Texture information processing in the Parahippocampal Place Area (PPA)

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INTRODUCTION

• Traditional view of the PPA
  – Parahippocampal "Place" Area
  – Specific module for "scene" processing

• More Recent view
  – PPA represents spatial layout (Epstein & Kanwisher, 1998; Park et al., 2011), scene category (Wulff et al., 2006; Epstein & Morgan, 2011), line drawings (Walther et al., 2011), big objects (Konkle & Oliva, 2011; Troiani et al., 2012), etc.
  – PPA also represents texture information!
  (Kombith et al., 2013; Cant & Goodale, 2011; Cant & Xu, 2012; Cant & Xu, in press)

• However, not much is known about how the PPA represents texture in the context of a scene
  – The stimuli used in previous studies were patches (Cant & Xu, 2012)
  – Or surfaces of objects (Cant & Goodale, 2011)
  – It has been suggested that the texture information might provide a cue to identifying a scene

Research Question

How does the PPA represent texture within a scene?

Hypothesis 1

The PPA represents the "ensemble" of texture (e.g., what kind of texture)

Hypothesis 2

The PPA represents the texture as a cue to the identity of a scene ("placeness")

EXPERIMENT 1

Methods

• Stimuli
  – 8 Different images were repeated
  – Texture Ensemble 1 × Texture Location 2
  – Presented in a random order

Procedure

1. Place all stimuli in a random order
2. Amazon Mechanical Turk
   – 256 different images
   – Image presentation order was counterbalanced (1: same, 2: different)
3. Peak activation (beta weights) in the PPA
   – No difference between left and right PPA
   – Significant difference between Condition 1 (identical) and Cond 2 (Same Texture Ensemble, Different Placeness)

Behavioral Results

1. Place all stimuli in a random order
2. Amazon Mechanical Turk
   – 256 different images
   – Image presentation order was counterbalanced (1: same, 2: different)

MVPA Results

1. Measurement of representational similarity between activation patterns of each condition pair
2. MVPA: coarser categorical representation

Neural Adaptation Results

1. Peak activation (beta weights) in the PPA
   – No difference between left and right PPA
   – Significant difference between Condition 1 (identical) and Cond 2 (Same Texture Ensemble, Different Placeness)

DISCUSSION

• Different results from Experiment 1 & 2!
  – Texture information in the PPA might be represented hierarchically
    – At coarser level: texture ensemble information (the kind of texture) is represented
    – At finer level: placeness information of a texture (e.g. specific texture location) is represented
  – MVPA and Adaptation methods allow us to observe different levels of representation (Epstein & Morgan, 2011)
    – MVPA: coarser categorical representation
    – Neural Adaptation: finer grained exemplar representation; closely related to the representational distinctions revealed by behavior (e.g., placeness judgment)