Task Demands Affect Color Feature Selection: Comparing the Perception of Correlation with Perception in Typical Vision Science Tasks

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In this work, we measure attentional performance for selecting correlation information in a two-population scatterplot (i.e. a dichotomized variable represented with two different colors). We then compare these results to results from a typical conjunction search task, and numerosity estimation task.

In the correlation discrimination task, observers viewed two such scatterplots side-by-side (each containing a target and a distractor population), and were asked to identify the one with the higher target correlation. Methods from Rensink & Baldridge (2010) were used to measure discrimination via just noticeable differences (JNDs) at 75% correct. Target items were always black, and the background always white. Distractor items could be one of four different shades of red. In the conjunction search task, participants search for a black vertical line, among black horizontal and the same four shades of red vertical lines. In the numerosity discrimination task participants viewed black dots and the same shades of red dots, and were asked to report, "which has more?" the black population of dots, or the shades of red dots. All three visual tasks share the same featural components: 1) a "target" population and a "distractor" non-target population; 2) one population is always one of four shades of red; 3) the other population is always black.

Results from the correlation discrimination task showed a categorical effect of attentional selection, where bright red colors were just as distracting as very dark red colors (just one perceptual jnd) from the target color. The conjunction search task results showed a linear degradation in search efficiency, as distractor colors went from light to dark (the darkest red distractor yielded the least efficient search performance for the black target). The numerosity estimation task results showed equivalent accuracy for identifying when the black, light red, and bright red conditions had more dots, but a decrease in accuracy for identifying when the darkest red population had more dots.

In summary, this work provides new evidence for perceptual interactions between feature-based attention and task demands. Specifically, while all three experiments contained the exact same low-level information (color values), the

colors that limited selection differed for each task. These findings reinforce the idea that the perception of correlation is not simply an estimation or search task. Importantly, this work also shows that real-world visualizations like scatterplots are indeed powerful tools for answering basic questions in vision science.