THE INTEGRATION OF PARTS DURING VISUAL COMPLETION IS INEFFICIENT

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How efficiently do we integrate information across disconnected parts during visual completion?

• 1-of-2 discrimination task performed with individual object parts and all object parts combined. 3 different kinds of objects:

1. Leftward vs. Rightward Illusory & Fragmented Bent Bars
2. Leftward vs. Rightward Occluded & Fragmented Rotating Squares
3. Expanding vs. Shrinking Occluded & Fragmented Squares

• ***Bent Bars:*** The orientations of object parts were varied to produce either a complete or fragmented percept when shown in combination

• ***Rotating Squares & Expanding/Shrinking Squares***: the presence of occluders was varied to produce either a complete or fragmented percept

• ***Summation-at-threshold[1,2] method:***

○ Measure contrast sensitivity *CS* (i.e., 1/threshold) for each of *n* individual object parts and for all *n* object parts combined, in Gaussian additive contrast noise

○ Compute Integration Index Φ as: $\Phi = \frac{CS^2_{combined}}{\sum_{i=1}^{n} CS^2_{part_i}}$

$\Phi = 1$: *optimal integration*
$\Phi < 1$: *sub-optimal integration*
$\Phi > 1$: *super-optimal integration*

○ 'Best feature' model prediction for each human observer: uses only the single feature with the highest sensitivity when recognizing the combination

• ***Results & Conclusions***

○ Average integration efficiency was suboptimal for all perceptually complete conditions

○ Average fragmented efficiency *exceeded* perceptually complete efficiency for all 3 object types, and fragmented efficiency was nearly optimal for 2 of 3 object types

○ Lower integration efficiency with perceptually complete stimuli may be due to the use of regions where only noise -- and no additional stimulus information -- is present[3]

• ***References***

[1]Nandy, A. S., & Tjan, B. S. (2008). Efficient integration across spatial frequencies for letter identification in foveal and peripheral vision. *Journal of Vision*, 8(13), 3 1-20.

[2]Gold, J. M., Mundy, P.J. & Tjan, B.S. (2012). The perception of a face is no more than the sum of its parts. *Psychological Science*, 23(4), 427-434.

[3]Gold, J. M., Murray, R. F., Bennett, P.J. & Sekuler, A.B. (2000). Deriving behavioral receptive fields for visually completed contours. *Current Biology* 10, 663-666.

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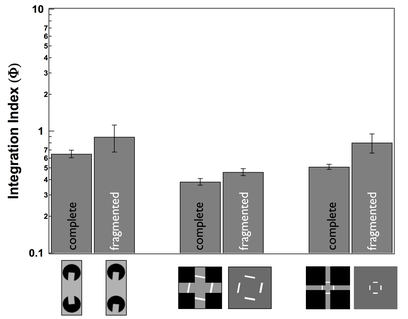
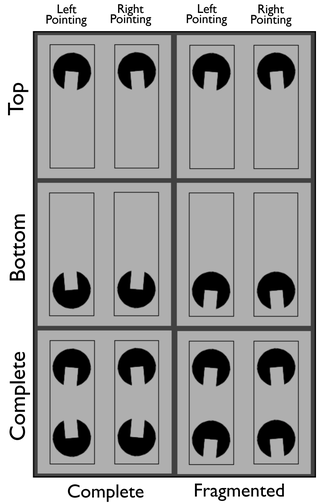
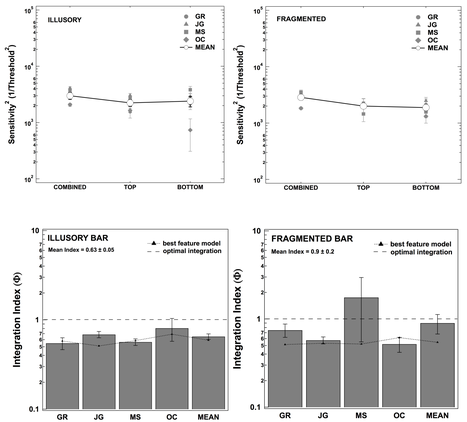
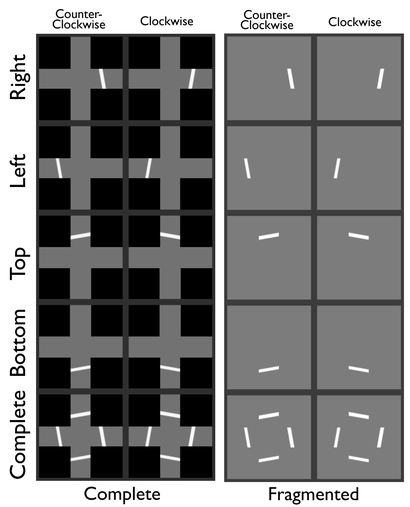
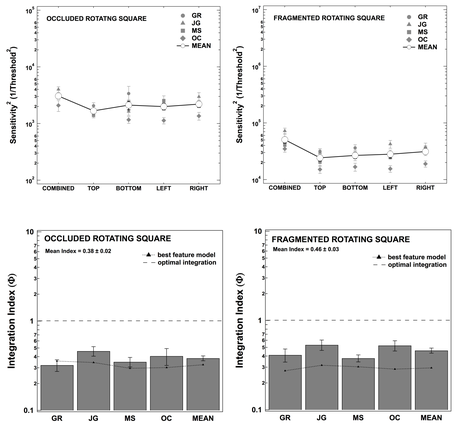




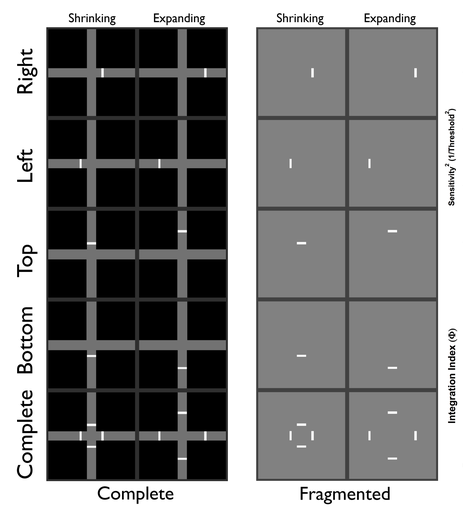


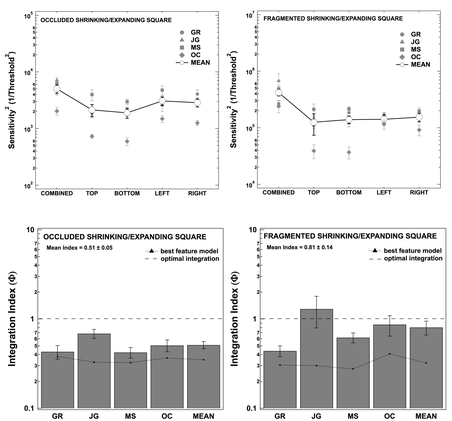
1. Bent Bars





2. Rotating Squares





3. Expanding & Shrinking Squares