Perceptual and Working Memory Deficits in Unilateral Neglect

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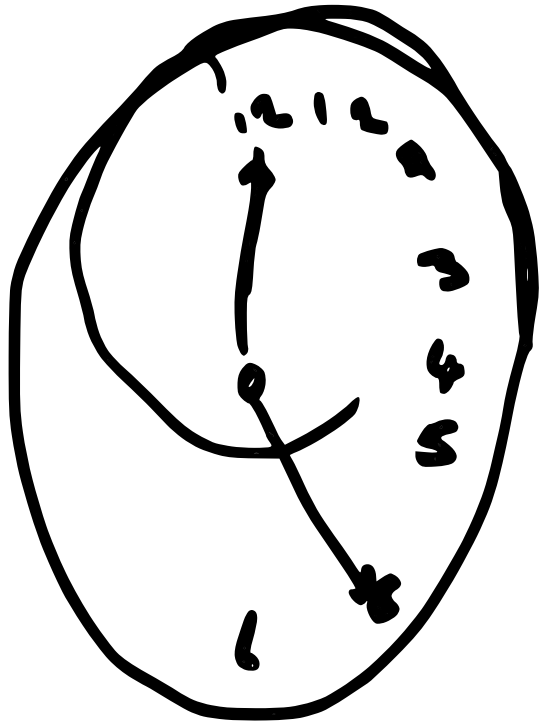
Unilateral Neglect

- Typically results from damage to the right inferior parietal or superior temporal cortex.
- Inability to respond to the left side of space.



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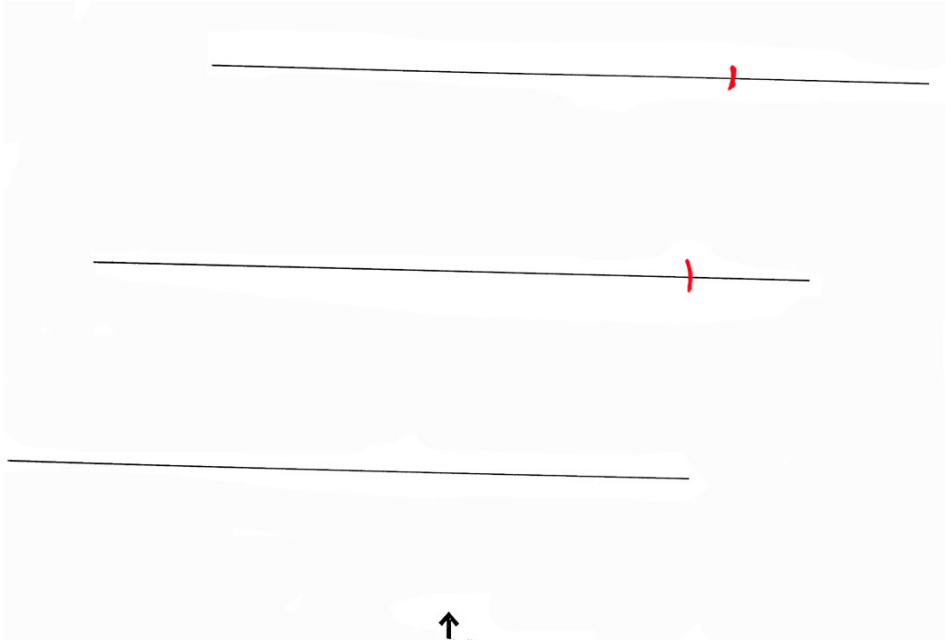
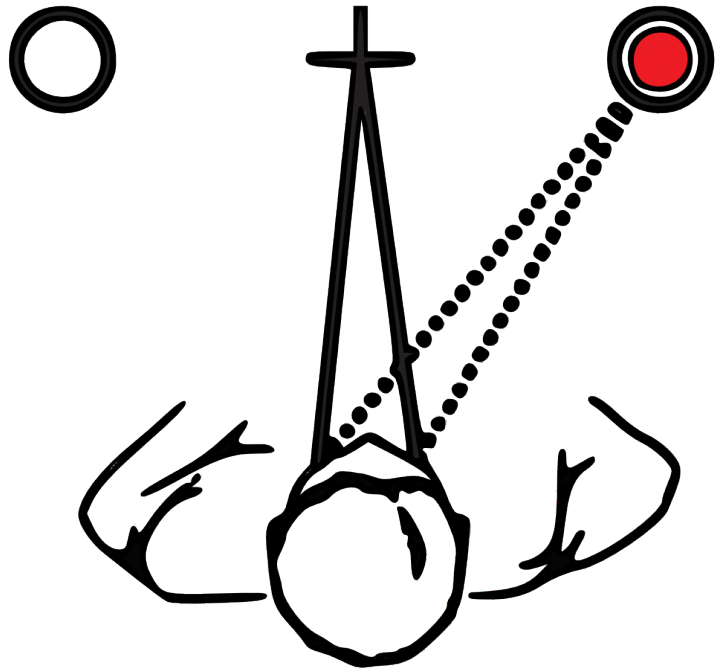


Neglect as a Lateralized Disorder of Attention

- Preferential orienting rightward
- Delayed re-orienting leftward.



Impaired Perceptual Representation as a Key Component of Neglect

Perceptual deficits:

Chimeric face perception

Perceptual judgment of spatial extent.
("Landmark Task")

Working Memory deficits:

- Spatial Working Memory in Right Space.

Possible Explanations of Observed Working Memory (WM) deficits

1. WM intact, but WM tasks influenced by attention deficits.
2. WM intact, but degraded when it needs access to spatial attention for rehearsal.
3. WM impaired by neglect-inducing parietal lesion

Possible Explanations of Observed Working Memory (WM) deficits

1. WM intact, but WM tasks influenced by attention deficits.
2. WM intact, but degraded where it would normally accesses spatial attention for rehearsal.
3. WM impaired by neglect-inducing lesion.

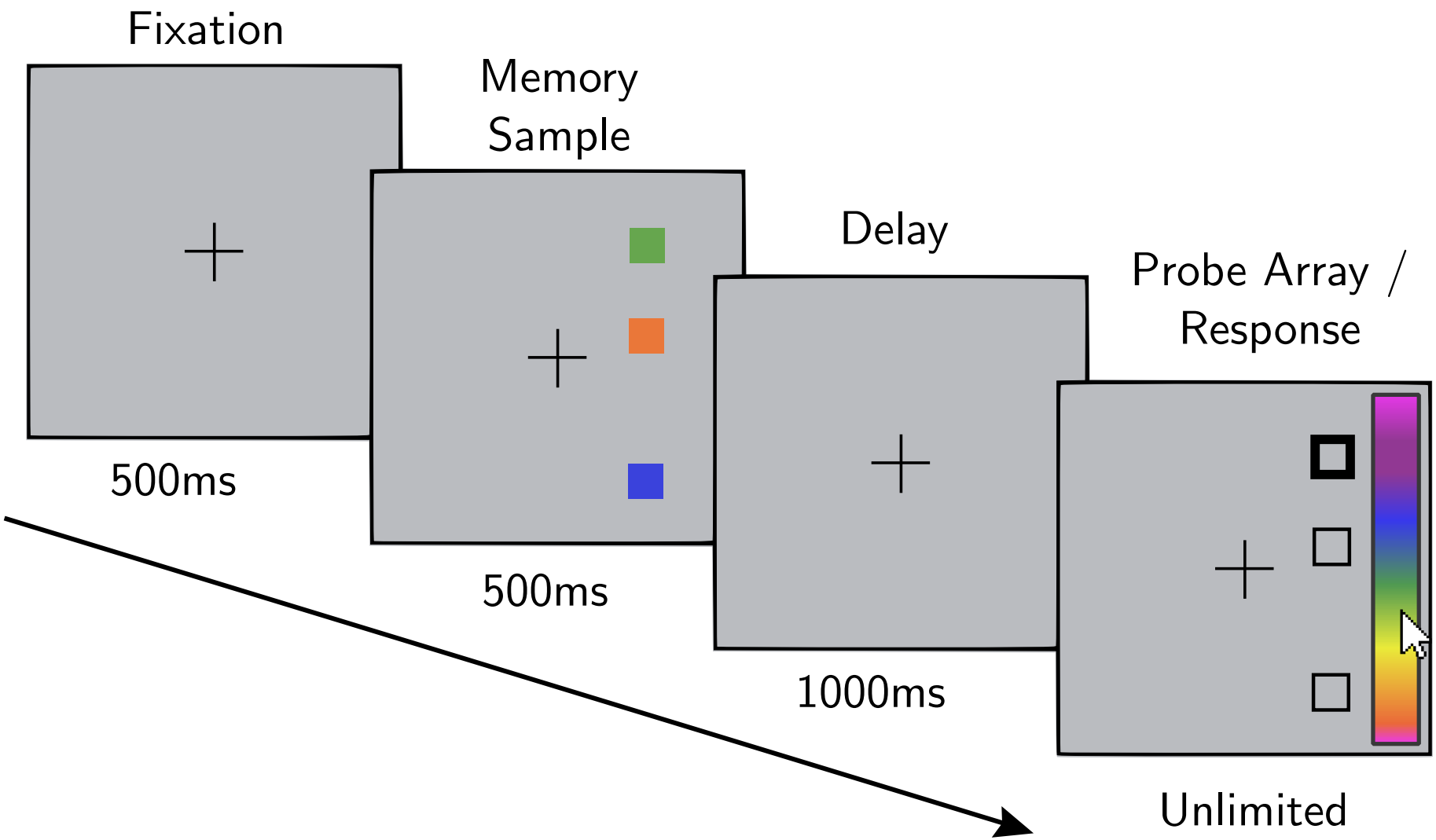
Experiment 1: WM deficits or Rehearsal Failure?

1. Examine non-spatial "visual" WM and compare with attention
2. Prism Adaptation and Perceptual Representation
3. Saccadic Adaptation for Action and Perception

Participants and Procedure

- 8 RBD neurological patients, demonstrating Neglect in pre-testing.
- 8 healthy older controls + 9 healthy young adults on first task only
- "Visual" Working Memory and Covert Attention.

