

Focal striatum lesions impair decision threshold adjustments in humans

... a little later today



Birte Forstmann
Jasper Winkel

Accumulation versus urgency

Why evidence accumulation is required to
explain reaction time data



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Jasper Winkel

Model-in-the-middle

Behavioral data

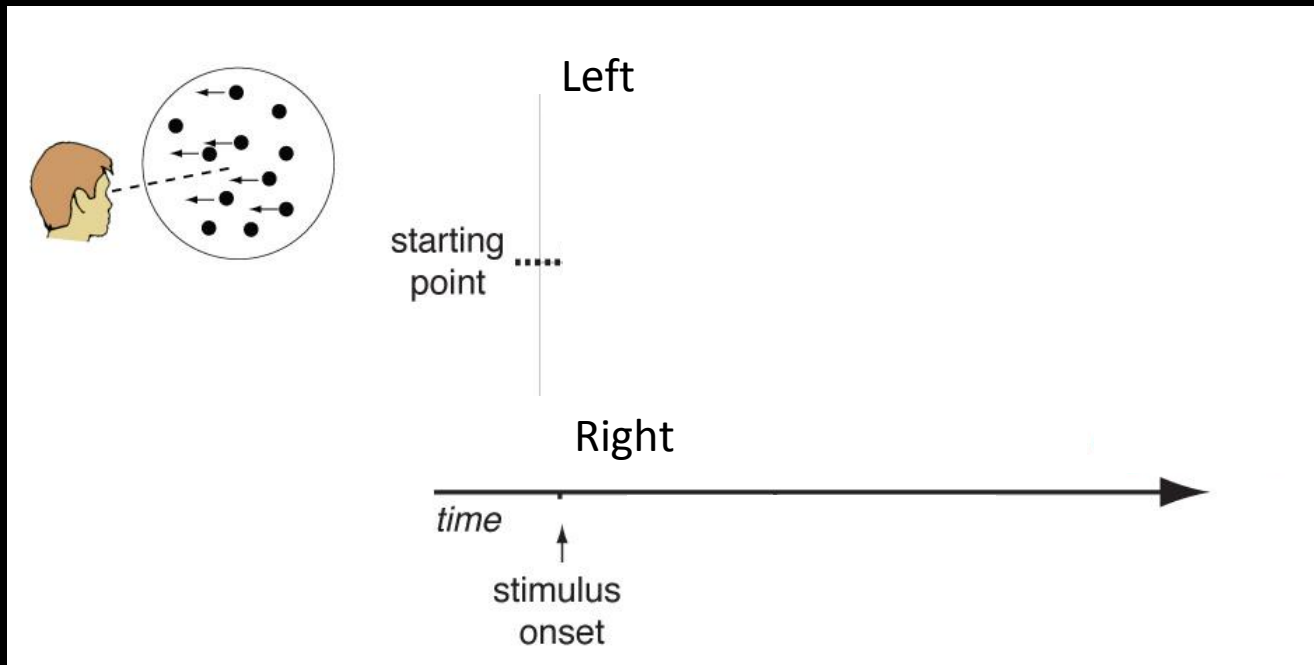


Introduction

- How do we make decisions?
 - Collect evidence or decide based on urgency?
- Compare two models of decision making
 - Drift diffusion model (Ratcliff, 1978)
 - Urgency gating model (Cisek et al., 2009)

