



Max Wertheimer Minerva Center for
Cognitive Processes and Human Performance

The Hierarchical Navigation of Visual Attention: Organizational and Spatial Aspects of Focusing and Orienting

Dr. Meni Yeari

Supervisor: Dr. Morris Goldsmith

Visual Attentional Navigation



Types of Attentional Shifts

- **Attentional focusing:** Change in the spatial size of attentional selection.
- **Attentional orienting:** Change in the spatial location of attentional selection.



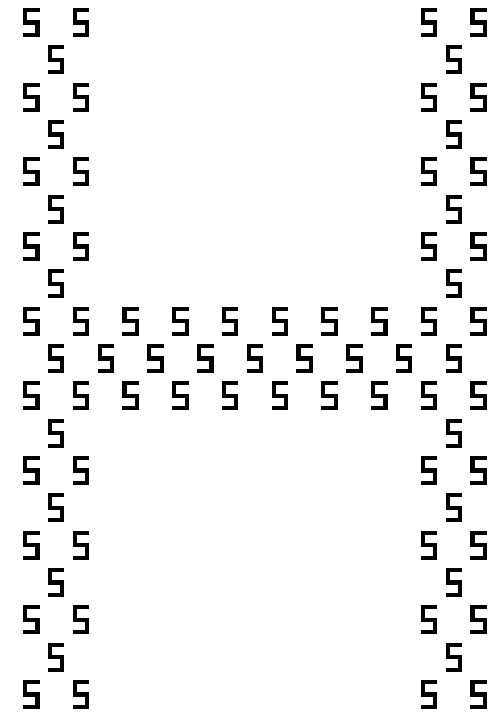
Theoretical Questions

- **Spatial aspect:** Attentional focusing is sensitive to the magnitude of change in the size of focus.
- **Organizational aspect:** Attentional navigation is constrained by the hierarchical structure of the visual scene.



Research Paradigm

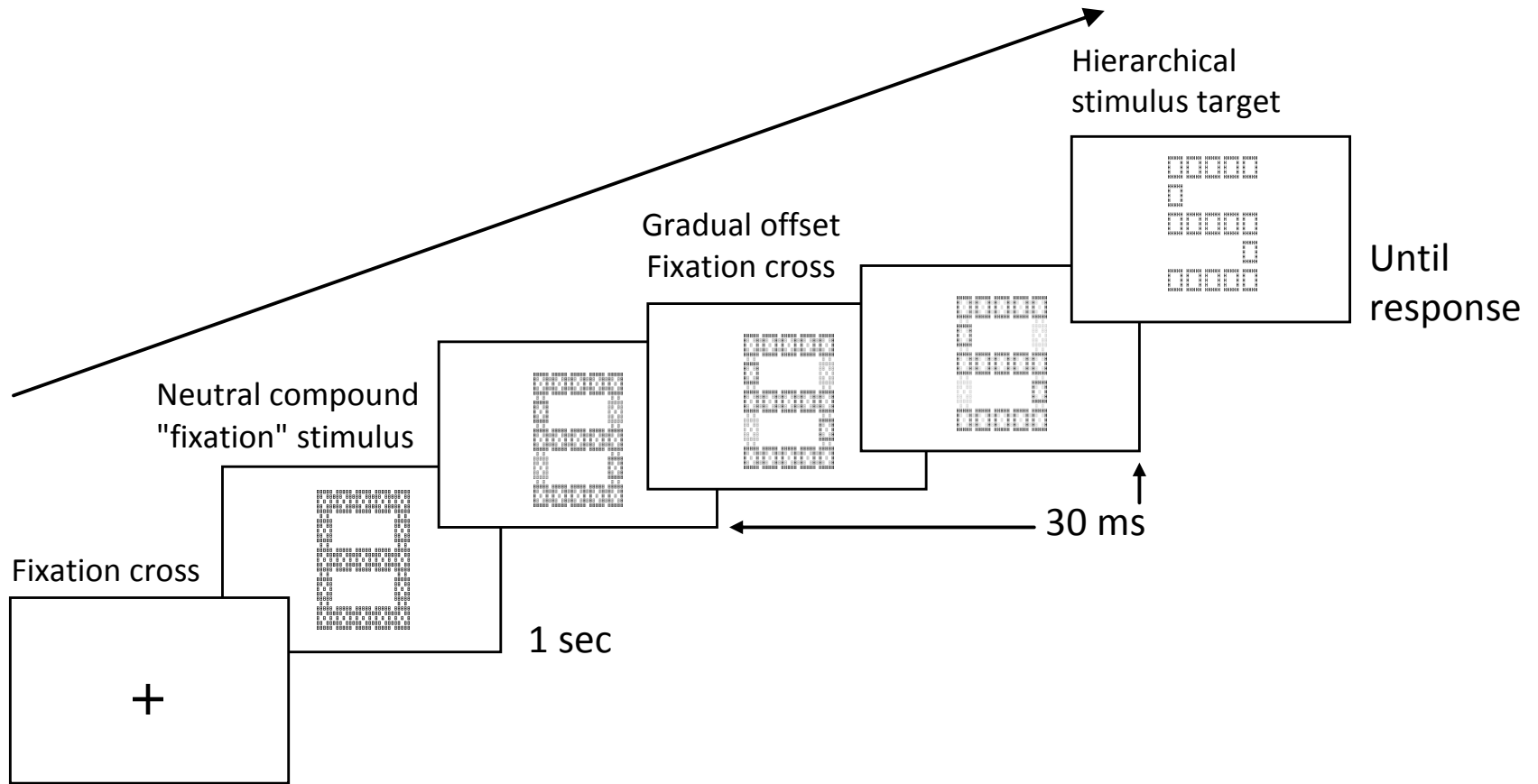
- Using Navon's Compound letter stimuli.
- Two successive identifications in each trial.
- **Part A – Attentional focusing:**
Identification of both global and local levels of the same stimulus.
- **Part B – Attentional orienting:**
Identification of one target level in each stimulus.