Visual Working Memory Task



Response Model Calculations

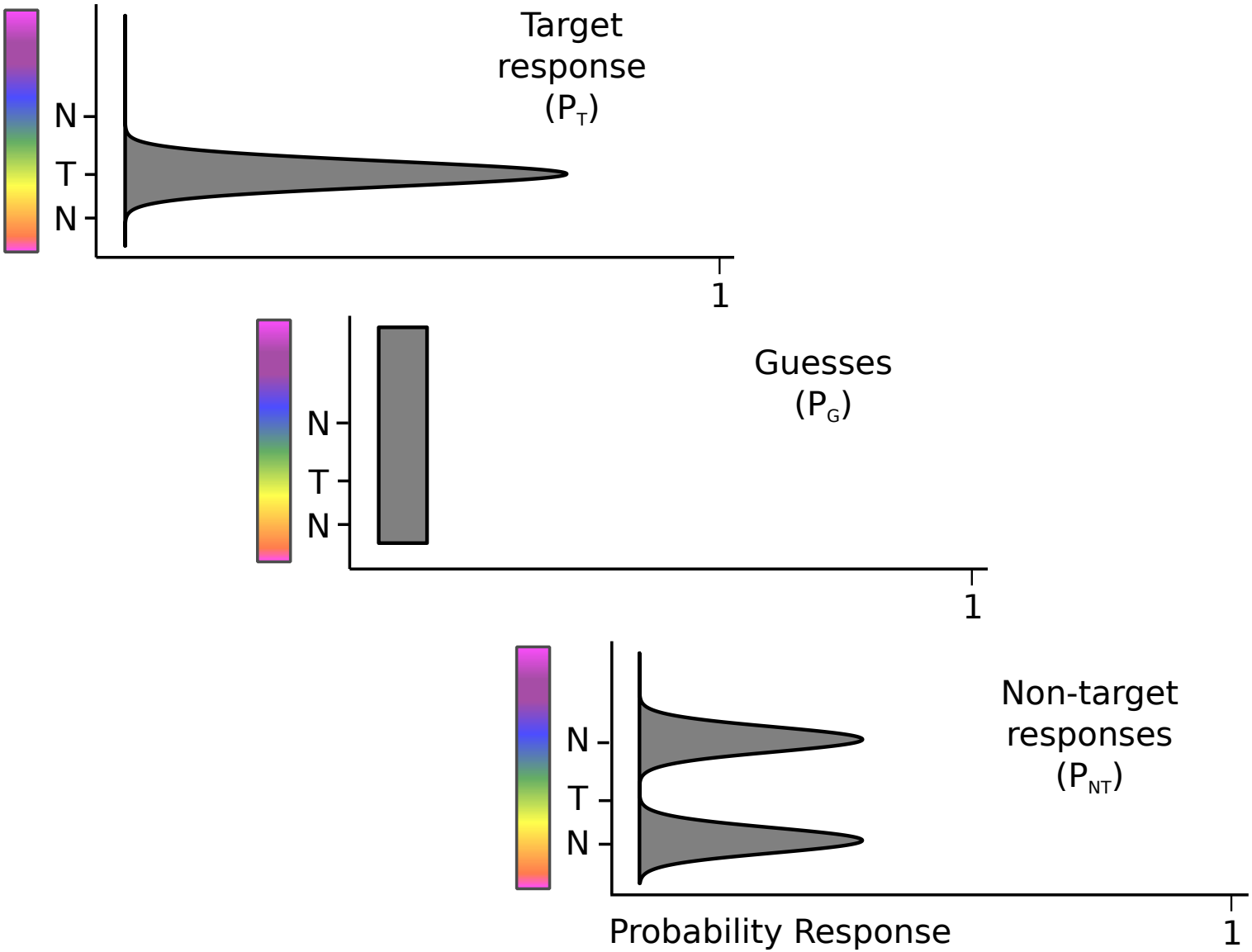


Figure 2.4

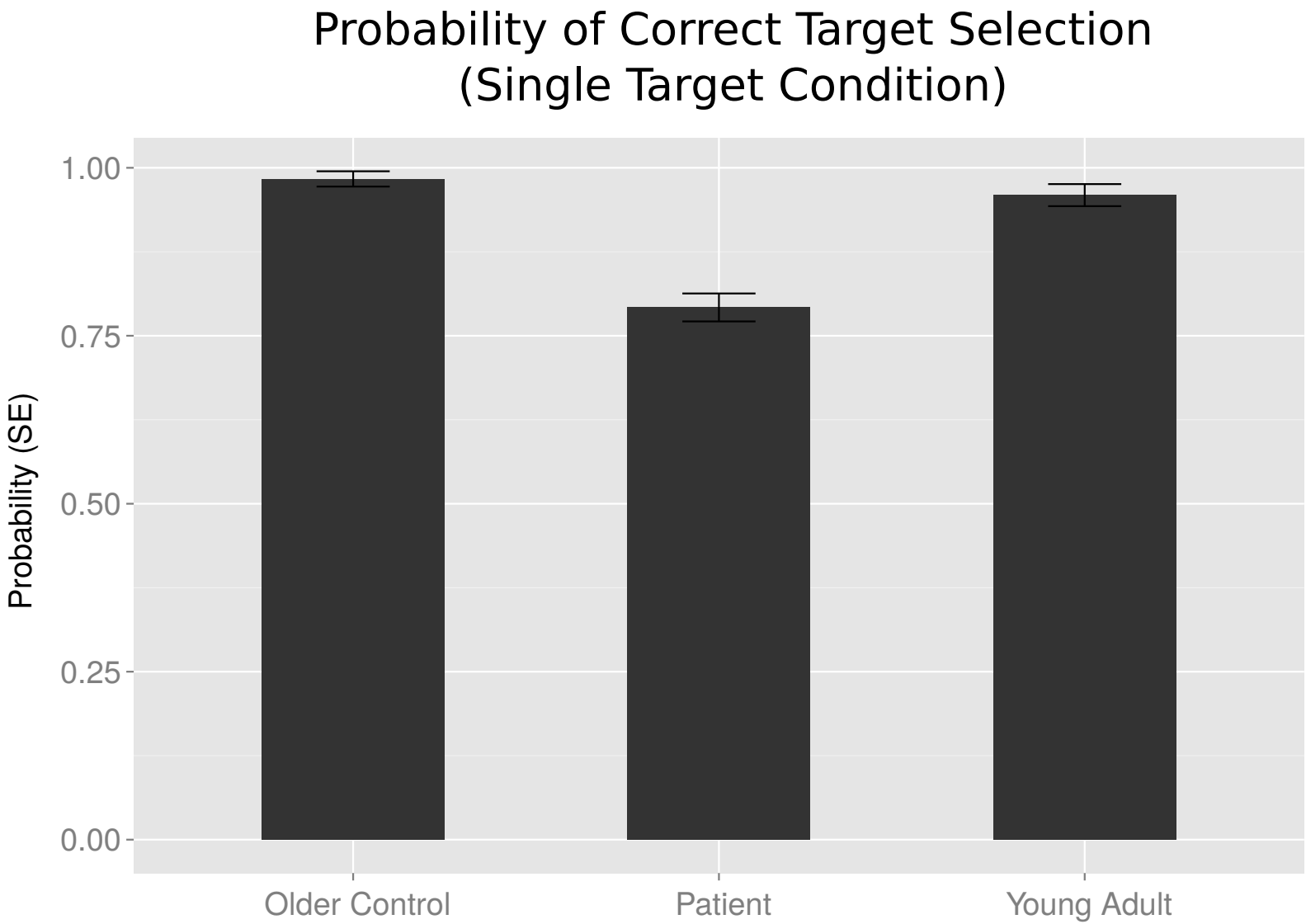
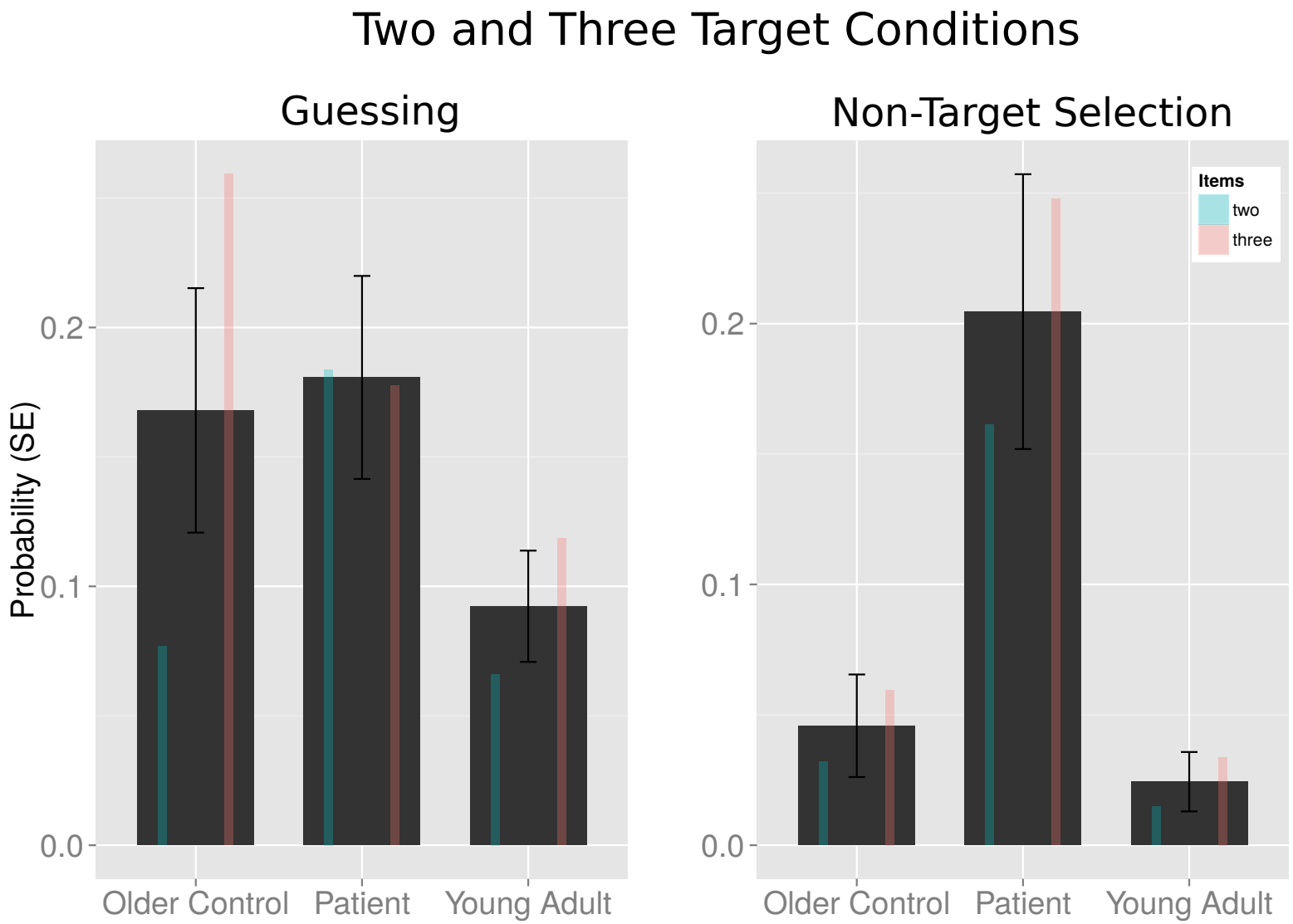

Probability of Correct Target Selection
(Single Target Condition)
Probability (SE)
1.00
0.75
0.50
0.25
0.00
Older Control
Patient
Young Adult

Figure 2.5


Two and Three Target Conditions
Guessing
Non-Target Selection
Probability (SE)
0.0
0.1
0.2
Older Control
Patient
Young Adult
Items
two
three

