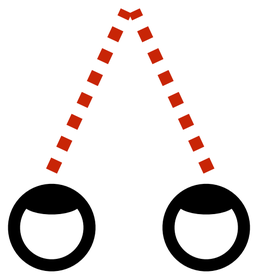
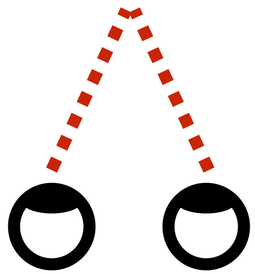
Reader targeting of words is guided by the statistical structure of the lexicon

Jon W. Carr
Davide Crepaldi

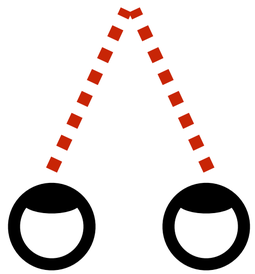
statistical



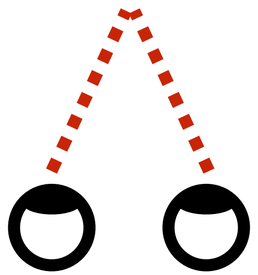
statistical



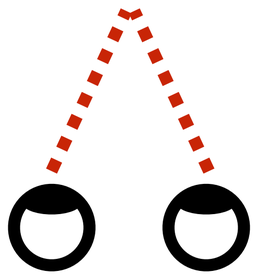
statistical



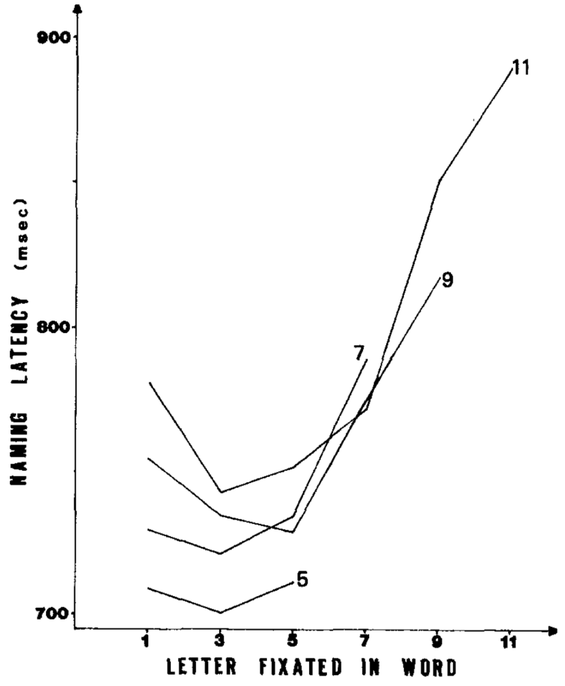
statistical



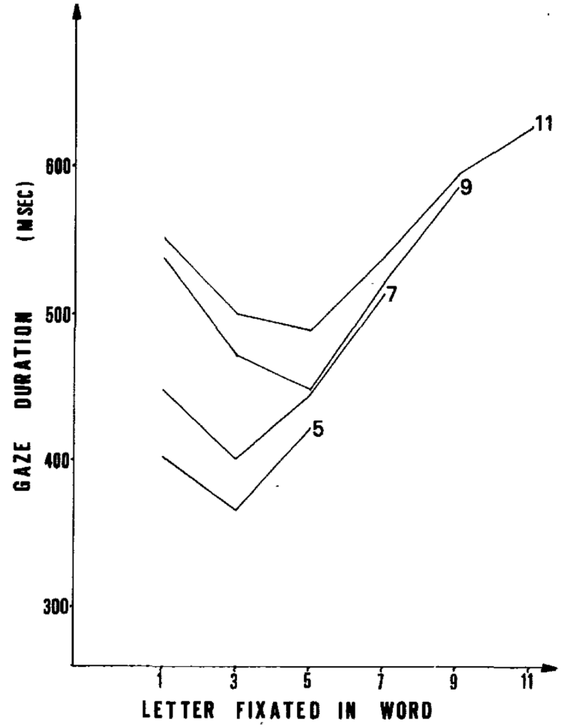
statistical



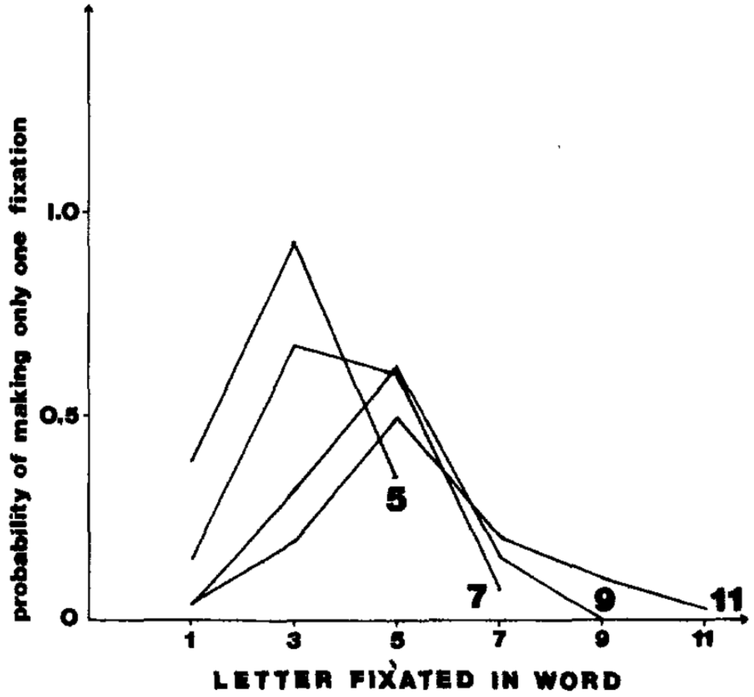
Naming latency



Gaze duration

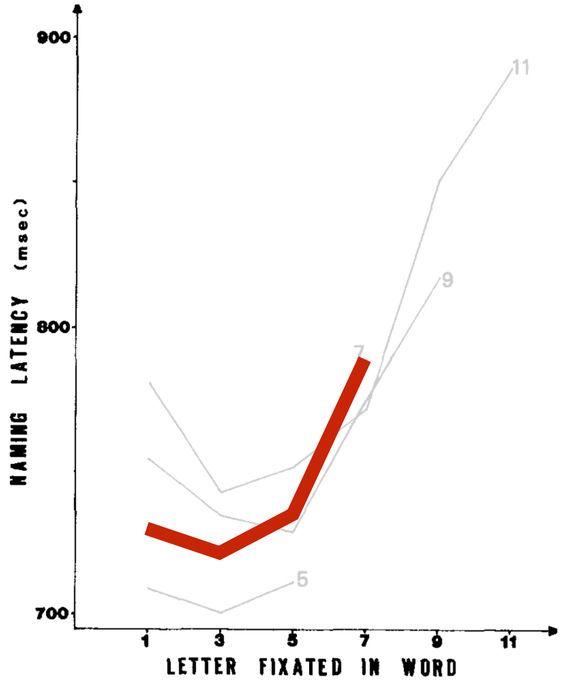


Probability of one fixation

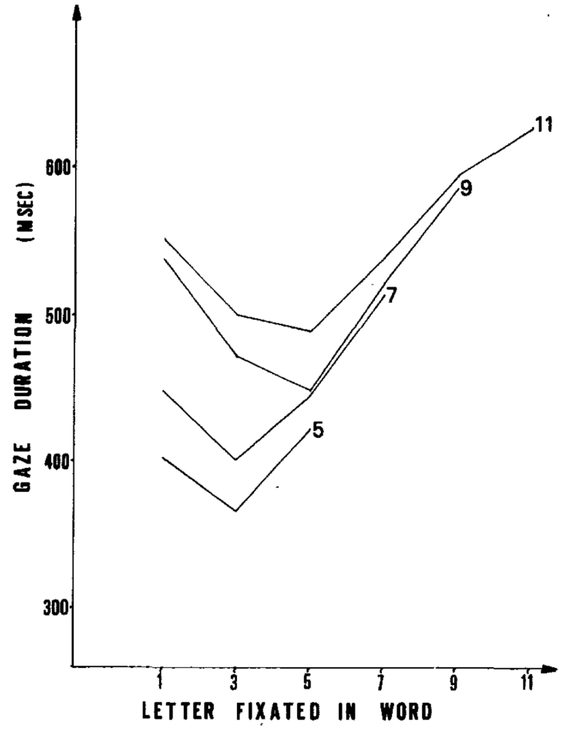


O'Regan et al. (1984)

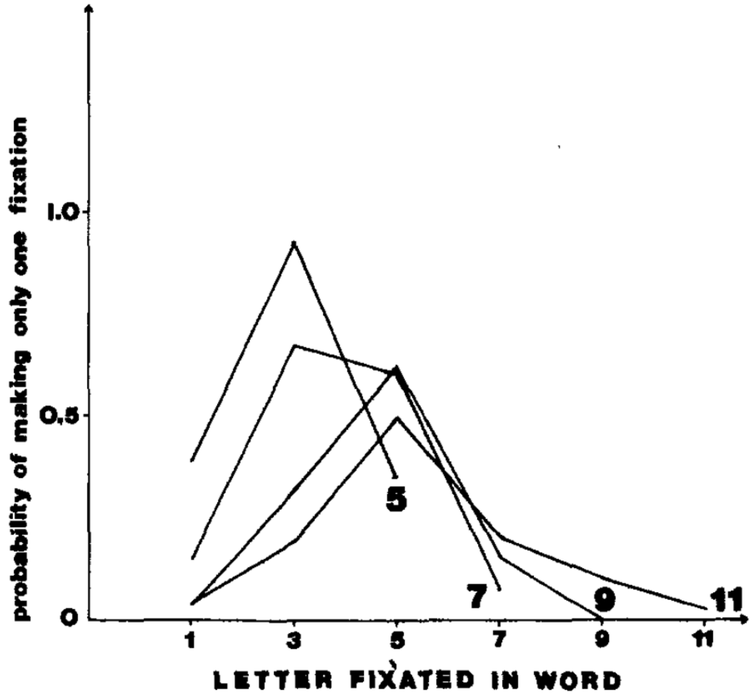
Naming latency



Gaze duration

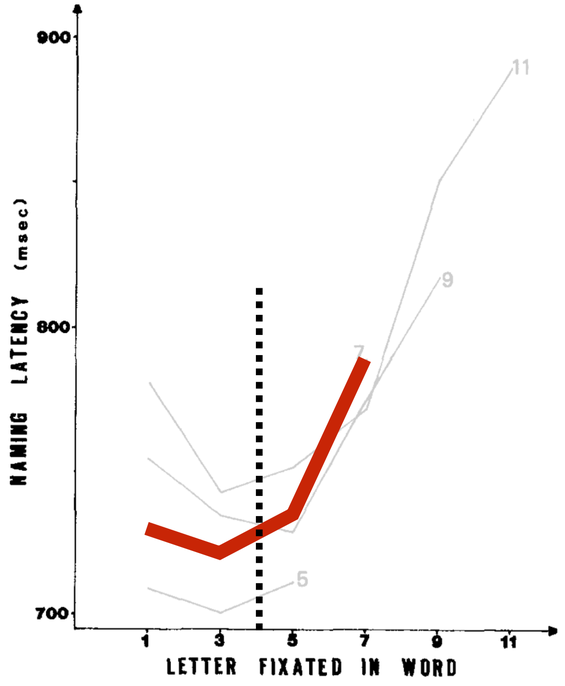


Probability of one fixation

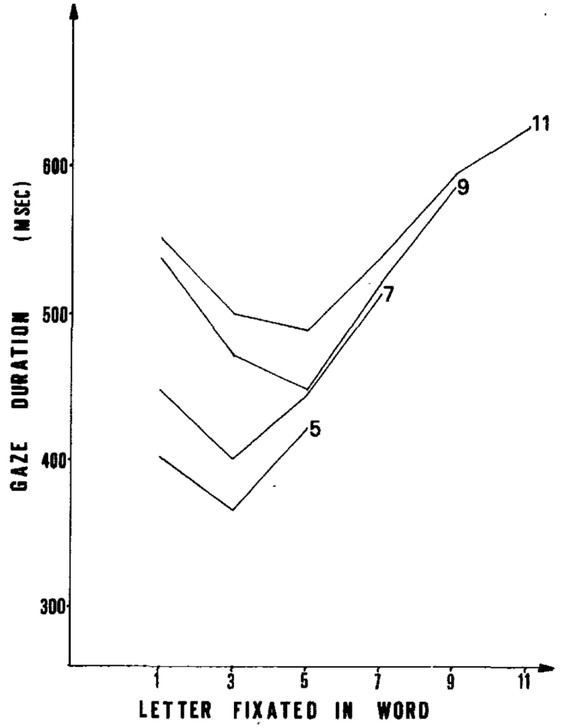


O'Regan et al. (1984)