Research Stimuli

		Organizational Complexity (OC)			
		2-Level		3-Level	
Global Size (GS)	large	<pre>H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H H 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Basic Research Procedure



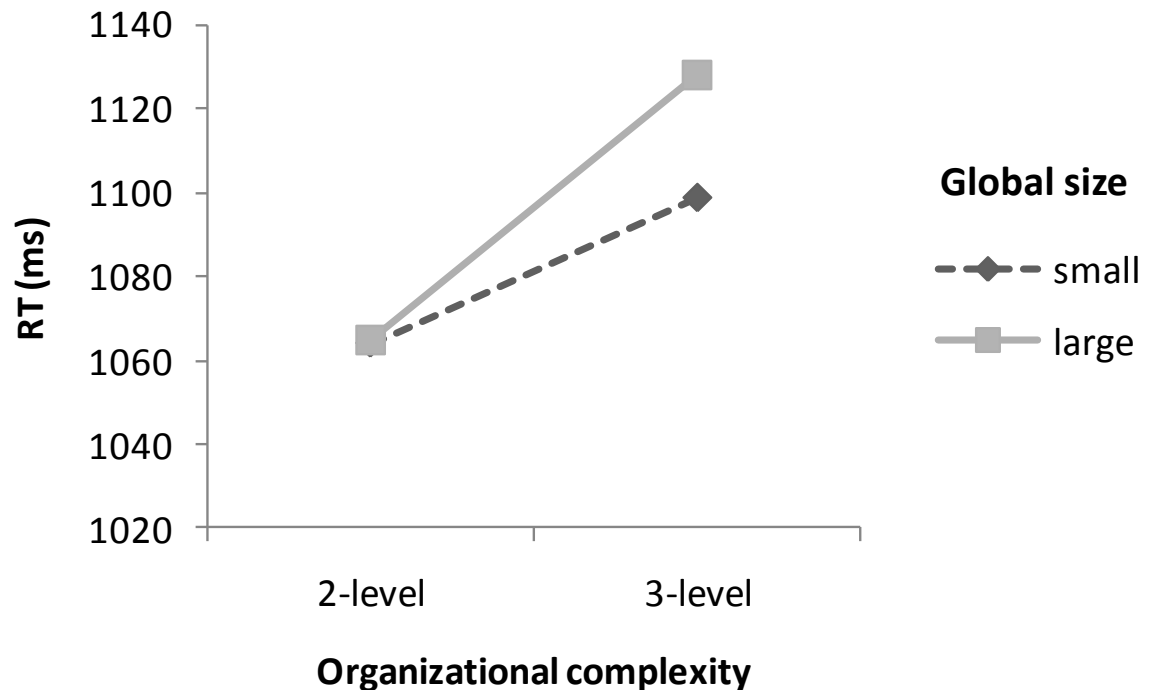
Research Pretest

- **Goal:** To verify that the global and the local letters are equally discriminable across the four different types of stimuli.
- **Method:** Single identification of the global or the local letters in each trial.
- **Results:** Null results with regard to organizational complexity (OC) and global size (GS) effects.

