Temporal Organization of Color and Shape Processing During Target Detection in Conjunctive Visual Search

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Introduction

- Systems Factorial Technology is a nonparametric statistical framework for discriminating serial/parallel, stopping rule, and workload capacity of cognitive processes that combine at least two sources of information.
- Our previous work using total search times indicated that the stimulus features color and shape are processed in parallel (coactively) during feature search and during target-absent conjunctive search, but our experimental manipulations failed to selectively influence total search times during target-present conjunctive search.
- **Do our prior manipulations selectively influence critical time intervals other than total response time?**
- **For these intervals, are color and shape processed in parallel as our initial results suggest?**

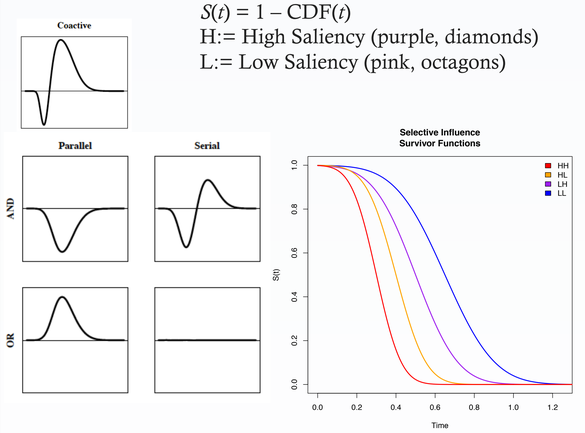
Survivor Interaction Contrast

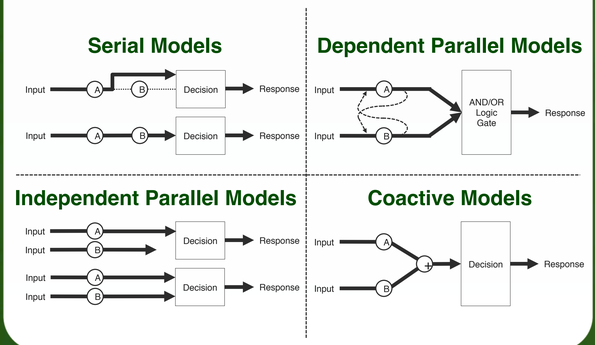
$$\mathrm{SIC}(t) = [S_{\mathrm{LL}}(t) - S_{\mathrm{LH}}(t)] - [S_{\mathrm{HL}}(t) - S_{\mathrm{HH}}(t)]$$

$S(t) = 1 - \mathrm{CDF}(t)$

H:= High Saliency (purple, diamonds)

L:= Low Saliency (pink, octagons)



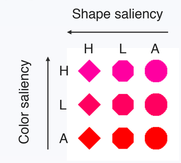


Methods

- 5 Subjects (15 goal)
- $10/session ($50 total) in Amazon gift cards
- 5 one hour sessions
  - Session 1: 30 minutes of training with feedback, remaining time divided between the 3 blocks
  - Sessions 2-4: 5 minutes of each single-feature block, 40 minutes of two-feature blocks, calibrate every 10 minutes
- # of Color-Only Trials: $M = 267.20$, $SD = 39.09$
  # of Shape-Only Trials: $M = 234.00$, $SD = 30.56$
  # of Color-Shape Trials: $M = 1963.80$, $SD = 240.39$

Materials

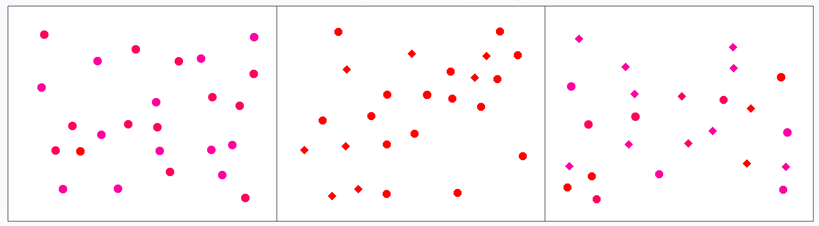
- Target (always red circle) present on 50% of trials
- Always 24 stimuli on screen (diameter = 0.747°, minimum separation = 1.120°)
- One distractor-type chosen to be more prevalent on each trial
  - 16 / 8 for single-feature blocks
  - 10 / (2 x 7) for two-feature blocks
  - Target replaces one of prevalent distractors
- 20” (23.56° x 18.94°) Display
- EyeLink 1000 with chin rest