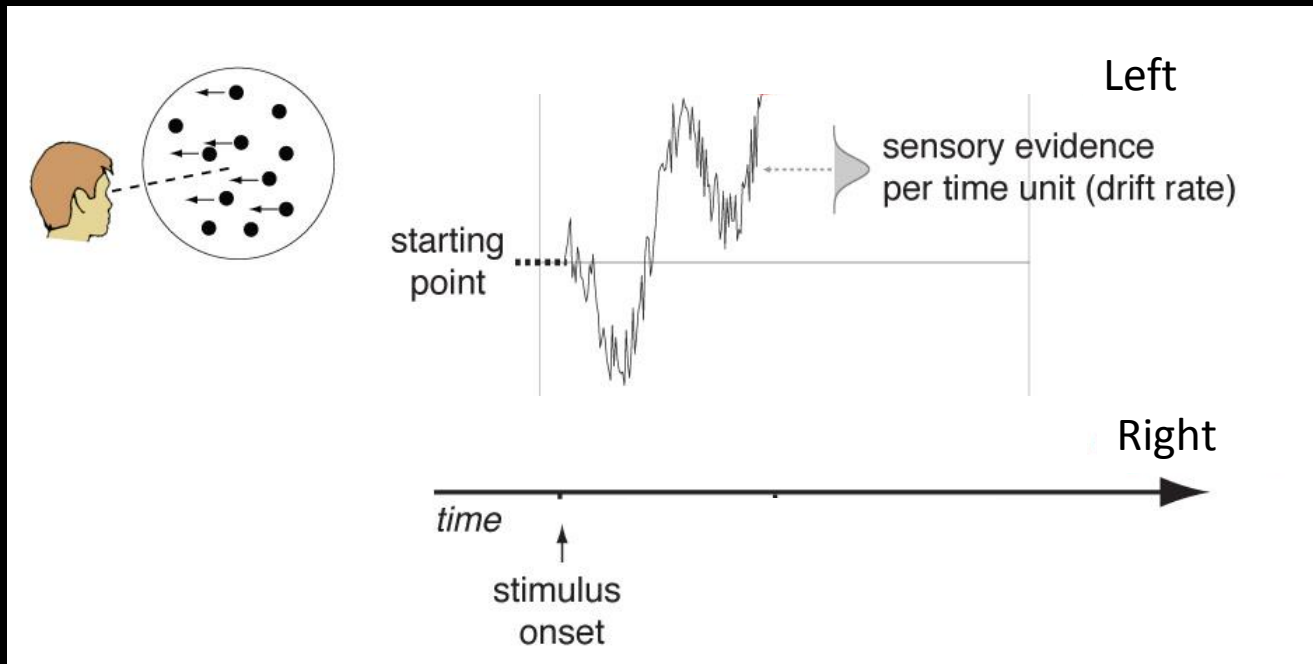
Introduction

- Drift diffusion model:
Choice RT based on evidence accumulation



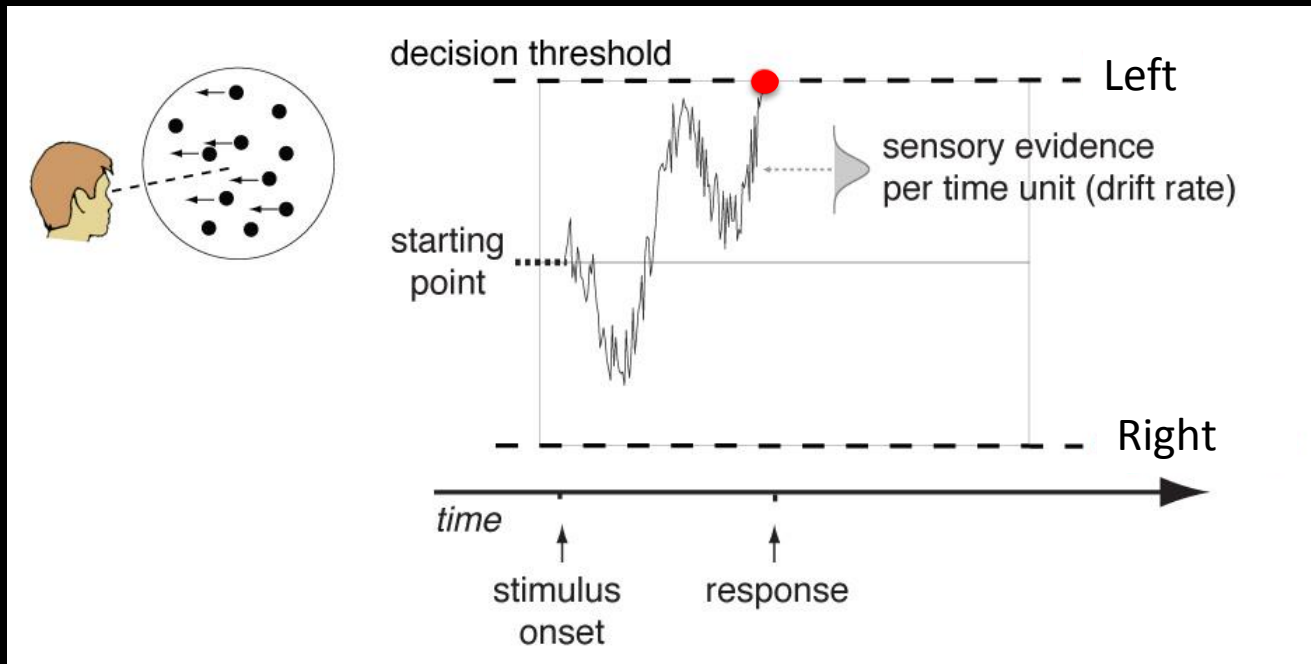
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Choice RT based on evidence accumulation