Experiment A-1 Results

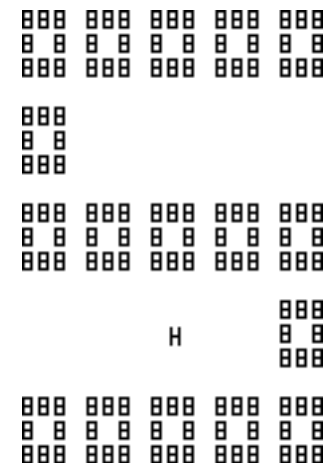
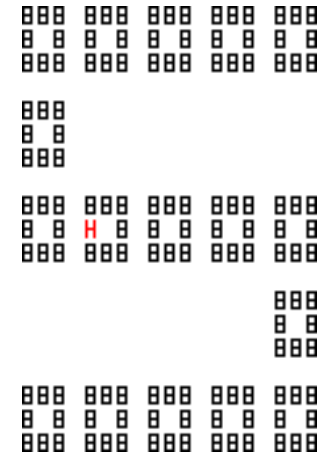
Experiment A-1 Results

- Significant OC main effect.
- Significant GS main effect.
- Significant OC \times GS interaction.

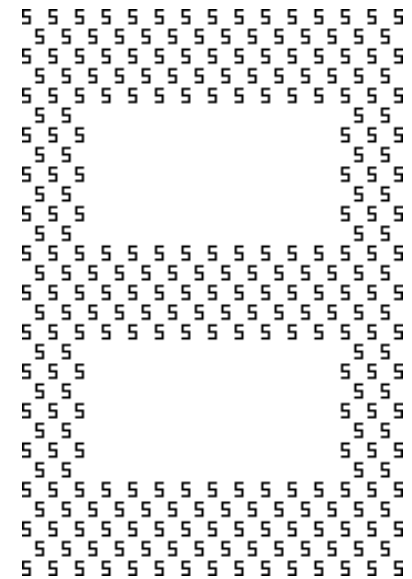


Part A: Subsequent Experiments

- **Exp. A-2 - Two types of tasks:** Identification vs. detection of a singleton local element.
- **Results:** OC effects in the identification but not in the detection condition.
- **Exp. A-3:** The local target is not part of the hierarchical structure.
- **Results:** OC effects were significantly attenuated.



