Perceptual Load in Different Regions of the Visual Field and its Effect on Attentional Selectivity
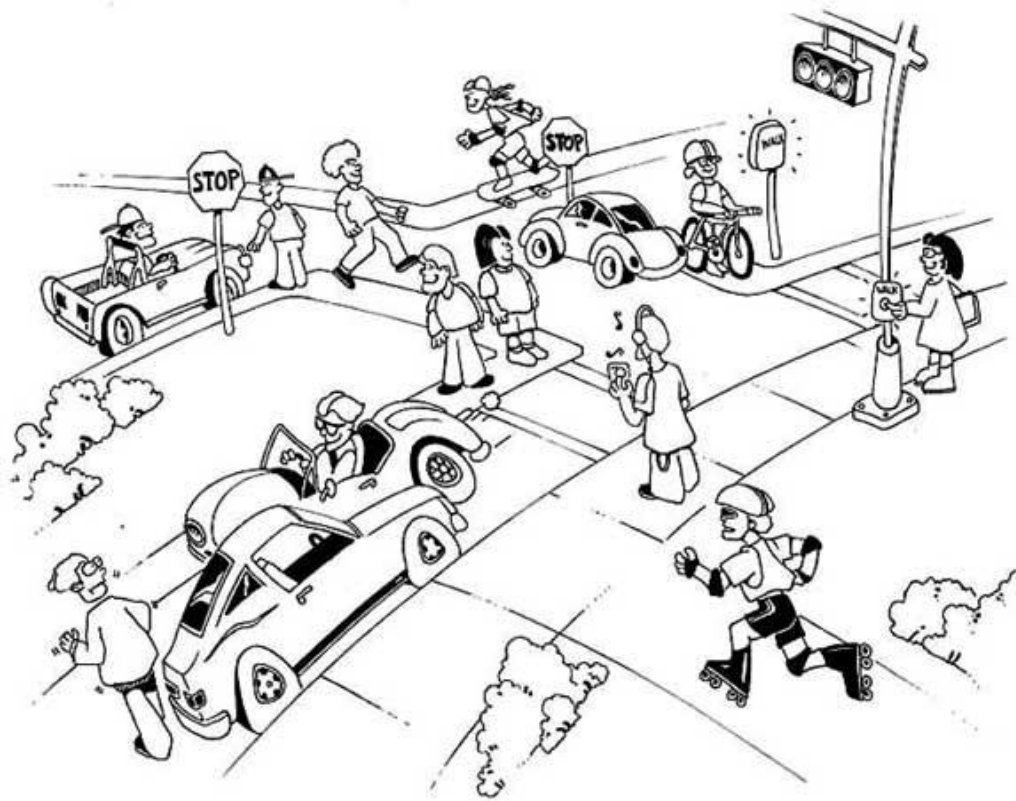
Hadas Marciano

Advisor: Yaffa Yeshurun

Attention

> Attention as selective process.

> Sometime the selectivity is too high, e.g., "Inattentional Blindness".

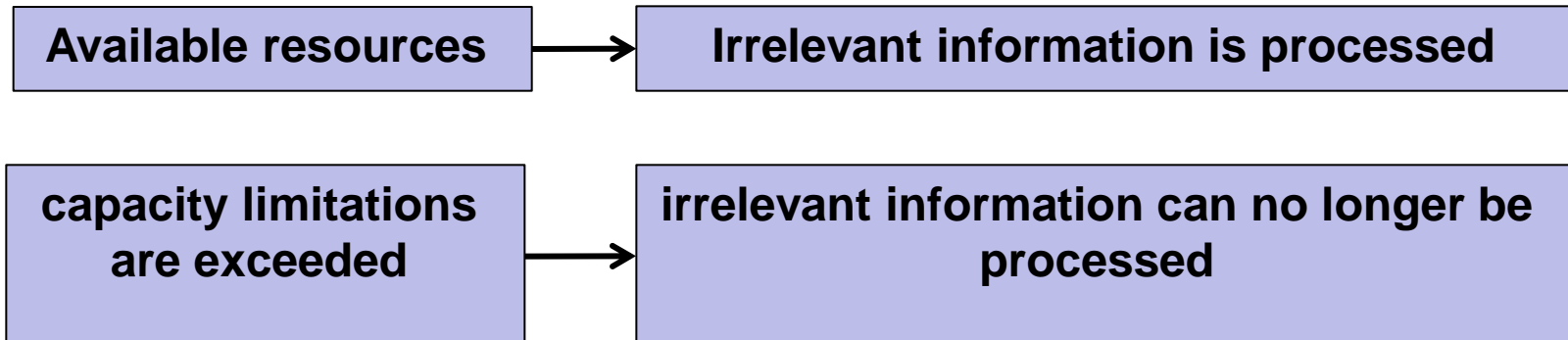> Sometime it is too low, e.g., irrelevant distractor interference.

Perceptual Load Model - Lavie (1995)

Why attention seems to be too selective or non-selective at different times?

The selectivity of the attention depends on the perceptual load of the relevant information.

Perceptual Load Model - Lavie (1995)

➢ Availability of resources.

Available resources →	**Irrelevant information is processed**
capacity limitations are exceeded →	**irrelevant information can no longer be processed**

Perceptual Load Model - Lavie (1995)

➢ When the perceptual load is **low** the task does not consume all the resources.

  ▪ The available resources then spill over to process irrelevant information.

➢ When the perceptual load is **high** all the resources are consumed and irrelevant information cannot be processed.

Perceptual Load Model - Lavie (1995)

- ➢ What is perceptual load?

- ➢ **Relevant set size** – the number of stimuli among which target has to be found**.**

- ➢ **Relevant actions –** the processing requirements for the same stimuli (e.g., Features vs. Conjunction).

Lavie and Cox (1997)

Lavie and Cox (1997)

Low Load　　　　　**High Load**

Incompatible

O X O
O N
O O O

X M K Z
H N
W

Neutral

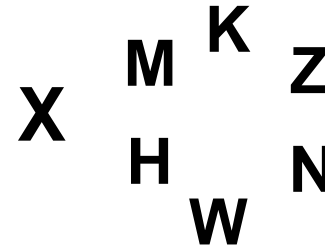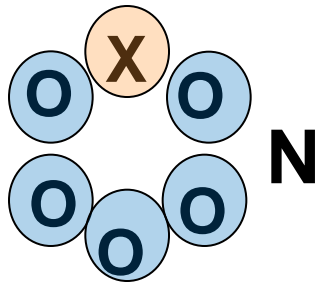O O O
L
O X
O

K H W
M N L
Z

Compatible

O O O
N
N O
O

K W M
Z X
X H

Lavie and Cox (1997)

Low Load	High Load

Incompatible
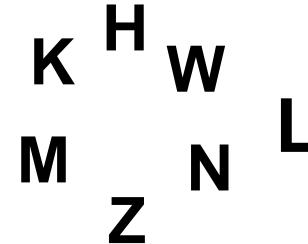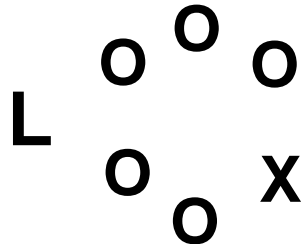

Neutral

Compatible

Lavie and Cox (1997)

Low Load	High Load

Incompatible

O X O
N
O O O
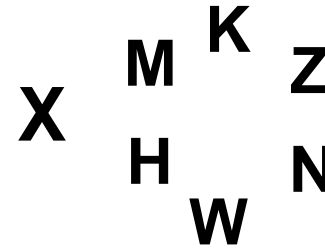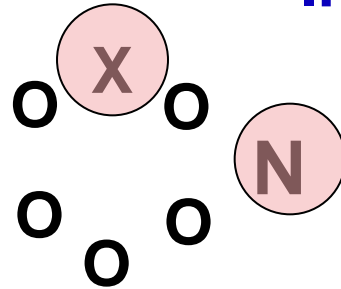
X M K Z H N W

Neutral

L O O O
O X O

K H W
M Z N L

Compatible
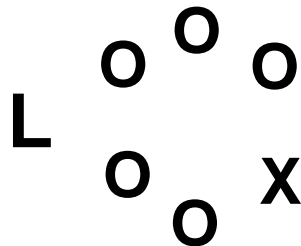
N O O O
N O O

K W M
Z X H X

Lavie and Cox (1997)

Low Load   **High Load**

Incompatible
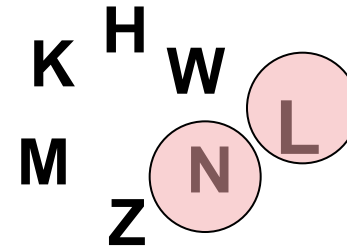
Neutral
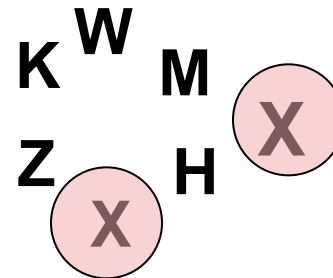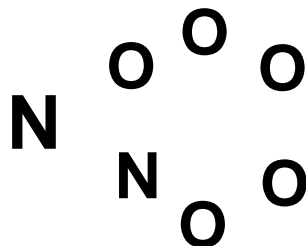
Compatible

Lavie and Cox (1997)