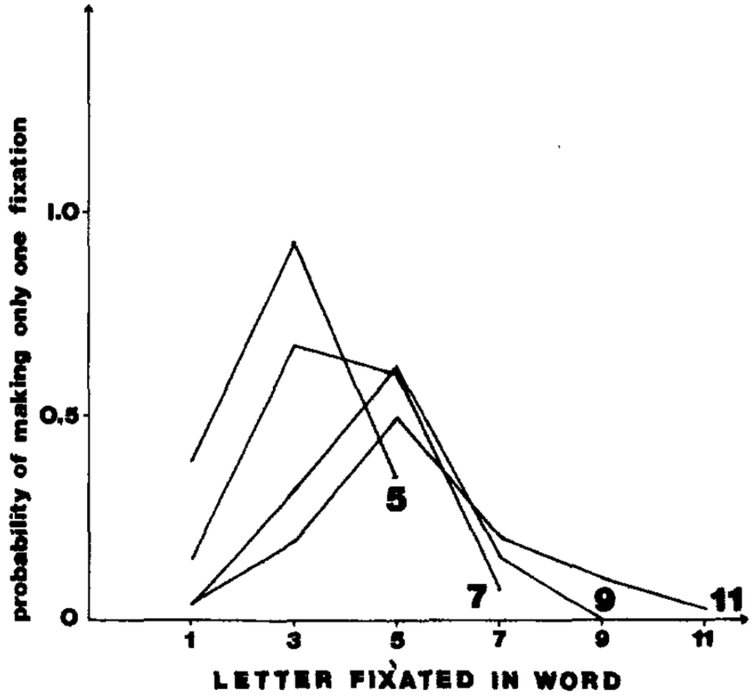
Naming latency



Gaze duration



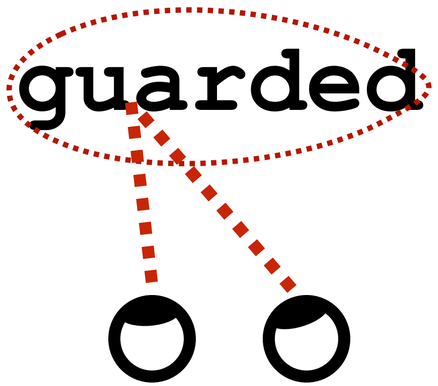
Probability of one fixation



O'Regan et al. (1984)