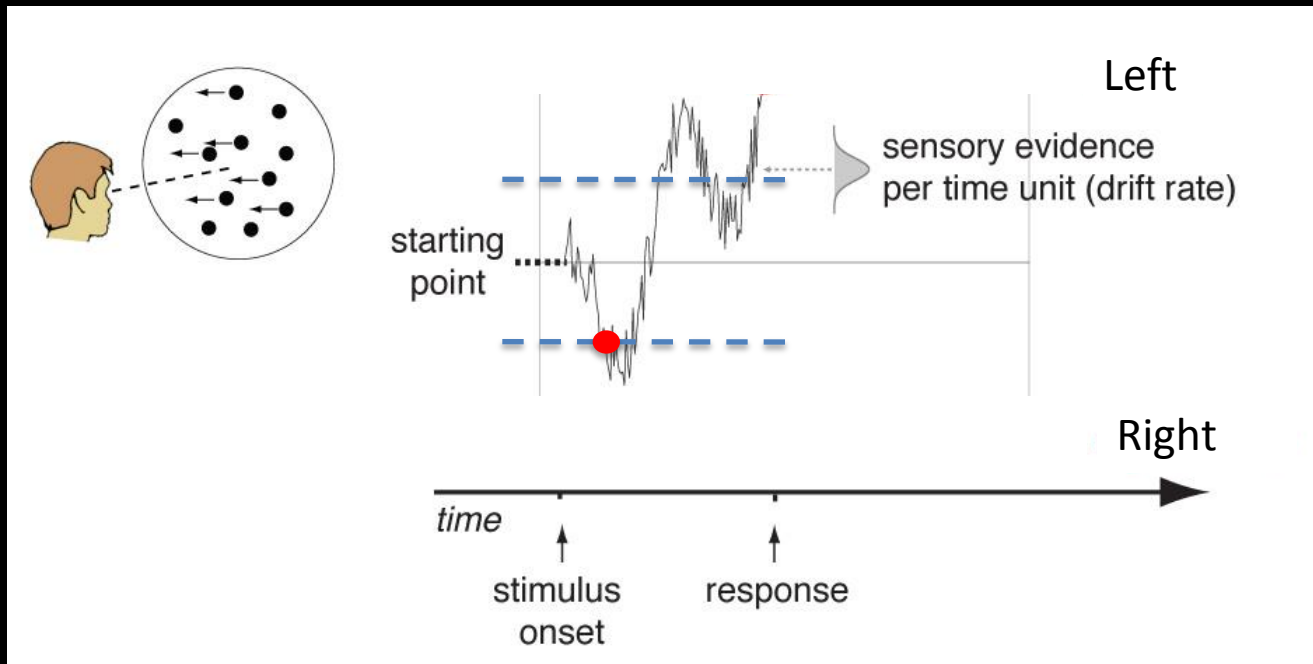
Introduction

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Introduction

- Drift diffusion model:
Choice RT based on evidence accumulation

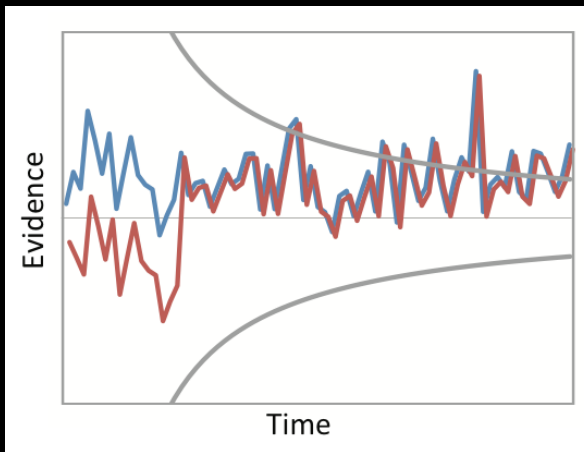


Introduction

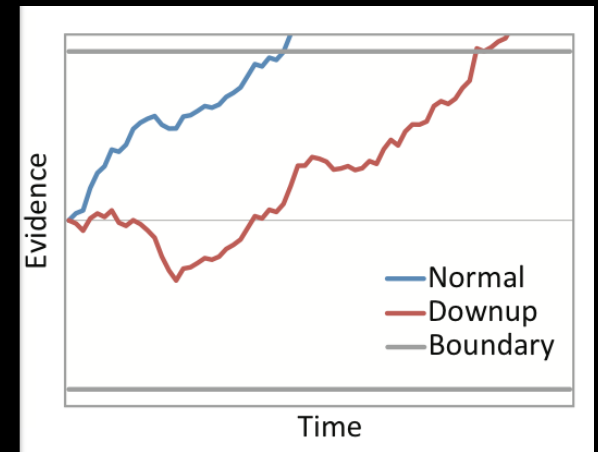
- Urgency gating model:
No evidence accumulation, choice RT
explained by urgency

Introduction

Urgency gating



Drift diffusion

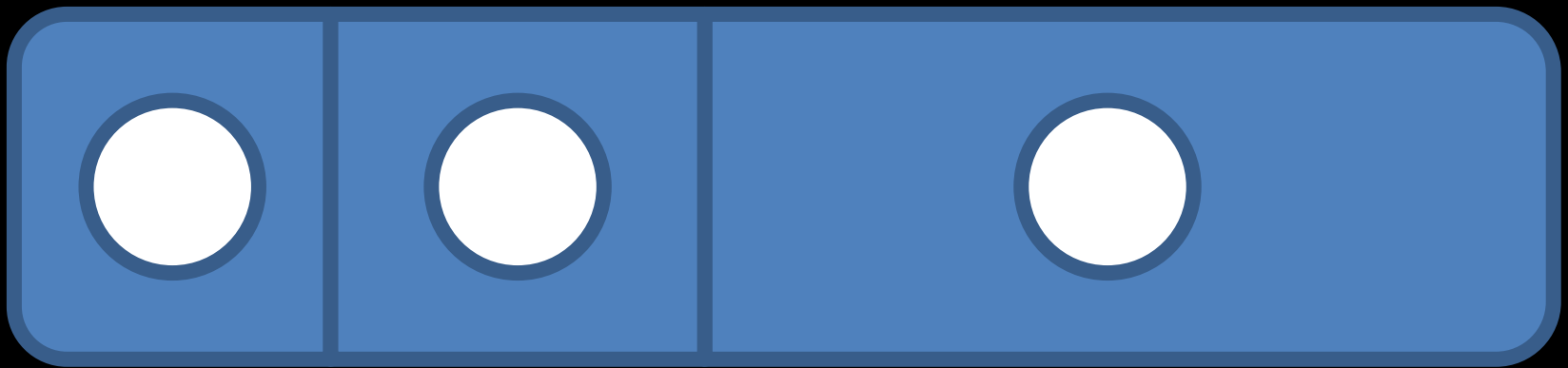


Methods

- Behavioral experiment
- Random Dot Motion task
- 22 subjects (19 included)
- 1000 trials, 9 trial types (varying evidence)