Covert Orienting Task

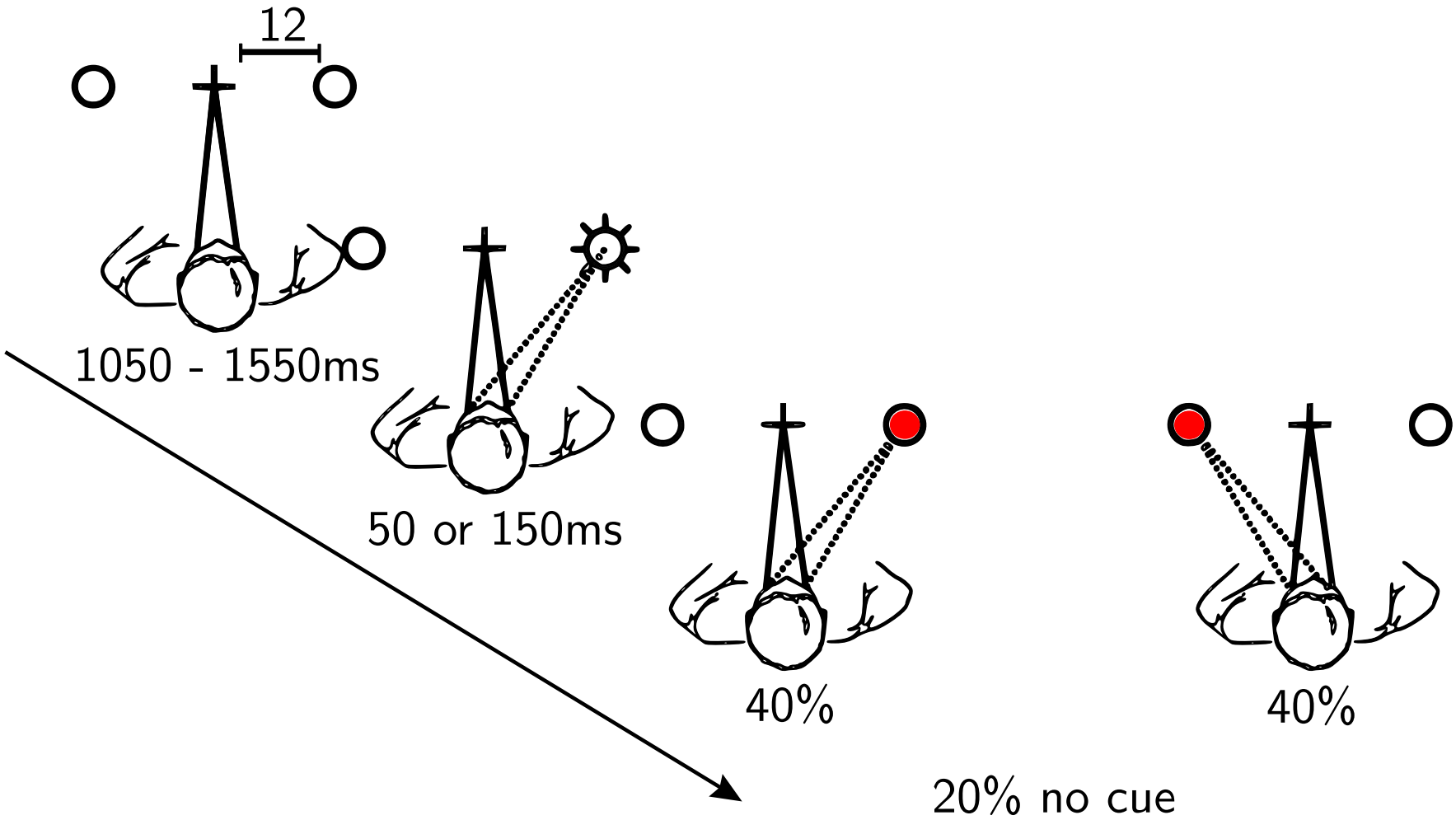
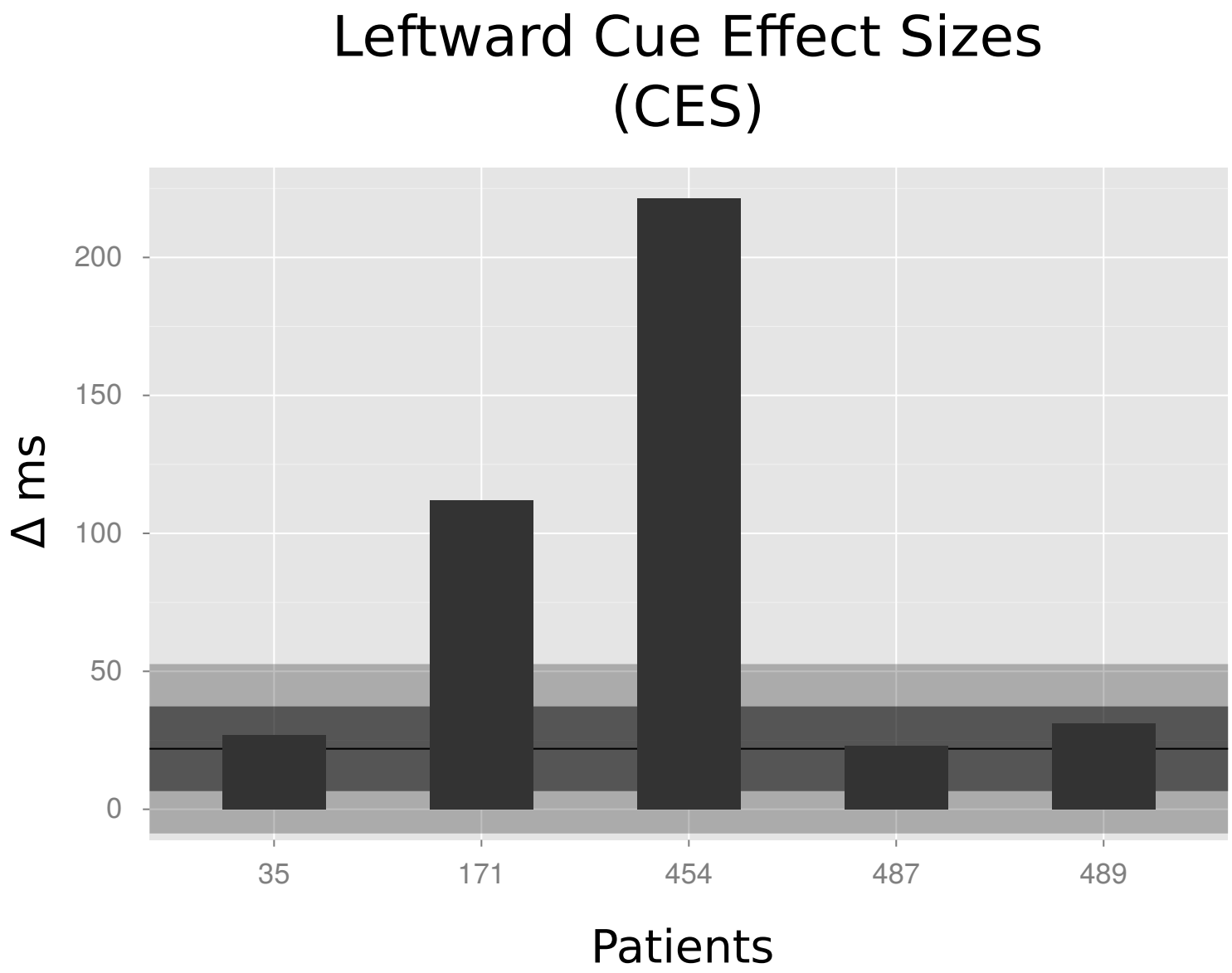


Figure 2.6


Leftward Cue Effect Sizes
(CES)
Δ ms
200
150
100
50
0
35
171
454
487
489
Patients

Comparison

- P_G significantly describes group differences, partialled on CES (and P_{NT}, Deviance$(12) = 12.44$, p < 0.001)

Recovery of Attention and Perceptual Representations

If perceptual representation deficits are independent of spatial attention, *then* treatment of spatial attention will not improve perceptual representation

Prism Adaptation

- 10° rightward shifting prisms.
- Alternate pointing to left and right table-top targets for 5 minutes.

Prism Adaptation Improves of (re)orienting, but Produces Limited Change in Perceptual Awareness

- Prisms improve leftward re-orienting
- Perception of spatial extent and chimeric faces provide evidence of limited change in awareness.

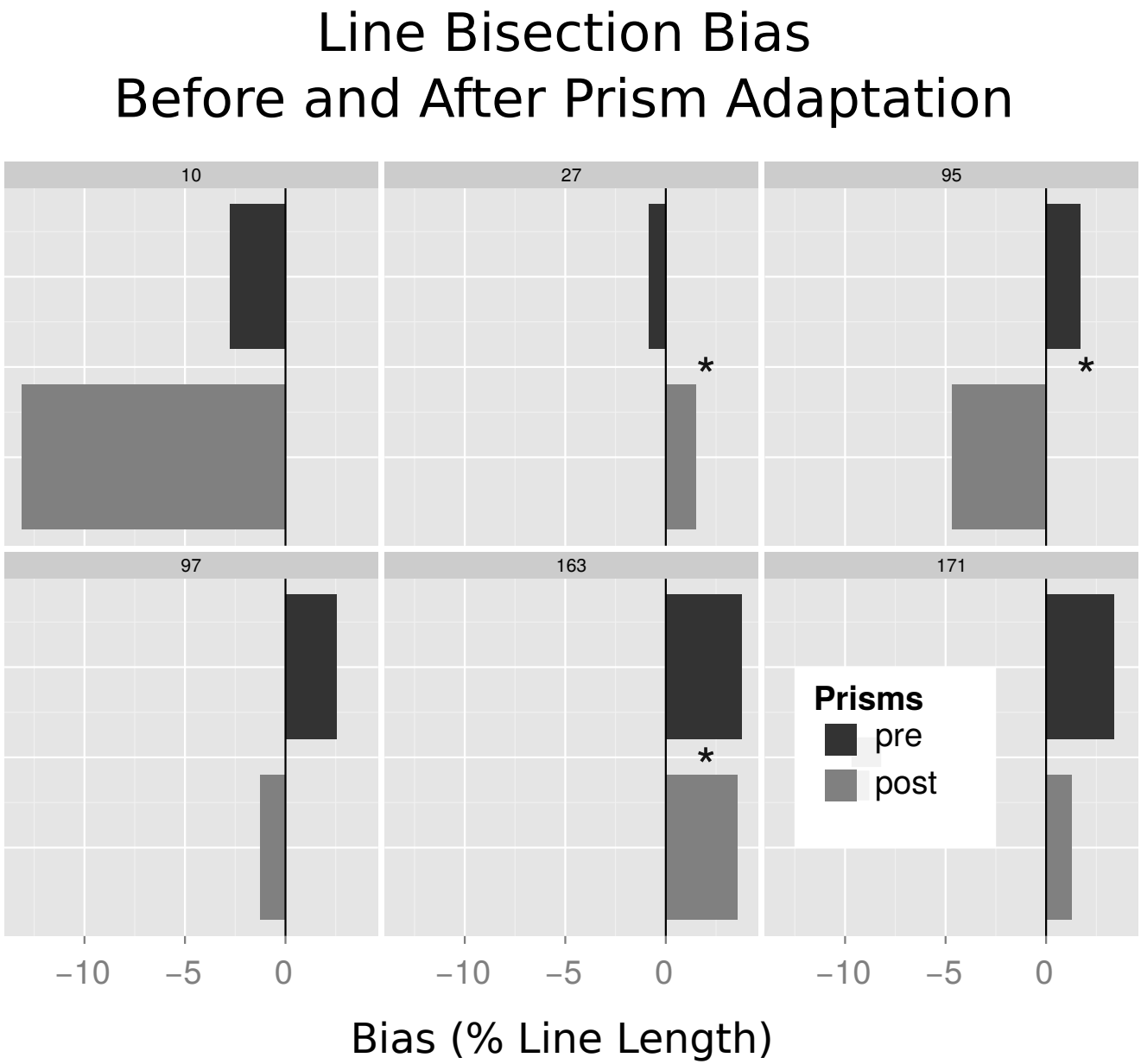
Experiment 2: Does treatment of attention deficits influence perceptual representations?

1. Examine non-spatial "visual" WM and compare with attention
2. Prism Adaptation and Perceptual Representation
3. Saccadic Adaptation for Action and Perception

Participants and Procedure

- 6 RBD neurological patients who demonstrated neglect in pre-testing.
- Line Bisection, Spatial Working Memory, and Time Estimation.

Figure 3.4


Line Bisection Bias
Before and After Prism Adaptation
10
27
95
97
163
171
*
*
*
Prisms
pre
post
−10
−5
0
Bias (% Line Length)

