrow Span



Size

