Subitizing: What The Eyes Do

Martha E. Crosby
Dept. of Information and Computer Sciences
University of Hawaii, Honolulu, HI 96822
crosby@uhics.ics.hawaii.edu

Catherine Sophian
Department of Psychology
University of Hawaii, Honolulu, HI 96822
csophian@hawaii.edu

Although the phenomenon of subitizing has been noted for many years, it has only recently come to be understood as a reflection of basic characteristics of visual/spatial processing. Specifically, Trick and Pylyshyn (1993, 1994) have proposed that it reflects the operation of a limited capacity but spatially parallel preattentive mechanism that enables us to individuate and keep track of several locations in a visual image at the same time. The present research utilized eye-tracking methodology to examine patterns of fixations in numerical processing. We recorded the fixation patterns of adults who viewed arrays containing 1, 2, 3, 4, 5, 6, or 7 target items.. Following Trick and Pylyshyn (1993), we contrasted a condition in which targets could be distinguished from distractors on the basis of a single visual feature (orientation) versus one which depended on the conjunction of two visual features (color and orientation). The latter is thought to require focal attention and thus to block subitizing (Trick & Pylyshyn, 1993).

31 computer science students viewed 5 conditions of 7 scenes). We focus here on two of the conditions, illustrated in Figure 2. In the simple distractor condition, the targets were black vertical bars in a field of black horizontal bars. In the complex distractor condition, the targets were white vertical bars in a field of black vertical and white horizontal bars. Each set of scenes was preceded by an instruction slide which asked the participant to state, as quickly as possible without making errors, the number of black or white vertical bars in the scenes that followed. Eye movement data was collected non-instrusively by an Applied Sciences Laboratory Eye Movement Monitor which utilized the reflection of an infrared beam projected to the viewer's eyes to automatically compute where the eye fixated. Samples of eye-movements were collected 60 times a second. Figure 1 shows the time spent viewing the arrays in each condition. For the simple distractor condition, there was a mean decrement of 358 msec per item in the 1-3 range vs. a mean increment of 1115 msec in the 5-7 range, t (3) = 4.61, $p \leq 0.01$. For the complex distractor condition, there was a decrement averaging 78 msec per additional item in the 1-3 range vs. an increment averaging 576 msec per item in the 5-7 range, t (5) = 7.63, $p \leq 0.001$. Clearly, total viewing times were much longer in the latter condition, although the discontinuity in slopes from small to large numbers was similar for both. Examination of the patterns of fixations that comprise total viewing time provides a means of clarifying the basis for this pattern of results. Figure 2 presents illustrative data on fixation patterns, from one of the participants. Typically, fixations covered a substantially larger portion of the scene in the complex than in the simple distractor condition, and there were more total fixations. Peripheral vision appears to play a greater role in the simple distractor condition.

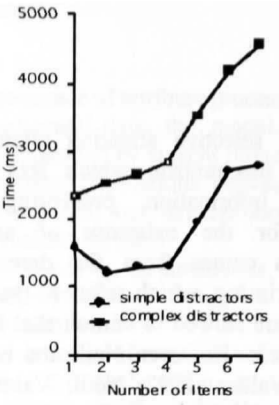

Figure 1. Times for Viewing Vertical Bars

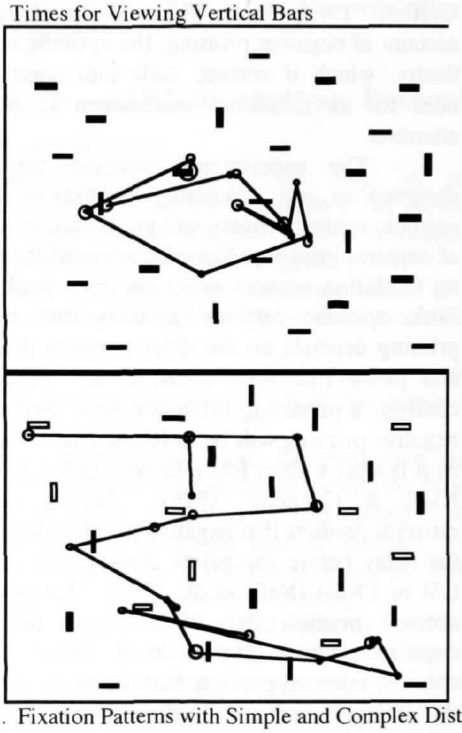

Figure 2 . Fixation Patterns with Simple and Complex Distractors

REFERENCES

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