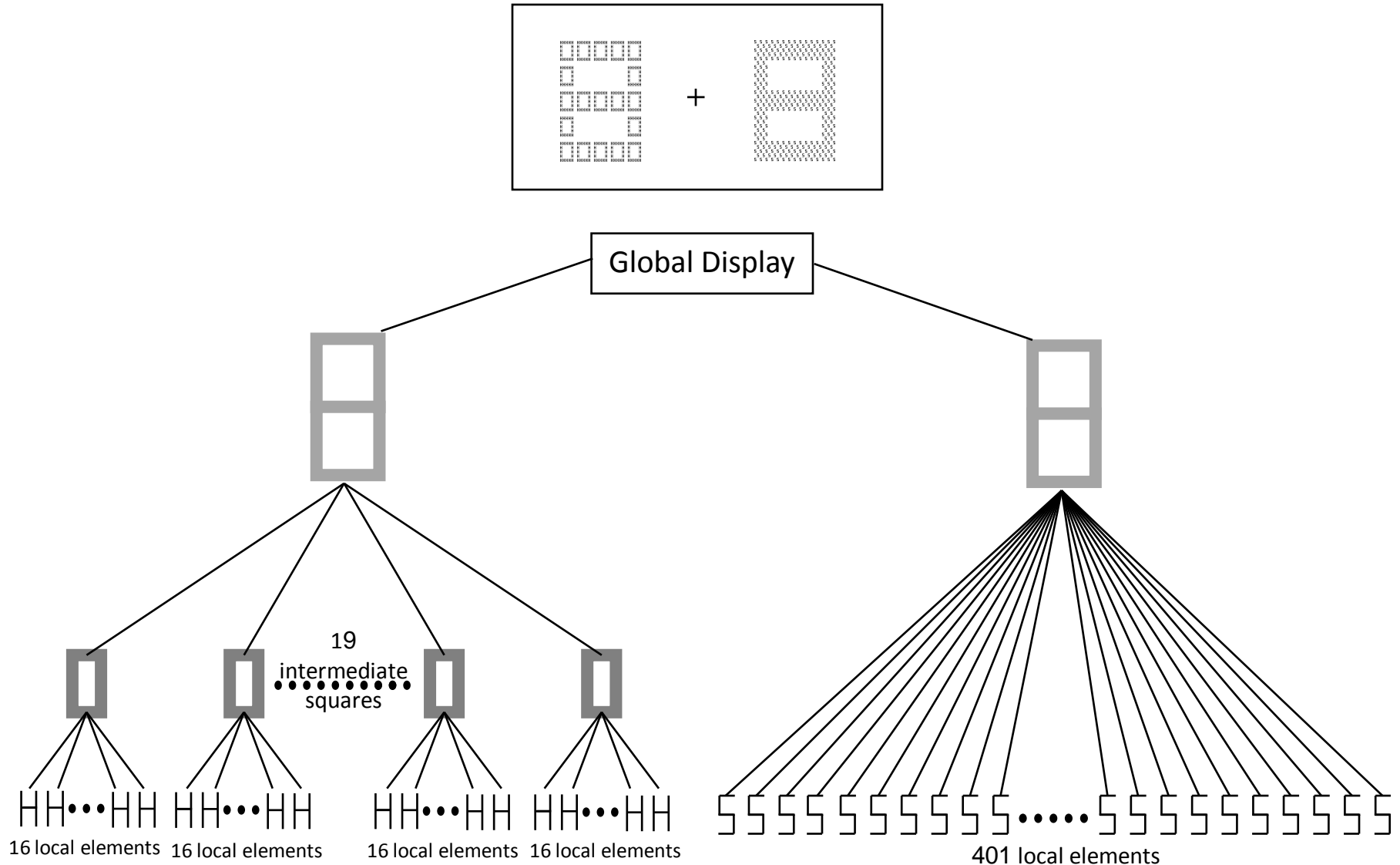
Part B: Attentional orienting



Hierarchical Attentional Navigation (HAN) Hypothesis

- Attentional orienting is constrained by the inner hierarchical-organization of the visual scene.
- Attention follows an hierarchical route that links the target stimuli (levels) on a perceptual hierarchical representation.

Perceptual Hierarchical Representation



Hierarchical Attentional Navigation (HAN) Hypothesis

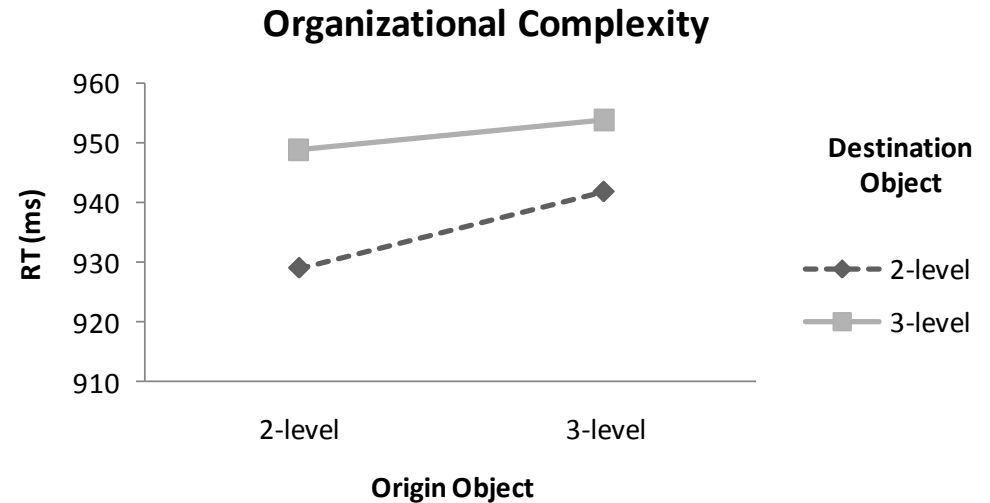
- Attentional orienting is constrained by the inner hierarchical-organization of the visual scene.
- Attention follows an hierarchical route that links the target stimuli (levels) on a perceptual hierarchical representation.
- Attention is defocused and/or (re)focused through irrelevant higher levels if necessary.
- Attention traverses intervening hierarchical levels represented on the route.
- Attention navigates through the highest common level of the target levels (strictest version).

