

Emergent Features Predict Grouping of Line Segments in Search and Classification Tasks

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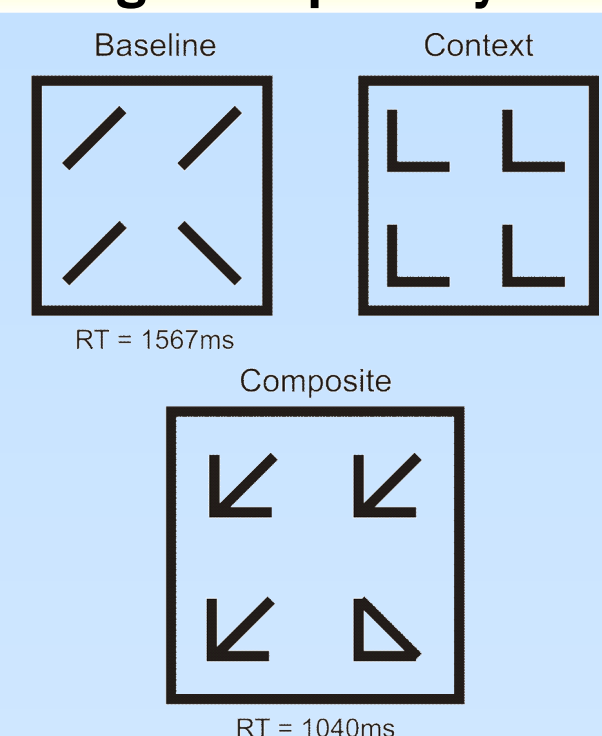
Introduction

- How do objects group into a unitary configuration (Gestalt)?
- What defines a “part” of an object?
- Sometimes, during grouping, certain features emerge from the configuration that make the object more salient – Emergent Features (EFs)
- EFs can be used to diagnose grouping and define the relationship between parts of an object

Emergent Features

- EFs are defined as properties of objects that:
 - Are not possessed by any individual part
 - Are processed as or more quickly than are the properties of the parts