Spatial Working Memory Task

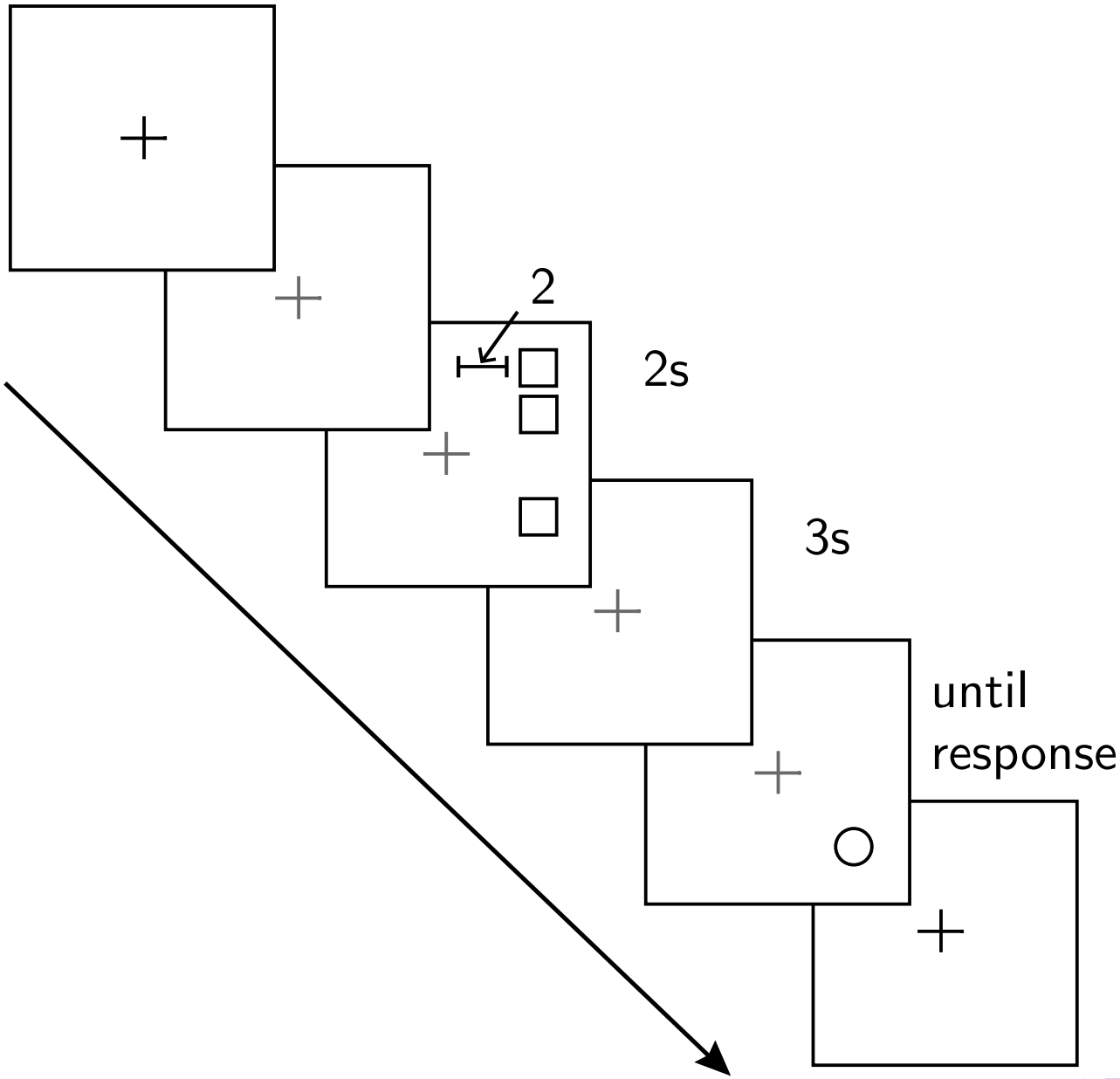
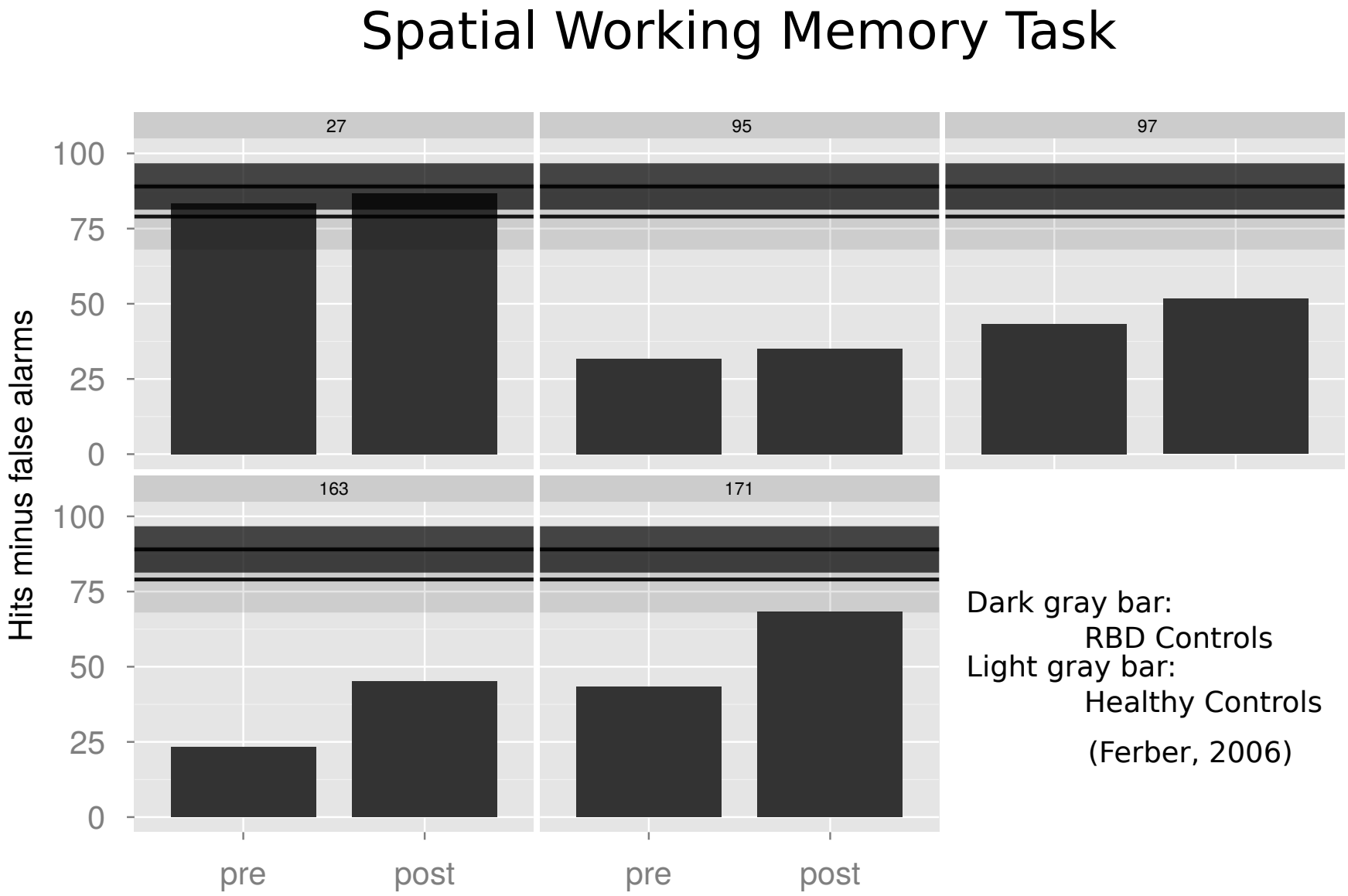


Figure 3.2


Spatial Working Memory Task
27
95
97
163
171
Hits minus false alarms
100
75
50
25
0
pre
post
Dark gray bar:
RBD Controls
Light gray bar:
Healthy Controls
(Ferber, 2006)

Temporal Estimation Task

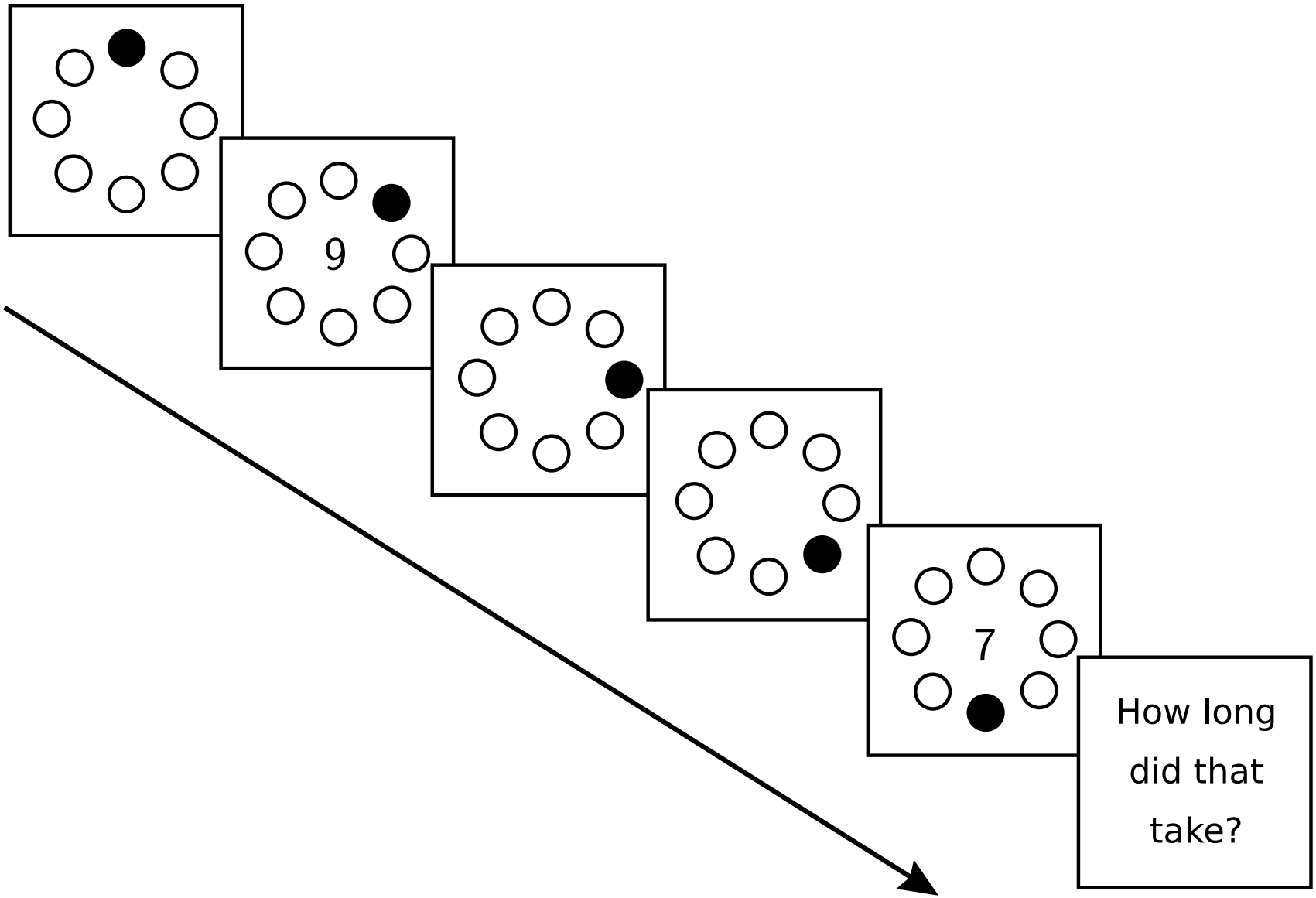
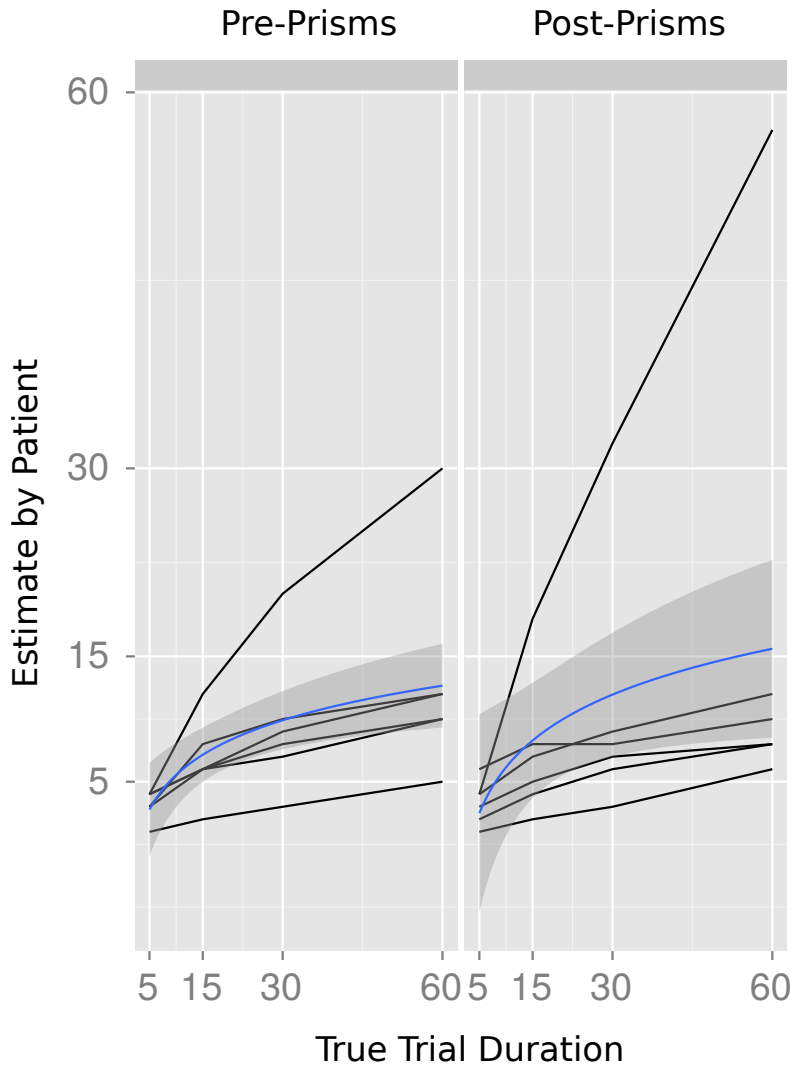


Figure 3.3: Temporal Estimation Across Intervals



Prisms are not influencing perceptual representations, so what will?

