Representation of visual information for rapid motor responses

Rajendran Pottayil and Marjan Persuh

Department of Social Sciences, Human Services and Criminal Justice, Borough of Manhattan Community College, City University of New York

Introduction

Conscious visual perception has limited capacity. Our visual working memory capacity as well as our ability to track objects is limited to only a few individual items at a time (1, 2).
We hypothesized that capacity limitations originate at the encoding stage and are a general property of the visual system. We tested our prediction using response priming (3), which differs substantially from both working memory and object tracking paradigms.

Experiment 1 (n = 20)

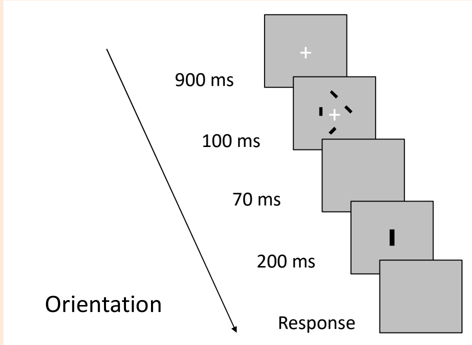
Participants responded to targets of different orientations, while we varied the number of objects presented simultaneously with the prime.

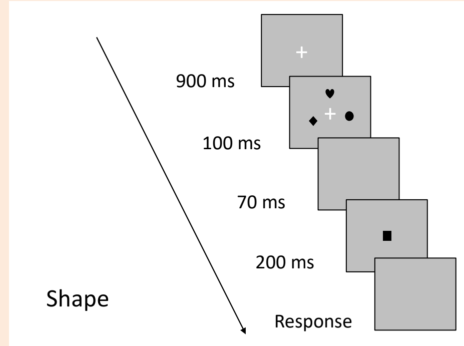
Method

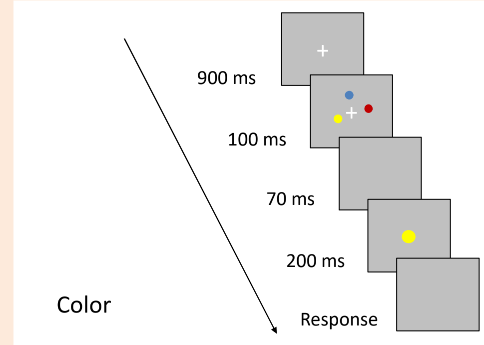
Participants made speeded responses to targets at the center of the display. Prior to target presentation, a prime was presented at one of the eight positions around the imaginary circle. We varied the number of items on the screen by presenting a single prime with distractors.
Primes and targets were rotated 0º or 90º. Distractors were rotated 45º or 135º.

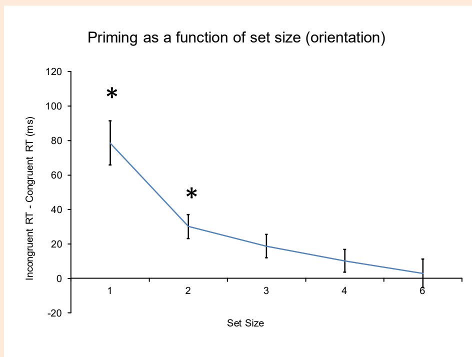
Results

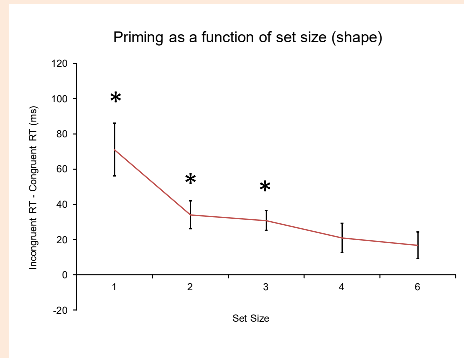
ANOVA revealed a main effect of congruency ($p < .001$) and set size ($p < .001$) as well as significant interaction between congruency and set size ($p < .001$). Priming effects were the strongest for a single prime, presented in isolation. As the number of distractors increased, priming effects become progressively weaker and with the set size of six, were eliminated.

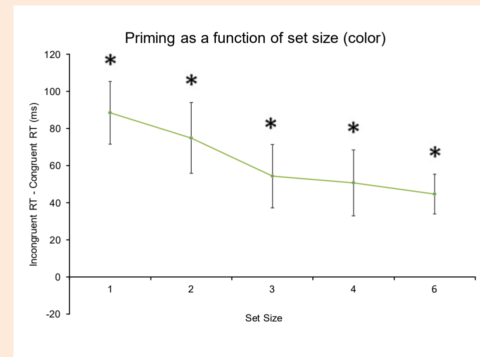












Experiment 2 (n = 19)

In this experiment we used different shapes for primes (circle and square) and distractors (heart and diamond).

Results

ANOVA revealed significant main effects of congruency and set size (*ps* < .001) as well as significant congruency x set size interaction ($p = .04$). Priming was significant for set sizes 1-3 and decreased with increasing set size.

Experiment 3 (n = 9)

Here, we used different colors for primes (green and yellow) and distractors (red and blue).

Results

ANOVA revealed a main effect of congruency (p = .002) and congruency x set size interaction (p = .028). Mixed ANOVA revealed significant congruency x set size x feature interaction ($p < .001$).

Conclusions

(1) The results of Experiment 1 show that orientation priming exhibits capacity limitation.
(2) Results of Experiment 2 replicate Experiment 1 with shape as prime stimulus, demonstrating that capacity limitation is a general property of response priming.
(3) Results of Experiment 3 suggests that color is better represented than orientation and shape.

Our results demonstrate that visual information representation is limited in capacity even for response priming, suggesting a general limitation for all visual pathways. Furthermore, capacity limitations are feature specific, and color, in particular, shows higher representational capacity than other features.

References

1. Luck, S.J. & Vogel, E.K. (1997). The capacity of visual working memory for features and conjunctions. Nature 390, 279-281.
2. Pylyshyn, Z. W & Storm, R. W. (1988). Tracking multiple independent targets: evidence for a parallel tracking mechanism. Spat. Vis., 3:179–197.
3. Neumann, O., & Klotz, W. (1994). Motor responses to nonreportable, masked stimuli: Where is the limit of direct parameter specification? In C. Umilta & M. Moscovitch (Eds.), Attention and performance XV (pp. 123-150). Cambridge, MA: MIT Press.

Contact: prajendran1@gmail.com