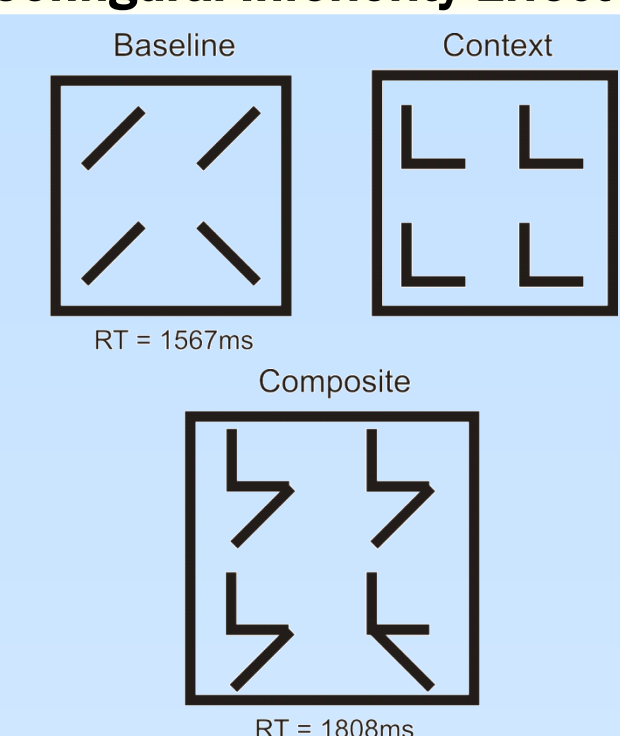
Configural Superiority Effect



Strong Grouping

Weak Grouping

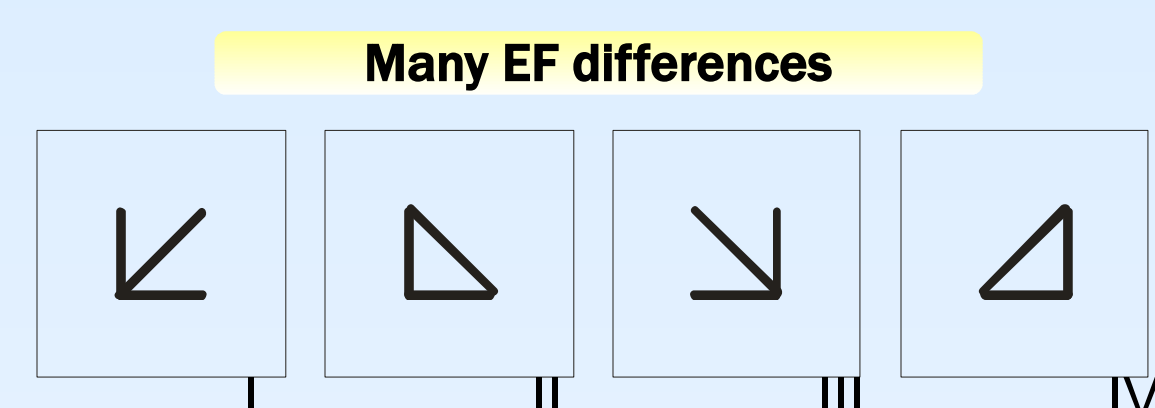
Configural Inferiority Effect



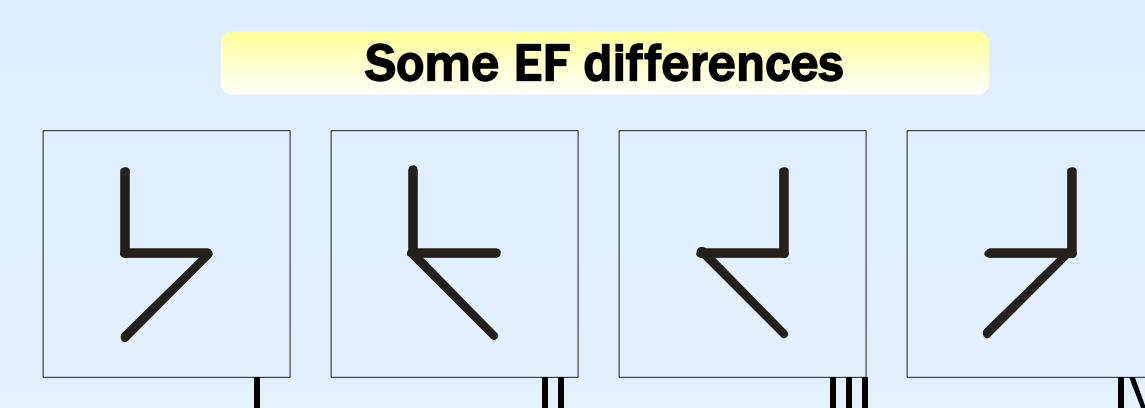
- Candidate EFs: Change in # of Terminators, Collinearity, Symmetry, Parallelism, Lateral Endpoint