Saccadic adaptation is similar to prism adaptation, but produces subtle effects on perception in healthy populations.

- Motion Sensitization
- Target Mislocalization
- Perception of Spatial Extent

Experiment 3: Does Saccadic Adaptation influence perceptual representations?

1. Examine non-spatial "visual" WM and compare with attention
2. Prism Adaptation and Perceptual Representation
3. Saccadic Adaptation for Action and Perception

Participants and Procedure

- 37 young adults.
- Baseline Line Bisection (LB) and Landmark Task (LT).
- Up to 4 blocks of Saccadic Adaptation + LB and LT.

Saccadic Adaptation

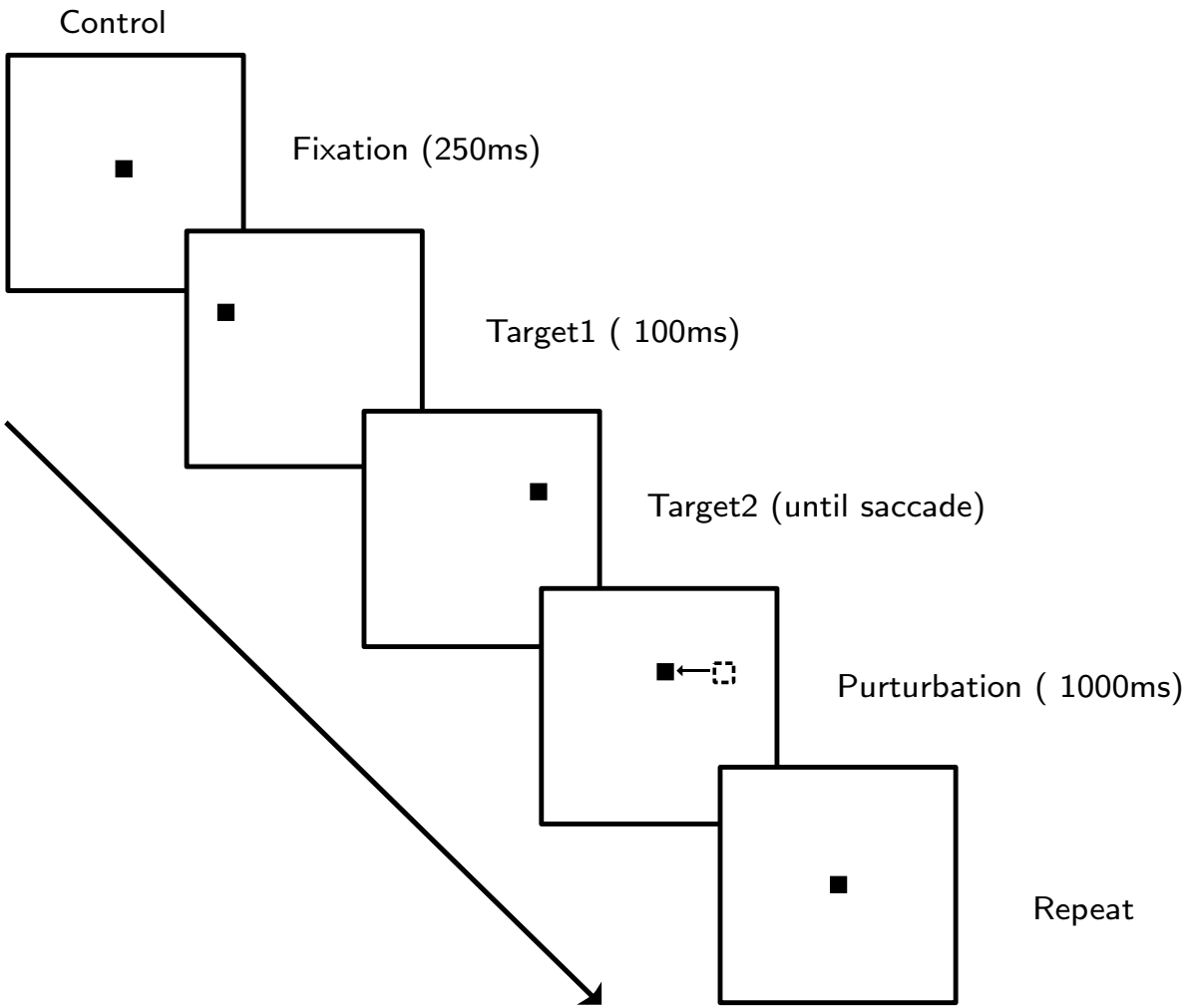
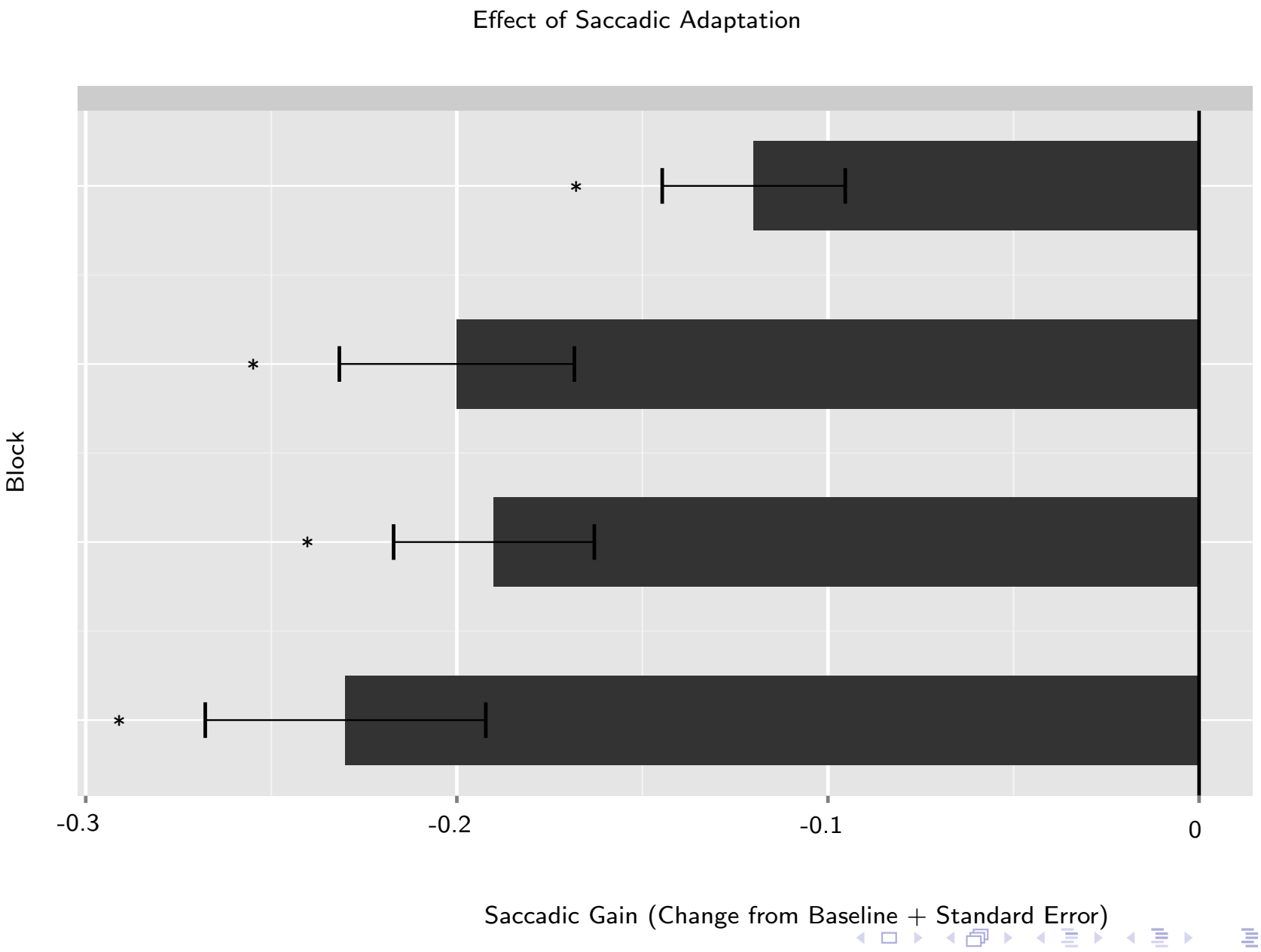
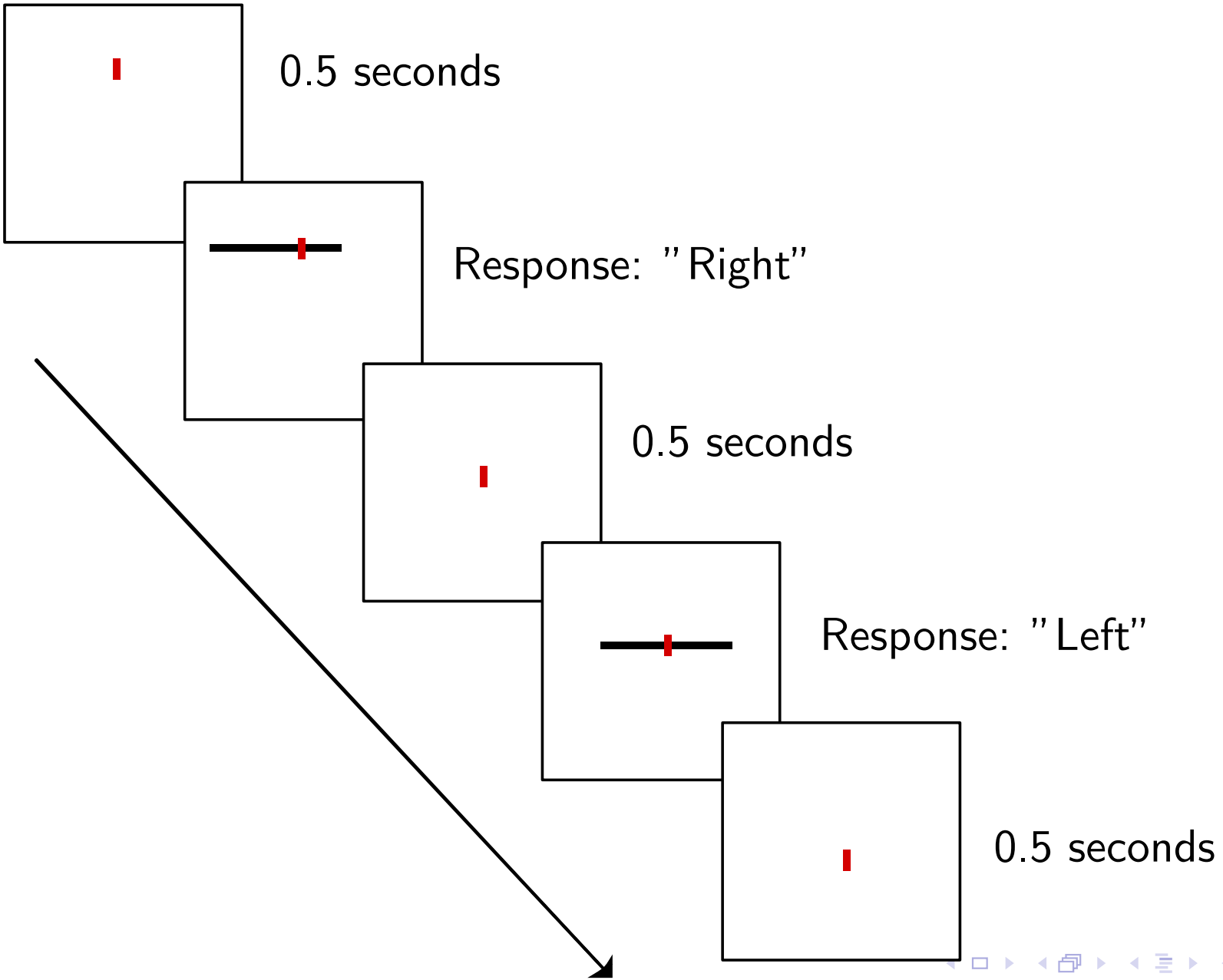


