The coding of navigational distance in scene-selective regions of human visual cortex

Jeongho Park¹ & Soojin Park¹²

¹Department of Cognitive Science, Johns Hopkins University; ²Department of Psychology, Yonsei University

INTRODUCTION

• Representing visual features for navigation
  ✓ Multiple sources of environmental features available (e.g., room shape, color on walls, etc)
  ✓ Which features are most fundamental to navigation?

• Previous studies suggest the importance of distance to boundaries
  ✓ Reorientation paradigm: distance information was consistently used more than angle or length of boundaries.
  ✓ Boundary cells: respond to the presence of a boundary at a specific allocentric direction and distance

• Navigational distance
  ✓ A distance to a local boundary, which determines the navigational affordance of an environment.

THE GOAL OF STUDY

Examine the neural representation of the navigational distance in the human visual cortex

METHODS

• ROIs were individually defined (independent localizers)
  ✓ PPA & OPA: Scene – Face (p < 0.0001, uncorrected, A×R)
  ✓ LOC: Objects – Scrambled (FDR q < 0.05)
  ✓ V1: Retinotopic localizer (Vertical – Horizontal)

• Blocked design (12 seconds / 12 images)
  ✓ One-back repetition task
  ✓ TR = 2 sec / 600ms exposure + 400ms blank

DESIGN & RESULTS

• 6 Conditions: Visible Distance(3) x Local Boundary (2)
  ✓ 24 Exemplars per condition (counterbalanced across participants)

• Behavioral Rating (independent participants)
  ✓ Navigational distance was measured by a separate experiment. (the mean estimation is shown under each stimulus)
  ✓ No significant difference of the estimated navigational distance in the Glass-Wall condition, but not in Glass-Wall condition (the same navigational distance).

Hypothesis: If a region represents the navigational distance, Near, Middle, and Far will be differently represented in No-Glass-Wall condition, but not in Glass-Wall condition (the same navigational distance).

Univariate

Multivariate (SVM classification)

DISCUSSION

• OPA represents the navigational distance in a scene.
• PPA does not respond to changes of navigational distance.
• Future direction: What if there is a crossable boundary? (e.g., curtain)

This work is supported by a grant to S.P. by National Eye Institute (NEI R01EY026042)