The perception of multi-dimensional regularities

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How does the visual system extract structured information from multiple feature dimensions?

Boundary discrimination task:

What is the orientation of the boundary between the two halves in the matrix?

Division: vertical

Structured half	Random half
consists of a binary sequence with a switch rate of 0.2:	consists of a binary sequence with a switch rate of 0.5:
20% chance of switching from the previous color	50% chance of switching from the previous color
80% chance of repeating the previous color	50% chance of repeating the previous color
Proportion of red and blue is equal	Proportion of red and blue is equal

Experiment 1: How does the visual system extract regularities from color and shape dimensions?

Condition 1: Color regularities (red/blue)

Division: horizontal

Condition 2: Shape regularities (circle/square)

Division: vertical

Condition 3: Color+Shape regularities

Division: horizontal

Experiment 2: Is the finding specific to the color dimension?

Condition 1: Color regularities (red/blue)

Division: horizontal

Condition 2: Shape regularities (circle/square)

Division: horizontal

Condition 3: Surface regularities (solid/hollow)

Division: vertical

Condition 4: Color+Shape+Surface regularities

Division: horizontal

Boundary discrimination performance

Color = Color+Shape ($p=.63$)
Color > Shape ($p<.001$)

n = 45

Detection of two-dimensional regularities is as good as the detection of regularities on a more salient (color) dimension

Boundary discrimination performance

Surface = Color+Shape+Surface ($p=.95$)
Surface > Color ($p<.001$), Surface > Shape ($p<.001$)

n = 47

Detection of three-dimensional regularities is as good as the detection of regularities on the most salient (surface) dimension

No additive benefit of multi-dimensional regularities

Visual system relies on the most salient feature dimension to extract regularities, even though every dimension is equally informative