Experiment B-1

- **Task:** Identification of the local letters of each stimulus.
- **Independent variables:** OC and GS of each stimulus.
- **Dependent variable:** Overall RT for both identifications.
- **Predictions:** OC (and GS) effects for one or both stimuli.

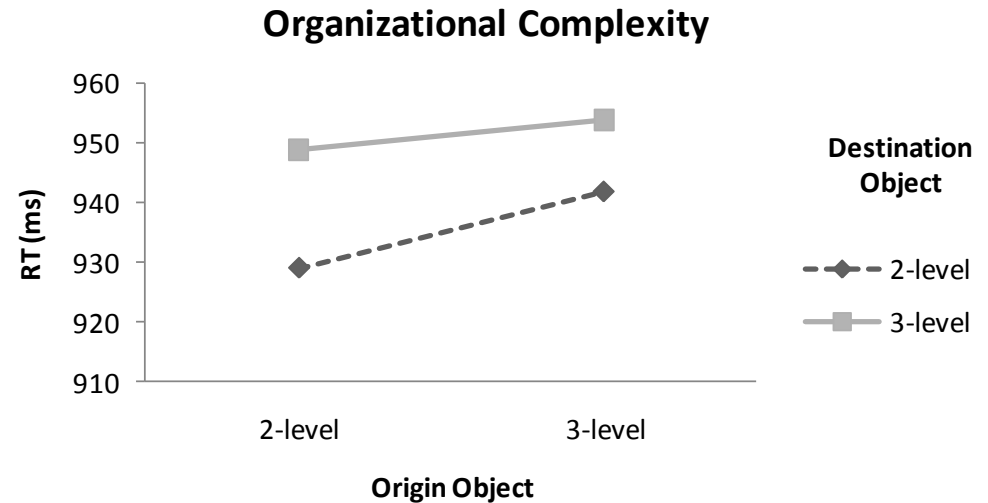
Experiment B-1 Results

- Significant OC main effects for both **Origin** and **destination** stimuli.

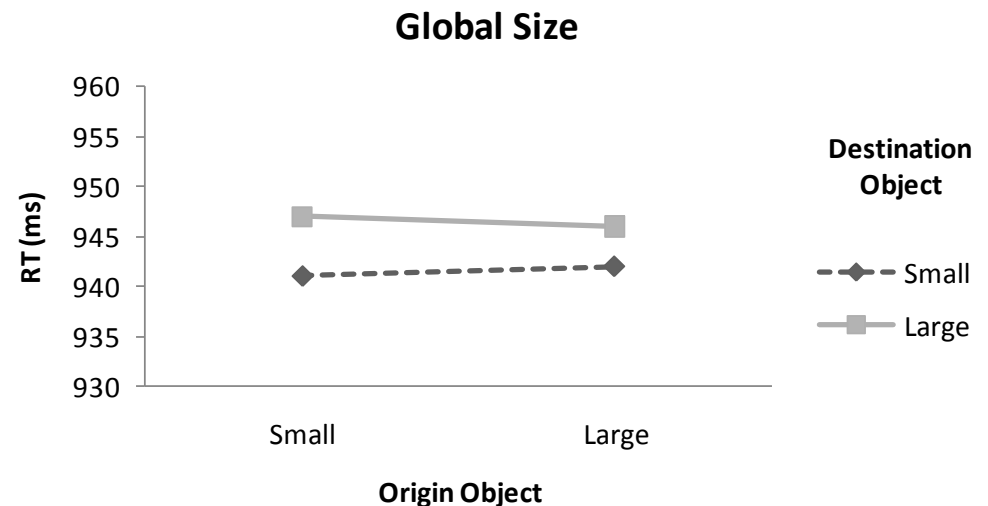


Experiment B-1 Results

- Significant OC main effects for both **Origin** and **destination** stimuli.



