Representations in visuospatial working memory depend on locations within the visual field

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Background and Aims

- Visuospatial working memory (VSWM) has limited capacity (Baddeley & Hitch, 1974), but debate over the nature of this limit:
  - Slot model: VSWM stores a limited number of items at fixed precision in an all-or-none manner (Zhang & Luck, 2008)
  - Resource model: VSWM stores all relevant memoranda, but precision differs depending on task parameters (Bays et al., 2009)
- Eccentricity affects cortical processing of items (Carrasco & Frieder, 1997) and offers a way to differentiate the two models:
  - Slot model: there should be no difference in VSWM performance across the visual field
  - Resource model: precision depends on availability of cortical resources
- Aim: to examine whether the representation of spatial locations in VSWM is best characterised by a slot or resource model by varying eccentricity of items at presentation.

Methodology

Set size varied between one and eight items
Eccentricity varied between 5° and 10° or 200px and 400px
Mixture modelling (Bays et al., 2009) applied to response data

Experiment 1: Online

29 participants (M = 23.14 years, SD = 7.14, 26 females, all normal or corrected-to-normal vision)
Data collected online via Pavlovia

Main effects of set size and eccentricity for imprecision (A)
- Significant increase at set size 2 compared to set size 1
- Significant difference between 200px and 400px, and between 200px and 300px

Significant interaction between set size and eccentricity for pTarget (B) and pGuess (D)
- Significant difference in pMisbinding between 5° and 10° at set size 8
- Significant difference in pGuess between 5° and 7.5° at set size 7, between 5° and 10° at set size 8

No significant effects for pMisbinding (C)

Experiment 2: Lab, Fixed Viewing

15 participants (M = 22.67 years, SD = 6.67, 12 females, all normal or corrected-to-normal vision)
Central fixation maintained throughout
Trials with eye movements were excluded from analysis; data from 3 participants and 19.44% of remaining data were excluded.

Main effects of set size and eccentricity for imprecision (A)
- Significant increase between set sizes 1 and 2
- All differences between eccentricities were significant

Significant main effect of set size for pTarget (B)
- Significant decrease between set sizes 3 and 4, set sizes 5 and 6, and set sizes 6 and 7

Significant interaction between set size and eccentricity for pMisbind (C) and pGuess (D)
- Significant difference in pMisbind between 5° and 10° at set size 8
- Significant difference in pGuess between 5° and 7.5° at set size 7, between 5° and 10° at set size 8

Conclusions

- Reliable eccentricity effect, but pattern of response errors different between two experiments:
  - Experiment 1 offers potential support for a revised slot mode, which accounts for eccentricity but lack of control over environment when collecting online data
  - Experiment 2, carried out in a more controlled environment, offers support for the resource model

- Differences in eye movements between the two experiments might have affected results
- Current work is looking at a free viewing control condition
- Cortical magnification as a potential confound – future research

References