PROCESSING OF IMAGE SYMMETRY IN AN RSVP TASK

Mary M. Conte, Keith P. Purpura and Jonathan D. Victor
Department of Neurology and Neuroscience, Weill Medical College of Cornell University, New York, NY 10021

INTRODUCTION

Bilateral symmetry is visually salient and facilitates image segmentation. Previous modeling of perceptual performance suggests first, in contrast to processing of local statistics, processing of symmetry does not proceed in parallel over wide regions. Here we examine spatial and temporal factors that influence symmetry processing. Each stimulus consisted of four 8x8 arrays of black and white checks. Three of the arrays (distractors) were colored at random. Bilateral symmetry is visually salient and facilitates image segmentation. Previous modeling of perceptual performance assumed the array was processed sequentially from fixation along the cardinal axes, for durations of either 100 or 400 ms. If RSVP was not sequential, sequential presentation of the four arrays, centered at fixation, 100 ms duration, 50 ms ISIs, followed with the RSVP-C time course, but the four locations trained in SIM-P, in random order. In all modes, a 500 ms exposure duration in SIM-P mode equaled the total presentation time in RSVP mode.

We conclude that processing of bilateral symmetry is constrained by attentional scanning, and is neither purely parallel nor purely serial. Supported by EY17977 (MC, JV) and NS36699 (KP).

TASK: Which one of the four arrays is different?

Simultaneous - Parafoveal

Simultaneous - Parafoveal

STIMULI

Bilaterally symmetric arrays are followed by focal attention and processing - a parallel mechanism followed by a serial process. Processing of bilateral symmetry is not consistent with either a purely parallel or serial model. We suggest that the advantage of simultaneous presentation seen in 4 of 6 observers is that it allows a strategy in which visual selection of a subset of the arrays is followed by focal attention and processing - a parallel mechanism followed by a serial process. Symmetry detection is best along the vertical axis of symmetry in the display, whether or not arrays are presented simultaneously. In sequential presentations, the first stimulus is processed most efficiently, and errors generally reflect temporal confusion. Together, these findings suggest that symmetry detection utilizes a dynamic visual routine, rather than a static neural computation.

Comparison Across Presentation Modes

Summary & Conclusions

In these subjects, processing is more efficient when targets are visible simultaneously, thus indicating that processing is not purely serial.

Errors were spatially random; adjacent arrays accounted for 25% of the errors. There was no significant difference between RSVP-parafoveal and RSVP-central conditions. In the three conditions, processing was more efficient when targets are visible simultaneously; thus indicating that processing is not purely serial. Errors were not temporally random; most incorrect choices consisting of selecting a distractor that immediately preceded or followed the target.

Since these phenomena were seen equally for stimuli that overlapped spatially (RSVP-parafoveal) and those that did not (RSVP-central), they implicate attentional mechanisms rather than spatial masking.

For subject CC, fraction correct was highest in the RSVP-parafoveal condition (lower horizontal line) is less than for both of the RSVP-parafoveal conditions. This indicates that processing is not purely parallel. In four of six subjects, fraction correct in the 400 ms simultaneous-parafoveal condition (upper horizontal line) is greater than for both of the RSVP-parafoveal conditions. In these subjects, processing is more efficient when targets are visible simultaneously, thus indicating that processing is not purely serial. Fraction correct for perfect symmetry (c = 1) is shown above. In all subjects, fraction correct in the 100 ms simultaneous-parafoveal condition (lower horizontal line) is less than for both of the RSVP-parafoveal conditions. This indicates that processing is not purely parallel. In four of six subjects, fraction correct in the 400 ms simultaneous-parafoveal condition (upper horizontal line) is greater than for both of the RSVP-conditions.

In the two central modes (RSVP central, RSVP-parafoveal) fraction correct was higher when the target was presented first and lowest when the target appears in the second stimulus interval. Errors were not temporally random; most incorrect choices consisting of selecting a distractor that immediately preceded or followed the target.

Since these phenomena were seen equally for stimuli that overlapped spatially (RSVP-parafoveal) and those that did not (RSVP-central), they implicate attentional mechanisms rather than spatial masking.

Fraction of correct responses with c = 1 corresponds to perfect bilateral symmetry; an array with a lower value than 0.5 is symmetric, and an array with a higher value than 0.5 is asymmetric. Fraction correct was highest for targets in the top position. Fraction correct was highest for targets in the top position.