Methods

- Vary coherence within a trial



Methods

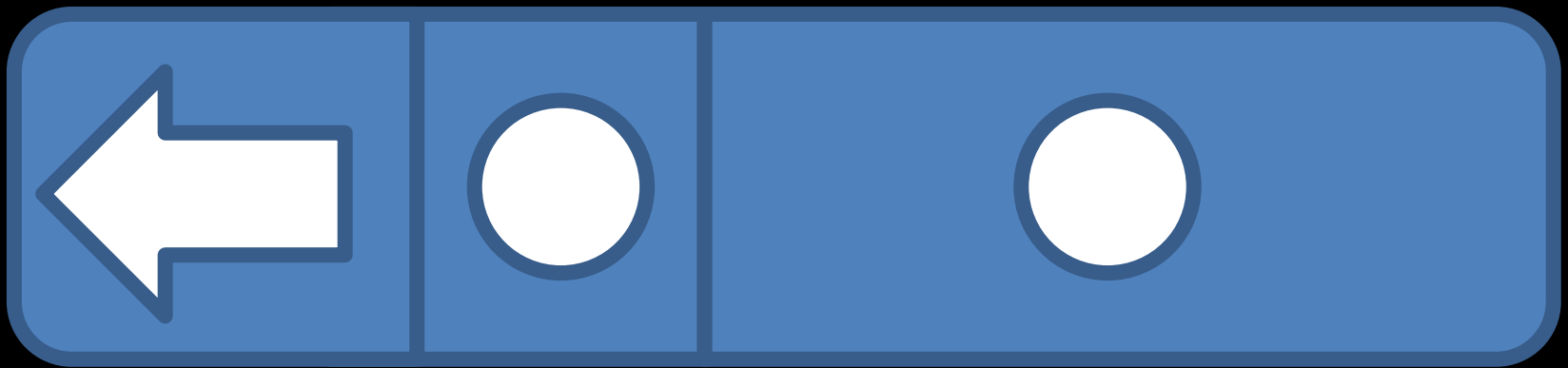
- Vary coherence within a trial



- Early information

Methods

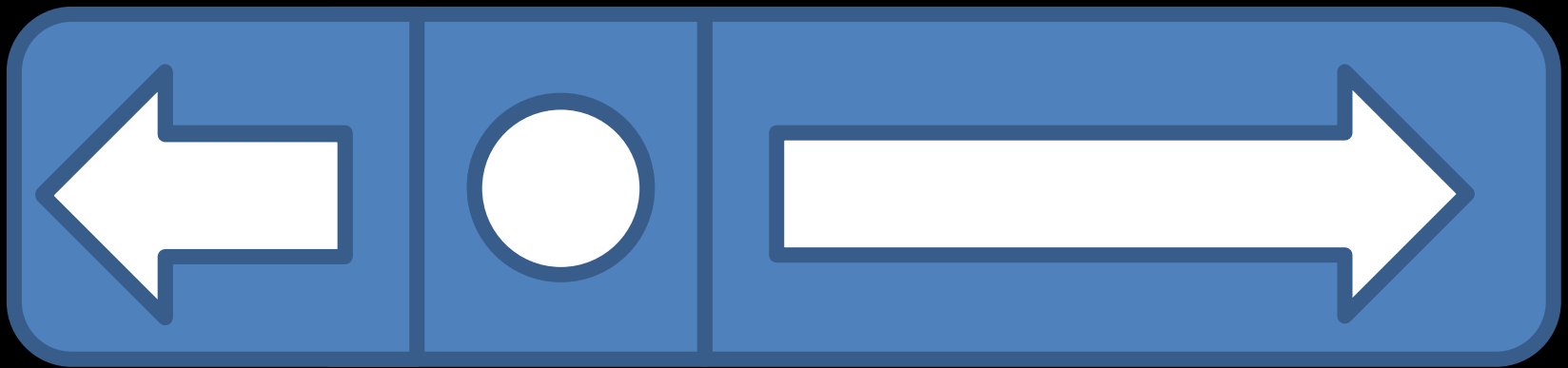
- Vary coherence within a trial



- Duration

Methods