- Significant GS main effect only for the **destination** stimulus.

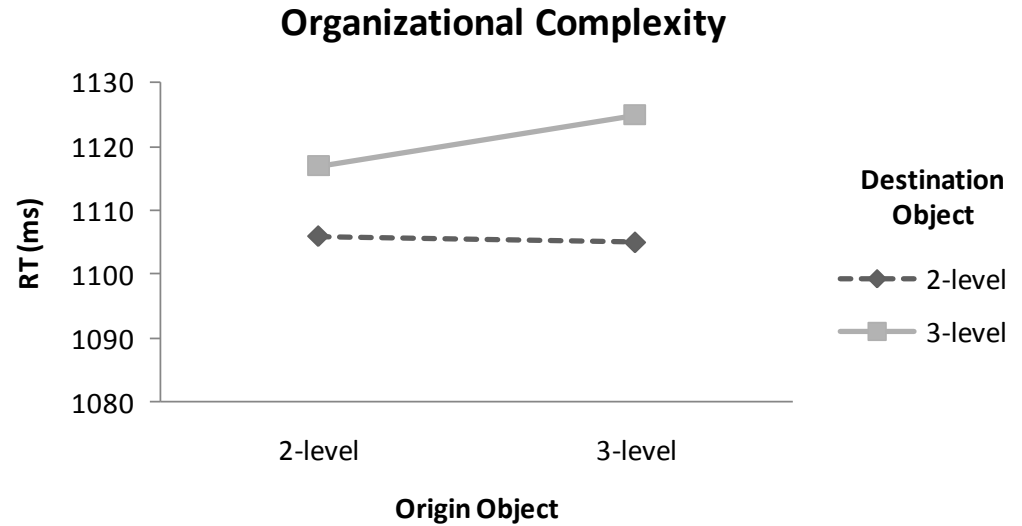


Experiment B-2

- **Task:** Identification of the global letter of one stimulus and the local letters of the other stimulus.
- **Predictions:**
 - **Global-Local navigation:** OC (and GS) effects for the destination but not for the origin stimulus.
 - **Local-Global navigation:** OC (and GS) effects for the origin but not for the destination stimulus.

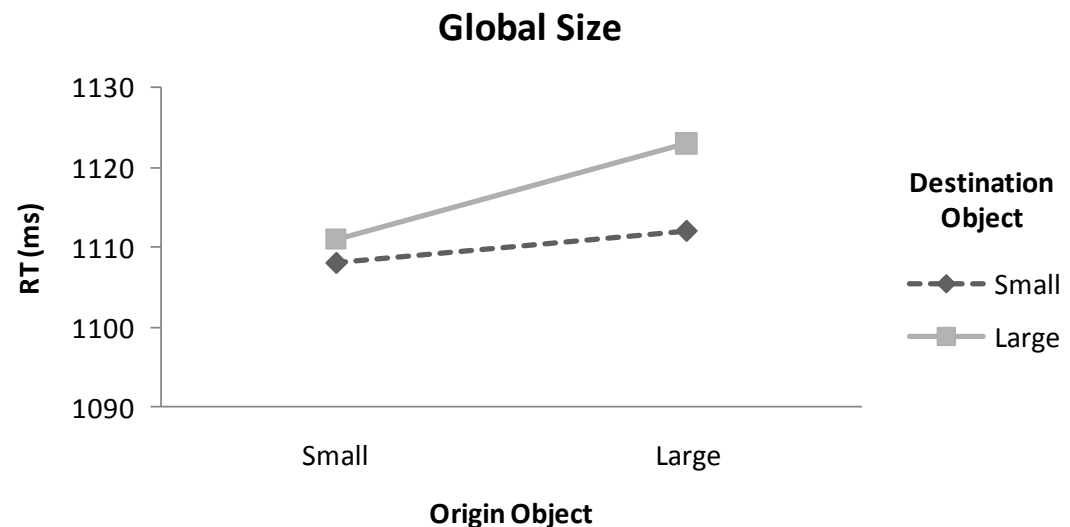
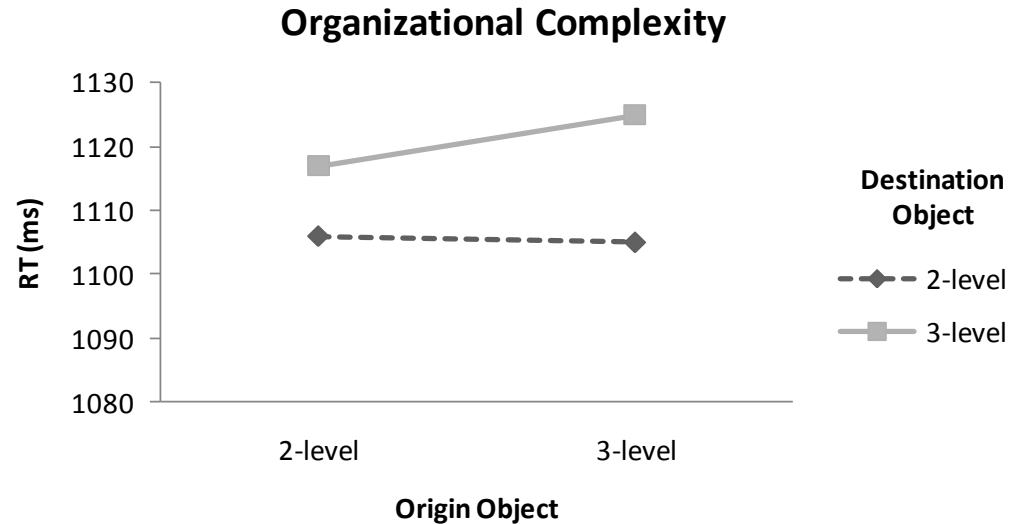
Experiment B-2 Results: Global-Local