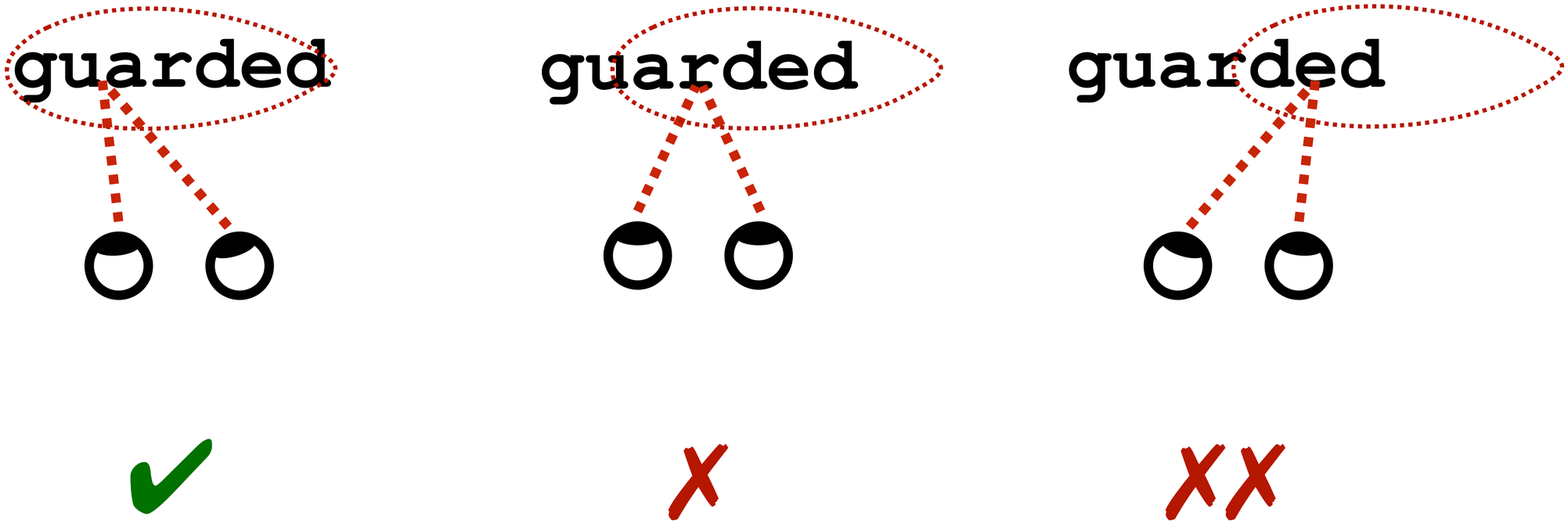
Theory 1

Perceptual-bias account



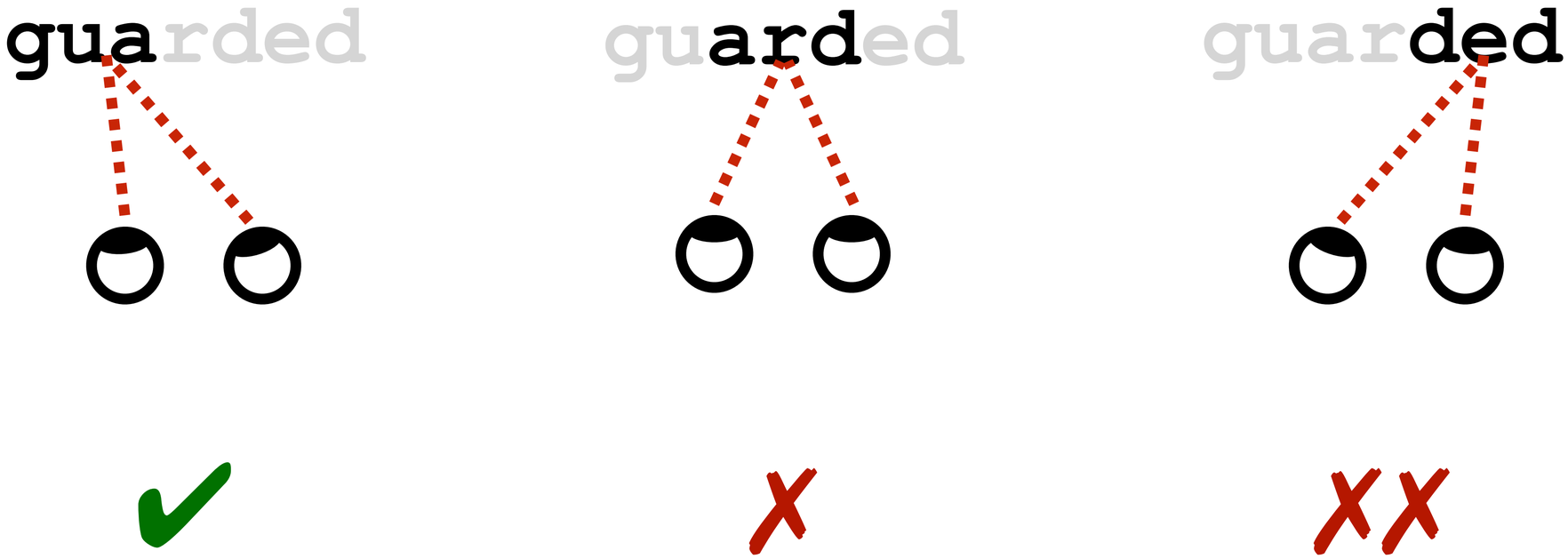
Theory 1

Perceptual-bias account



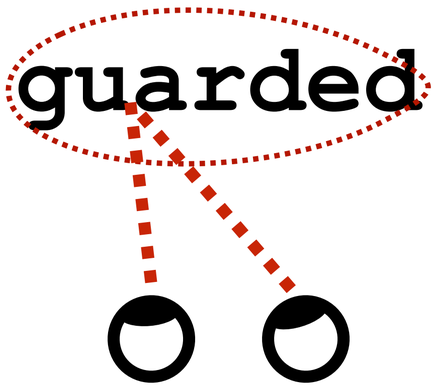
Theory 2

Informational-bias account



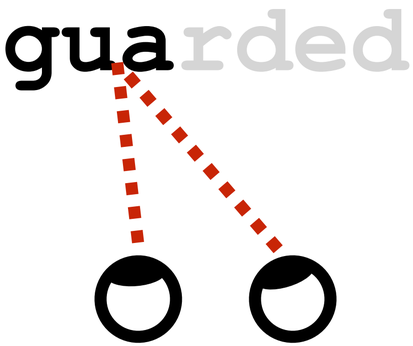
Theory 1

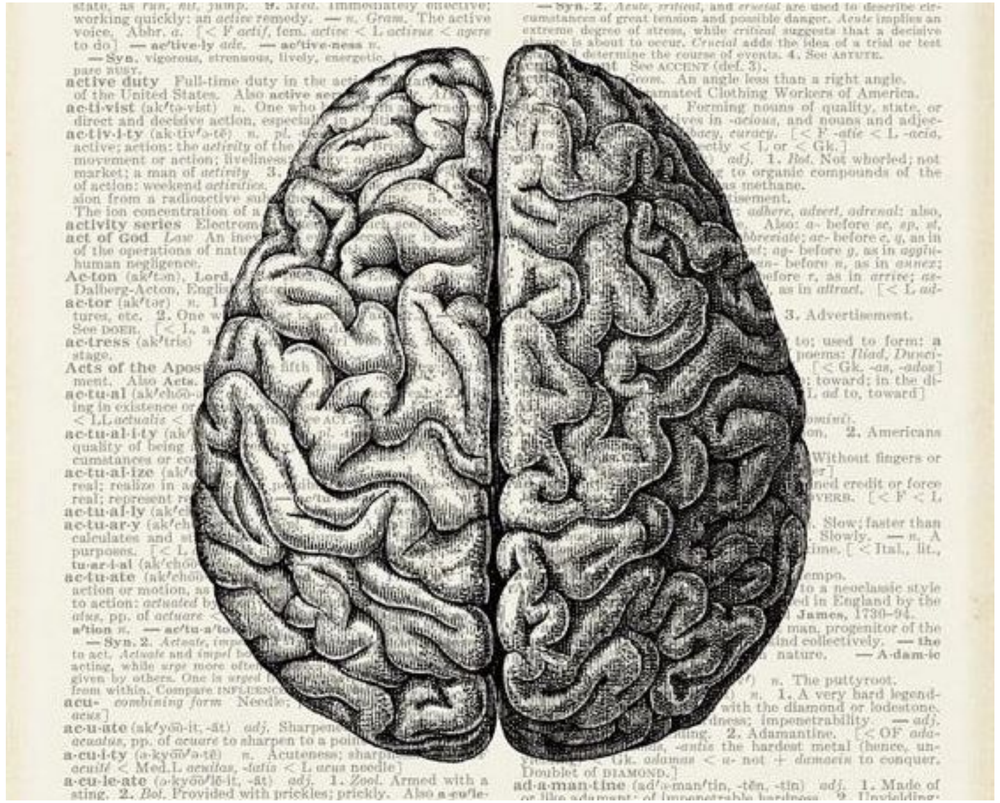
Perceptual-bias account



Theory 2

Informational-bias account

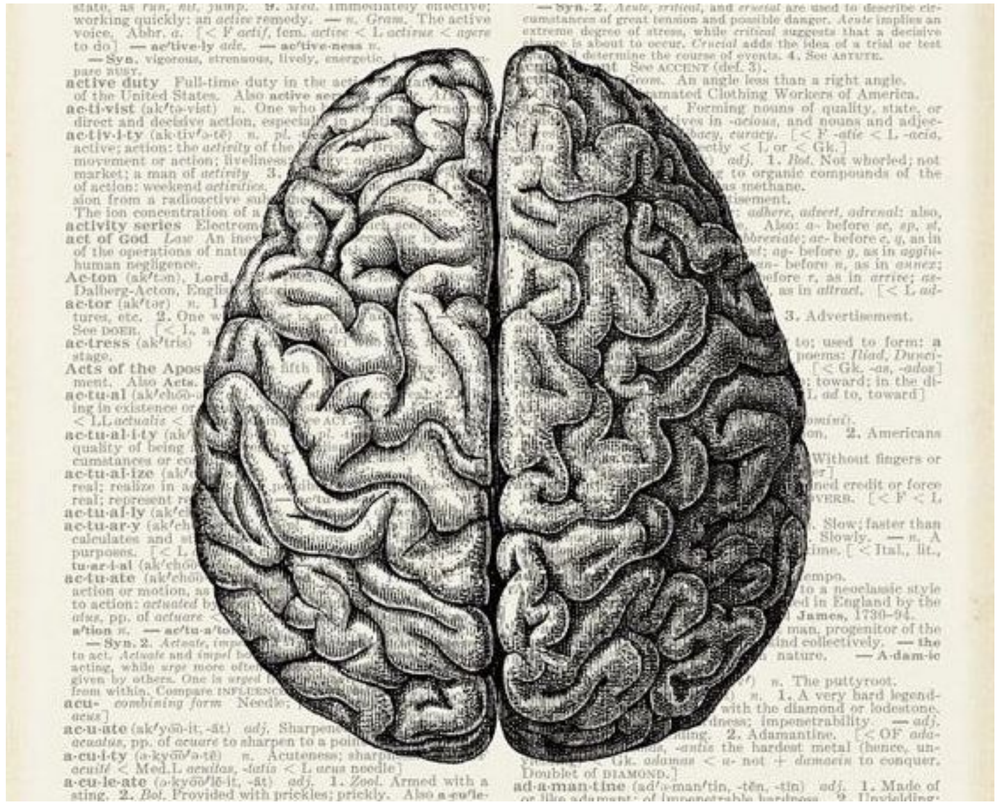




Perceptual-bias *Informational-bias*

Expected optimal viewing position

Pattern of eye movements

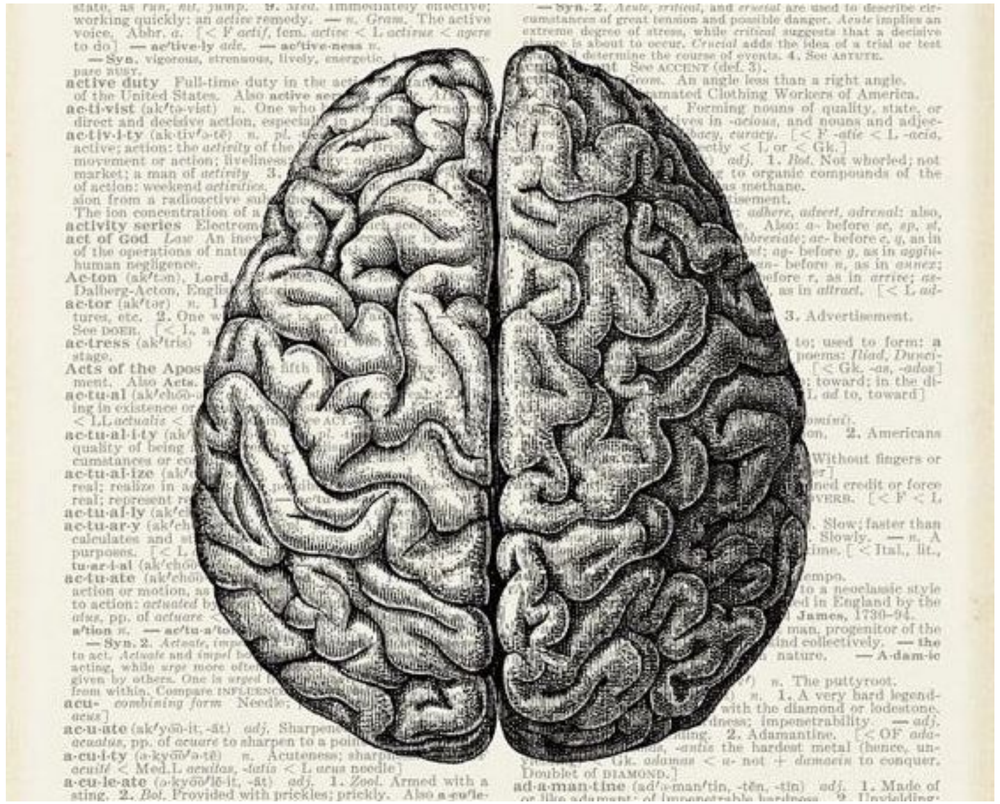


Perceptual-bias *Informational-bias*

Cognitive model

Expected optimal viewing position

Pattern of eye movements



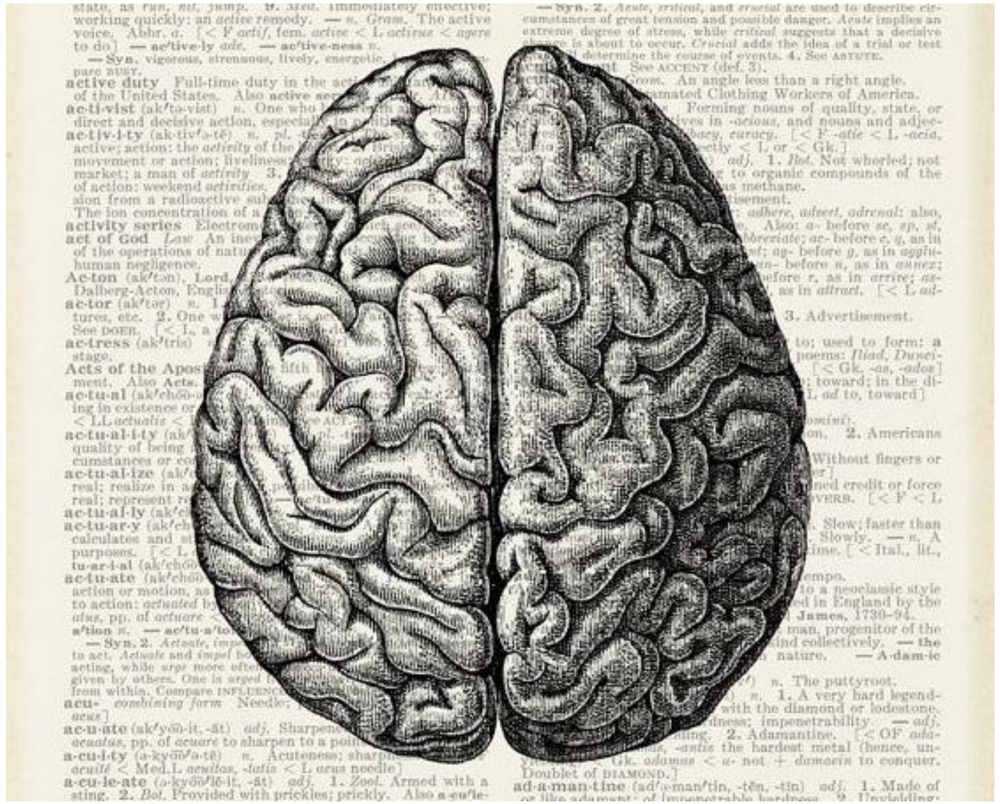
