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Introduction

Visual system utilizes distinct modes of visual processing^[1,2] based on level of information; mediated by activity in unique brain areas

- **Holistic:** Global shape, outlines, Gestalt; lateral occipito-cortex (LOC)^[3,4]
- **Configural:** Local features, details, parts; intraparietal sulcus (IPS)^[5,6]

Number of visual parts present within a stimulus influences the type of processing used^[5]

- Fewer parts = more holistic
- Many parts = more configural

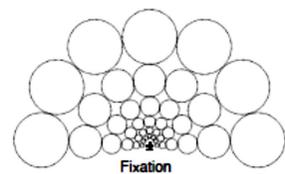
Visual stimuli may not be perceived strictly by one process alone^[7]

Visual Crowding: naturally occurring effect that disrupts recognition of closely-spaced objects presented in the peripheral field^[8,9]

- Crowding also occurs within objects such that those with more component parts experience more crowding and vice versa^[7,8]

Critical Spacing: minimum amount of distance necessary to distinguish amongst unique objects/shapes at various locations in the peripheral field^[7]

Isolation field: region described by a perimeter of minimum critical spacing around an object. Varies in size according to distance from fixation^[8]



Hypotheses

1. Objects with multiple parts must be closer to fixation to be correctly identified; objects with fewer parts can be recognized at higher eccentricities.
2. Visual structure drives variations in critical eccentricity, rather than higher-level semantic properties
3. Subjective reports of diagnostic parts are consistent only in objects recognized near fixation and less reliably in holistically-perceived objects

Method

Stimuli

- Bank of Standardized Stimuli (BOSS)^[10]
- High-resolution photographs of real-world objects
- Includes normalized data with ratings of semantic and higher-level visual properties (e.g., familiarity, category, complexity)

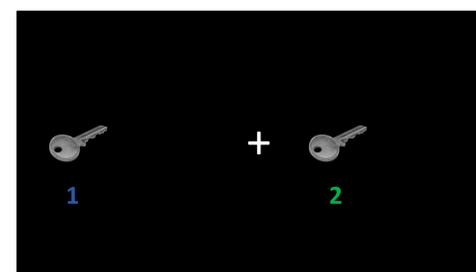
Preprocessing

- Converted to grayscale
- Normalized for contrast and luminance using the SHINE toolbox^[11]

Tasks presented using MATLAB and Psychophysics Toolbox software

Experiment 1

- 27 participants
- 50 objects
- Labels entered for all objects
- Used chinrest to fixate cross at center of black screen
- **1. Object presented briefly at various distances in peripheral field** on left or right side of screen (150 ms)
- Images identified aloud; coded for accuracy in real-time by experimenter
- **2. Incorrect: Image moved 75 px (2.8°) closer to fixation** when it next appeared on same side of screen
- **Correct:** Location on screen recorded as **critical eccentricity**
- Objects were correctly identified on both sides of screen before being removed from the set
- Maximum eccentricity = 42°



Experiment 2

Explore relationship between holism and diagnosticity of parts

- 24 participants
- 23 objects
- Replicated Expt 1 procedure
- **Additional task: Identify region of image that is most informative or distinguishing for that object**
- Image presented at fixation (0.5 s) then masked to reveal Gaussian window of visibility of fixed size (~100 px)
- Participant centered window on desired area and pressed left mouse button
- Location of mouse click on screen recorded

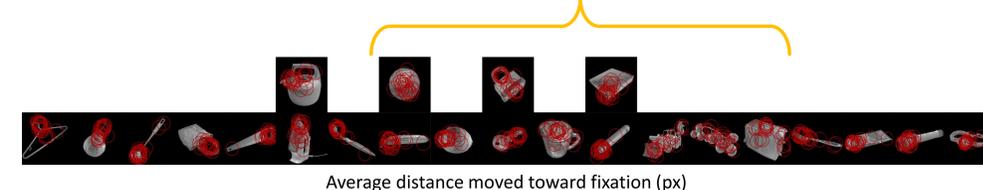
Results



Experiment 2

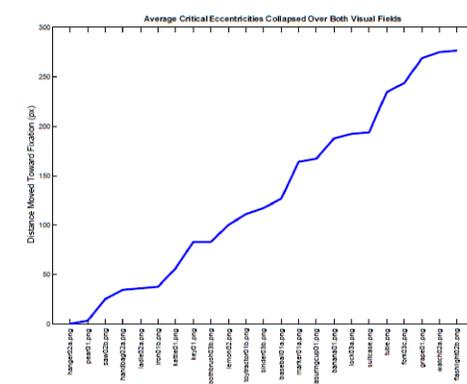
- Consistent subjective reports of diagnostic parts at extreme ends of distribution
- **More variability among objects near mid-range**

Continuous range of average critical eccentricities found in both experiments



Experiment 1

- **No significant relationships between average critical eccentricity and BOSS data**
- Significant relation with subjective rating of frontal-parallel viewpoint ($\alpha = .05$, $t = 2.745$, $p=0.0087$)



Discussion

Lack of significant relations amongst higher-level properties and critical eccentricity suggests this technique is a valid measure for determining relative number of parts in real-world objects

- **Continuous distribution suggests sensitivity to subtle differences in part/whole structure**
- Supports non-binary perspective of holistic and configural processing^[7]

- **Both holistically- and configurally-perceived objects may contain distinct diagnostic parts**
- No clear relationship with critical eccentricity

Limitations

- Variation in viewpoint may have biased recognition
- Crowding implies number of component parts not their size, location, or informative value

Future directions

- Use fMRI to study differential neural activation during object perception at fixation
- Examine relationship between critical eccentricity and brain areas related to holistic (LOC) and configural processing (IPS)
- Investigate reliability of identified diagnostic parts
- Analyze accuracy and reaction time to define what qualifies as diagnostic

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