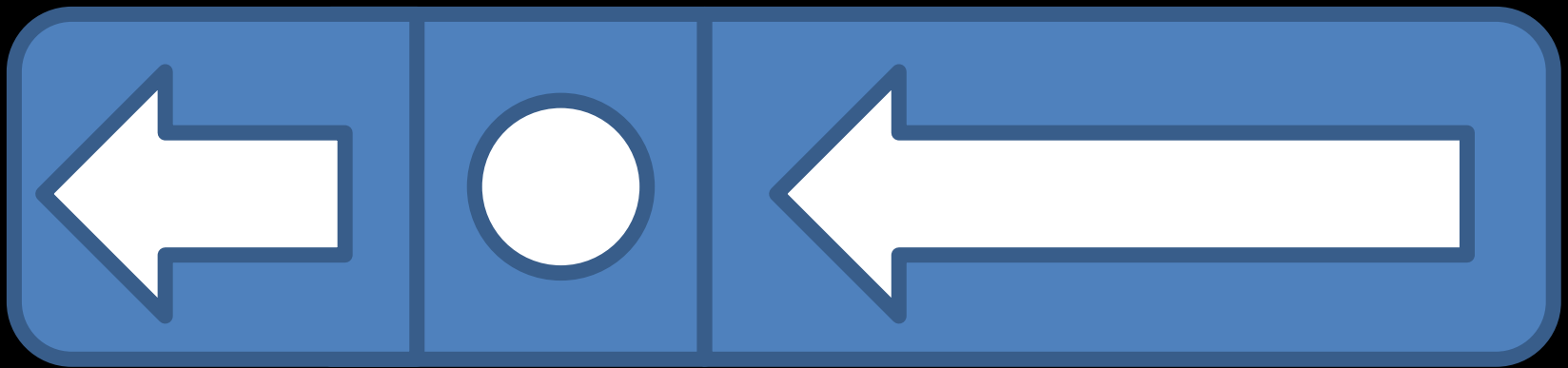
- Vary coherence within a trial



- Late information

Methods

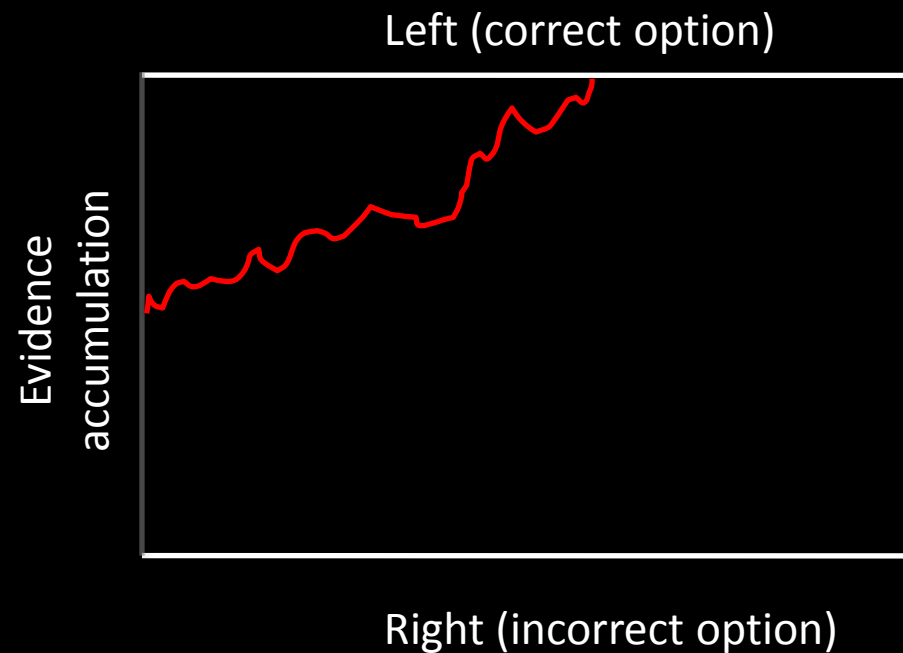
- Vary coherence within a trial



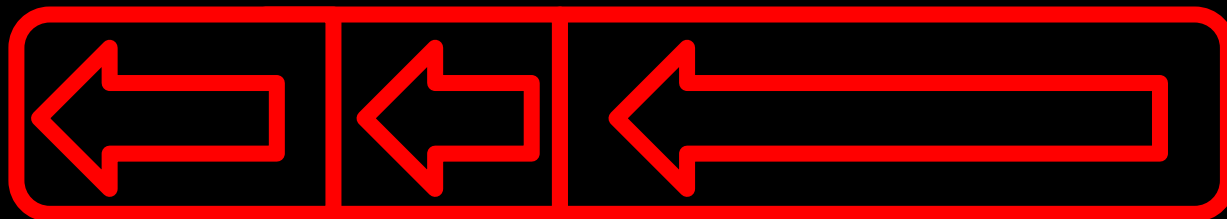
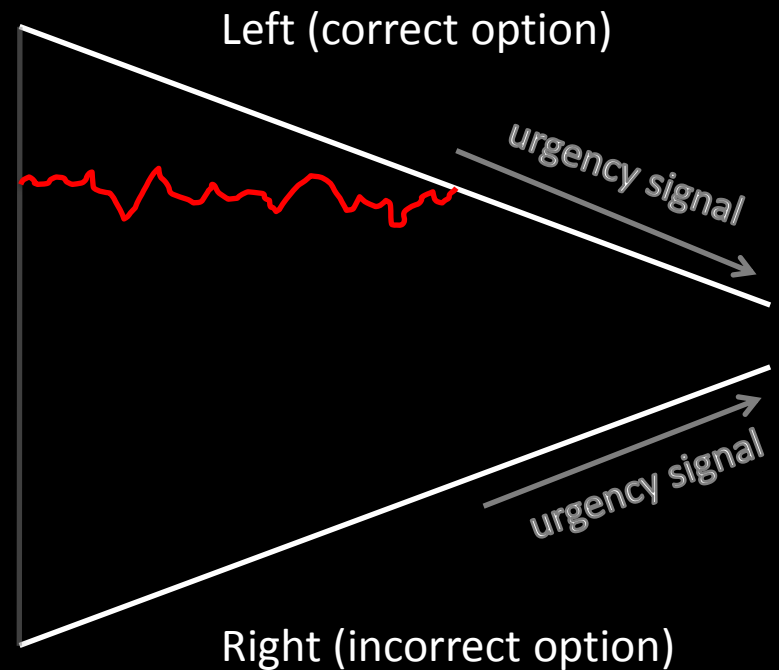
- Direction