Low Load   **High Load**

Incompatible

Larger than…

Equal to…

O X O
O N
O O O

X M K Z
H N
W

Neutral

L
O O O
O X
O

K H W
M N L
Z

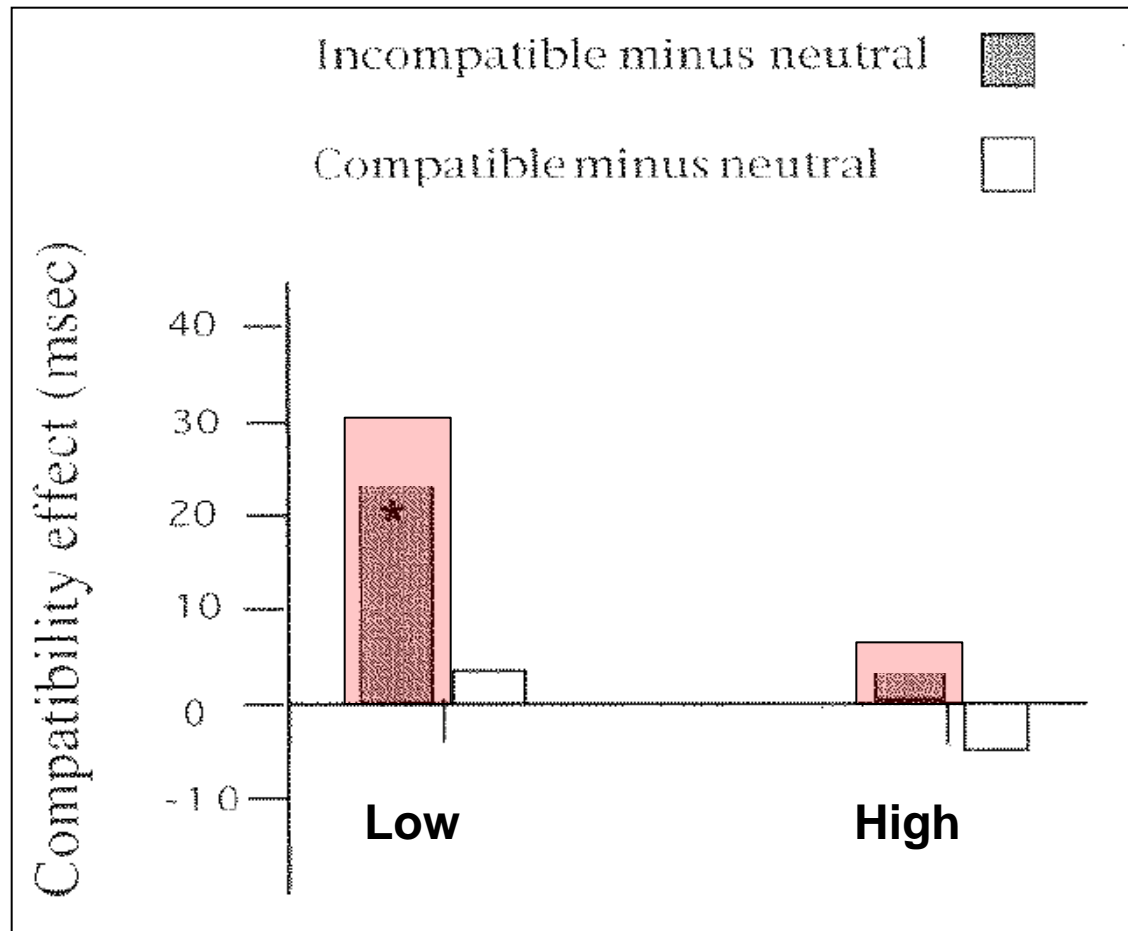**Compatible**

N
O O O
N O
O

K W M
Z H X
X

Results - Lavie and Cox (1997)

- Distractor interference was found only under low load

Figure legend: Incompatible minus neutral (shaded); Compatible minus neutral (white). Y-axis: Compatibility effect (msec). X-axis conditions: Low, High.

Lavie and Cox (1997)

Low Load	High Load

Incompatible

O X O O O O N	X M K Z H W N

Neutral

L O O O O X O	K H W M Z N L

Compatible

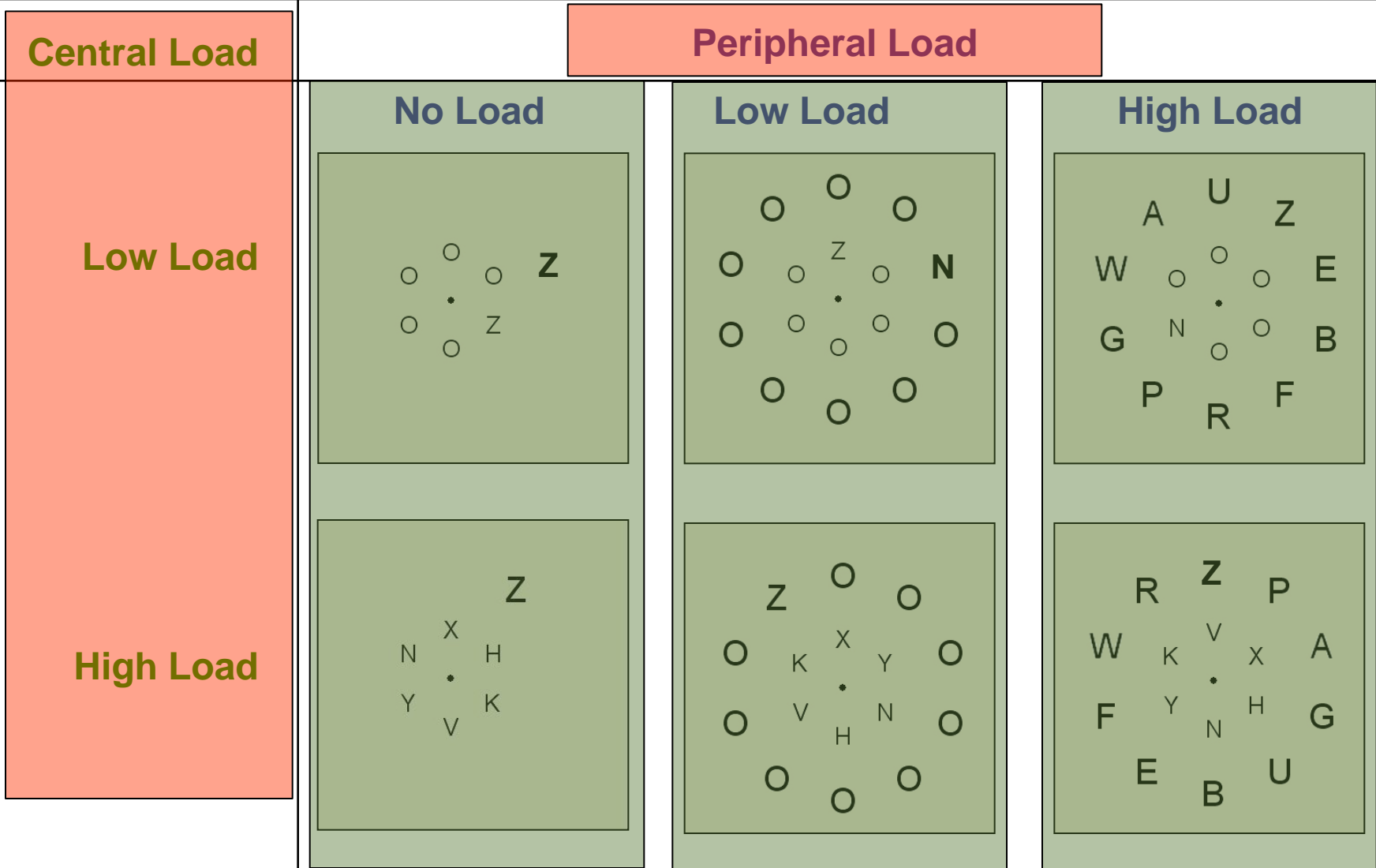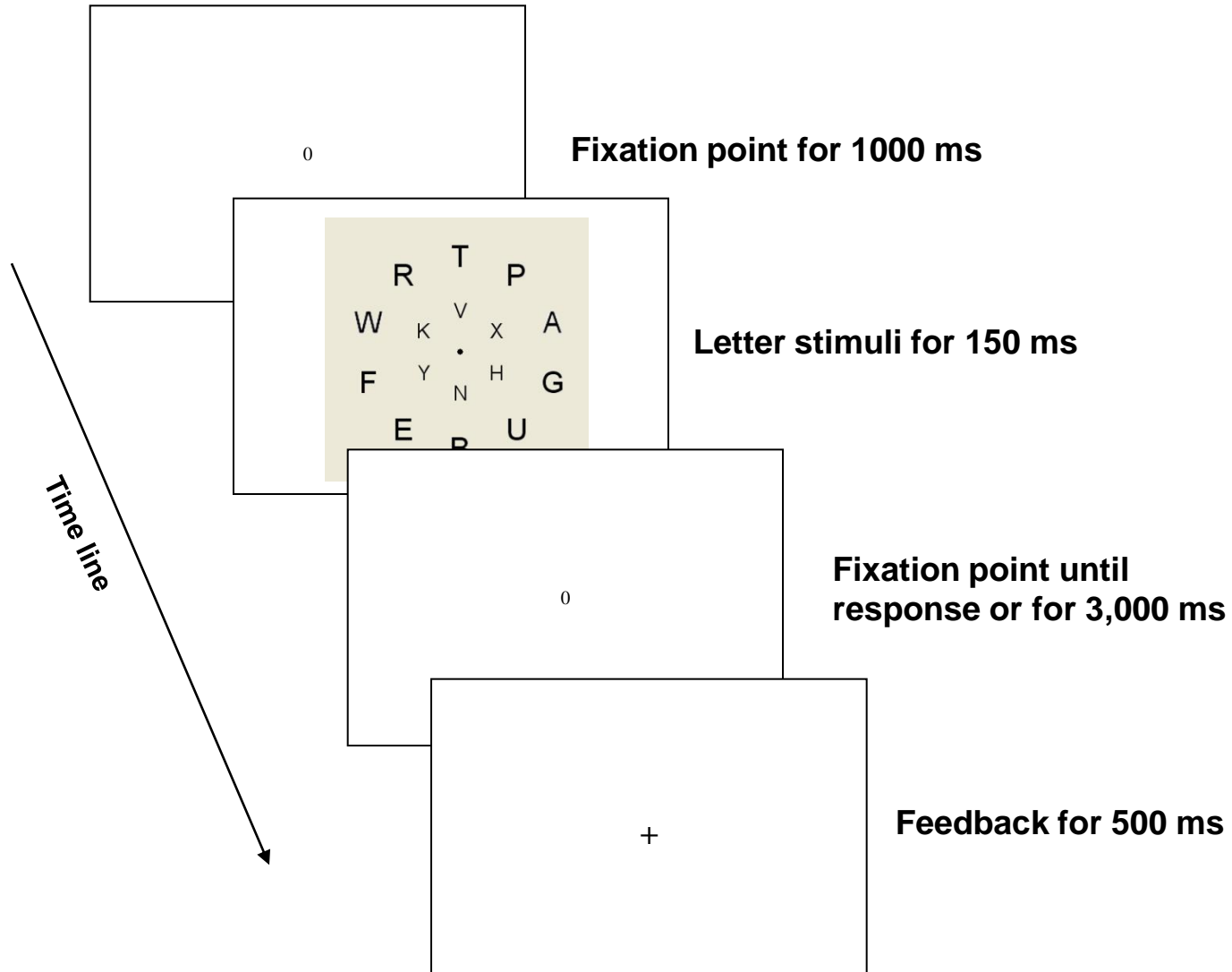|	
N O O O N O O	K W M Z X H X

Current Study

Experiment 1: Aim

To expand the load model to include not only different levels of load at the central region, as was done before, but also different load levels at more peripheral regions.