Offset, Intersections, Connectivity, Pixel Count, Closure

Stimuli and Predictions

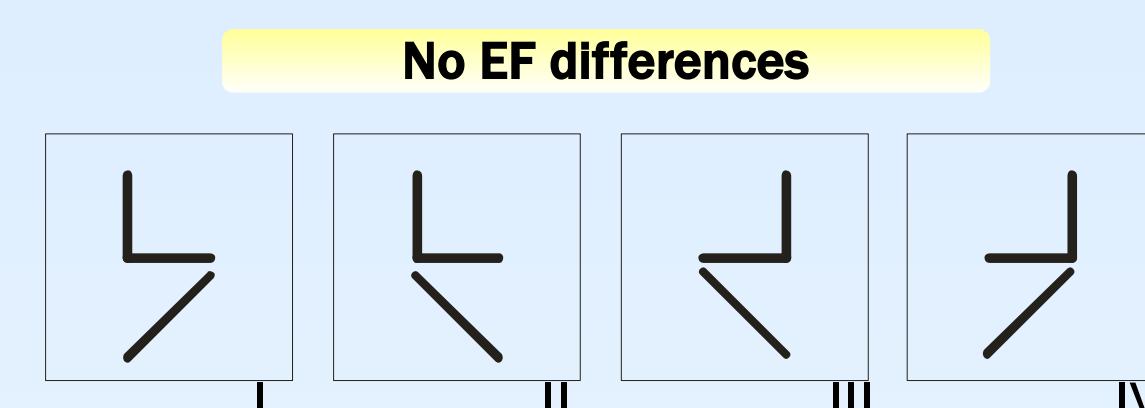
- Tversky Contrast Model of Similarity (1977): $S(a,b) = (A \cap B) - (A - B) - (B - A)$
- Difference = $1 - S$; higher scores indicate higher difference (faster predicted discrimination)