Predictions

Drift diffusion

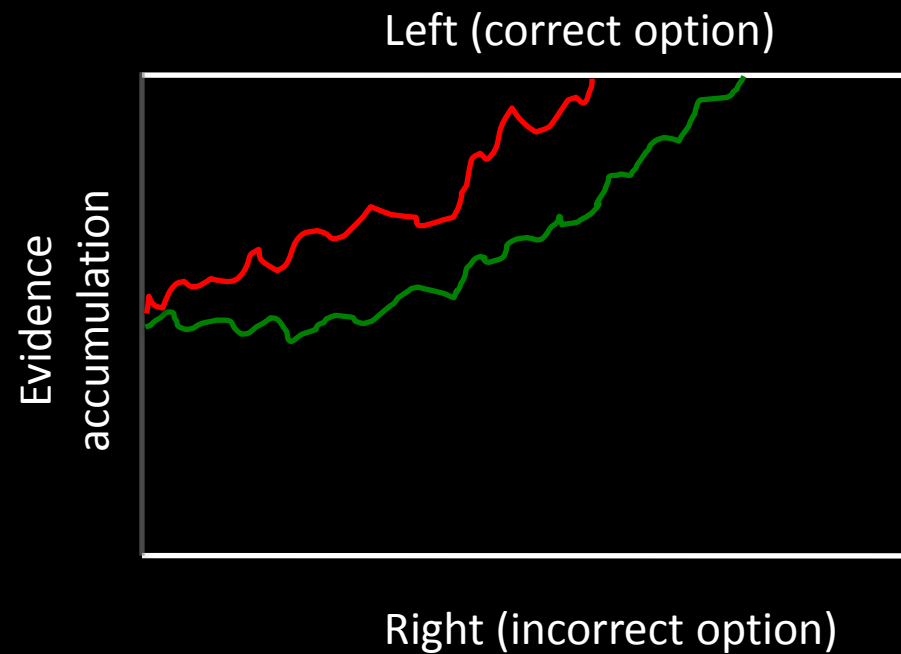


Urgency gating

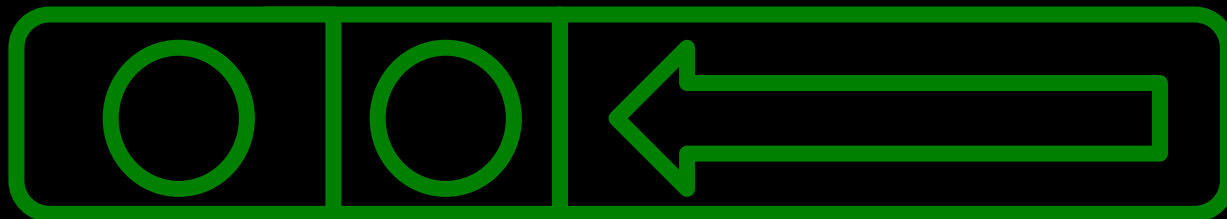
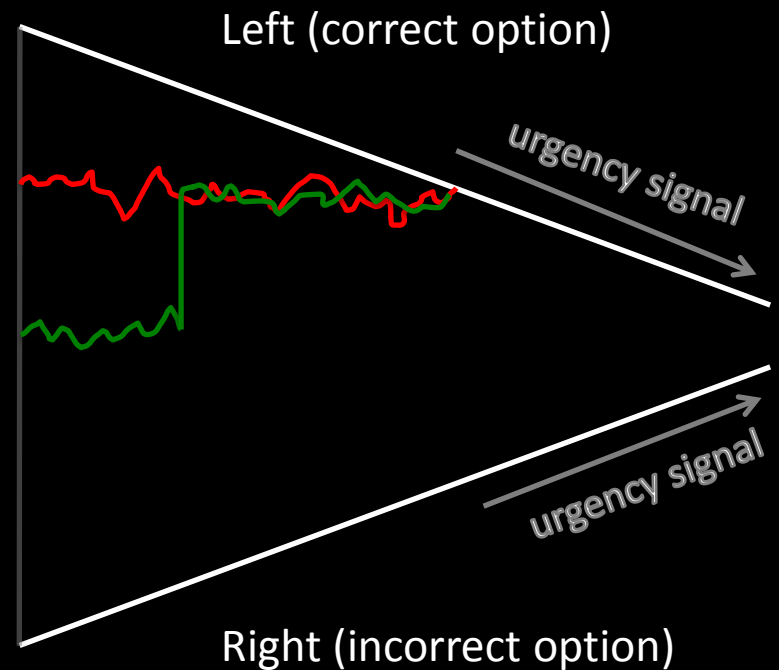


Predictions

Drift diffusion



Urgency gating

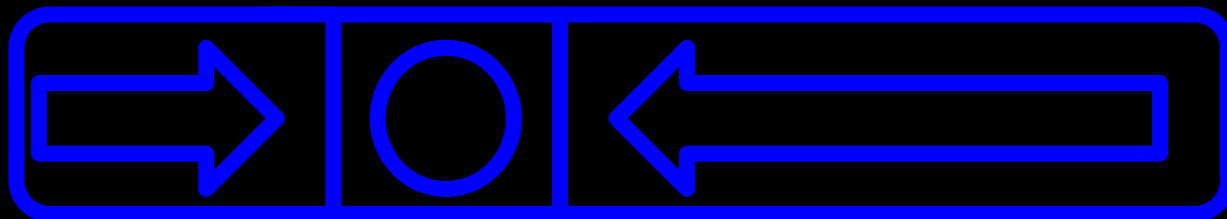
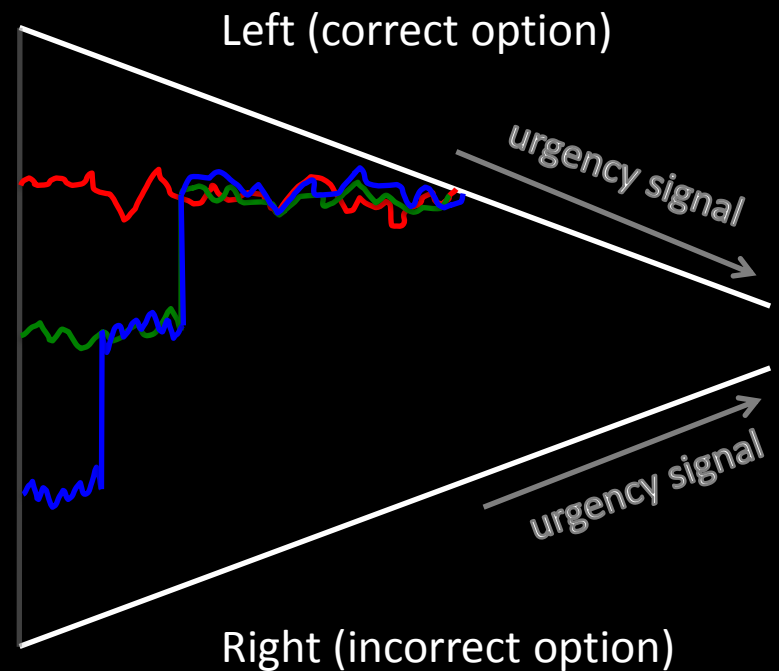