Experiment 1: Adding peripheral load

Incompatible Vs. Compatible

Experimental Trial

Fixation point for 1000 ms

Letter stimuli for 150 ms

Fixation point until
response or for 3,000 ms

Feedback for 500 ms

Time line

Experiment 1: Hypotheses

➢ **General performance:**

performance should deteriorate as the level of load at the periphery increases, but only under low central load.

➢ **Distractor interference:**

- With 'no' or 'low' peripheral load conditions, the results should replicate previous studies (e.g., Lavie & Cox, 1997).

- However, with high levels of peripheral load, minimal distractor interference should be found under both central load conditions.

Experiment 1: Results – General Performance Central Load X Peripheral Load (RT)
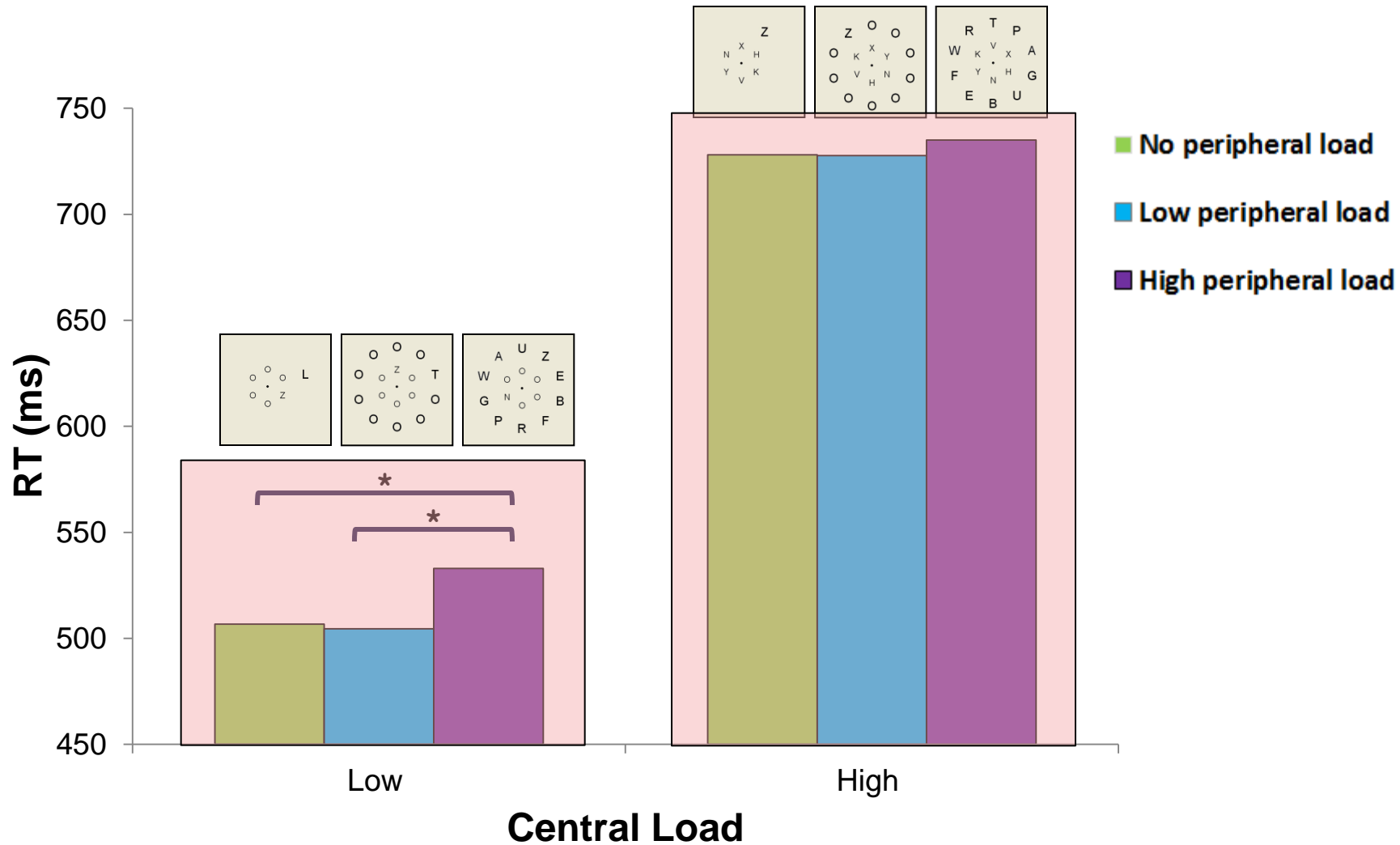
Experiment 1: Results
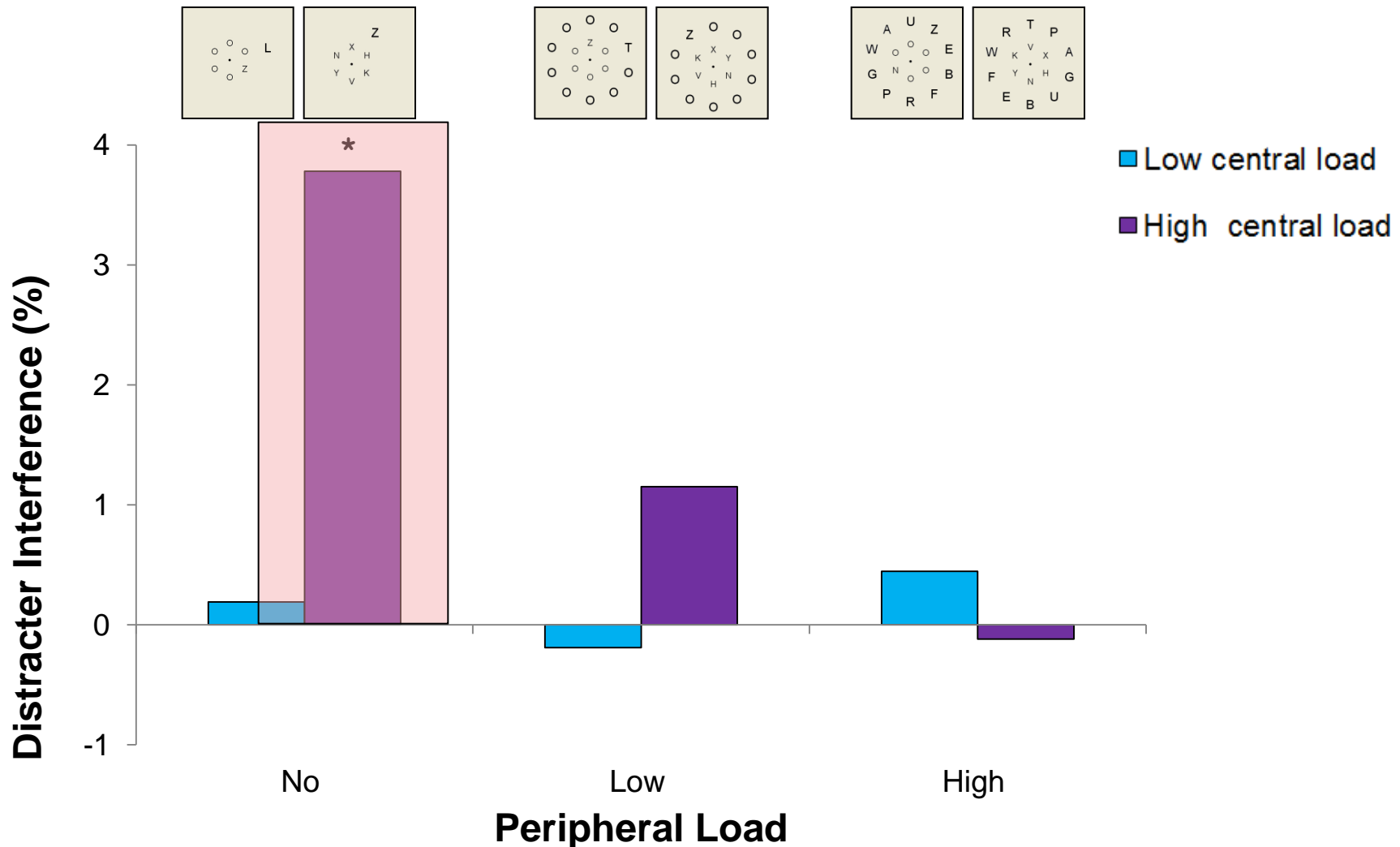## Distractor Interference (RTs - incomp minus comp)
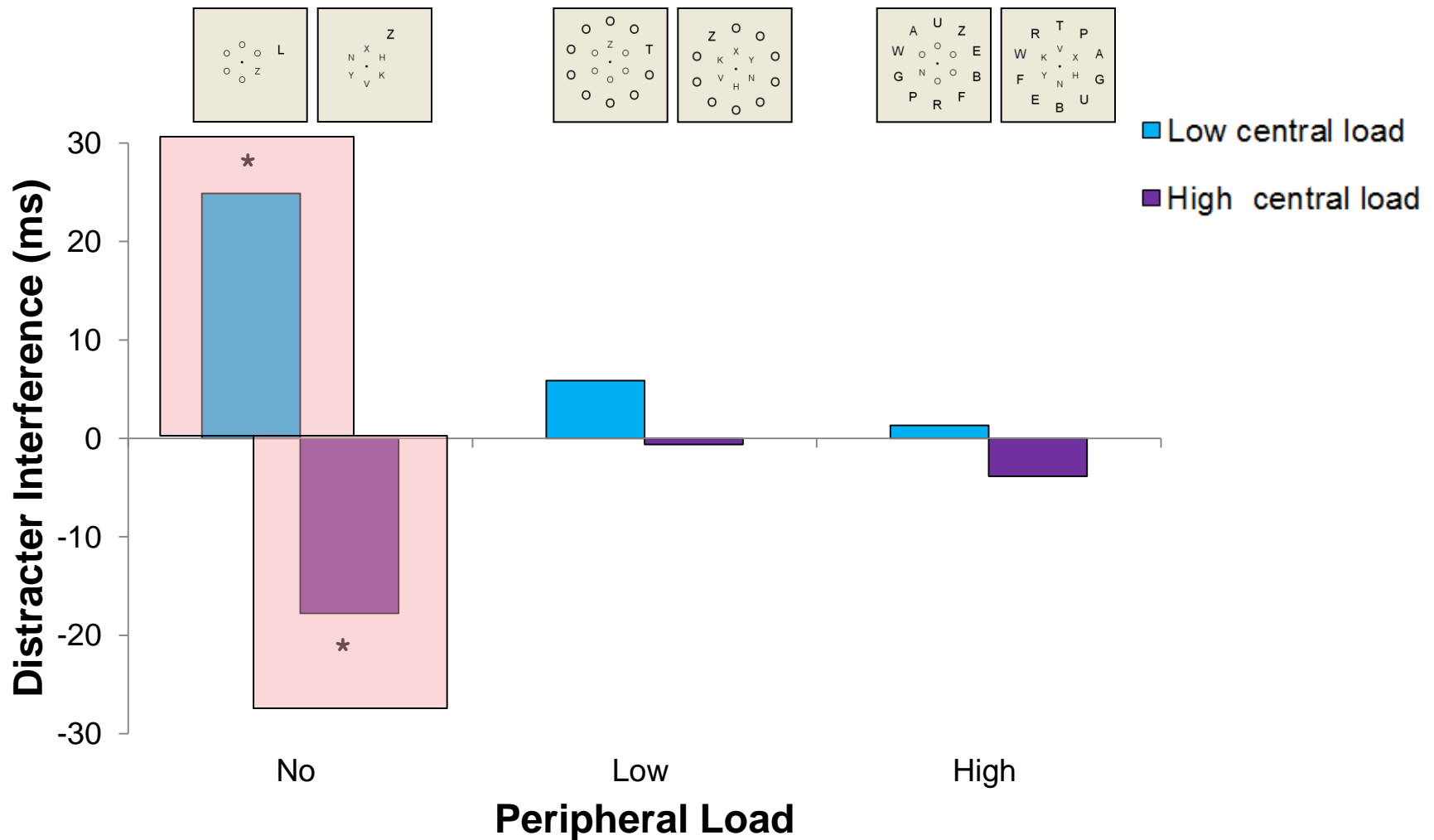
Experiment 1: Results
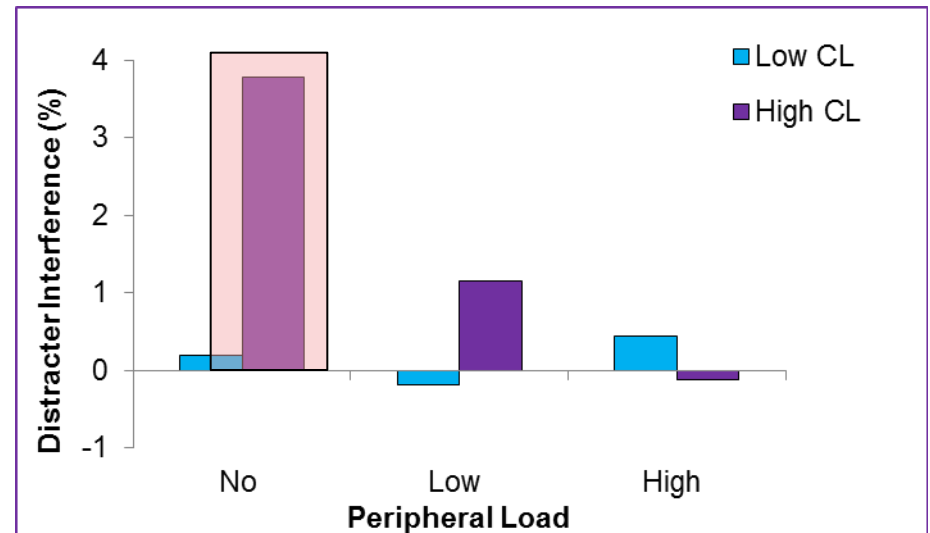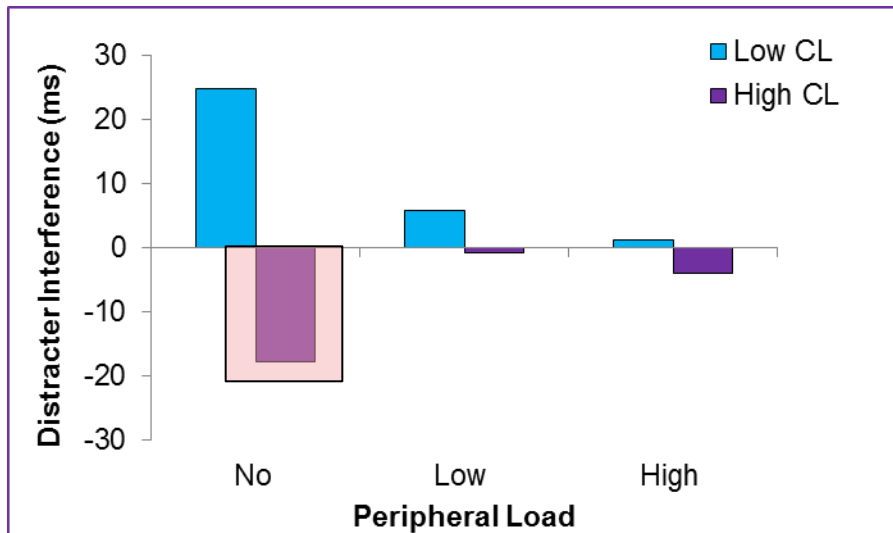Distractor Interference (RTs - incomp minus comp)
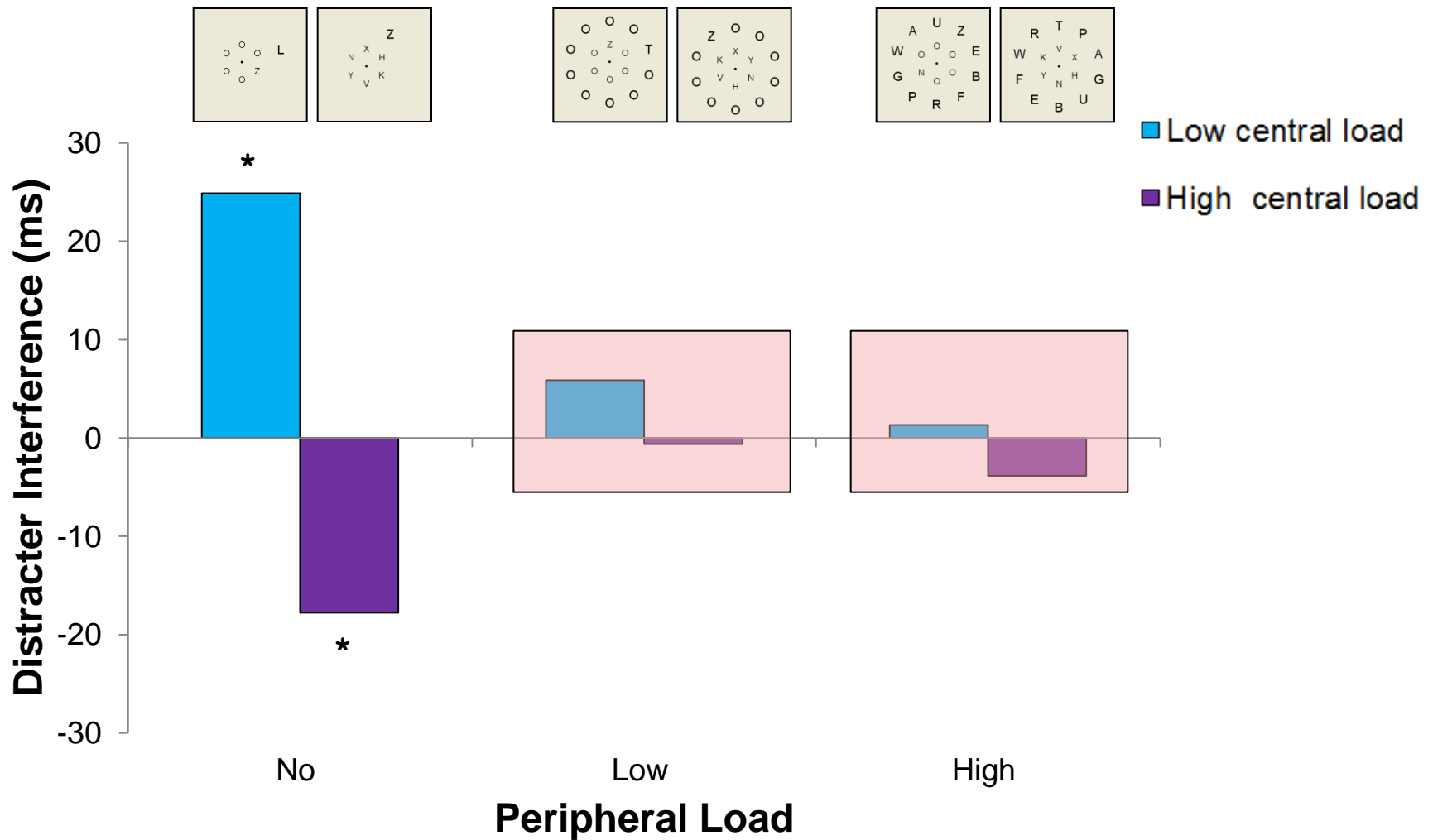
Experiment 1: Results
Distractor Interference (Accuracy: incomp minus comp)
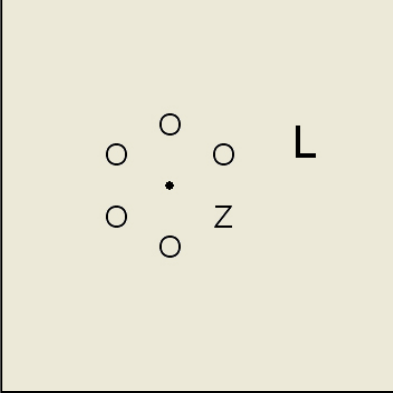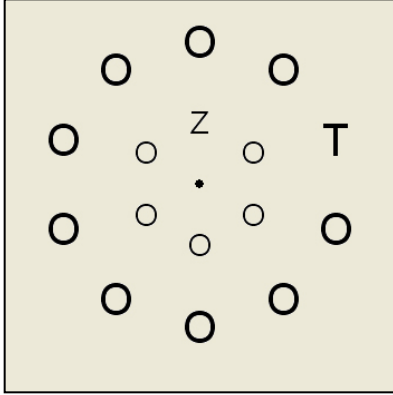
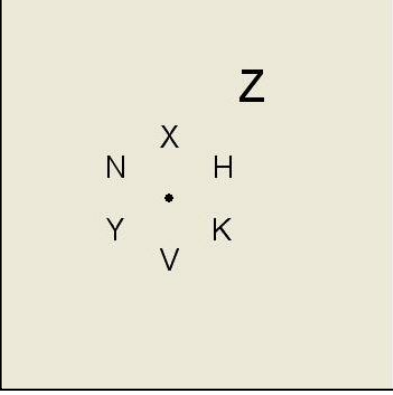# Experiment 1: Discussion