Perceptual-bias *Informational-bias*

Cognitive model

Expected optimal viewing position

Experiment 1

Pattern of eye movements



Perceptual-bias *Informational-bias*

Cognitive model

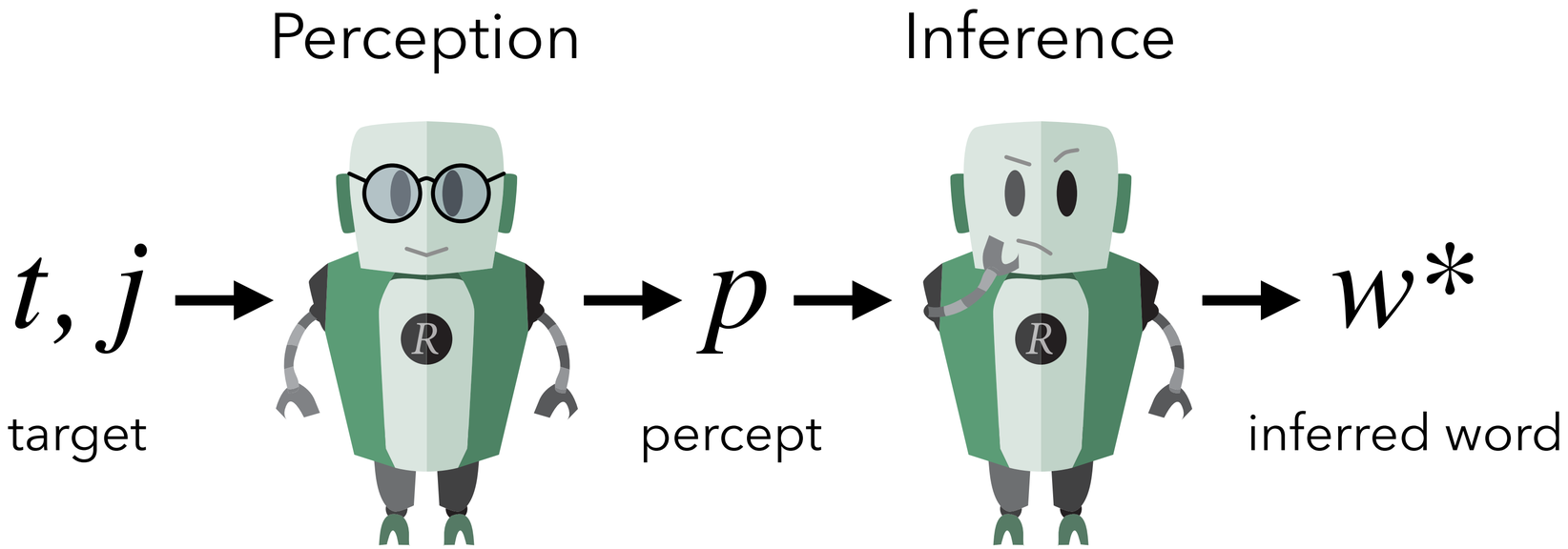
Expected optimal viewing position

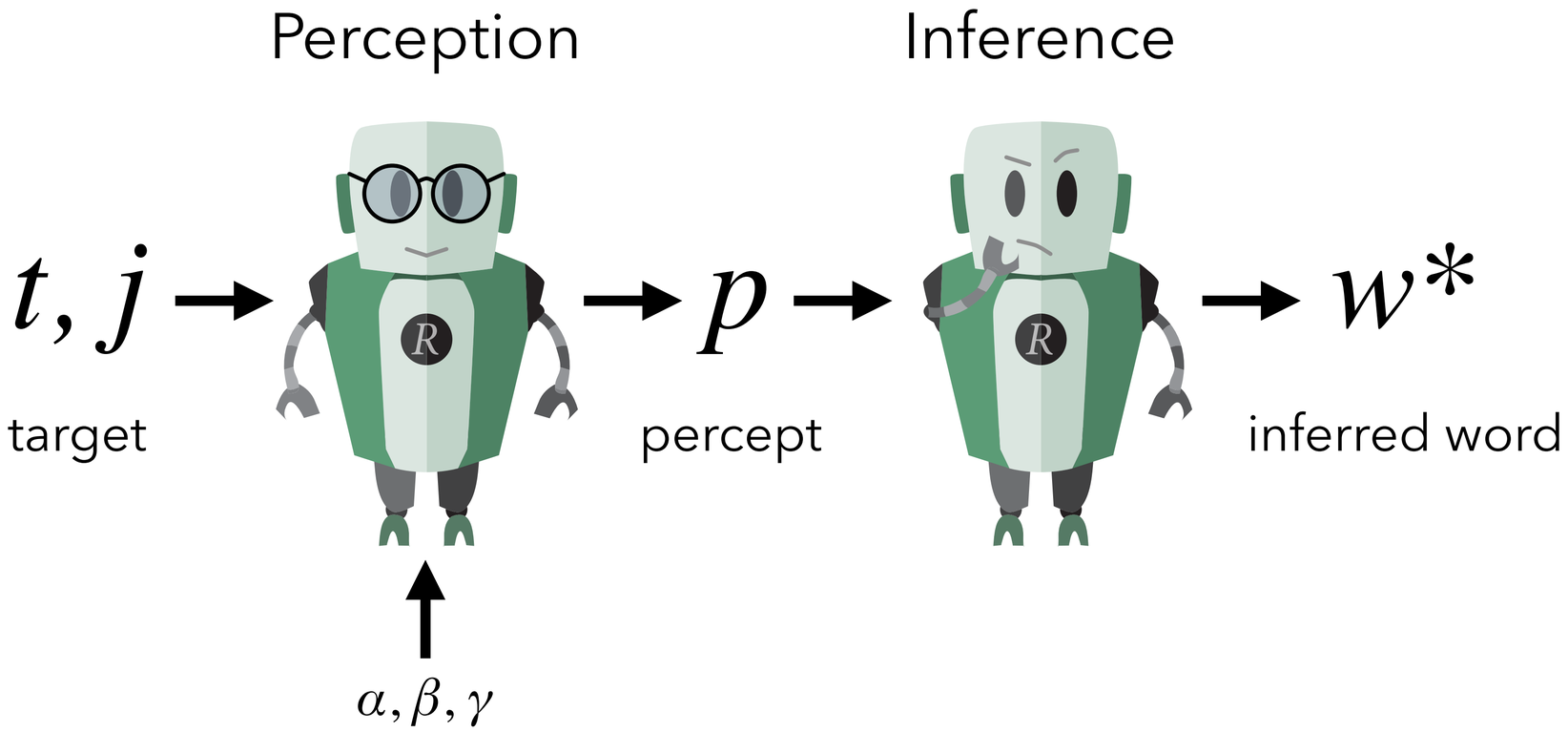
Experiment 1

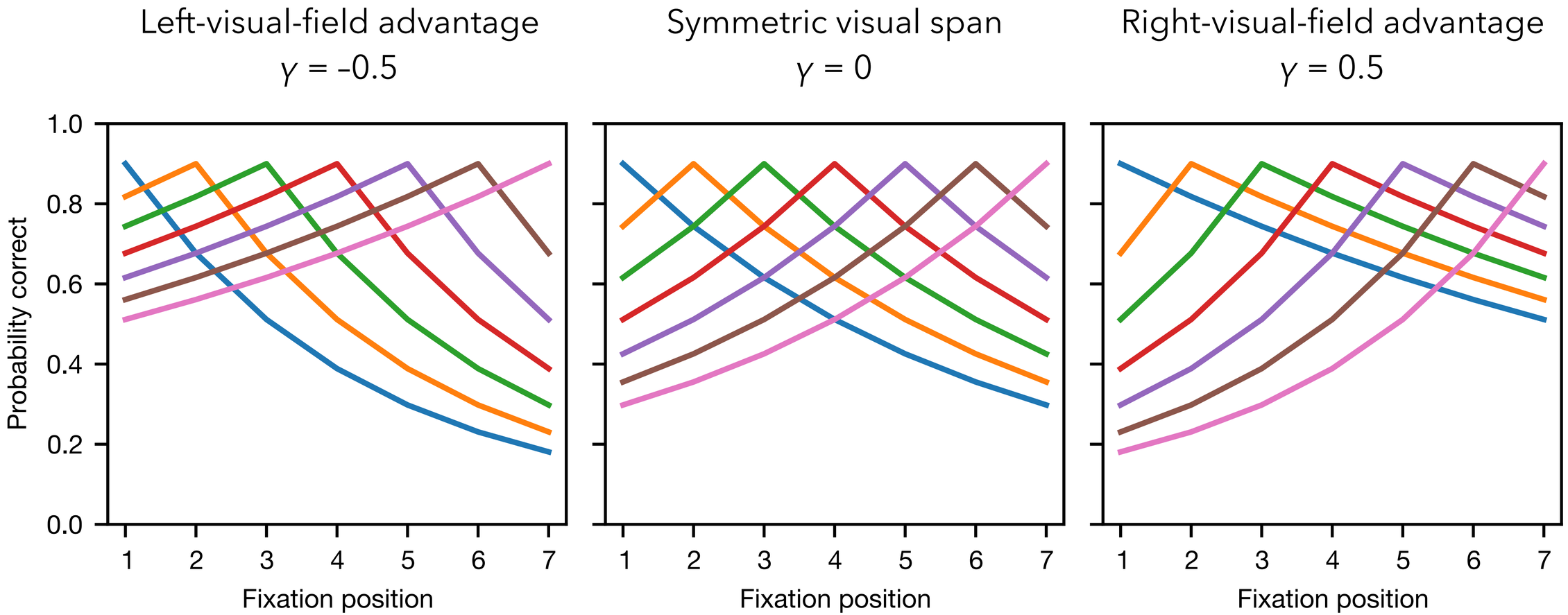
Pattern of eye movements

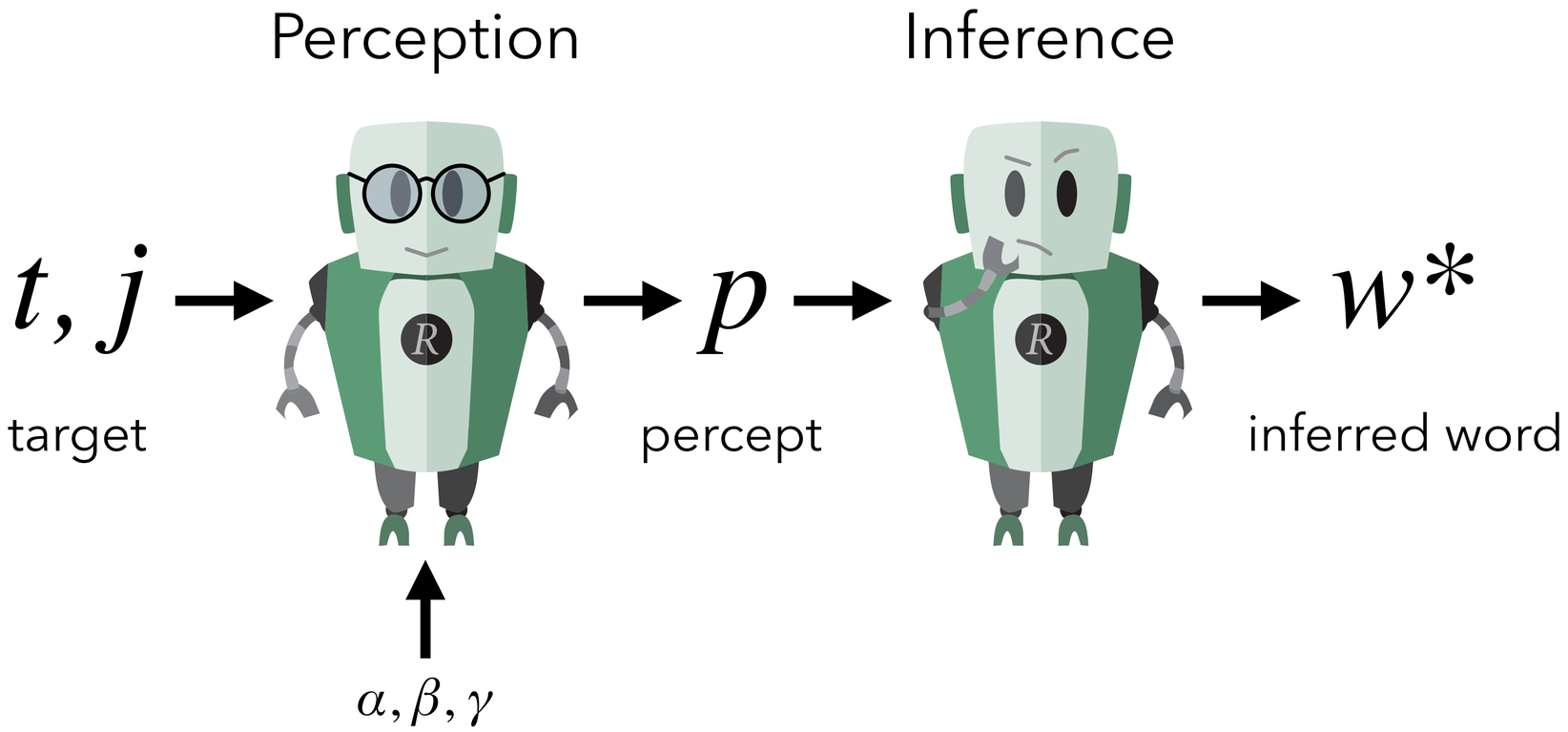
Experiment 2

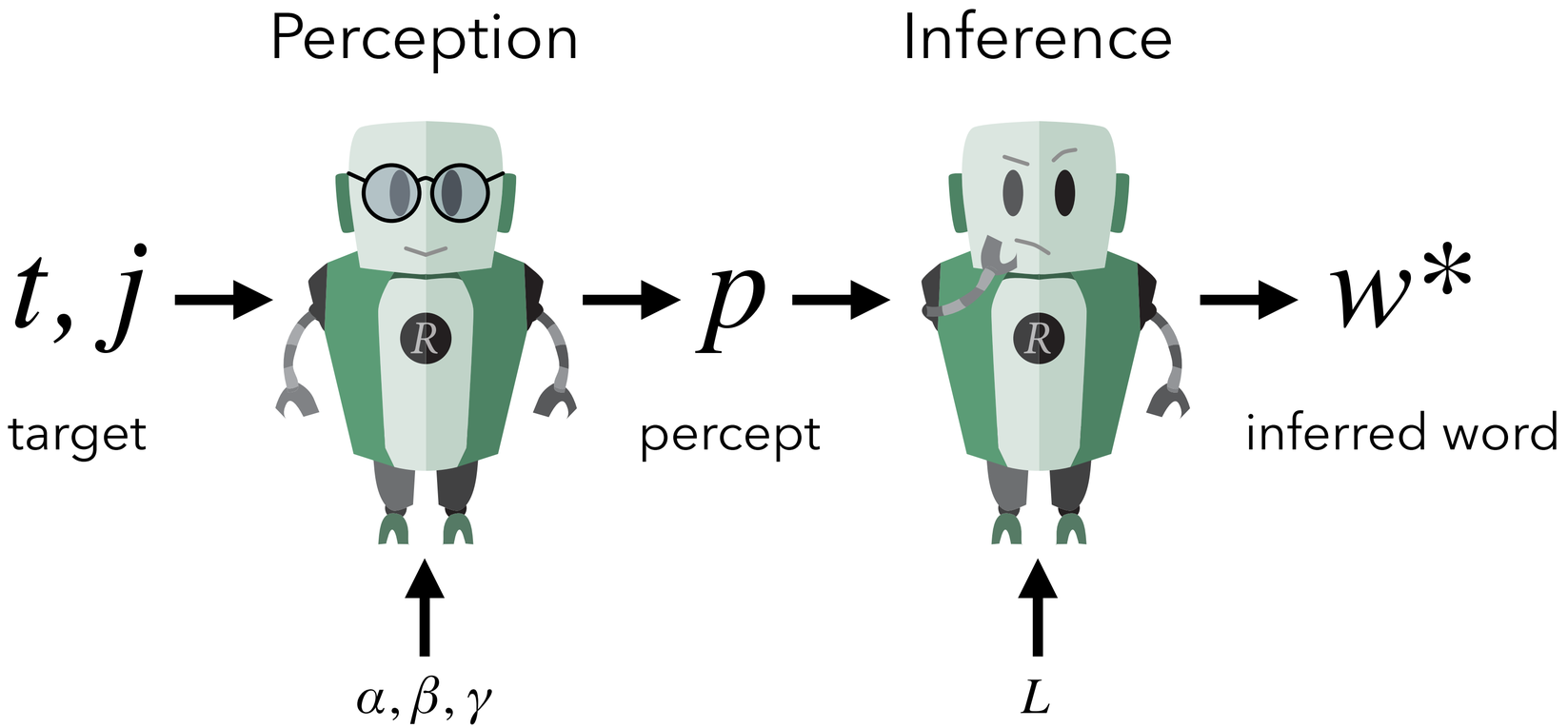
Cognitive model

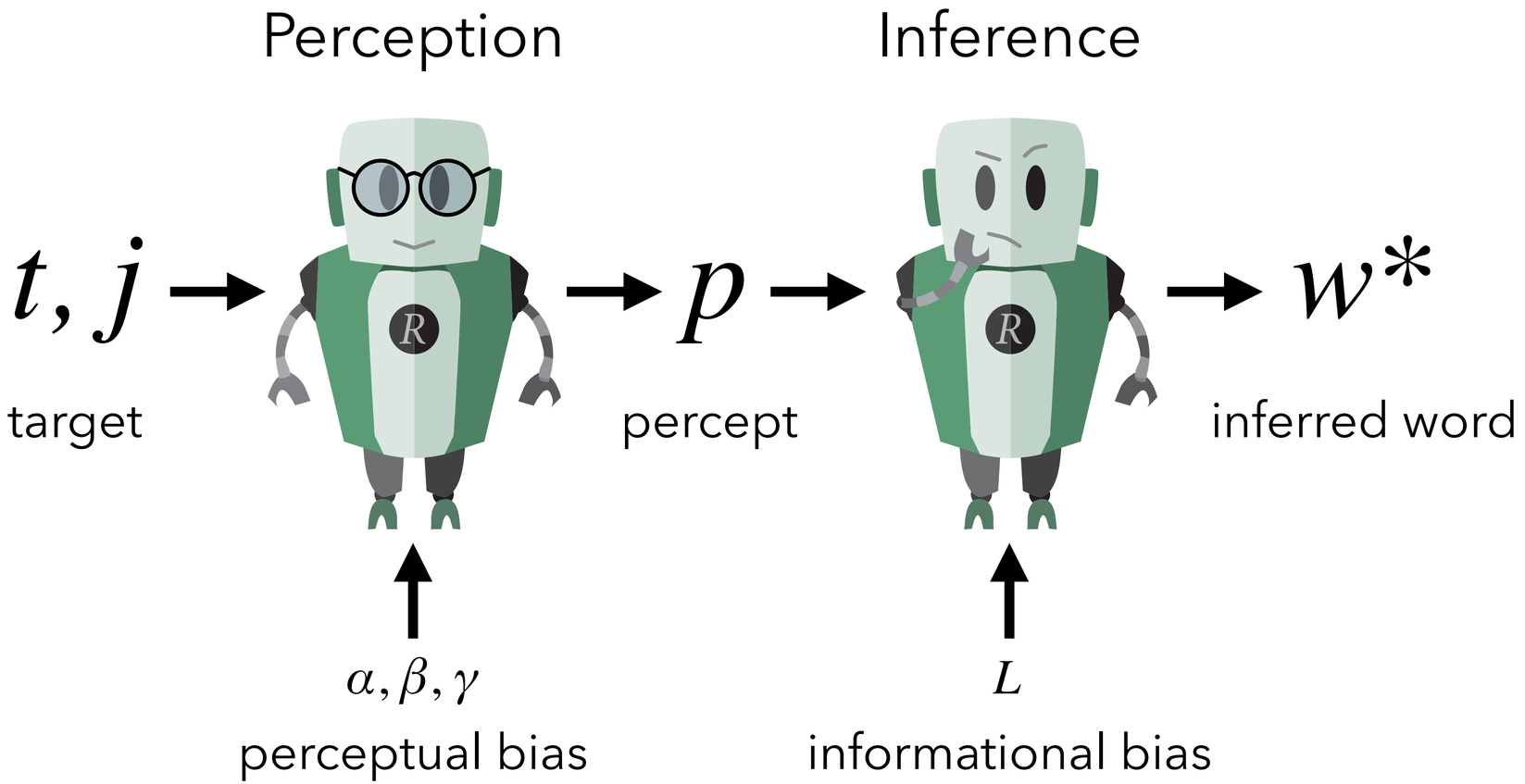

Perception
Inference
t, j
target
p
percept
w^*
inferred word

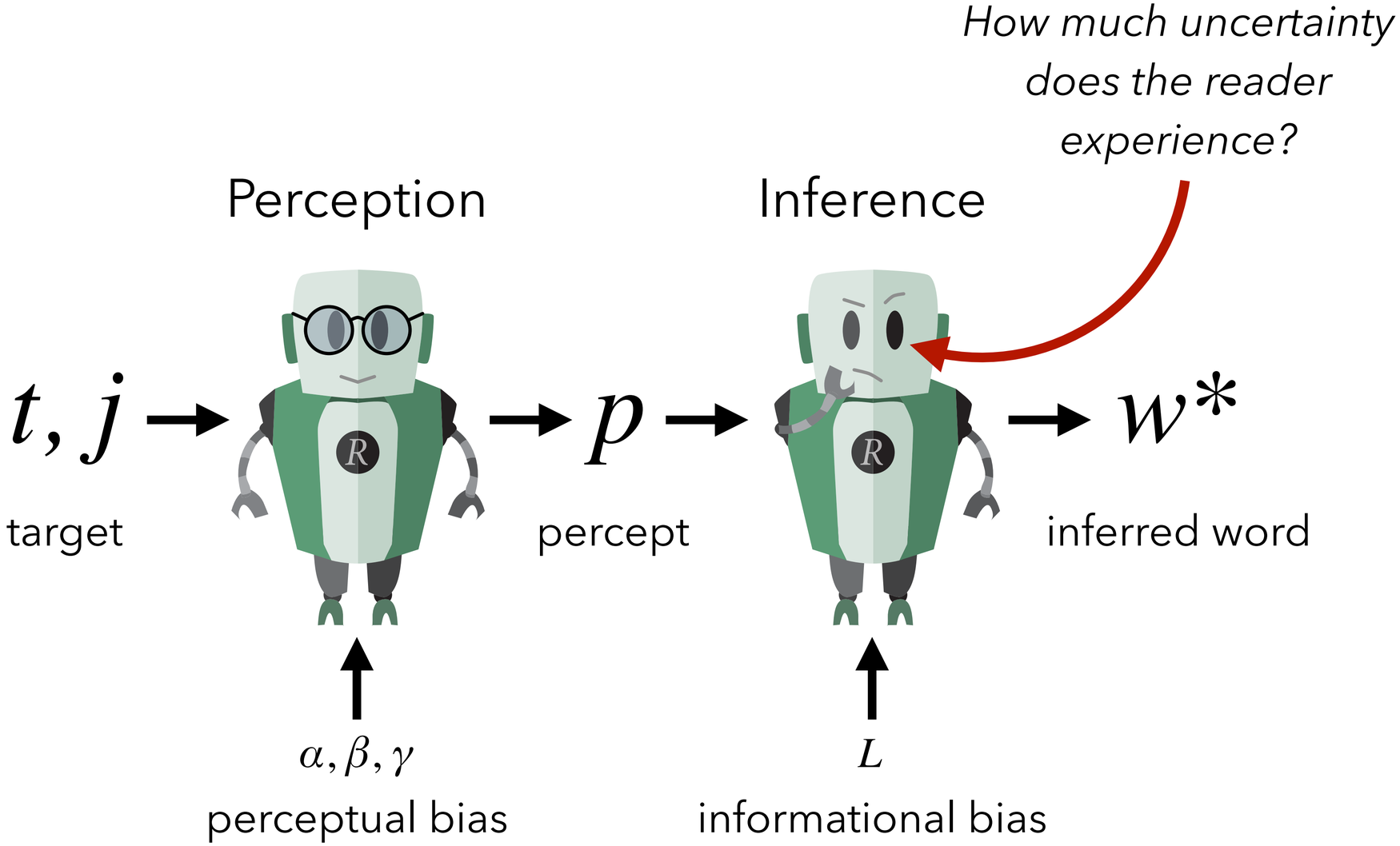

Perception
Inference
t, j
target
p
percept
w^*
inferred word
α, β, γ


Left-visual-field advantage
γ = -0.5
Symmetric visual span
