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Fundamental Properties of Simple Emergent Feature Processing

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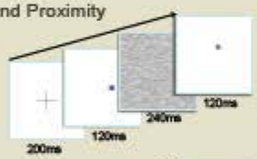
Motivation

The presence of emergent features in perceptual stimuli has long been associated with gains in processing efficiency, but the nature of the underlying processing has been unclear. We begin to investigate the hierarchy of emergent features from the simplest such case: pairs of dots.

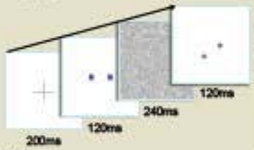
Method

- Adapted the odd-quadrant task from Portillo & Pomerantz (2005)
- Same/different task: participant is asked whether any dot changed position
- Investigated changes in Orientation and Proximity

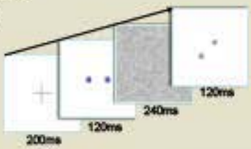
- Single Dot
  - Dot present on the left or right



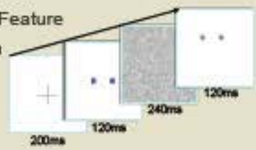
- Uninformative Context



- Redundant Target with Emergent Feature
  - Two sources of location information such that a feature emerges from change



- Redundant Target without Emergent Feature
  - Two sources of location information such that no feature emerges



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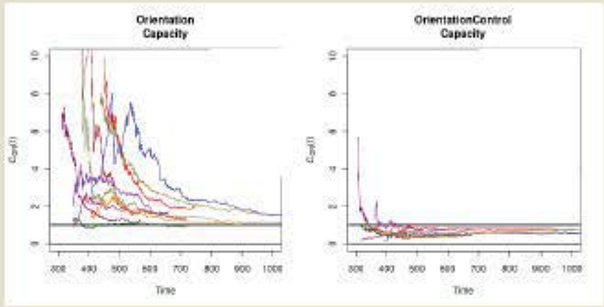
Contact Robert at hawkrobe@indiana.edu.

Results



	Orientation				
	Mean RT 1	Mean RT 2	Super capacity	Limited Capacity	Difference
Group	p<.001	p<.001	p<.001	p<.001	p<.001
01	p<.05	p<.001	n.s.	p<.001	p<.001
02	p<.001	p<.001	p<.001	p<.05	p<.001
03	p<.001	n.s.	p<.001	p<.001	p<.001
04	p<.001	p<.05	p<.001	p<.01	p<.001
05	p<.001	p<.001	p<.001	p<.001	p<.001
06	p<.001	p<.001	p<.01	p<.001	p<.001
07	p<.001	p<.001	p<.001	p<.001	p<.001
08	p<.001	p<.001	p<.001	p<.001	p<.001
09	p<.01	n.s.	p<.001	p<.001	p<.001
010	p<.001	p<.05	p<.001	p<.001	p<.001

	Proximity				
	Mean RT 1	Mean RT 2	Super capacity	Limited Capacity	Difference
Group	p<.001	p<.001	p<.01	p<.001	p<.001
P1	n.s.	p<.001	n.s.	p<.001	p<.001
P2	p<.001	n.s.	p<.001	p<.001	p<.001
P3	p<.001	p<.001	n.s.	n.s.	n.s.
P4	p<.001	p<.001	p<.001	p<.001	p<.001
P5	n.s.	p<.05	p<.01	p<.001	p<.05
P6	n.s.	p<.001	p<.001	p<.001	p<.001
P7	n.s.	p<.001	p<.001	p<.001	n.s.
P8	p<.001	p<.001	p<.01	p<.001	p<.001

Capacity Coefficient

- Measure of efficiency as workload increases (Townsend & Nozawa, 1995). Ratio of whole to sum of parts.

$$C(t) = \frac{H_{AB}(t)}{H_A(t) + H_B(t)}$$

- $C(t) = 1$ - standard independent parallel model (UCIP)
- $C(t) > 1$ - *super capacity* (facilitation or coactivation)
- $C(t) < 1$ - *limited capacity*

References

Portillo, M. C., Pomerantz, J. R. (2005). Evaluating grouping via emergent features: A systematic approach. *Journal of Vision, 5*(9).

Townsend, J. T., & Nozawa, G. (1995). Spatio-temporal properties of elementary perception: An investigation of parallel, serial, and coactive theories. *Mathematical Psychology, 39*(4).

Conclusion

- Successfully replicated Portillo & Pomerantz (2005) results with a same/different task.
- Significantly super capacity when emergent feature is present.
- Significantly limited capacity when emergent feature is not present, even when amount of location information is the same.
- Standard two-channel UCIP model cannot account for this.
- Model must include emergent feature information.