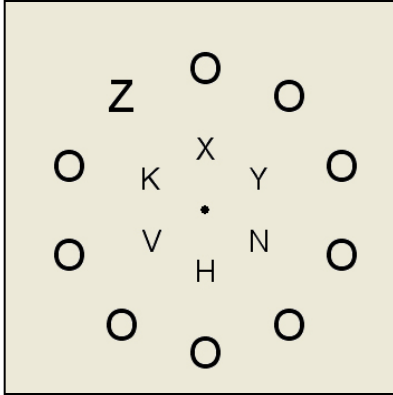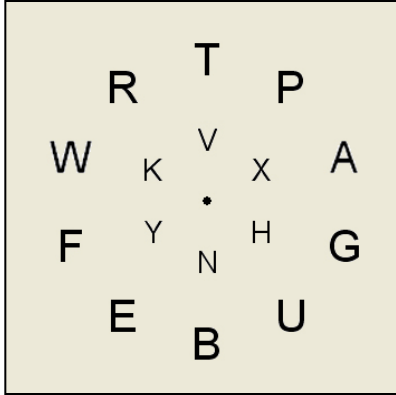➢ **speed-accuracy trade off:**

Experiment 1: Discussion

➢ **Compatibility effect**

- ▪ Lavie (1995) and Lavie and Cox (1997) manipulated three conditions of target-distractor compatibility: **compatible, incompatible and neutral.**

- ▪ They concluded that the compatible condition might be problematic because the physical similarity between the target and distractor might cause interference.

- ▪ They suggested comparing incompatible to neutral.
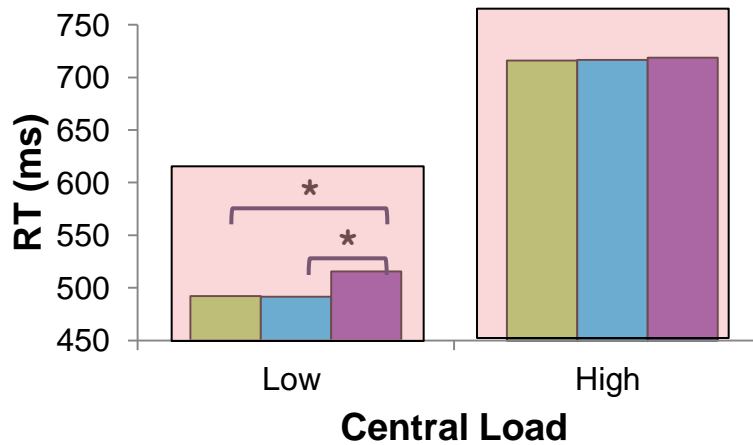
Exp. 2a and 2b : Adding peripheral load

Incompatible Vs. Neutral

Central Load	Peripheral Load		
	No Load	Low Load	High Load
Low Load			
High Load			

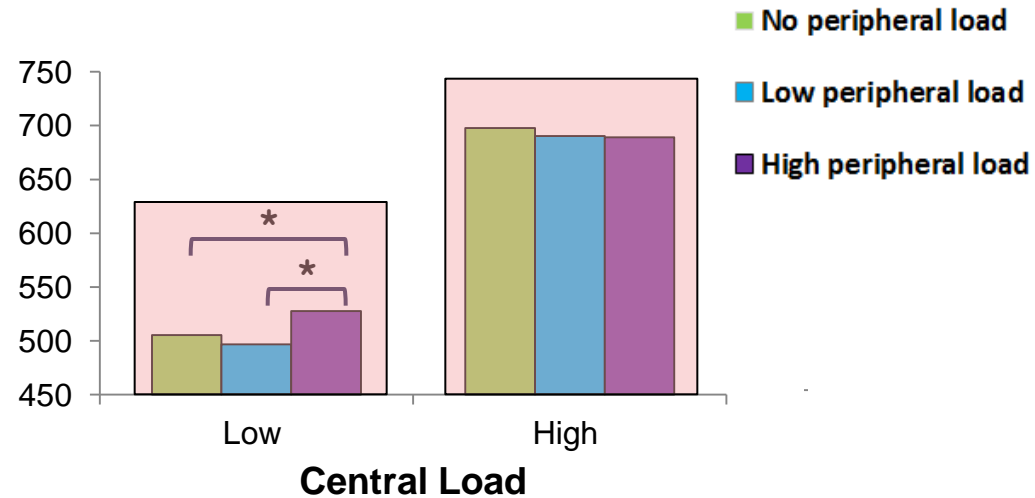# Exp. 2a and 2b: Results - General performance Central Load X Peripheral Load (RT)

Exp. 2a and 2b: Results
Distractor Interference (RTs - incomp minus neutral)

Exp. 2a (N and Z)

Exp. 2b (N and X)

Exp. 2a and 2b: Results
Distractor Interference (RTs - incomp minus neutral)
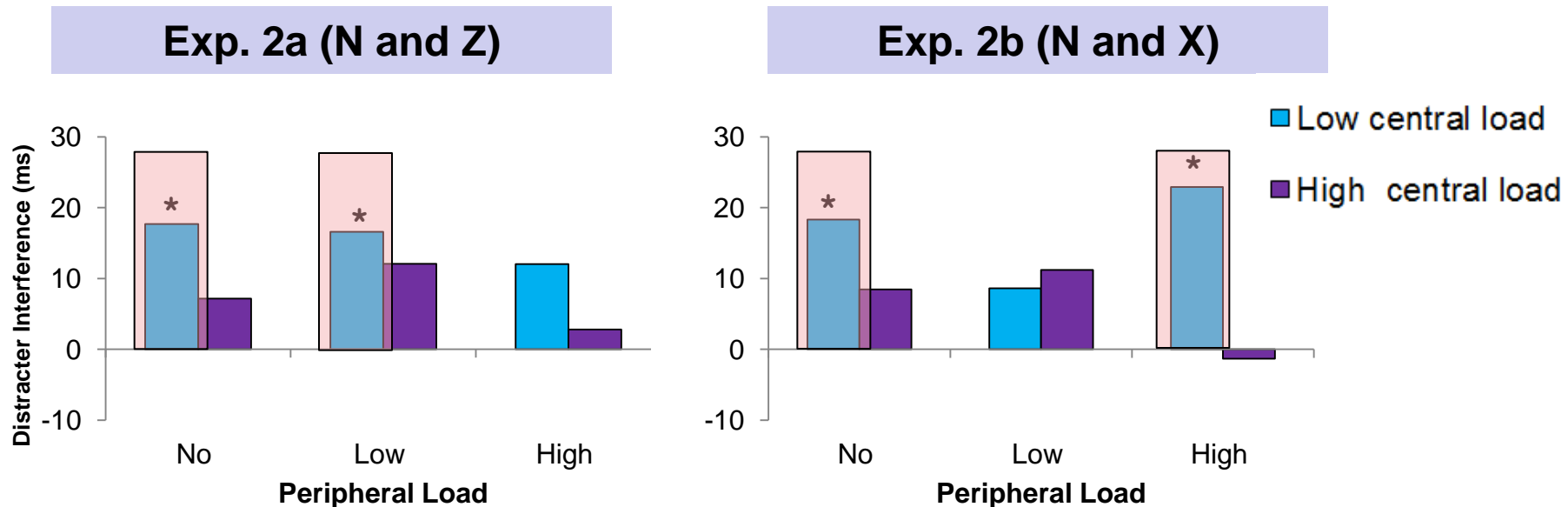
Exp. 2a (N and Z)
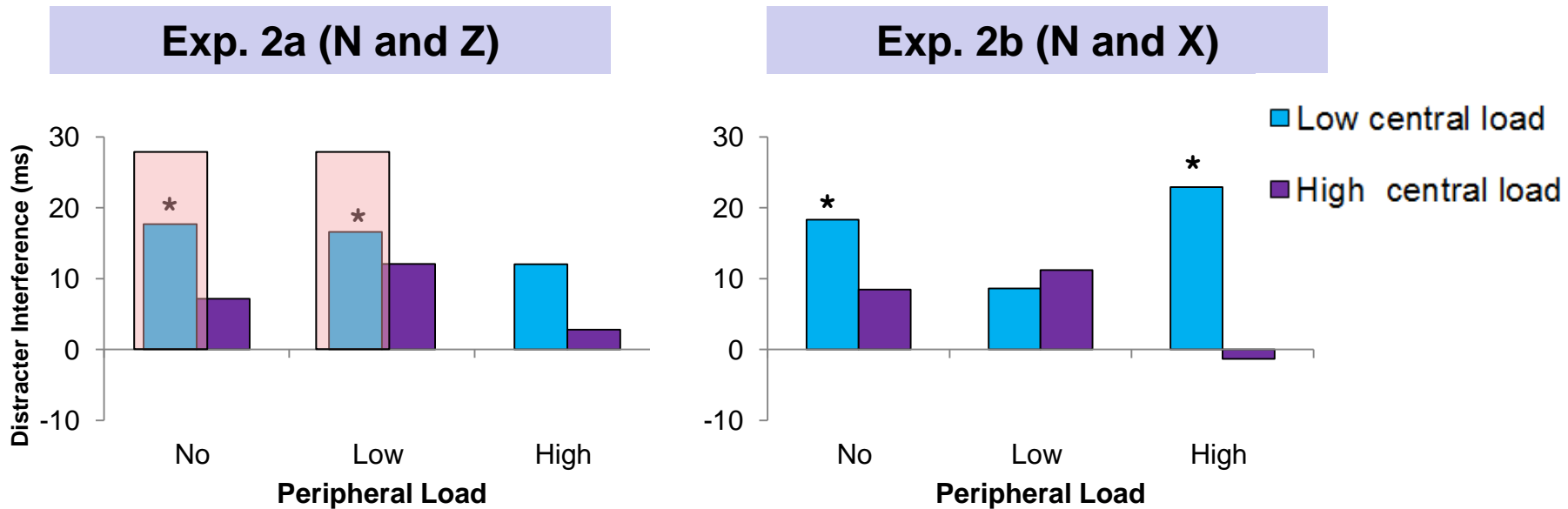
Exp. 2b (N and X)