γ = 0
Right-visual-field advantage
γ = 0.5
Probability correct
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
Fixation position

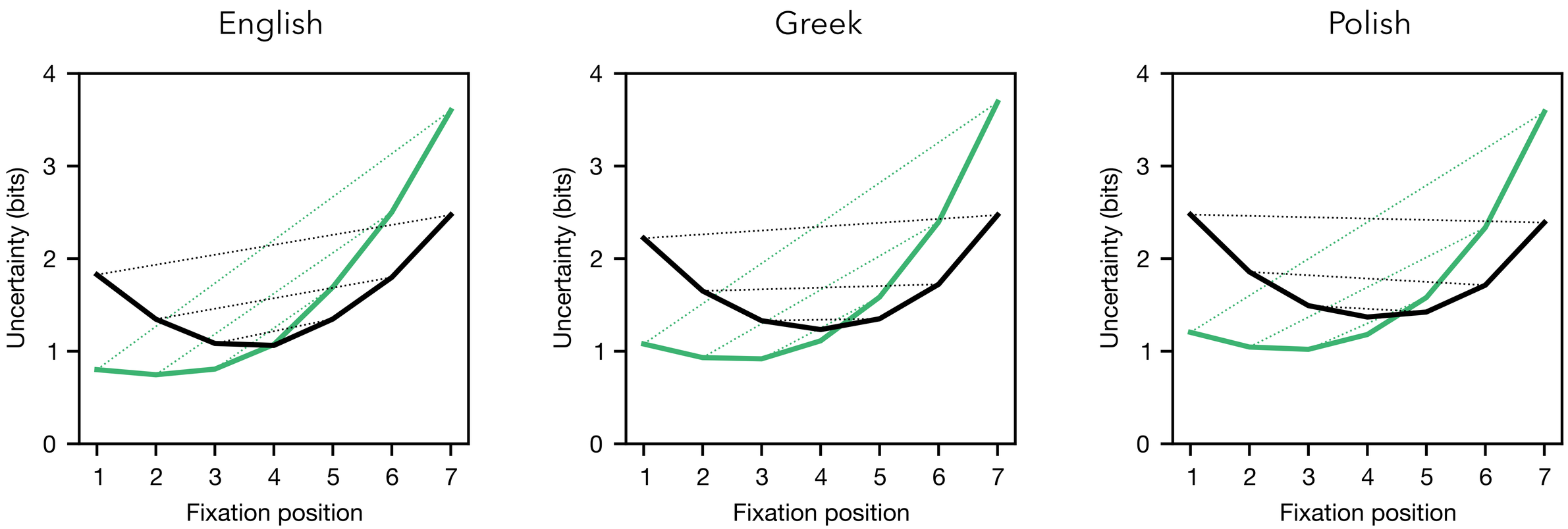

Perception
Inference
t, j
target
p
percept
w^*
inferred word
α, β, γ


Perception
Inference
t, j
target
p
percept
w^*
inferred word
α, β, γ
L


Perception
Inference
t, j
target
p
percept
w^*
inferred word
α, β, γ
perceptual bias
L
informational bias


How much uncertainty does the reader experience?
Perception
Inference
t, j
target
p
percept
w^*
inferred word
α, β, γ
perceptual bias
L
informational bias

informational bias alone ($\gamma = 0$)

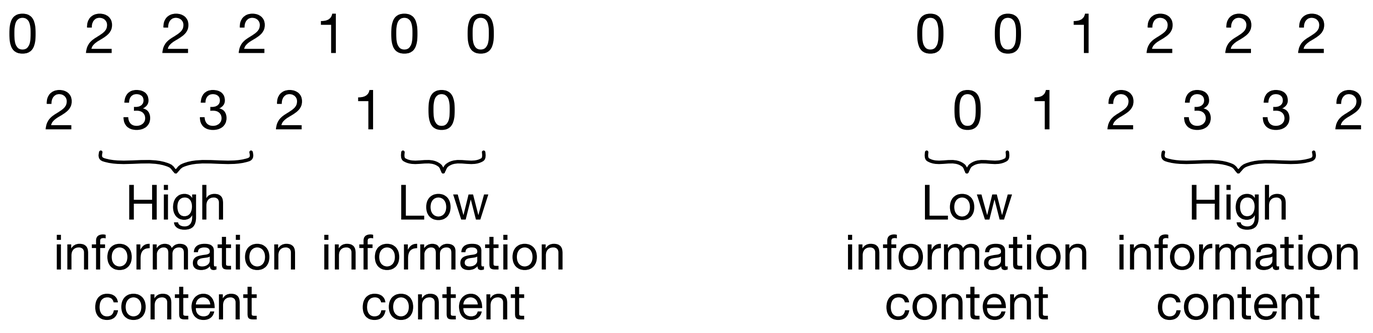


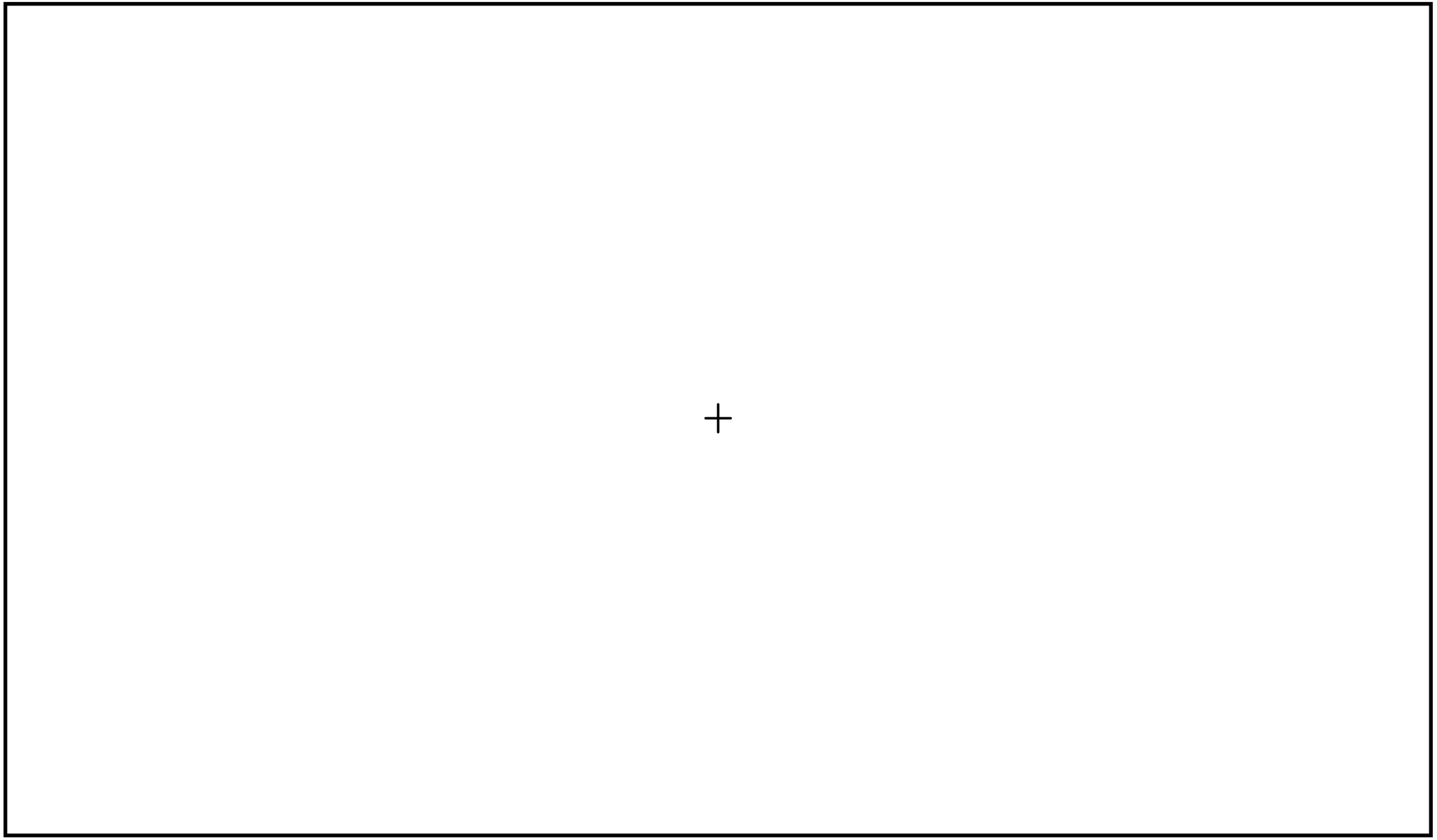
informational bias alone ($\gamma = 0$)