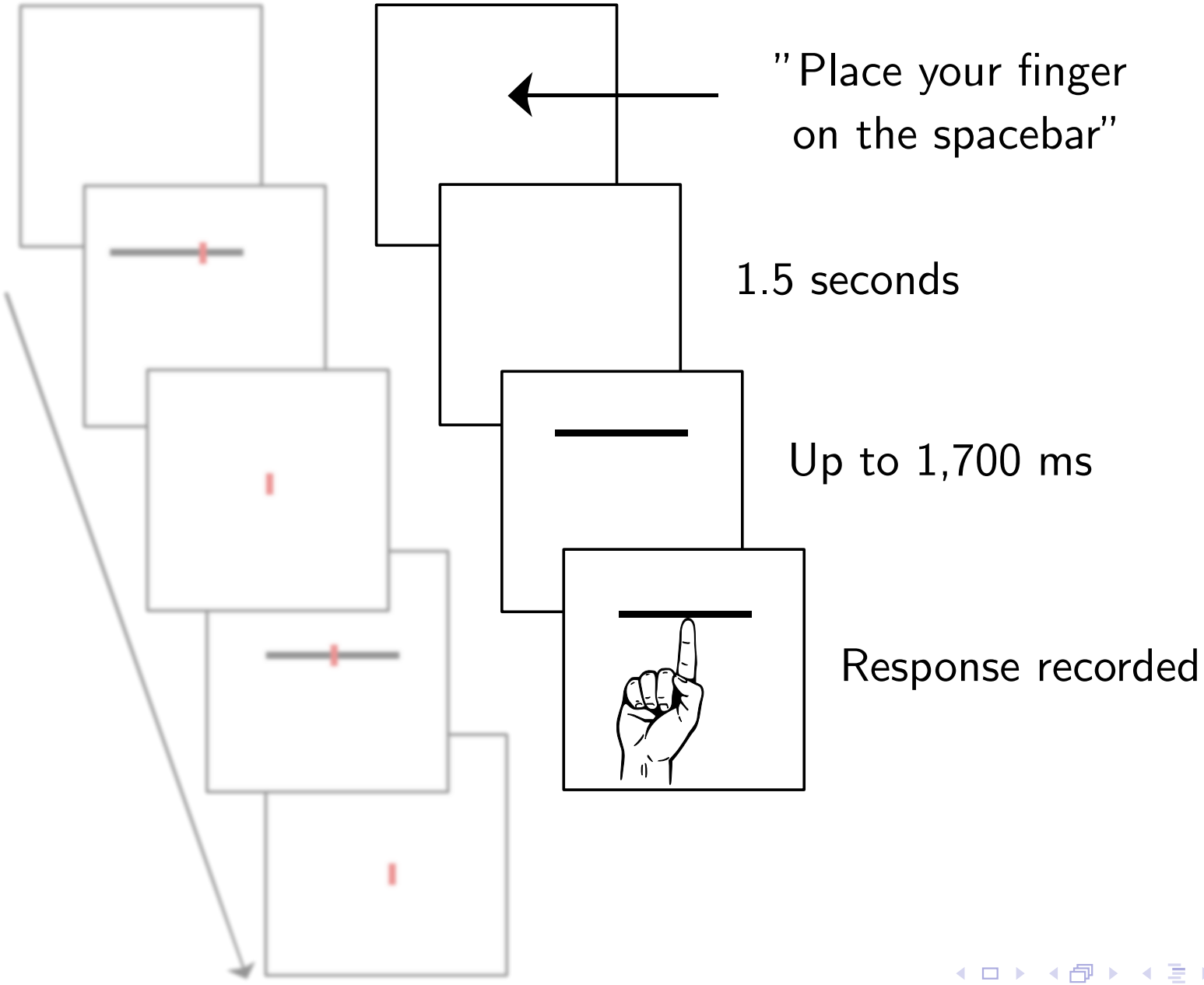
Figure 4.4: Effect of Saccadic Adaptation



Landmark Task



Line Bisection Task



Impact on Line Bisection (LB) and Landmark Task (LT)

- Two tasks were not correlated ($r = -0.03$, $p = 0.1$)
- No measurable chance in either LB or LT post prisms.
- "Strong adapters" also showed no change.

Overall Conclusions

- WM deficits appear to be independent of lateralized attention deficits in neglect.
- Perceptual representations, more generally, may be uninfluenced by changes in those lateralized attention deficits.
- More research is needed to examine saccadic adaptation as a possible method to influence those perceptual representations.

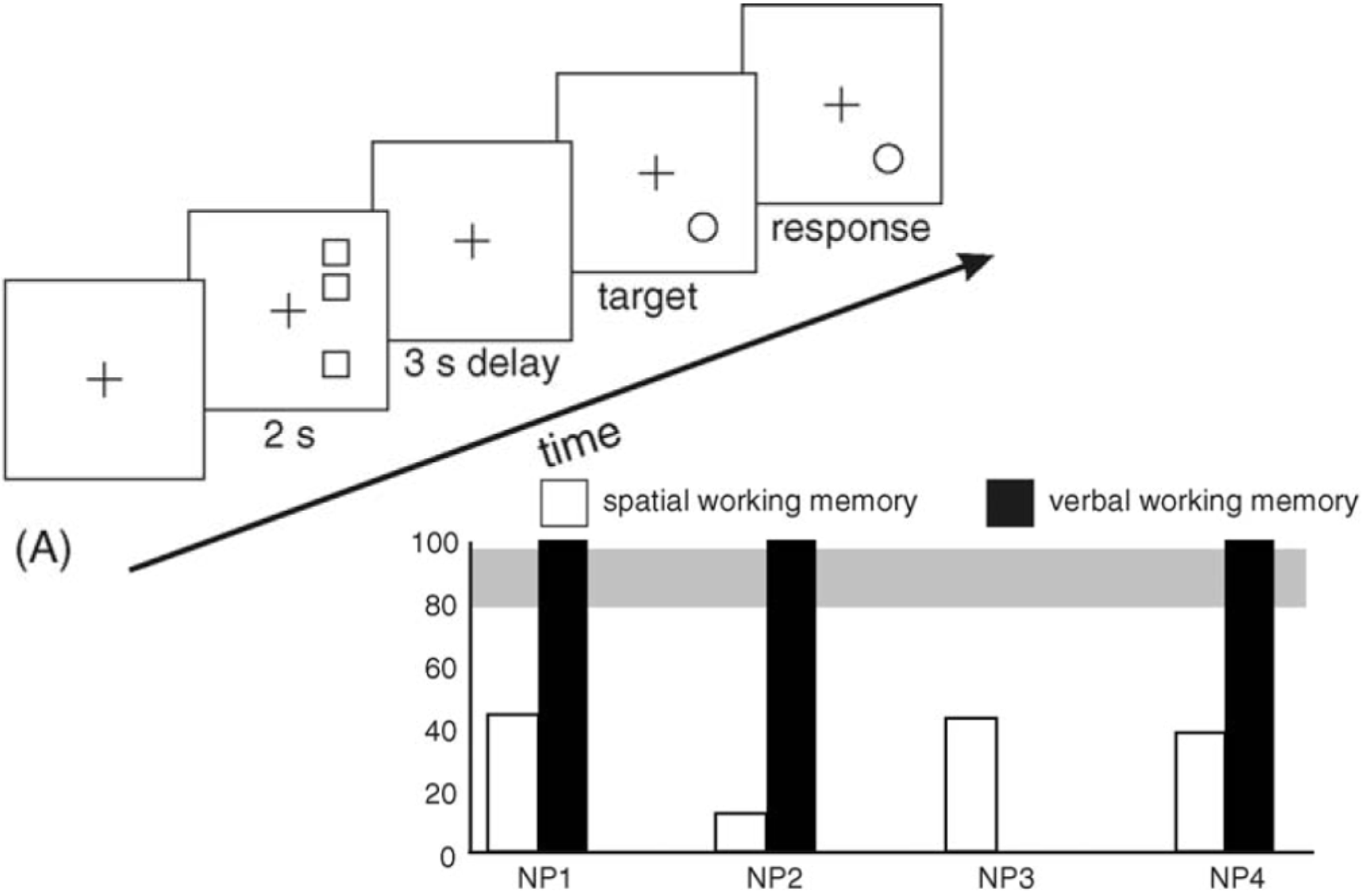
Future Directions

- Improve SA procedure, possibly with whole-field Adaptation
- If successful, compare the two in a neglect population.

Acknowledgements

Dr. James Danckert
DAAG lab,
funding agencies, etc.

Spatial Working Memory



(Danckert & Ferber 2006)

Table 2.1

	Age	Sex	Handedness	CES	VWM(1)	VWM(2/3)	Stars	Copying	Bisection
487	61	F	Right	23.0	0.15	0.04	0	+	2.2
35	51	F	Right	27.0	0.15	0.04	17	+	0.1
489	66	M	Left	31.0	0.25	0.08	0	+	1.0
171	71	F	Left	112.0	0.13	0.00	0	-	1.4
454	70	M	Right	221.5	0.23	0.17	0	+	6.3
213	65	F	Right	NA	0.2	0.30	100	+	7.3
396	85	M	Right	NA	0.3	0.55	87	+	8.1
465	63	F	Right	NA	0.3	0.45	97	+	12.9