Exp. 2a and 2b: Results
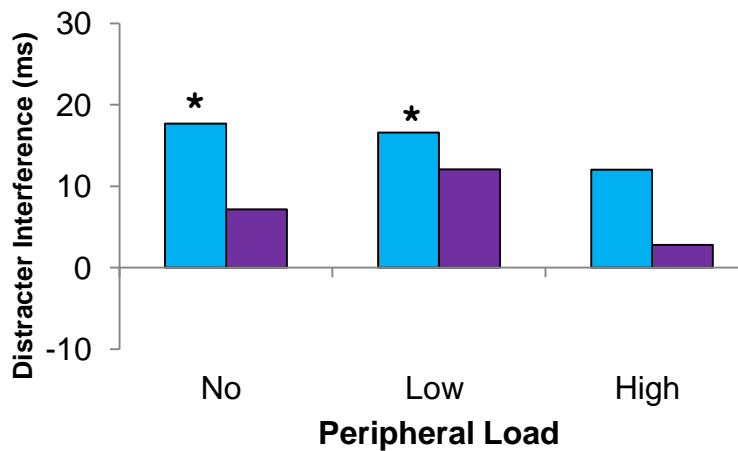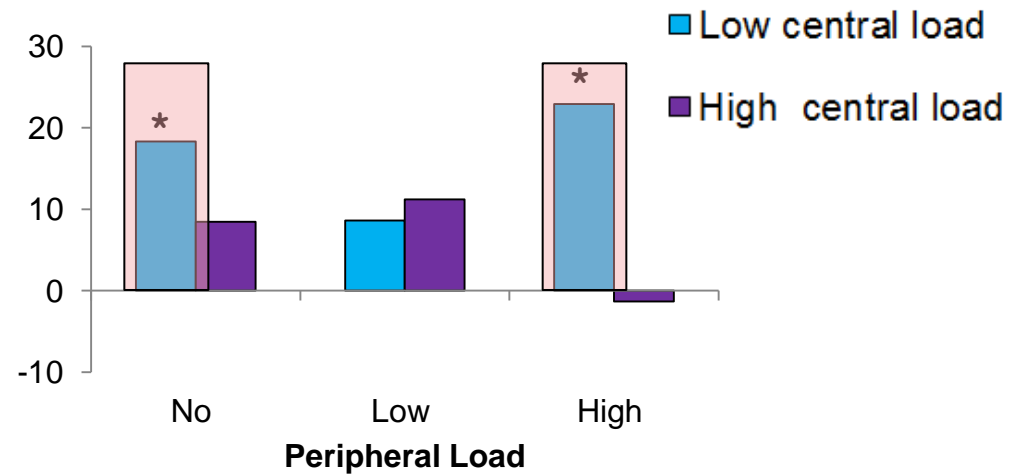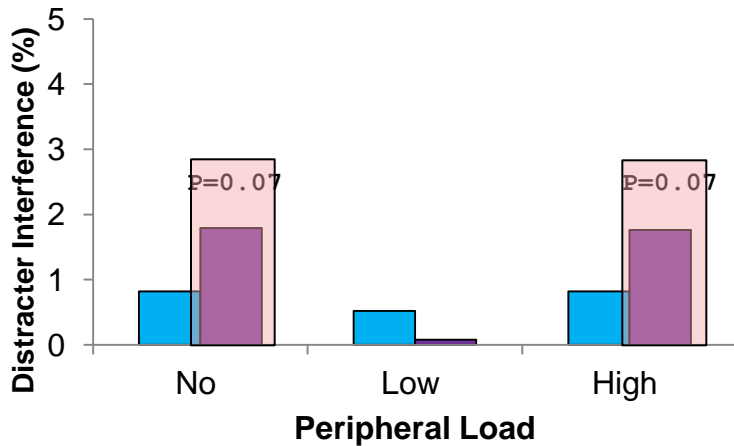# Distractor Interference (RTs - incomp minus neutral)
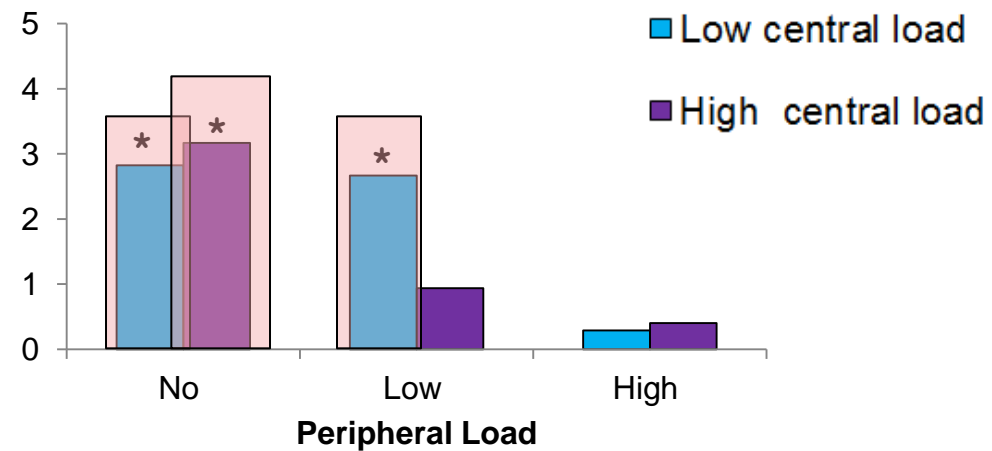

Exp. 2a (N and Z)

Exp. 2b (N and X)

Exp. 2a and 2b: Results
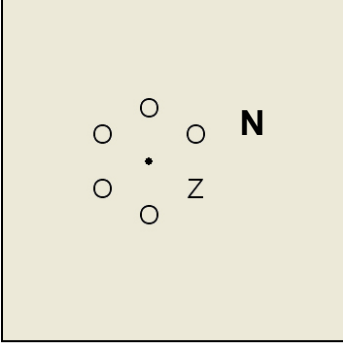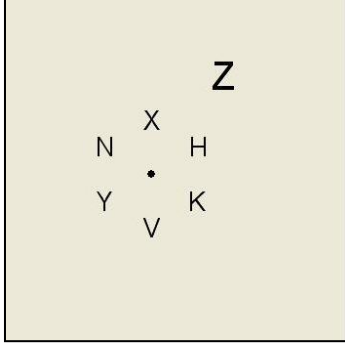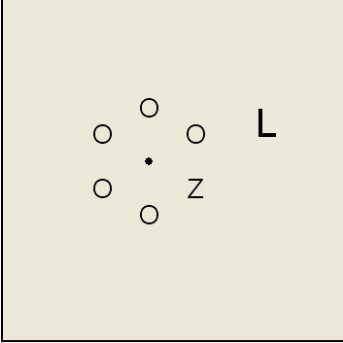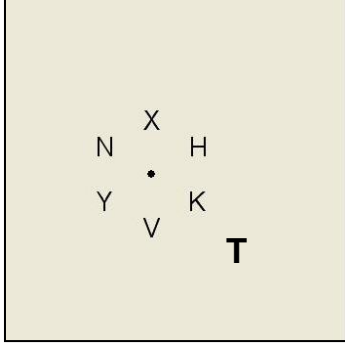# Distractor Interference (Accuracy: incomp minus neutral)
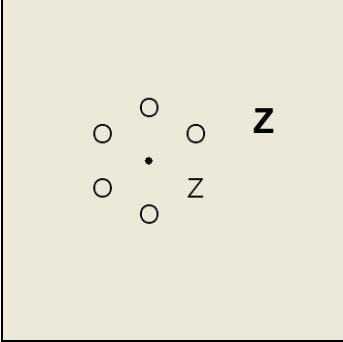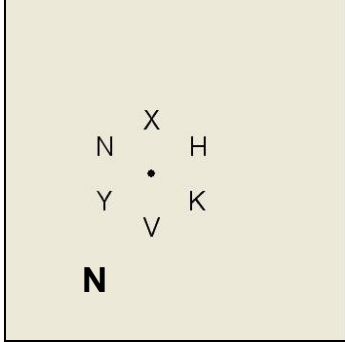

Exp. 2a (N and Z)

Exp. 2b (N and X)

Experiment 2a and 2b: Discussion

➤ Is it possible that the mere existence of peripheral circle in some of the experimental trials interferes with the selection processes and influences the results?