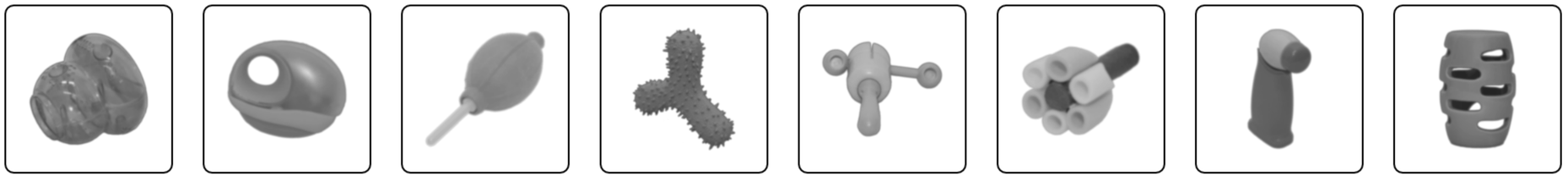
informational bias + perceptual bias ($\gamma = 0.5$)

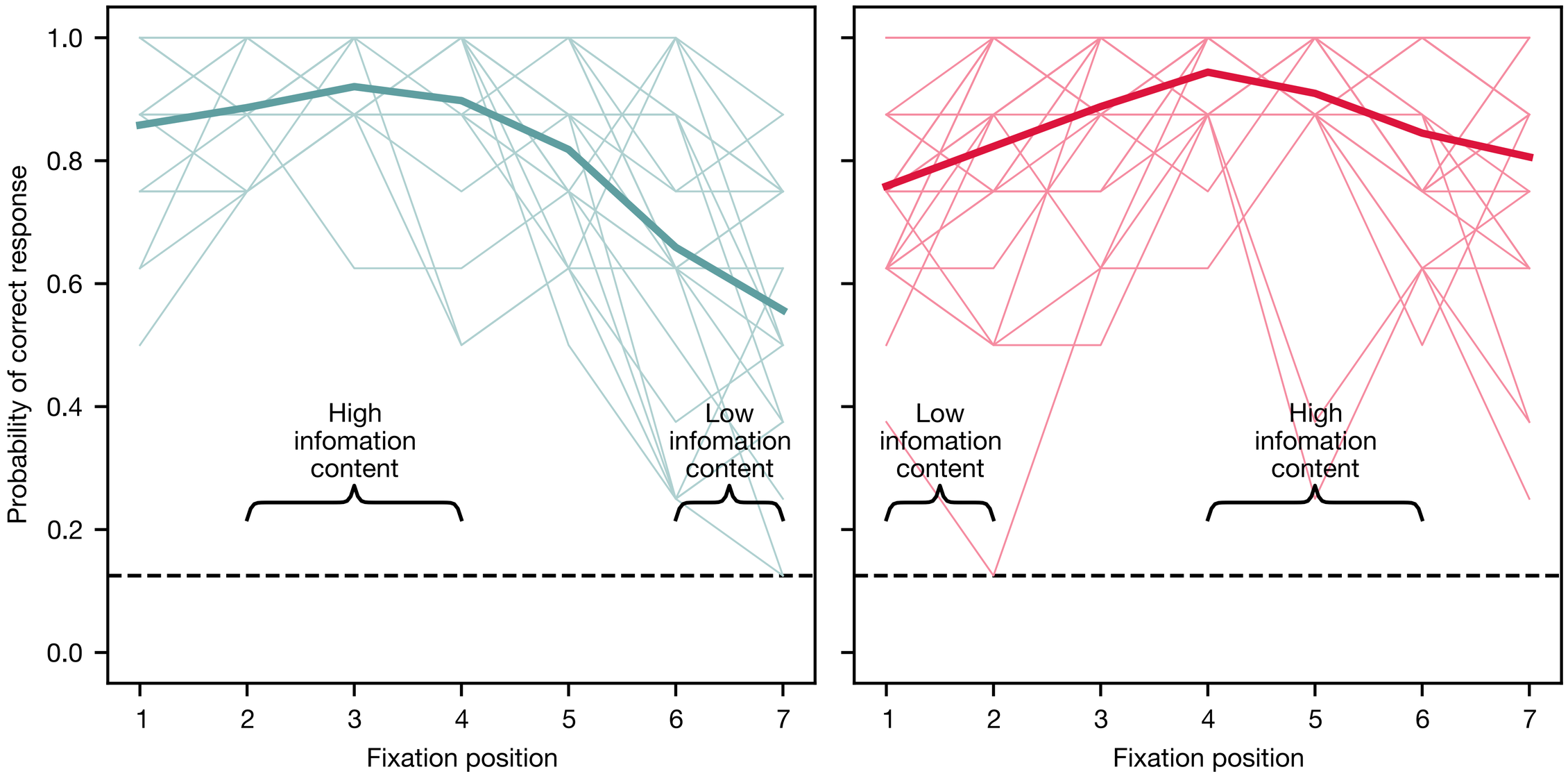
Experiment 1

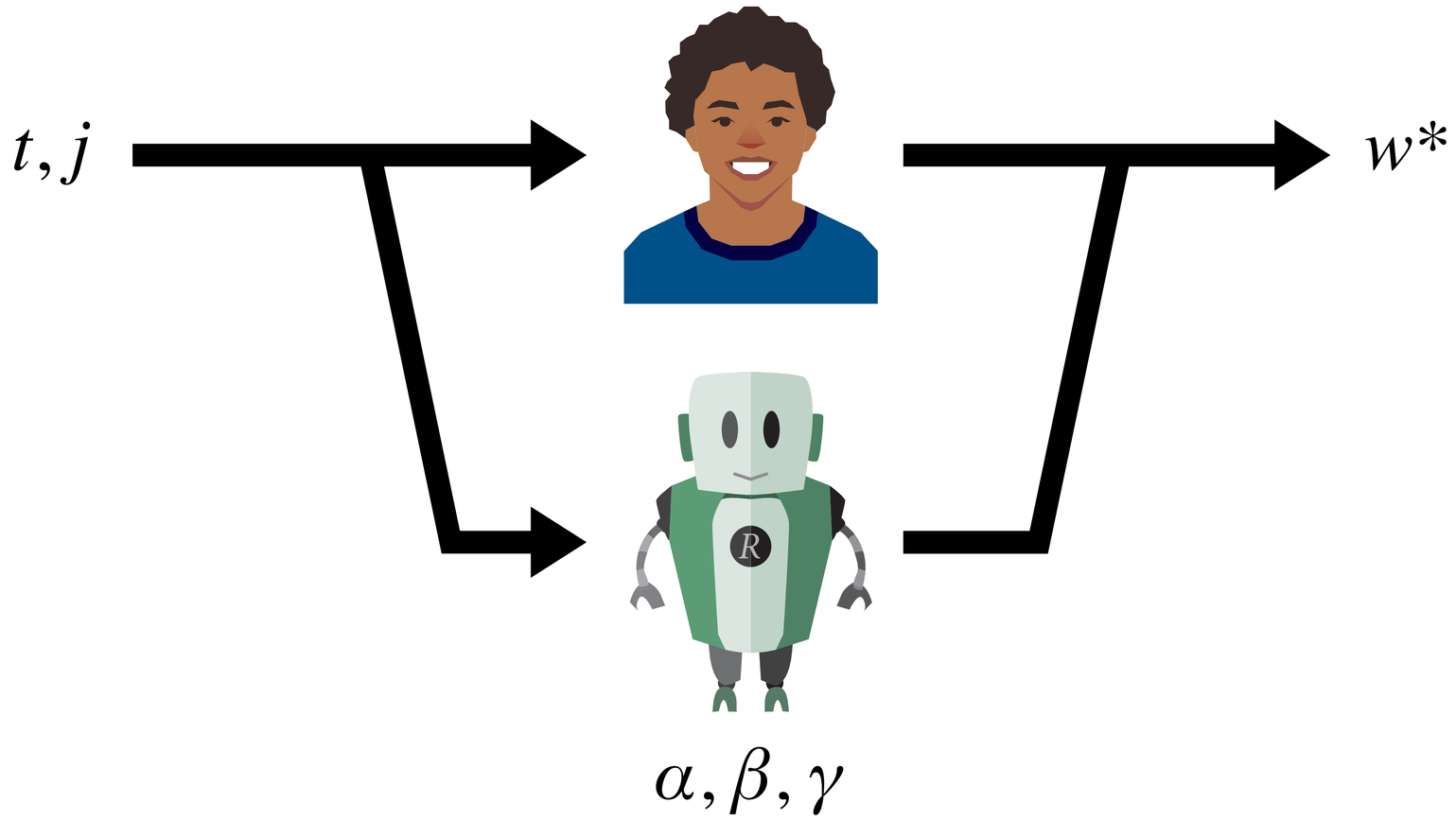
Left-heavy structure							Example	Right-heavy structure							Example
S	c_1	v_1	c_5	v_5	c_9	S	SNYBEVS	S	c_9	v_5	c_5	v_1	c_1	S	SVEBYNS
S	c_2	v_2	c_5	v_5	c_9	S	STOBEVS	S	c_9	v_5	c_5	v_2	c_2	S	SVEBOTS
S	c_3	v_3	c_6	v_5	c_9	S	SGUPEVS	S	c_9	v_5	c_6	v_3	c_3	S	SVEPUGS
S	c_4	v_4	c_6	v_5	c_9	S	SKAPEVS	S	c_9	v_5	c_6	v_4	c_4	S	SVEPAKS
S	c_3	v_1	c_7	v_6	c_9	S	SGYDIVS	S	c_9	v_6	c_7	v_1	c_3	S	SVIDYGS
S	c_1	v_2	c_7	v_6	c_9	S	SNODIVS	S	c_9	v_6	c_7	v_2	c_1	S	SVIDONS
S	c_4	v_3	c_8	v_6	c_9	S	SKUMIVS	S	c_9	v_6	c_8	v_3	c_4	S	SVIMUKS
S	c_2	v_4	c_8	v_6	c_9	S	STAMIVS	S	c_9	v_6	c_8	v_4	c_2	S	SVIMATS