- Significant OC main effect only for the destination stimulus.



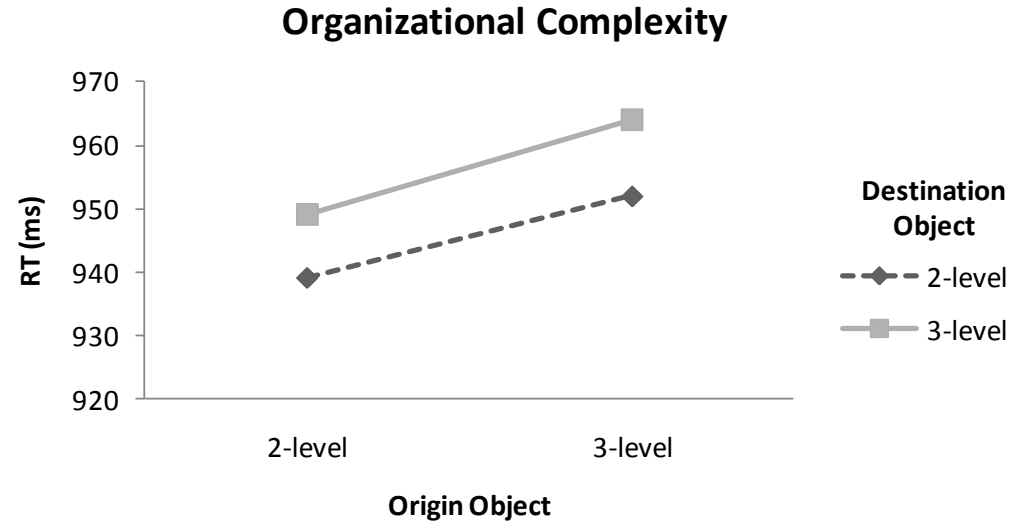
Experiment B-2 Results: Global-Local

- Significant OC main effect only for the **destination** stimulus.
- Marginally significant GS main effect for the **destination** stimulus.
- Significant GS main effect for the **origin** stimulus (speed-accuracy tradeoff).