Figure 2.3

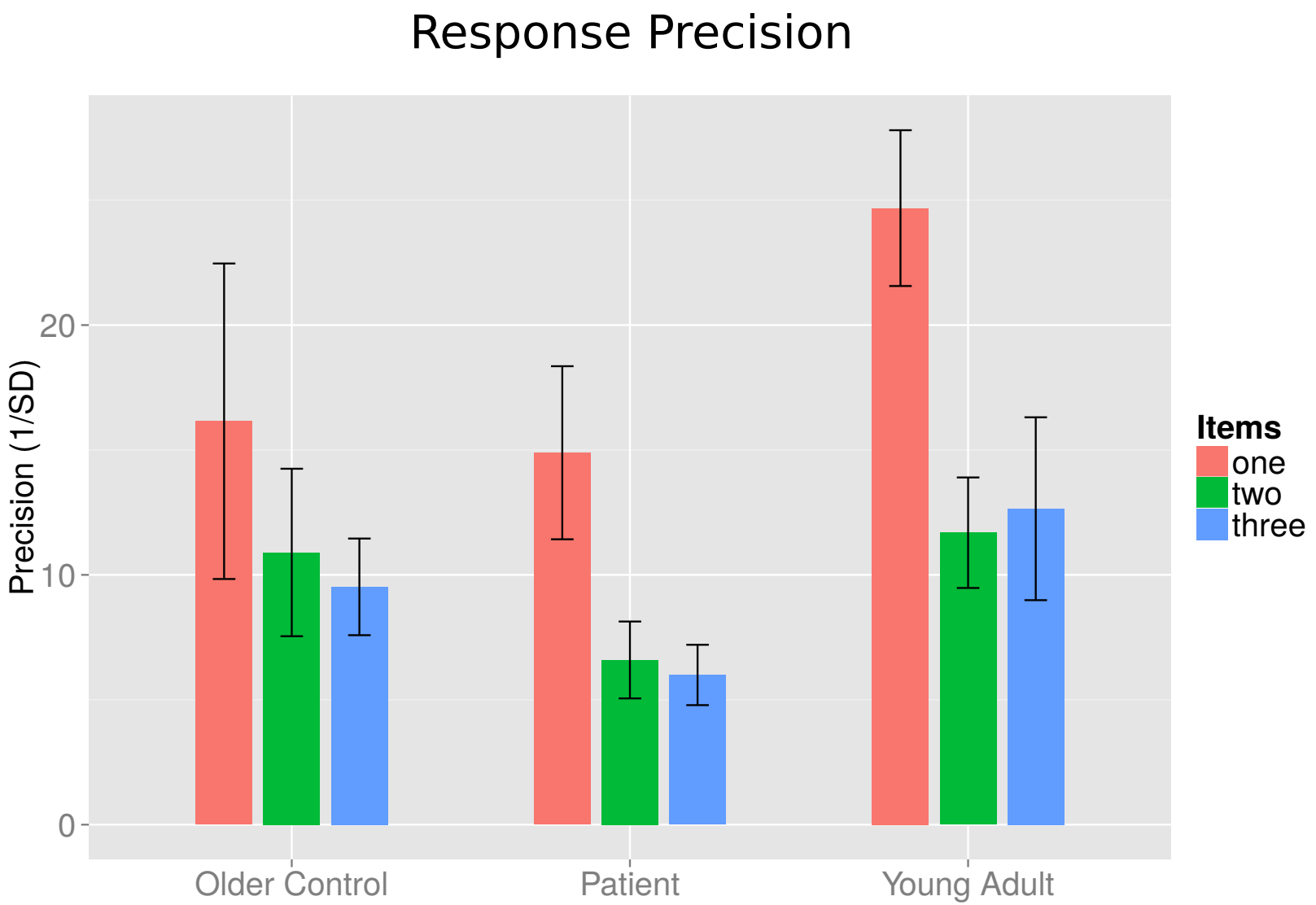

Response Precision
Precision (1/SD)
20
10
0
Older Control
Patient
Young Adult
Items
one
two
three

Table 2.2

	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)
NULL			15	22.18	
CES	1	8.62	14	13.56	0.0033
P_{NT}	1	1.12	13	12.44	0.2908
P_G	1	12.44	12	0.00	0.0004

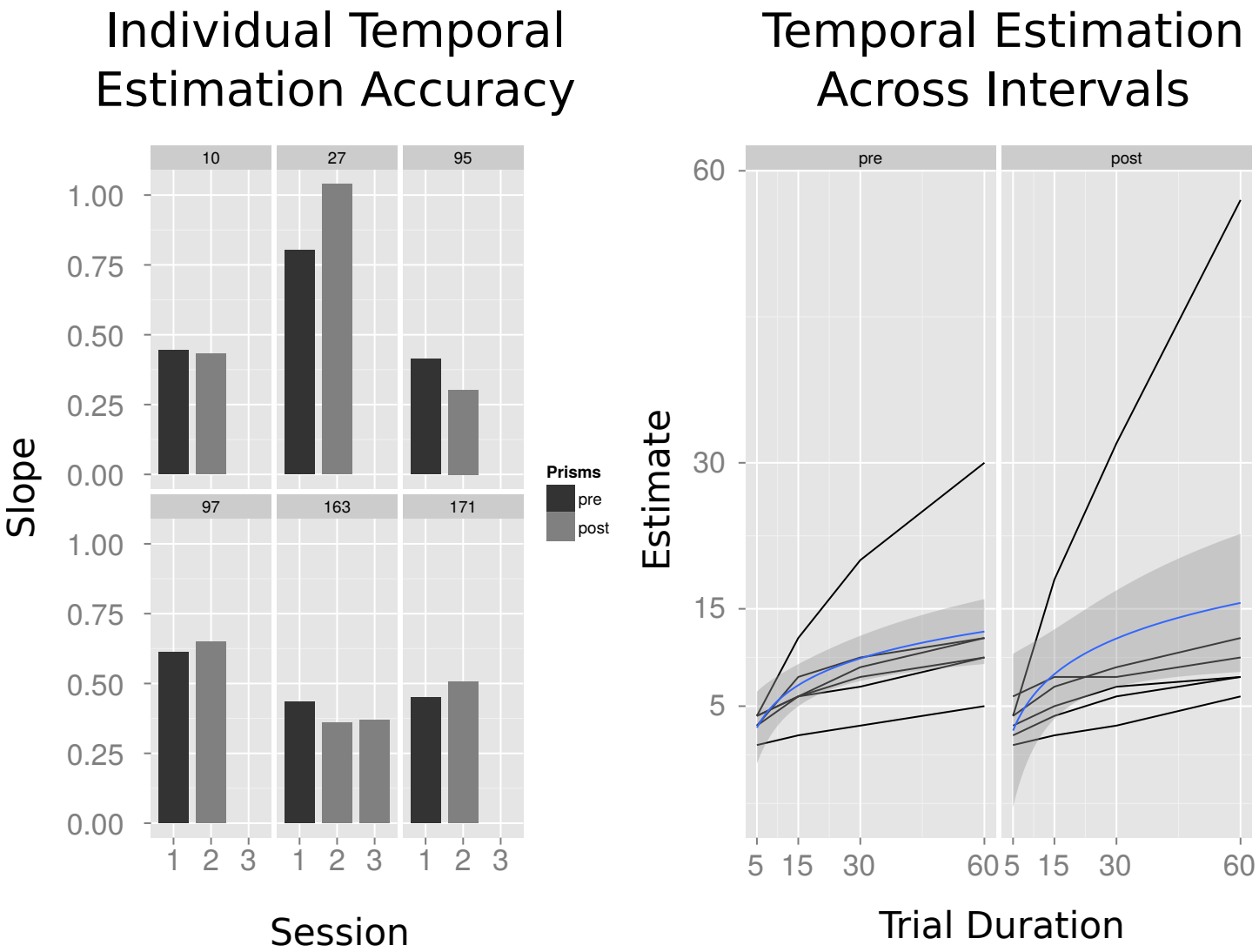
Table: Analysis of deviance table. Each row represents the change in deviance of the model with the addition of one term. Pr(>Chi) is the probability of obtaining a greater scaled deviance statistic than the observed under the null hypothesis (new term has true parameter of zero). Both CES and P_G result in statistically significant model improvement.

Table 3.1

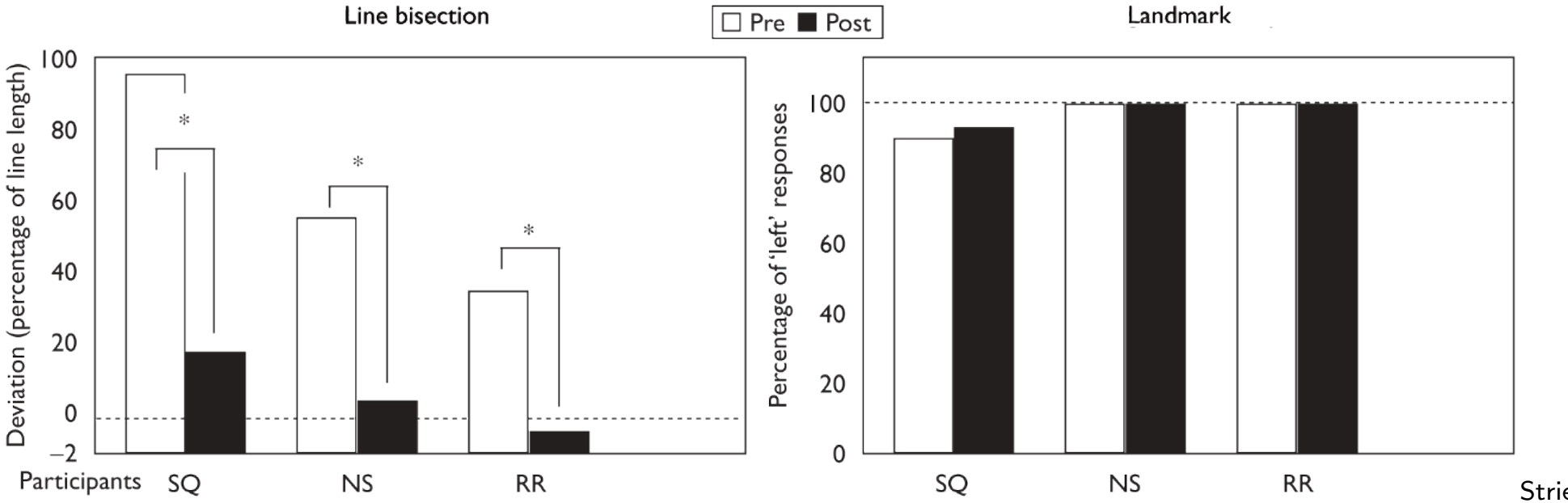
	Age	Sex	Handedness	Star(pre)	Star(post)	Bell(pre)	Bell(post)	Copy(pre)	Copy(post)
10	68	M	Right	93	87	100	89	+	+
27	43	M	Right	0	7	6	0	-	-
95	70	M	Right	7	0	33	39	+	+
163	68	F	Left	30	7	6	29	+	+
97	66	M	Right	0	0	0	0	-	-
171	71	F	Left	0	0	6	6	+	-

	LB(pre)	LB(post)	TE(pre)	TE(post)	SWM(pre)	SWM(post)
10	-0.80	-9.90	0.40	0.40		
27	-0.80	1.20	0.80	1.00	83.00	87.00
95	0.30	-3.80	0.40	0.30	32.00	35.00
163	0.90	4.90	0.40	0.40	23.00	45.00
97	1.90	-1.60	0.60	0.60	43.00	52.00
171	3.80	1.40	0.40	0.50	43.00	68.00

Figure 3.3


Individual Temporal Estimation Accuracy
10
27
95
97
163
171
Slope
1.00
0.75
0.50
0.25
0.00
1 2 3
Session
Prisms
pre
post
Temporal Estimation Across Intervals
pre
post
Estimate
60
30
15
5
5 15 30 60
Trial Duration

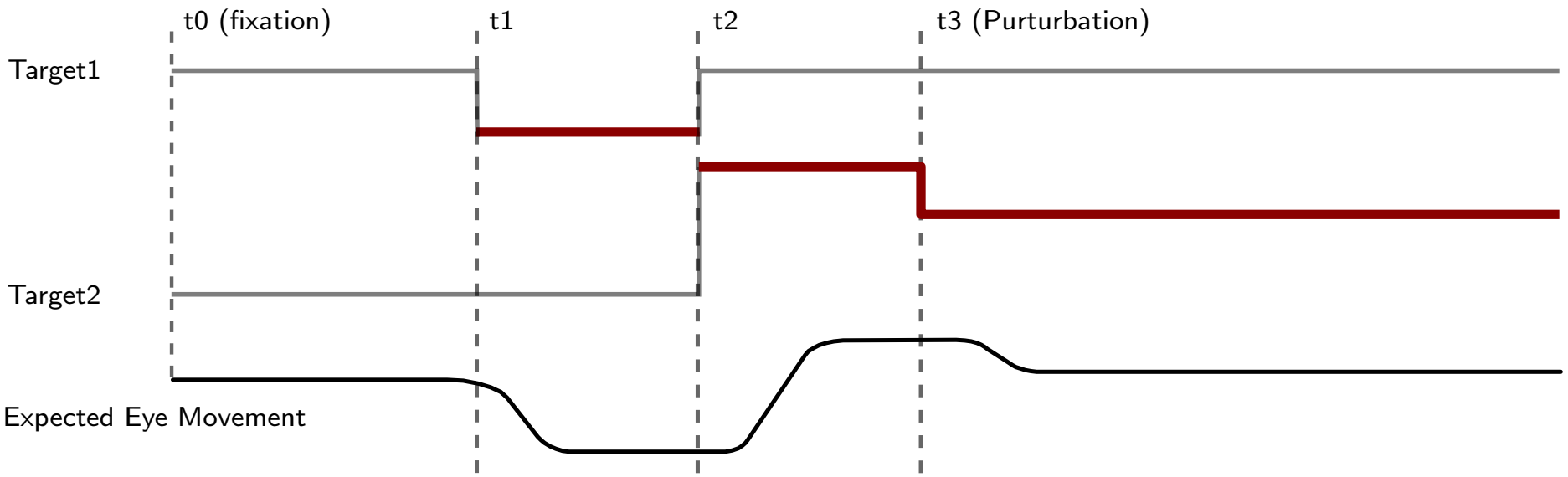
Landmark and Line Bisection Tasks



& Danckert 2010a

Saccadic Adaptation Event Time-line

Event Timecourse:



Analysis of an Example Saccade

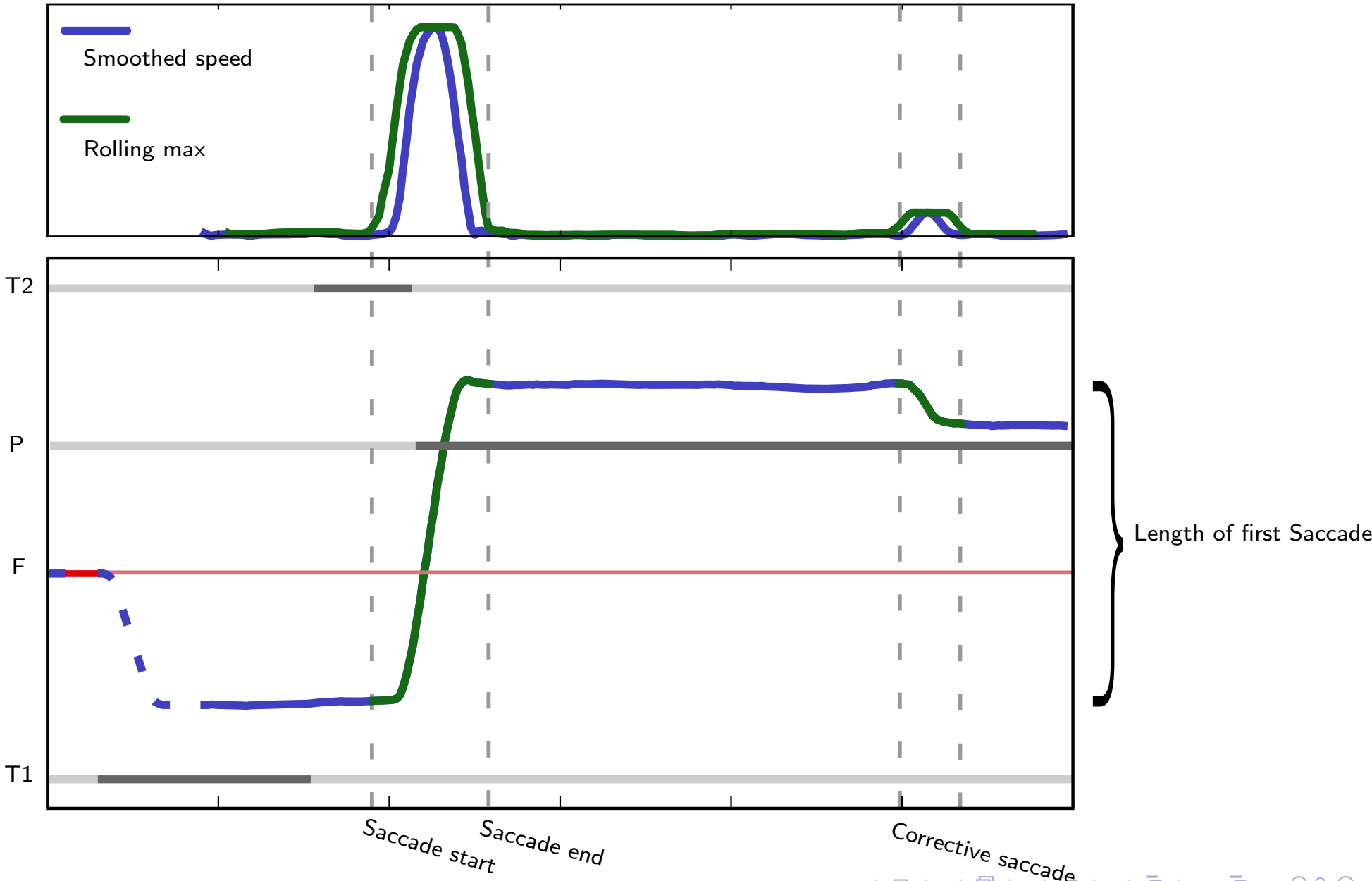
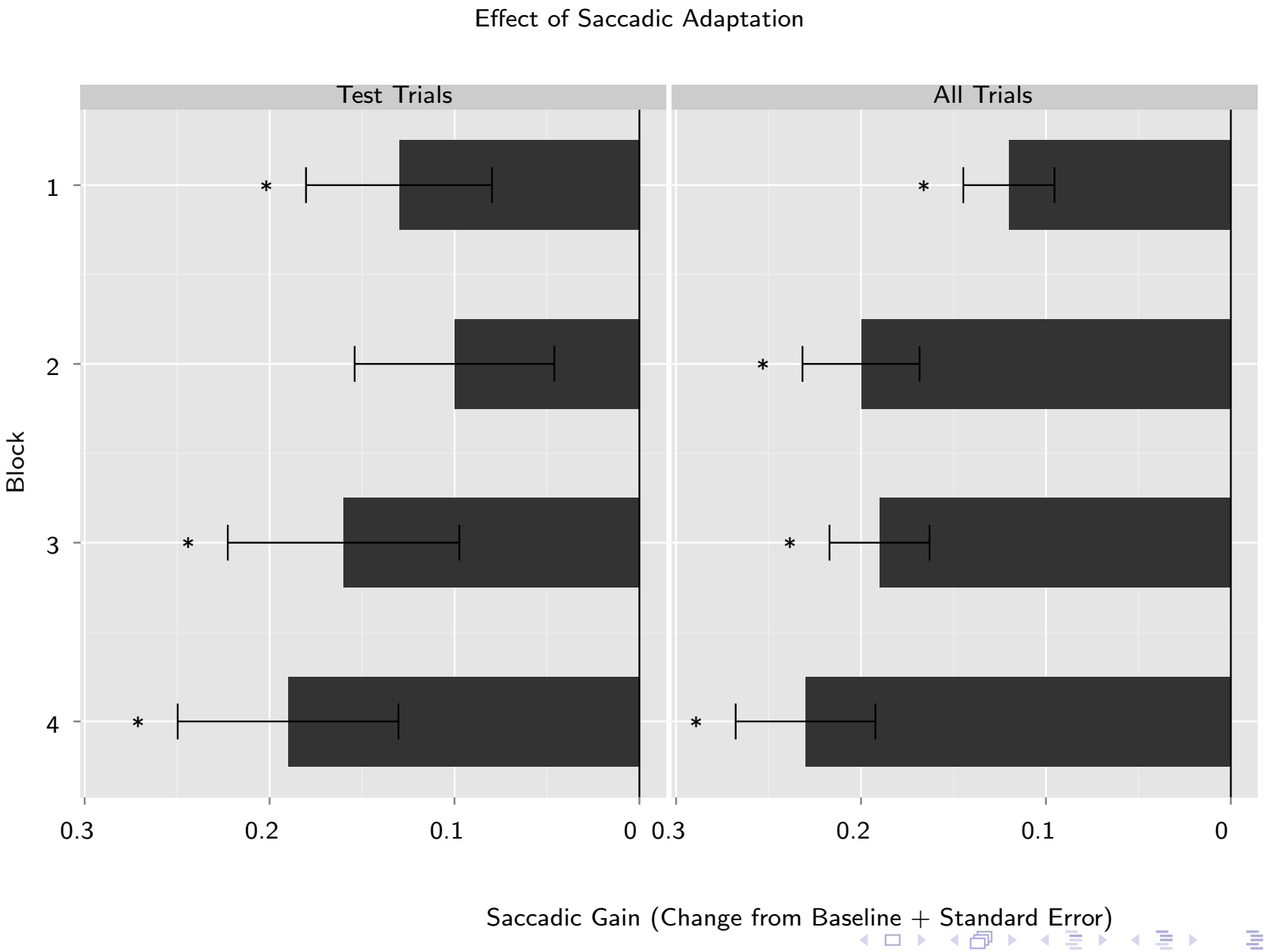
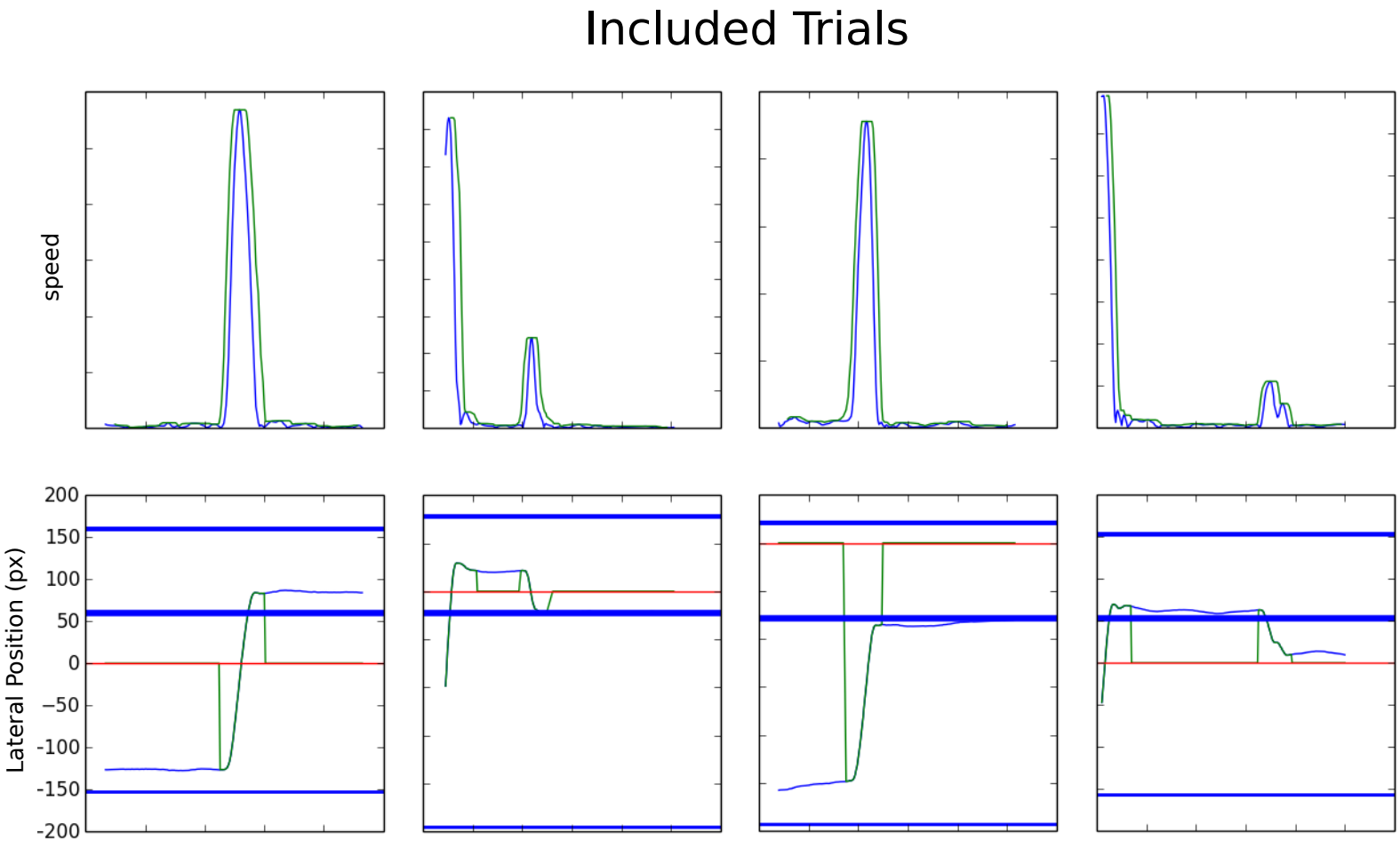


Figure 4.4: Effect of Saccadic Adaptation



Accepted Trials



Rejected Trials

Excluded Trials