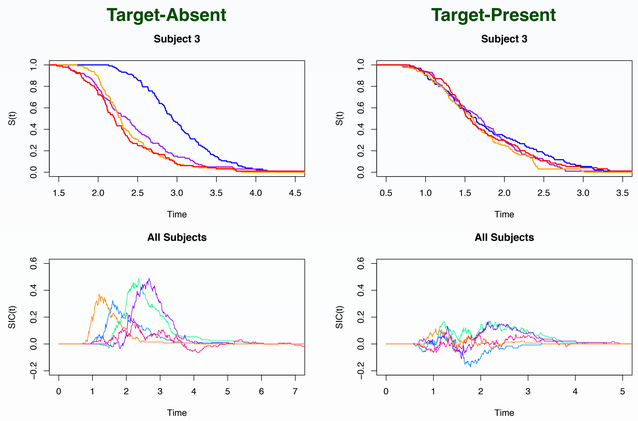
Procedure

- Fixate center cross (gaze-contingent trial initiation)
- If a red circle is present, move the mouse to left-click on it
- If a red circle is not present, right-click the mouse anywhere

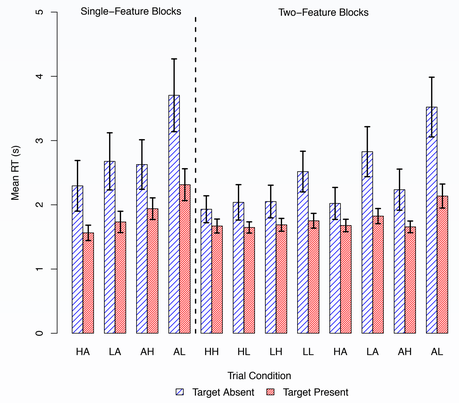
Example Displays



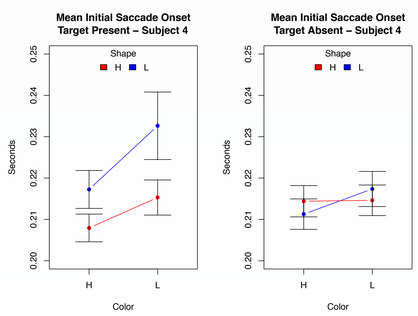
Replication of Previous Results



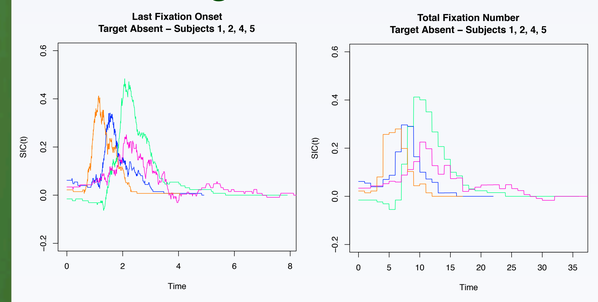
Response Times



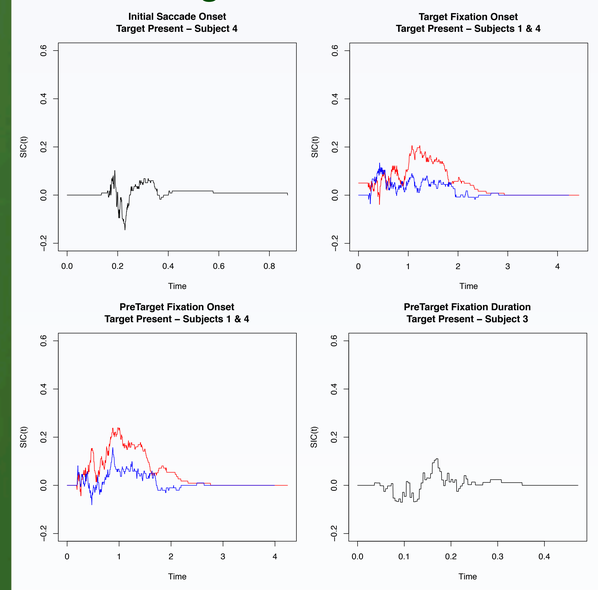
TESTING ALTERNATIVE INTERVALS		Survivor Ordering	
DV	Purpose	Target Present	Target Absent
Initial Saccade Onset	Guidance using initial information	1 / 5	0 / 5
Pre-Target Fixation Onset	Guidance + distractor rejection (minimal target information)	2 / 5	
Pre-Target Fixation Duration	Distractor rejection + target saccade planning	1 / 5	
Target Fixation Onset	Guidance + distractor rejection (some target information)	2 / 5	
Target Fixation Duration	Target affirmation (assuming no pre-fixation information)	0 / 5	
Total Fixation Number	Global guidance	0 / 5	4 / 5
Mouse Move Initiation	Threshold for sufficient evidence of target presence	0 / 5	
Mouse Move Duration	Target processing after mouse initiation	0 / 5	
Second last fixation duration	Distractor rejection + search continuation decision		0 / 5
Last fixation onset	Guidance + distractor rejection (no target information)		4 / 5
Last fixation duration	Distractor rejection + search termination decision		0 / 5



Target Absent SICs



Target Present SICs



Conclusions

- Replicated previous results: response times indicate parallel processing in target-absent condition; no effective selective influence in target-present condition
- Evidence for parallel processing of color and shape during visual search but prior to manual response in target-absent condition
- Examining components of target-present response times did not reveal consistent patterns of selective influence
  - Some parallel processing
  - One potential case of serial processing

Acknowledgements

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