Experiment B-2 Results: Local-Global

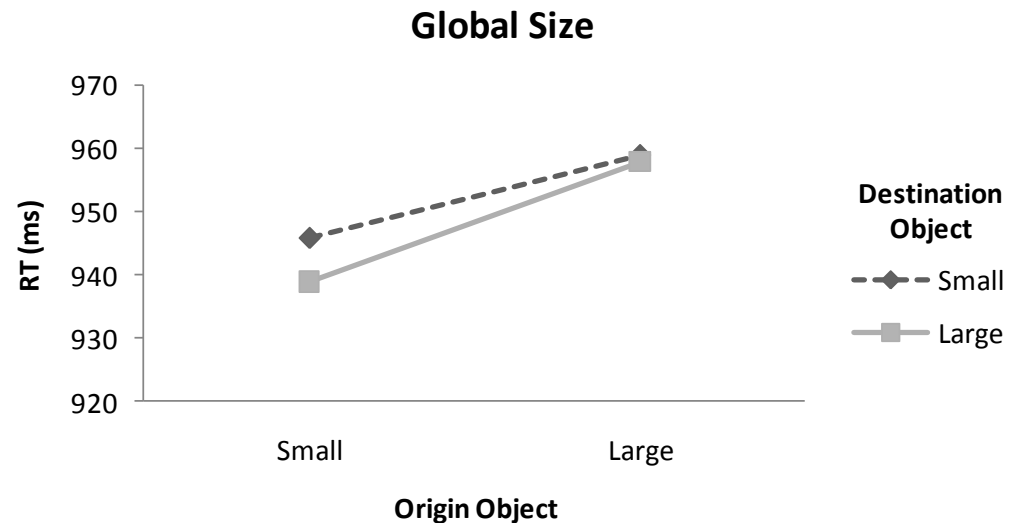
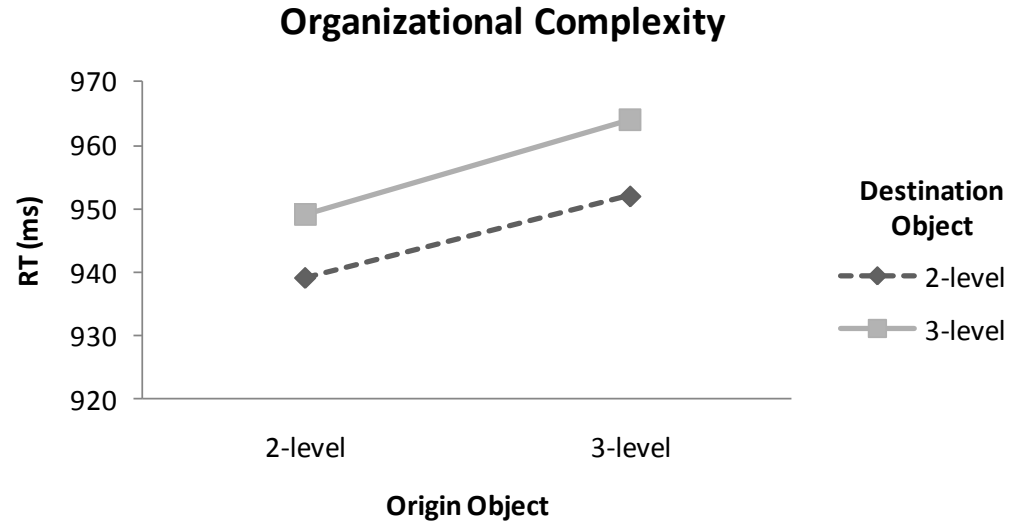
- Significant OC main effects for both **origin** and **destination** stimuli.



Experiment B-2 Results: Local-Global

- Significant OC main effects for both **origin** and **destination** stimuli.

- Significant GS main effect only for the **origin** stimulus.



Conclusions

- Attentional focusing is sensitive to both spatial and hierarchical-organizational aspects.
- Attentional navigation (focusing and orienting) is constrained by the hierarchical structure of the visual scene.
- Attention does not necessarily follow the complete hierarchical indirect path.
- Yet, attention is not oriented directly either.

Future Research

- Identifying the conditions in which attention does not follow the complete hierarchical path.
 - Differences between the physical and the perceptual hierarchical presentation?
- Generalizing these findings to additional types of hierarchical structures.
- Clarifying why attention follows such indirect longer routes.
 - Default strategic utilizing of the hierarchical organization of the visual scene?
 - To what extent perceivers can control the route of attentional navigation?

Thank you!



**Max Wertheimer Minerva Center for
Cognitive Processes and Human Performance**