Predictions

Drift diffusion



Urgency gating

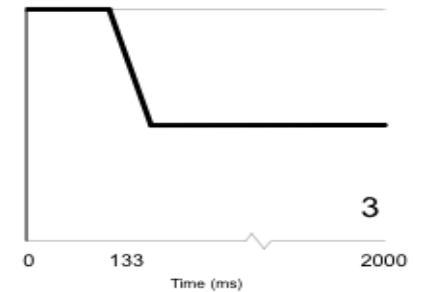
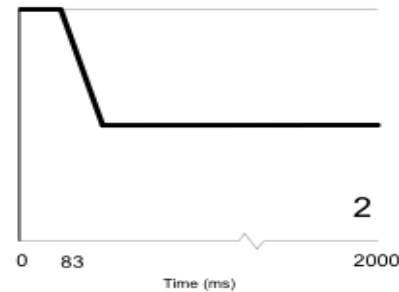
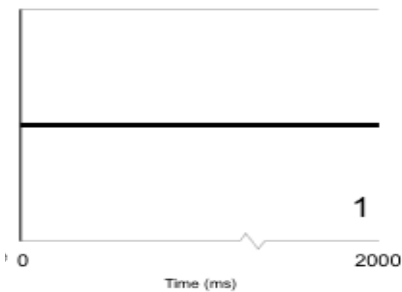


Methods

Evidence for the
correct alternative

No evidence for
either option

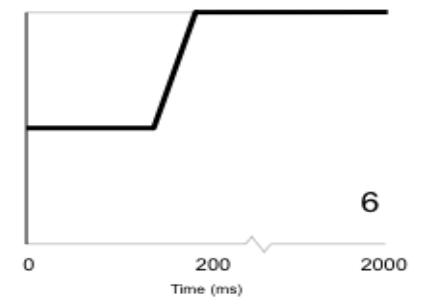
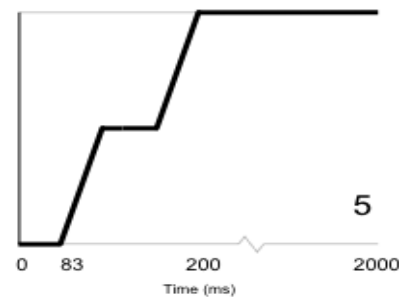
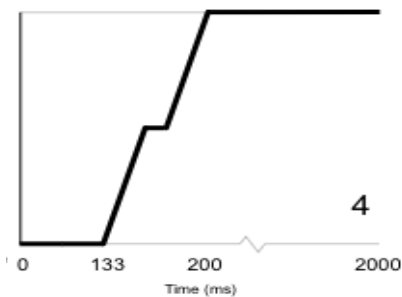
Evidence for the
incorrect alternative



Evidence for the
correct alternative

No evidence for
either option

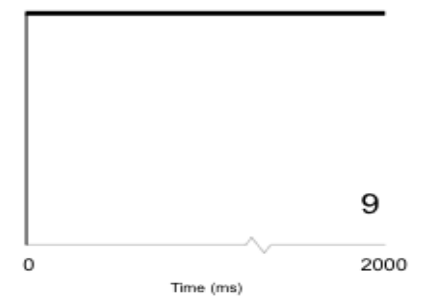
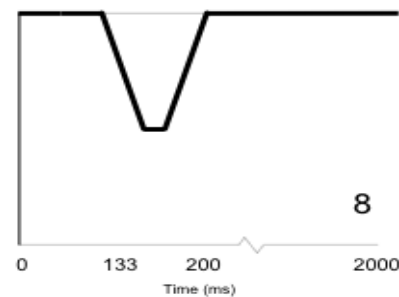
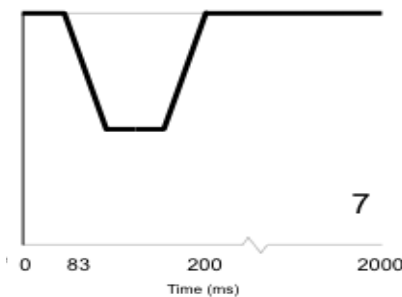
Evidence for the
incorrect alternative