- # of Endpoints
- Intersection type
- Closure



- # of Endpoints
- Intersection type



- none

Features of Arrows and Triangles

Name	Shared	Unique	Subtotal
Terminators	0	3	-3
Intersections	0	1	-2.5
Pixel Count	0	1	-1
Closure	0	0	-1
Connectivity	1	0	1
Similarity Score			-6.5

Some EF Differences Similarity Score: 0
No EF Differences Similarity Score: 5



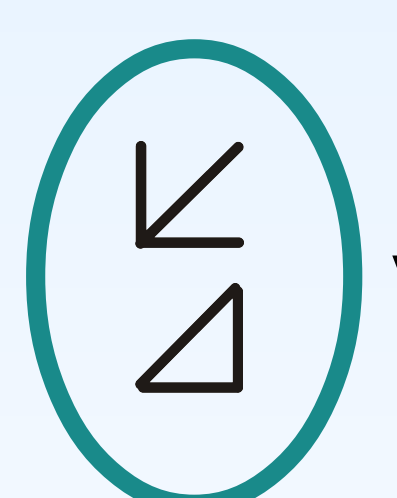
Response Category A



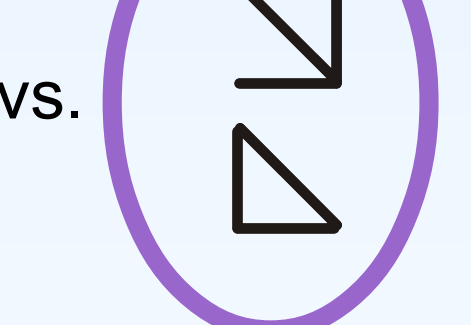
Response Category B

- 3 Terminators
- Intersections
- Pixel Count
- Connectivity

Underlined features signify shared EFs between categories



Response Category A

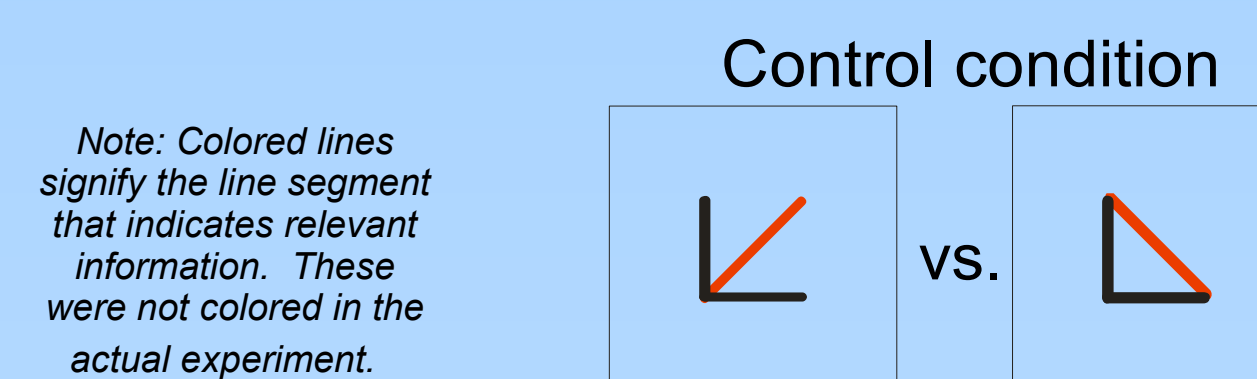


Response Category B

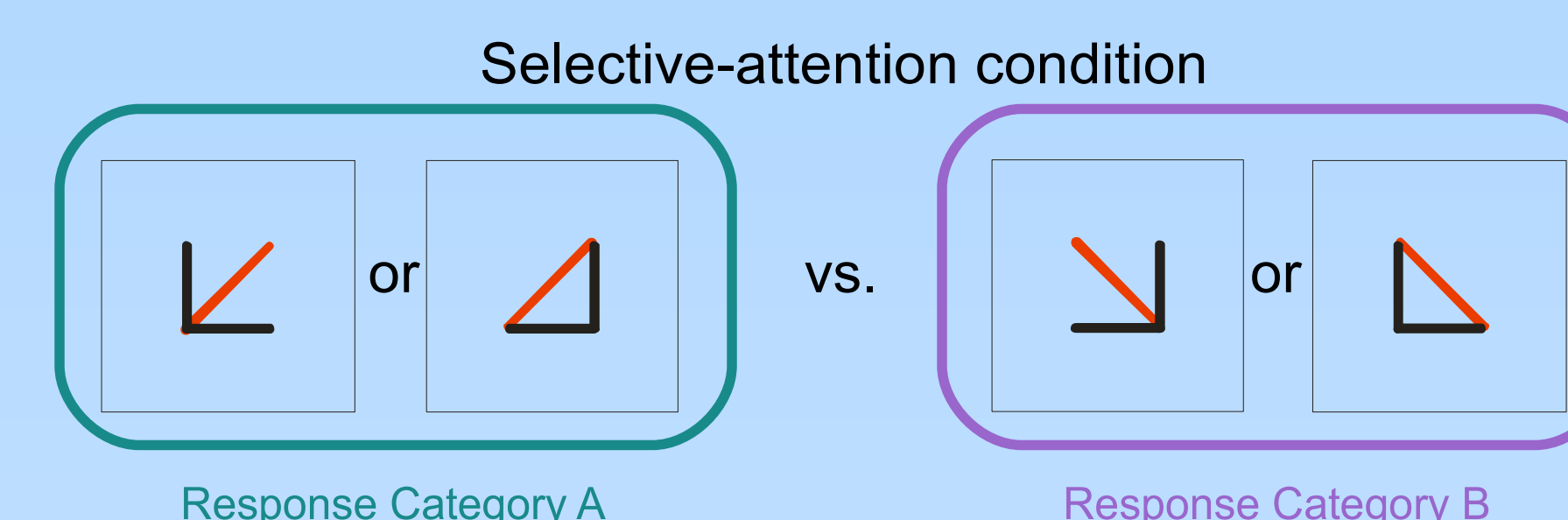
- All EFs shared

Selective Attention – Classification Task –

- Garner Interference (GI) = Selective Attention RT – Control RT



Note: Colored lines signify the line segment that indicates relevant information. These were not colored in the actual experiment.