Experiment 3: Back to Lavie and Cox (1997)

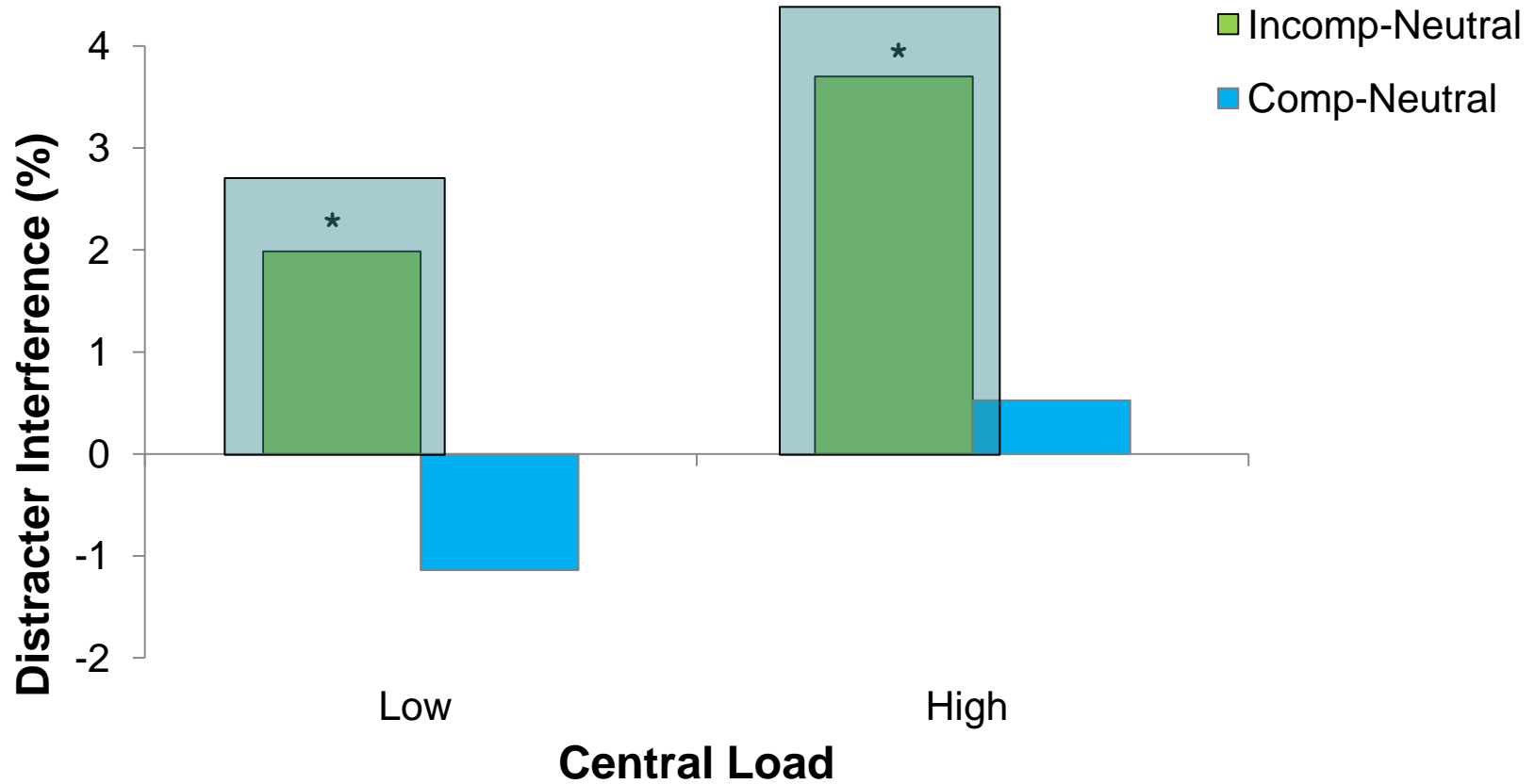| Distractor compatibility	Low Load	High Load
Incompatible		
Neutral		
Compatible		

Experiment 3: Results
Distractor Interference (RTs)
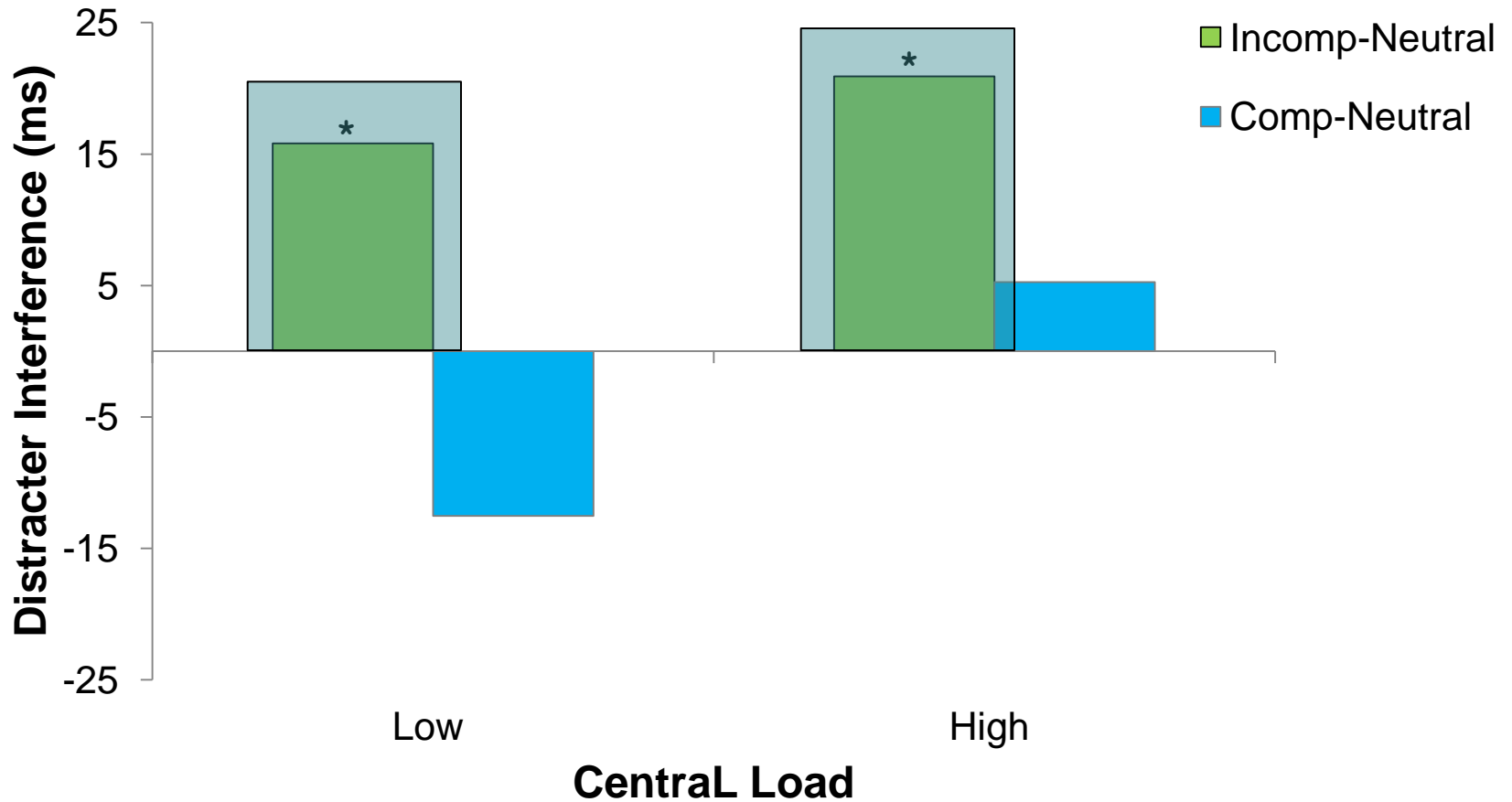
Experiment 3: Results
# Distractor Interference (Accuracy)

Experiment 3: Discussion

➢ These results indicate that interference under high load was not due to the presence of the peripheral load.
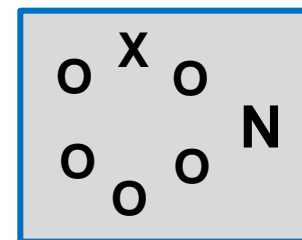
Experiment 3: Discussion
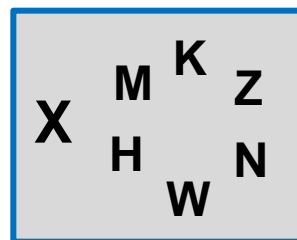
➢ The main difference between Experiment 3 and Lavie and Cox (1997) is:

▪ In Experiment 3 the critical distractor could be located in one of **ten** possible locations around a circle.
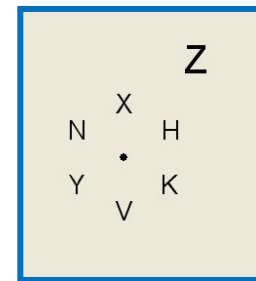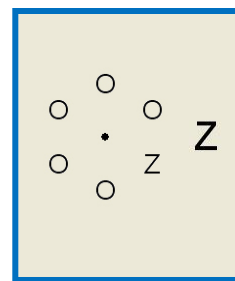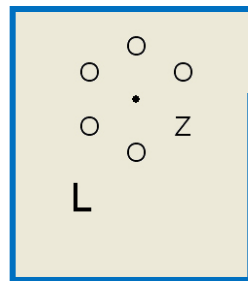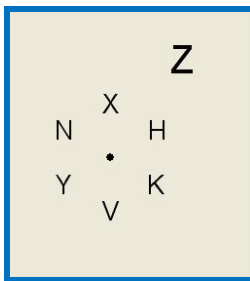
▪ In Lavie and Cox (1997) – the critical distractor could be located only in one of **two** possible locations: to the right or to the left.
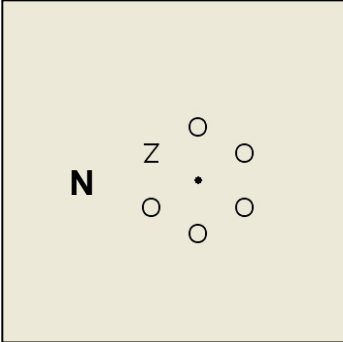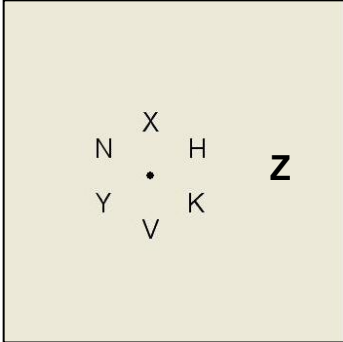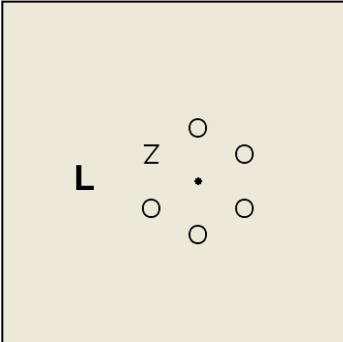
Experiment 3: Discussion

Ten Vs. two possible locations

?