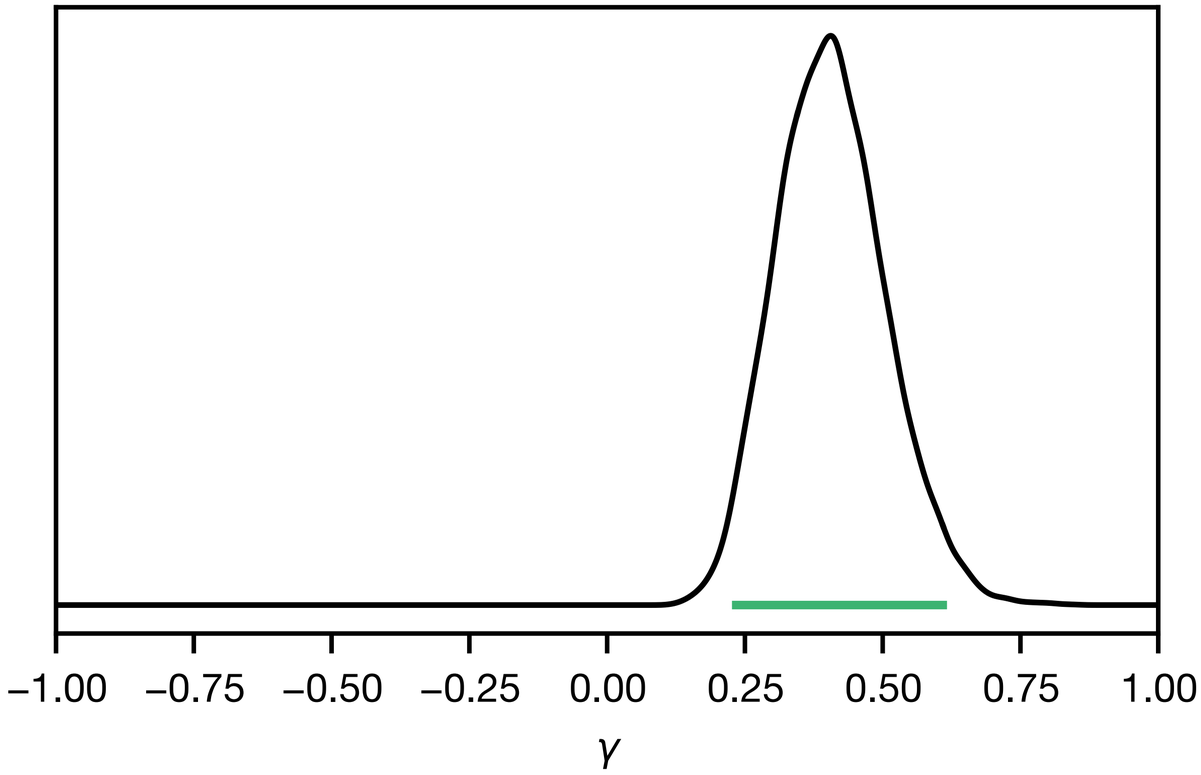


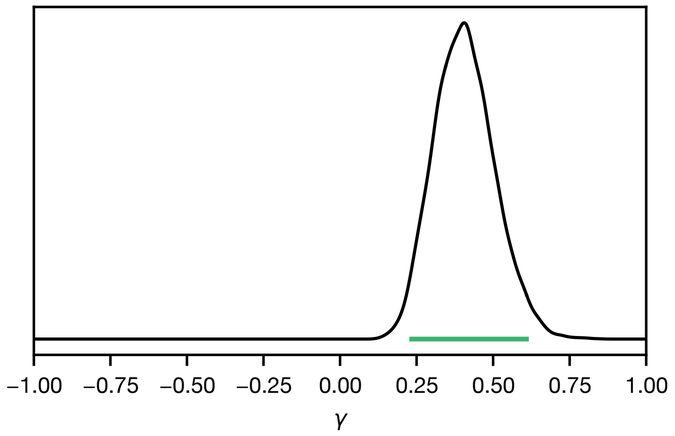




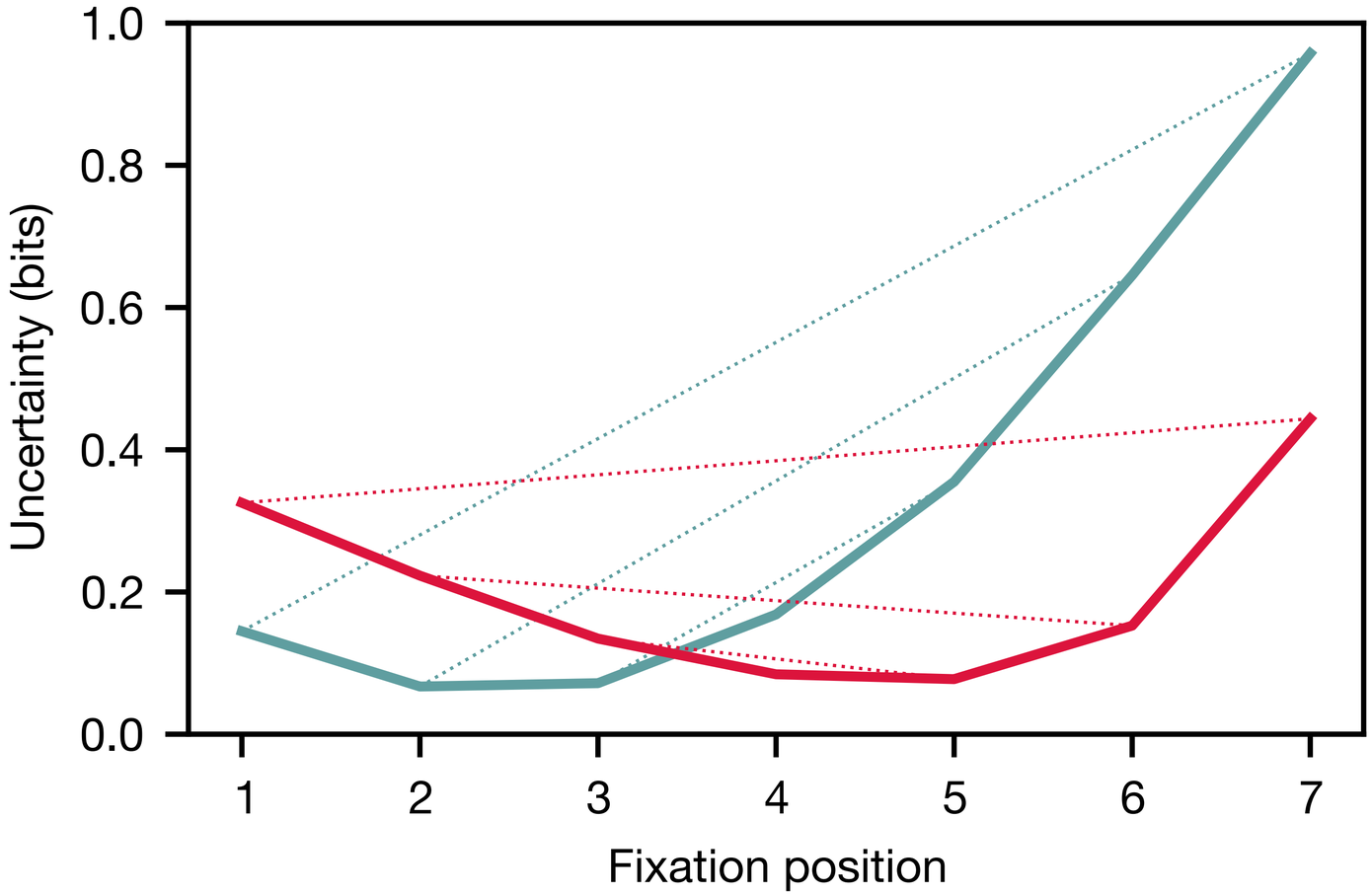

Probability of correct response
1.0
0.8
0.6
0.4
0.2
0.0
High infomation content
Low infomation content
1
2
3
4
5
6
7
Fixation position
Low infomation content
High infomation content
1
2
3
4
5
6
7
Fixation position