Response Category A

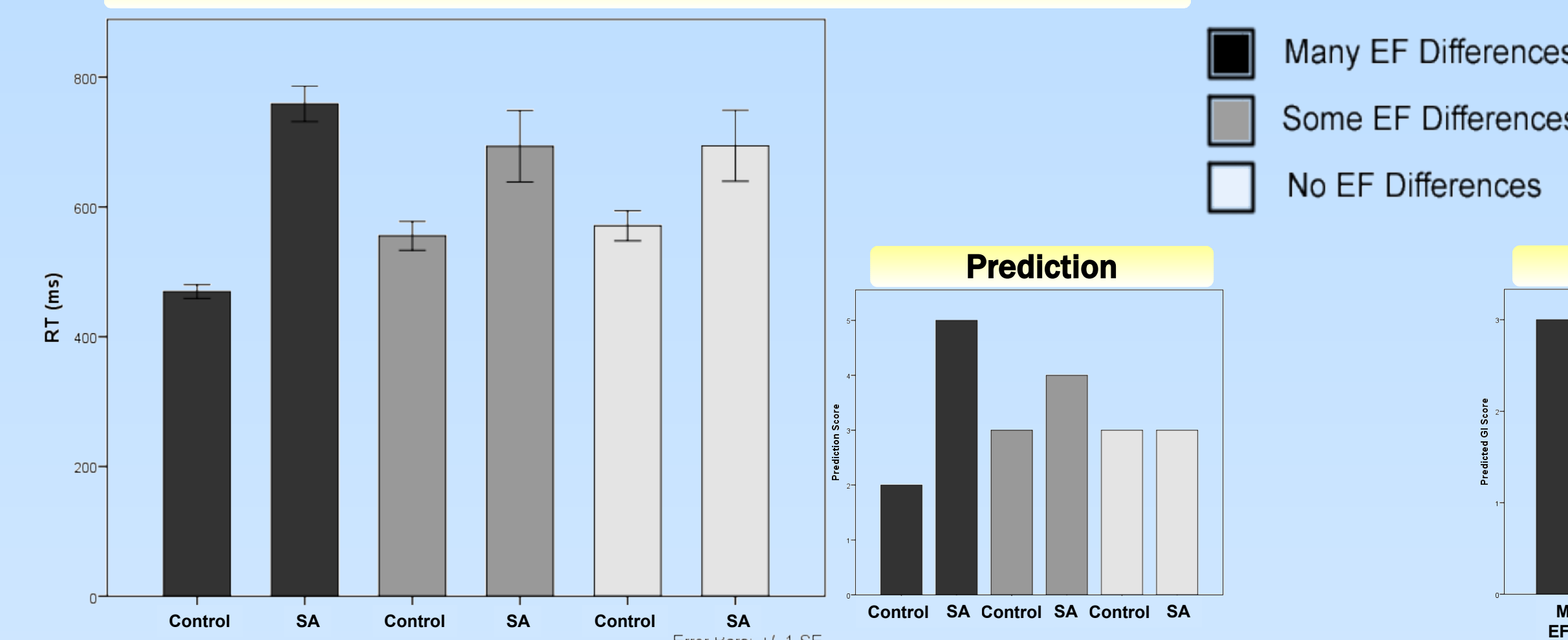
Response Category B

- GI is believed to indicate grouping, and is defined as the interference arising from variation on an irrelevant dimension (see left; non-colored line segments).

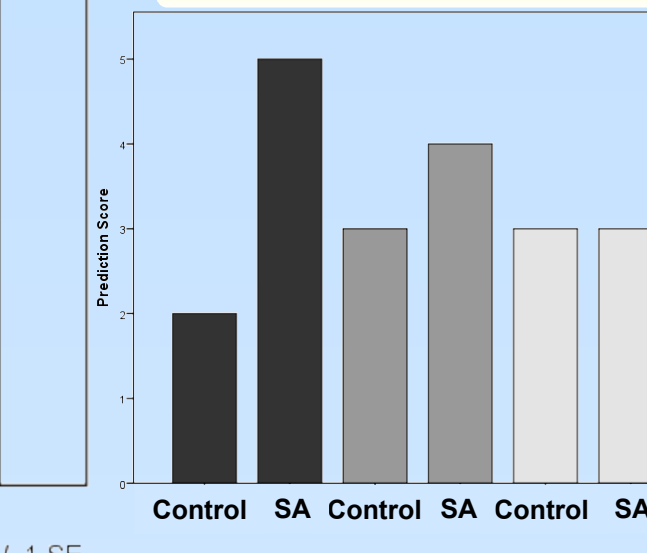
- EF differences predict amount of GI when there are many EF differences.

- Number of Endpoints and Intersection Type may not be salient enough to produce differential GI in their absence.

