Hierarchical Binding Overview

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# Methods

## Stimulus

Each trial started with q 400 msec fixation point, followed by a 100 msec presentation of a circular array of 22 stimuli one of which was cued by a line extending from fixation. The radius of the circular array of stimuli was roughly 5 degrees of visual angle, and the cueing line extended roughly 3 degrees away from ther fixation point toward the cued item. (See Figure ##).

Each stimulus was an object comprised of two parts, each of a different color. The geometric configuration of the parts varied aross experiment conditions (see Figure ##). Colors were assigned to object parts such that the 10 colors that appeared on the 5 items around the cued item (the target, and 2 items clockwise and counterclockwise) were all unique. This ensured that we could identify which part, and which adjacent object, a given reported came from. The other objects’ colors were randomly assigned to the 10 unique colors used.

### Object geometries

There were 11 different two-part objects that were run in our experiments. The objects used are somewhat arbitrary, and were chosen to test a number of specific hypotheses about when hierarchical binding occurs, and when it does not. In the end, we have a range of possible objects, and a range of outcomes about the extent to which these objects were bound.

## Response

After stimulus presentation, subjects were instructed to report the colors of both parts of the target object.

### Experiment 1: sequential report

In Experiment 1, report of the color of the two parts was done sequentially, such that first subjects identified (via keypress) the color of one part from the set of 10 unique colors, and then identified the color of the second part from the same set of colors. (See figure ##). Which part was probed first and the order of colors in the probe array were random on each trial.

### Experiment 2: simultaneous report

In Experiment 2, subjects picked which one of 90 possible two-color objects corresponded to the target color conjunction by clicking on one of the options arranged in a 10x10 grid; the 10 elements of the grid that would correspond to identical colors for both parts were not available (see Figure ##). The order of colors in the rows and columns was random on each trial.

* visual-search: identify one part among distracters of the other part (all monochrome)

## binding experiments (simultaneous & sequential)

showing number of subjects, and range of number of trials/subject.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| description | experiment | subjects | trials | accuracy |
| target (circ) | sequential | 24 | 500-500 | 22% |
| target (circ) | simultaneous | 26 | 400-400 | 26% |
| target (moon) | sequential | 28 | 300-500 | 22% |
| target (moon) | simultaneous | 26 | 400-400 | 26% |
| target (egg) | sequential | 27 | 300-500 | 18% |
| target (egg) | simultaneous | 26 | 400-400 | 27% |
| 2x1 (+gap) | sequential | 25 | 300-400 | 14% |
| 2x1 (+gap) | simultaneous | 26 | 345-400 | 16% |
| T (rotate) | sequential | 30 | 300-400 | 13% |
| T (rotate) | simultaneous | 18 | 400-400 | 17% |
| 2x1 (-gap) | sequential | 32 | 300-400 | 15% |
| 2x1 (-gap) | simultaneous | 17 | 400-400 | 14% |
| T (fixed) | sequential | 37 | 300-400 | 9% |
| T (fixed) | simultaneous | 25 | 289-400 | 13% |
| cross (+gap) | sequential | 27 | 450-500 | 13% |
| cross (+gap) | simultaneous | 24 | 400-400 | 7% |
| cross (-gap) | sequential | 24 | 300-400 | 8% |
| cross (-gap) | simultaneous | 25 | 400-400 | 8% |
| frame | sequential | 34 | 300-400 | 7% |
| frame | simultaneous | 24 | 400-400 | 8% |
| 2x2 | sequential | 30 | 300-400 | 4% |
| 2x2 | simultaneous | 24 | 322-400 | 11% |

blah blah, space.

|  |  |  |
| --- | --- | --- |
| description | sequential | simultaneous |
| target (circ) | N: 24; T/S: 500-500; acc: 22% | N: 26; T/S: 400-400; acc: 26% |
| target (moon) | N: 28; T/S: 300-500; acc: 22% | N: 26; T/S: 400-400; acc: 26% |
| target (egg) | N: 27; T/S: 300-500; acc: 18% | N: 26; T/S: 400-400; acc: 27% |
| 2x1 (+gap) | N: 25; T/S: 300-400; acc: 14% | N: 26; T/S: 345-400; acc: 16% |
| T (rotate) | N: 30; T/S: 300-400; acc: 13% | N: 18; T/S: 400-400; acc: 17% |
| 2x1 (-gap) | N: 32; T/S: 300-400; acc: 15% | N: 17; T/S: 400-400; acc: 14% |
| T (fixed) | N: 37; T/S: 300-400; acc: 9% | N: 25; T/S: 289-400; acc: 13% |
| cross (+gap) | N: 27; T/S: 450-500; acc: 13% | N: 24; T/S: 400-400; acc: 7% |
| cross (-gap) | N: 24; T/S: 300-400; acc: 8% | N: 25; T/S: 400-400; acc: 8% |
| frame | N: 34; T/S: 300-400; acc: 7% | N: 24; T/S: 400-400; acc: 8% |
| 2x2 | N: 30; T/S: 300-400; acc: 4% | N: 24; T/S: 322-400; acc: 11% |
| (abandoned) played with size A | N: 4; T/S: 300-400; acc: 12% | N: 1; T/S: 400-400; acc: 31% |
| (abandoned) 2x2 (box) | N: 1; T/S: 400-400; acc: 19% | NA |
| (abandoned) played with size B | N: 3; T/S: 400-400; acc: 17% | N: 1; T/S: 400-400; acc: 21% |
| (abandoned) T (stacked) | N: 2; T/S: 300-400; acc: 10% | NA |

henceforth, we are not mentioning the ‘abandoned’ object types.

## results