Experiment 4: Back to Lavie and Cox (1997)
2 possible distractor's locations

Distractor compatibility	Low Load	High Load
Incompatible		
Neutral		
Compatible		

Experiment 4: Results
Distractor Interference (RTs)

Experiment 4: Results
Distractor Interference (Accuracy)
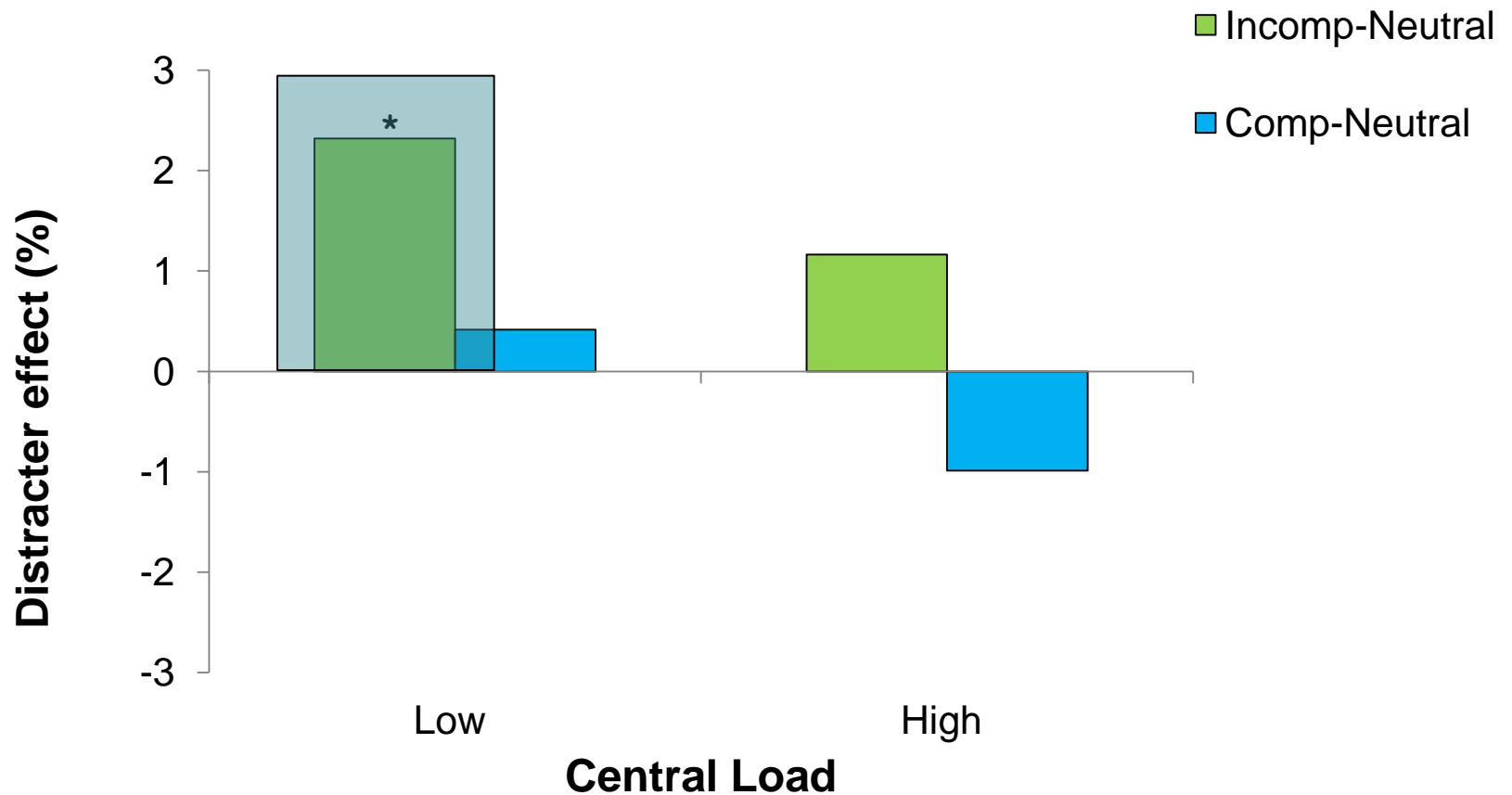
General Discussion
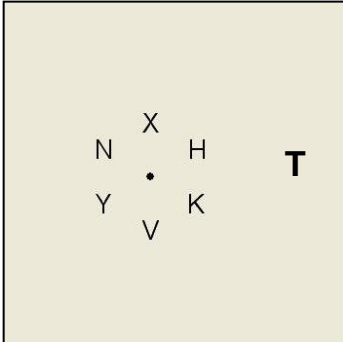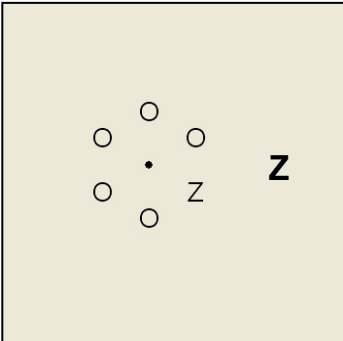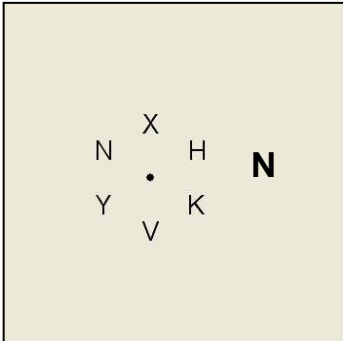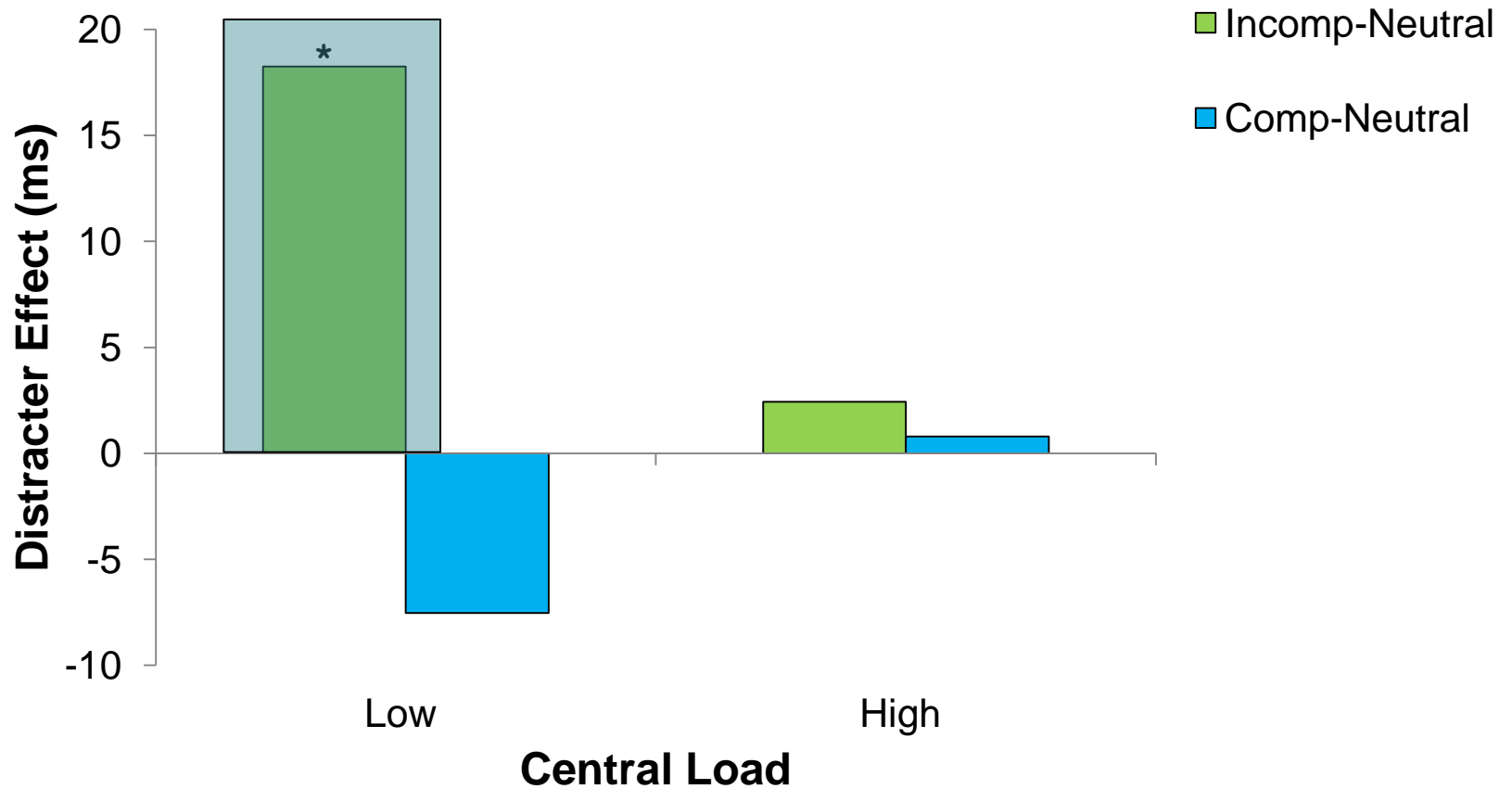
Spatial uncertainty

➤ When the distractor could appear in one of ten possible locations there is a large uncertainty regarding its spatial position.
When there are only two possible locations this uncertainty is greatly reduced.

➤ The results suggest that the ability to ignore irrelevant distractor depends on this spatial uncertainty.

➤ This implies that the selective process might be more active than originally suggested by the load model.

General Discussion

<u>Our suggestions</u>

➢ The selective process might reflect an active inhibition of the distractor that is strategically activated in the more demanding conditions (high load).

- ▪ This inhibition can be efficiently applied if the spatial uncertainty regarding the distractor location is low.

- ▪ Under higher spatial uncertainty it becomes hard or impossible to implement this inhibition.

- ▪ Under low load levels, there is no need to apply active inhibition: the task can be accomplished to a reasonable degree even if the distractor is perceived.

Implications to driving

Implications to driving

Thanks for your attention!!