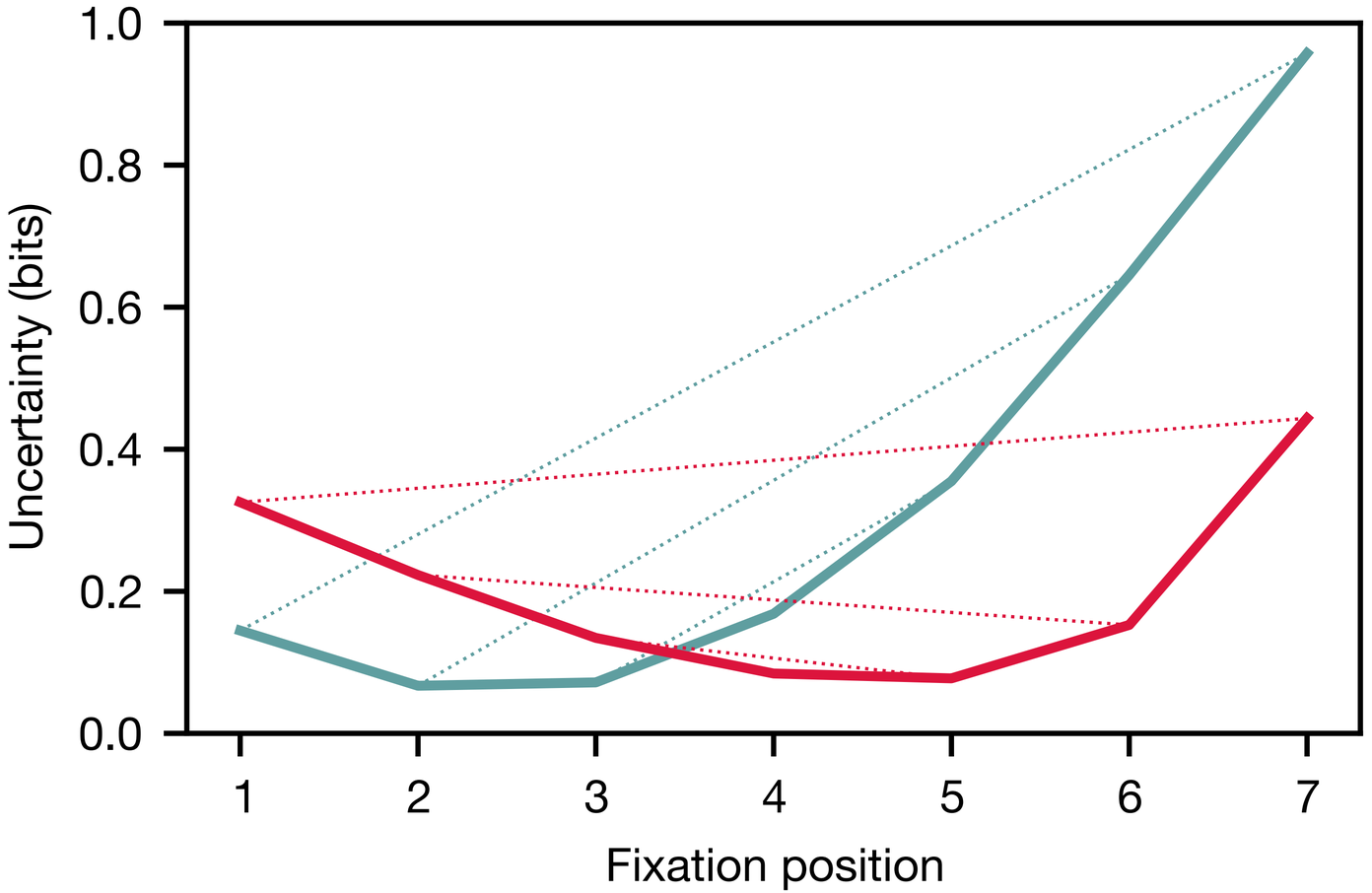

t, j
w^*
α, β, γ


−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00
γ



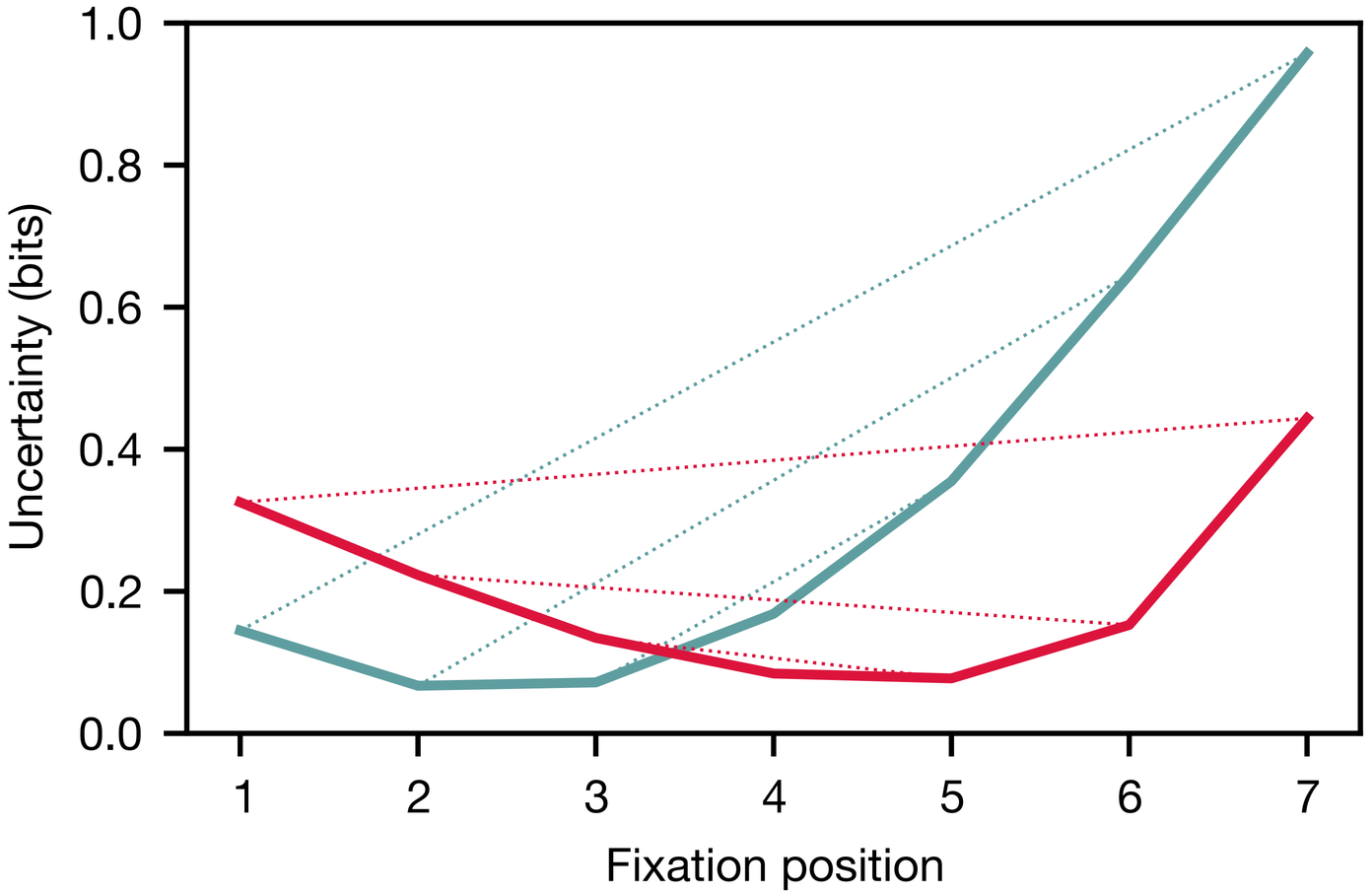
Left-heavy structure	Example	Right-heavy structure	Example
S c_1 v_1 c_5 v_5 c_9 S	SNYBEVS	S c_9 v_5 c_5 v_1 c_1 S	SVEBYNS
S c_2 v_2 c_5 v_5 c_9 S	STOBEVS	S c_9 v_5 c_5 v_2 c_2 S	SVEBOTS
S c_3 v_3 c_6 v_5 c_9 S	SGUPEVS	S c_9 v_5 c_6 v_3 c_3 S	SVEPUGS
S c_4 v_4 c_6 v_5 c_9 S	SKAPEVS	S c_9 v_5 c_6 v_4 c_4 S	SVEPAKS
S c_3 v_1 c_7 v_6 c_9 S	SGYDIVS	S c_9 v_6 c_7 v_1 c_3 S	SVIDYGS
S c_1 v_2 c_7 v_6 c_9 S	SNODIVS	S c_9 v_6 c_7 v_2 c_1 S	SVIDONS
S c_4 v_3 c_8 v_6 c_9 S	SKUMIVS	S c_9 v_6 c_8 v_3 c_4 S	SVIMUKS
S c_2 v_4 c_8 v_6 c_9 S	STAMIVS	S c_9 v_6 c_8 v_4 c_2 S	SVIMATS
0 2 2 2 1 0 0		0 0 1 2 2 2 0	
2 3 3 2 1 0		0 1 2 3 3 2	
High information content	Low information content	Low information content	High information content





SNYBEVS

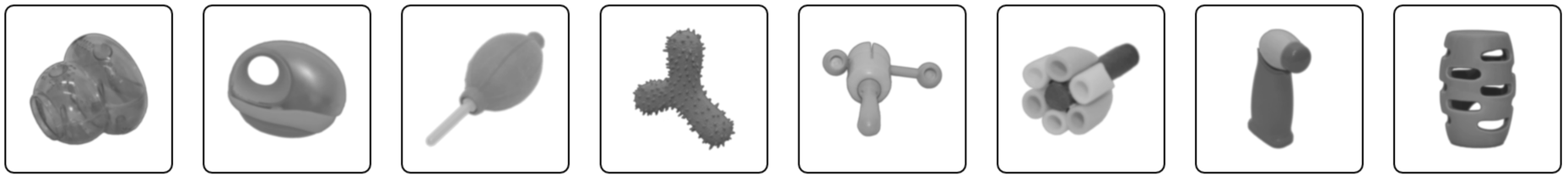
SVEBYNS



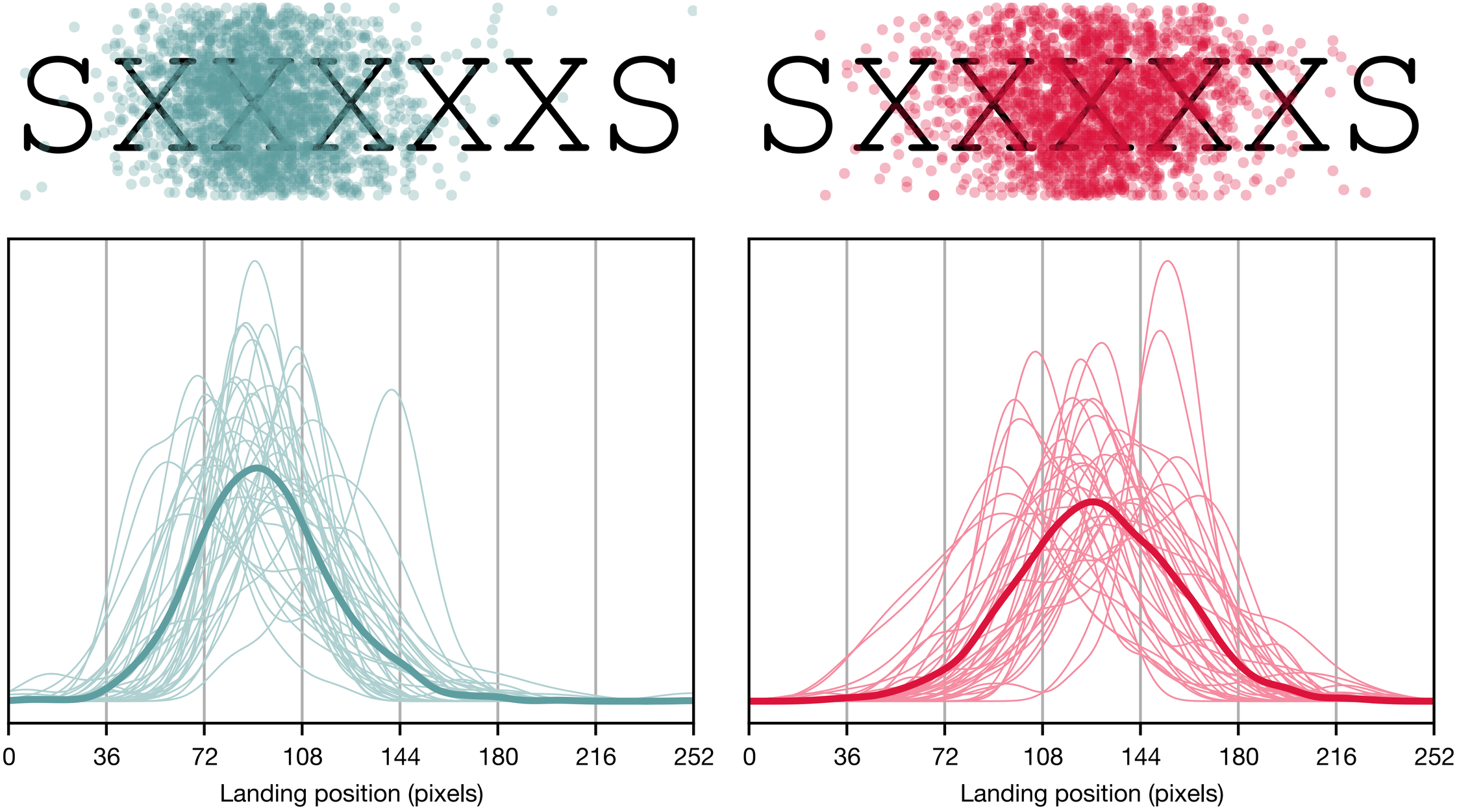
SNYBEVS

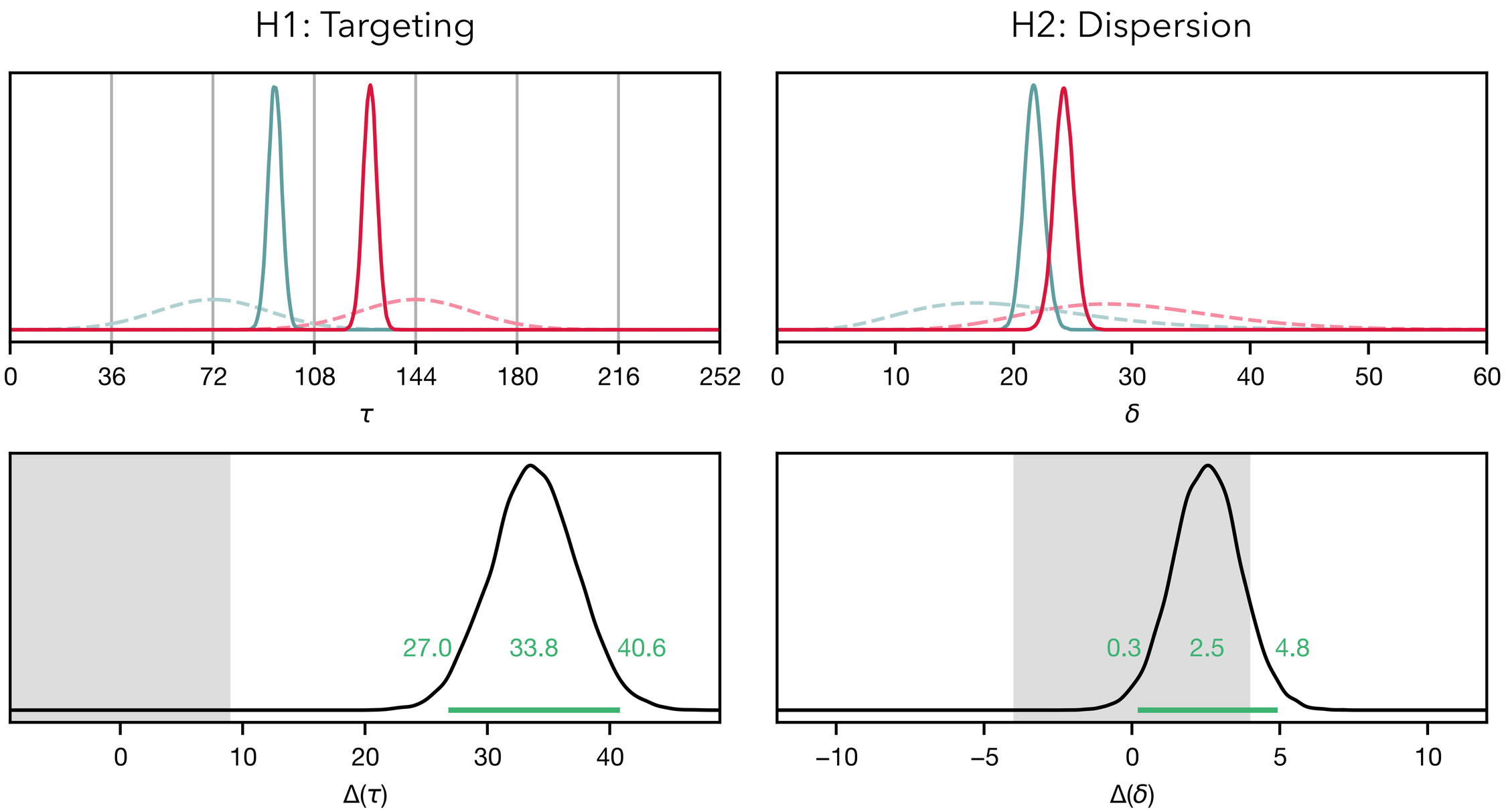
SVEBYNS

Experiment 2




SNYBEVS
initial landing position


SXXXXXXS
SXXXXXXS
0
36
72
108
144
180
216
252
Landing position (pixels)
0
36
72
108
144
180
216
252
Landing position (pixels)


H1: Targeting
H2: Dispersion
0
36
72
108
144
180
216
252
τ
0
10
20
30
40
50
60
δ
27.0
33.8
40.6
0
10
20
30
40
Δ(τ)
0.3
2.5
4.8
−10
−5
0
5
10
Δ(δ)

Perceptual bias *Informational bias*

Expected optimal viewing position

Pattern of eye movements

Perceptual bias *Informational bias*

Expected optimal viewing position

Pattern of eye movements

Model
Explore how perceptual and information biases interact, and make cross-linguistic predictions about the EOVP

Perceptual bias *Informational bias*

Expected optimal viewing position

Pattern of eye movements

Model
Explore how perceptual and information biases interact, and make cross-linguistic predictions about the EOVP

Experiment 1
Proof of concept of using artificial languages to explore OVP effects, and estimate the parameters of the visual span

Perceptual bias *Informational bias*

Expected optimal viewing position

Pattern of eye movements

Model
Explore how perceptual and information biases interact, and make cross-linguistic predictions about the EOVP

Experiment 1
Proof of concept of using artificial languages to explore OVP effects, and estimate the parameters of the visual span

Experiment 2
Causal demonstration that the statistical structure of the lexicon ultimately influences eye movements

Eskerrik asko!