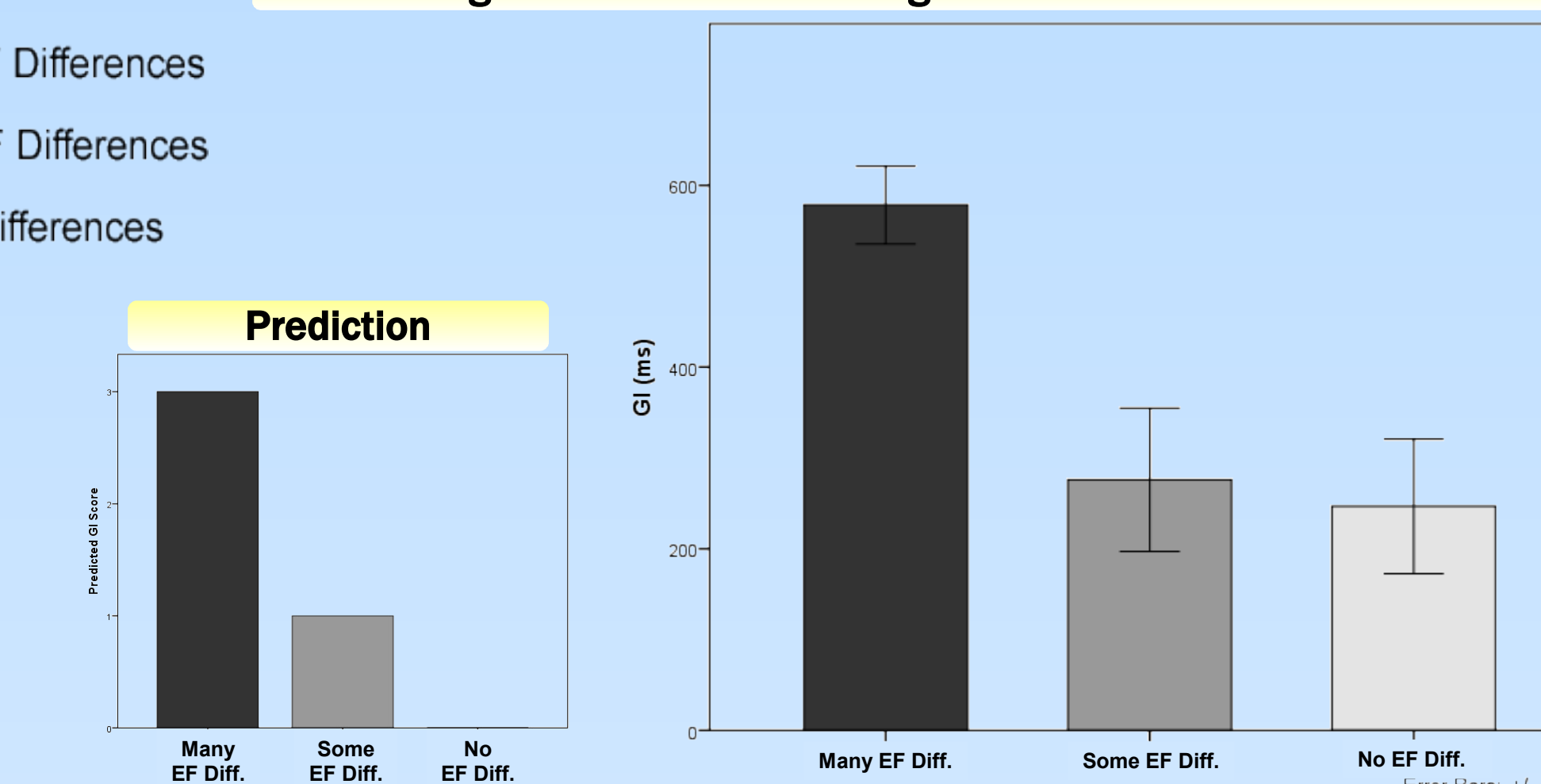
RT for Classification under Control and Selective Attention conditions



Prediction



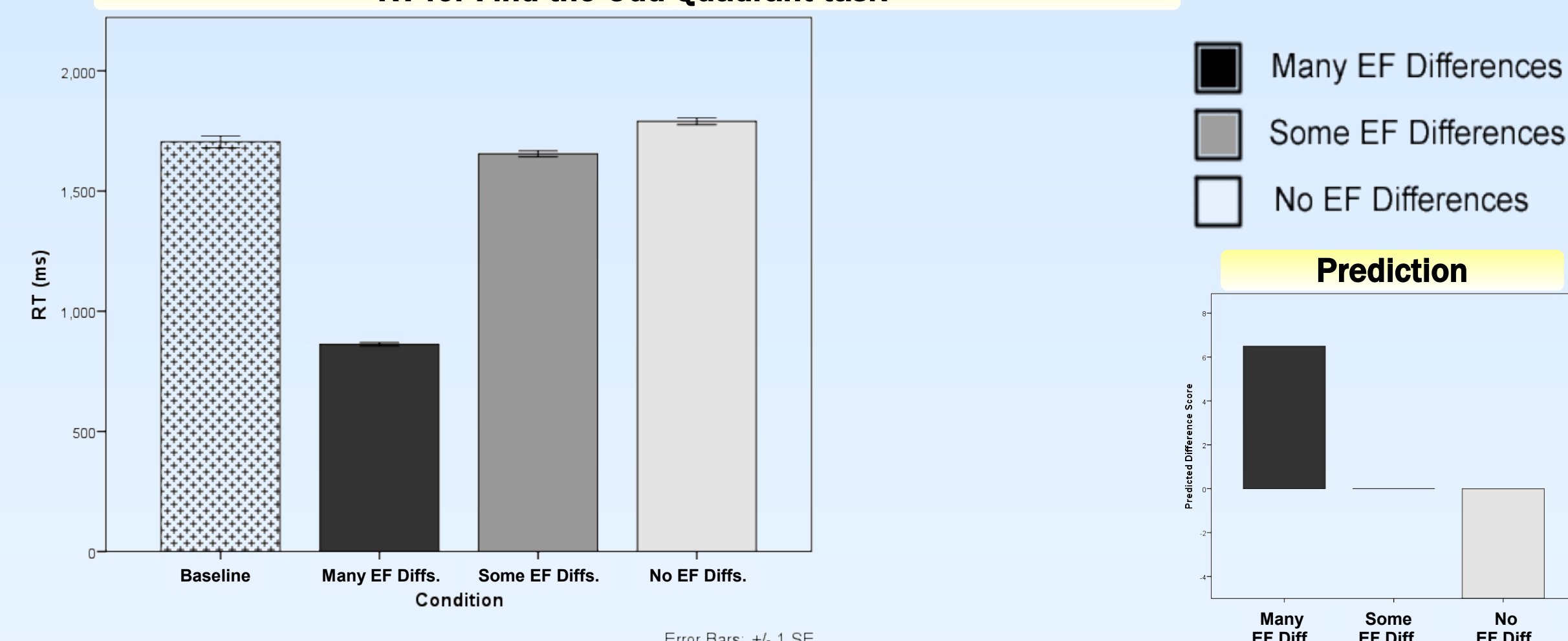
Magnitude of GI for differing numbers of EF differences



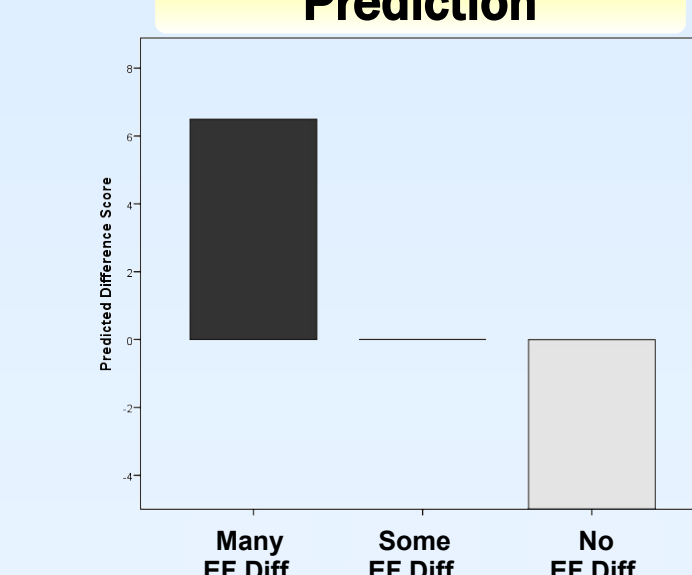
Find the Odd-Quadrant – Search Task –

- Configural Superiority Effect (CSE) = Composite - Baseline
- CSE is predicted by EF differences.

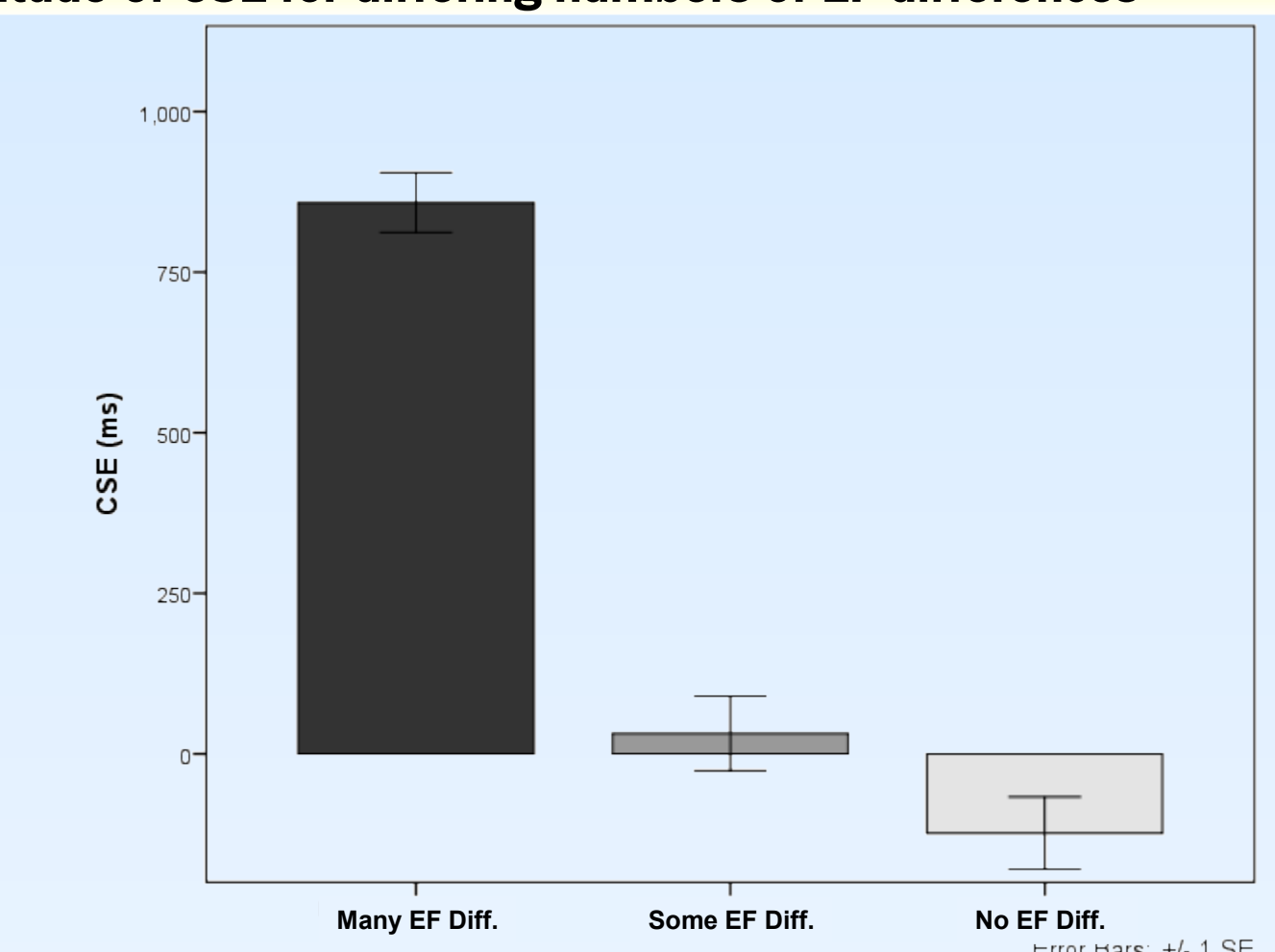
RT for Find the Odd-Quadrant task



Prediction



Magnitude of CSE for differing numbers of EF differences



Conclusions

- Differences in Emergent Features successfully predicted pattern of performance in two tasks of visual discrimination (Selective Attention task and Find the Odd-Quad task).
 - More EFs produced stronger grouping, which led to subjects electing not to pay selective attention, even when it was to their advantage. Instead, subjects chose to pay more attention to the EFs.
 - More EF differences between different response categories facilitated discrimination.
 - EF differences promote faster visual search.
- Converging pattern of results from the two tasks strongly supports the utility of EFs as a diagnostic for grouping.

Selected References

- Pomerantz, J.R. & Garner, W.R. (1973). Stimulus configuration in selective attention tasks. *Perception & Psychophysics*, 14, 565-569.
- Pomerantz, J.R. & Portillo, M.C. (2011). Grouping and Emergent Features in Vision: Toward a Theory of Basic Gestalts. *Journal of Experimental Psychology: Human Perception and Performance*, 37(5), 1331-1349.
- Stupina, A.I. & Pomerantz, J.R. (poster abstract 2010). Perceptual Organization Based on Gestalts: Emergent Features in Two-Line Space. *Journal of Vision*, 10(7), article 1198, DOI: 10.1167/10.7.119.
- Tversky, A. (1977) Features of Similarity. *Psychological Review*, 84(4) 327-352.