Evidence for the
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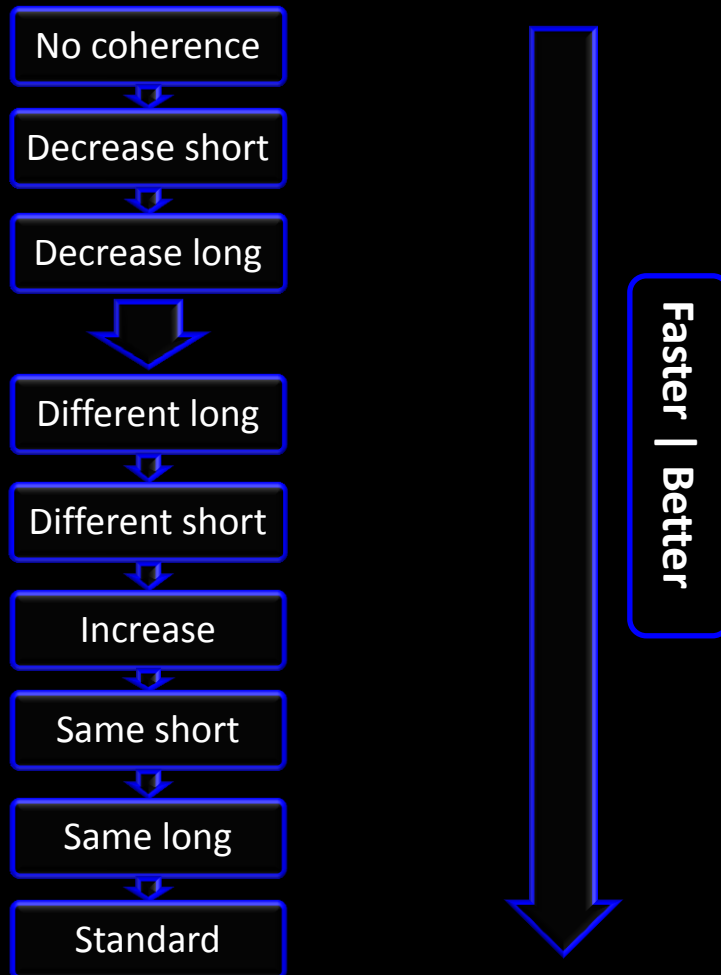
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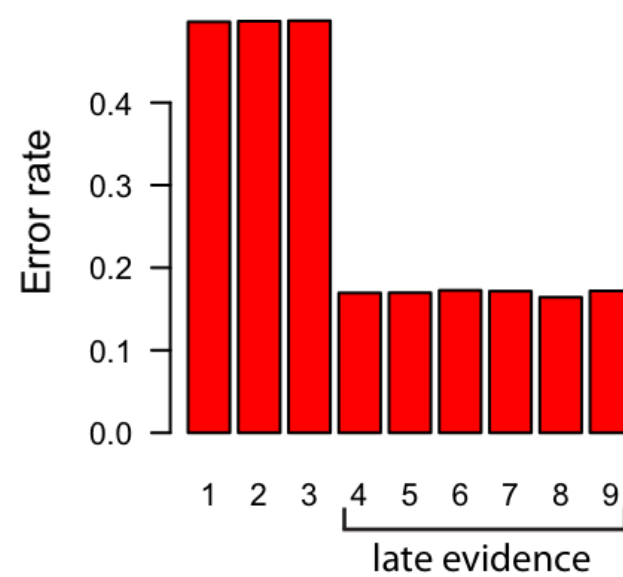
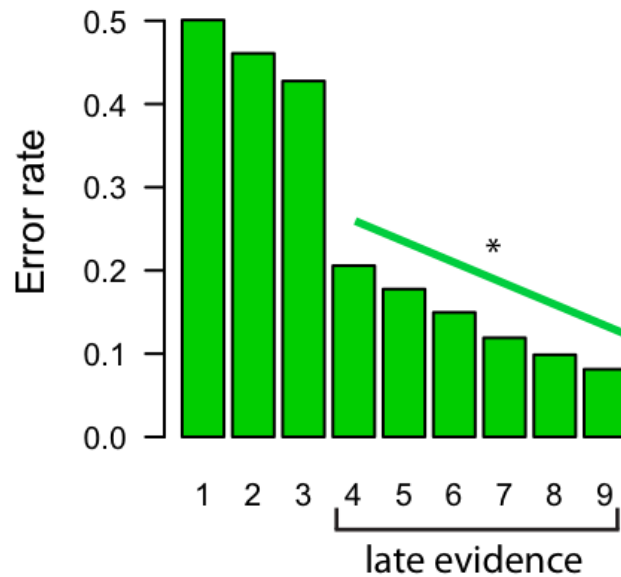
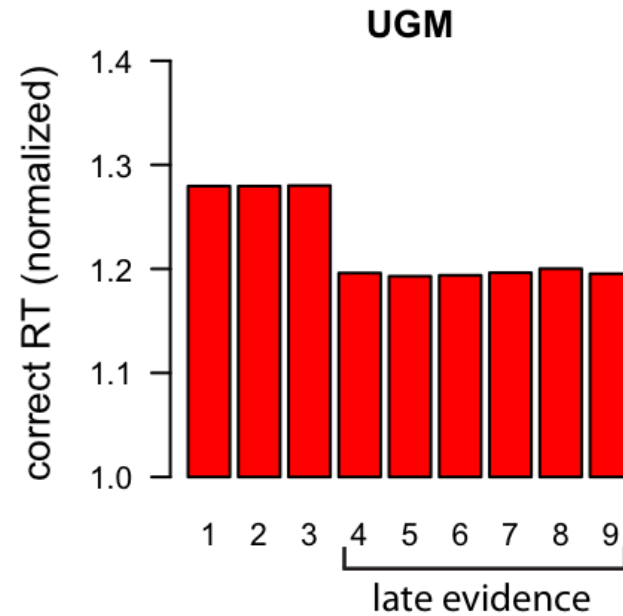
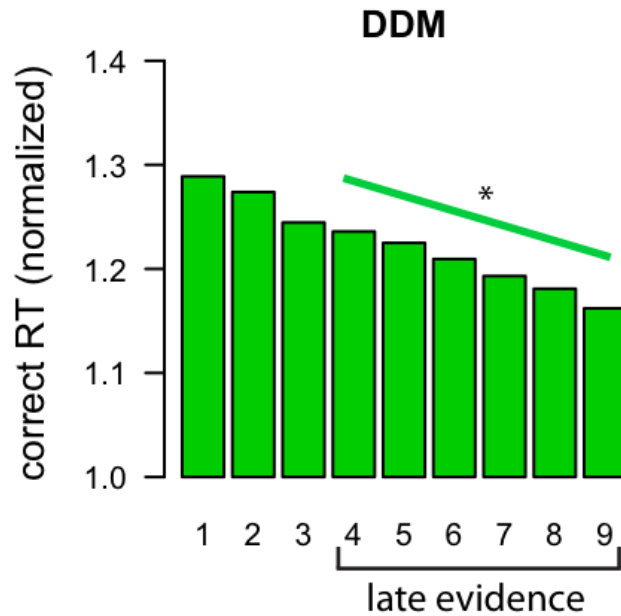


Predictions

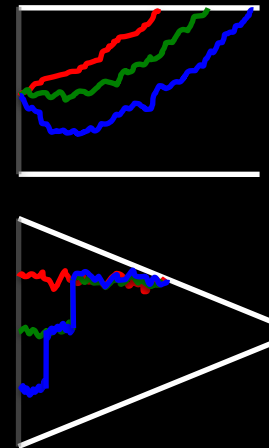
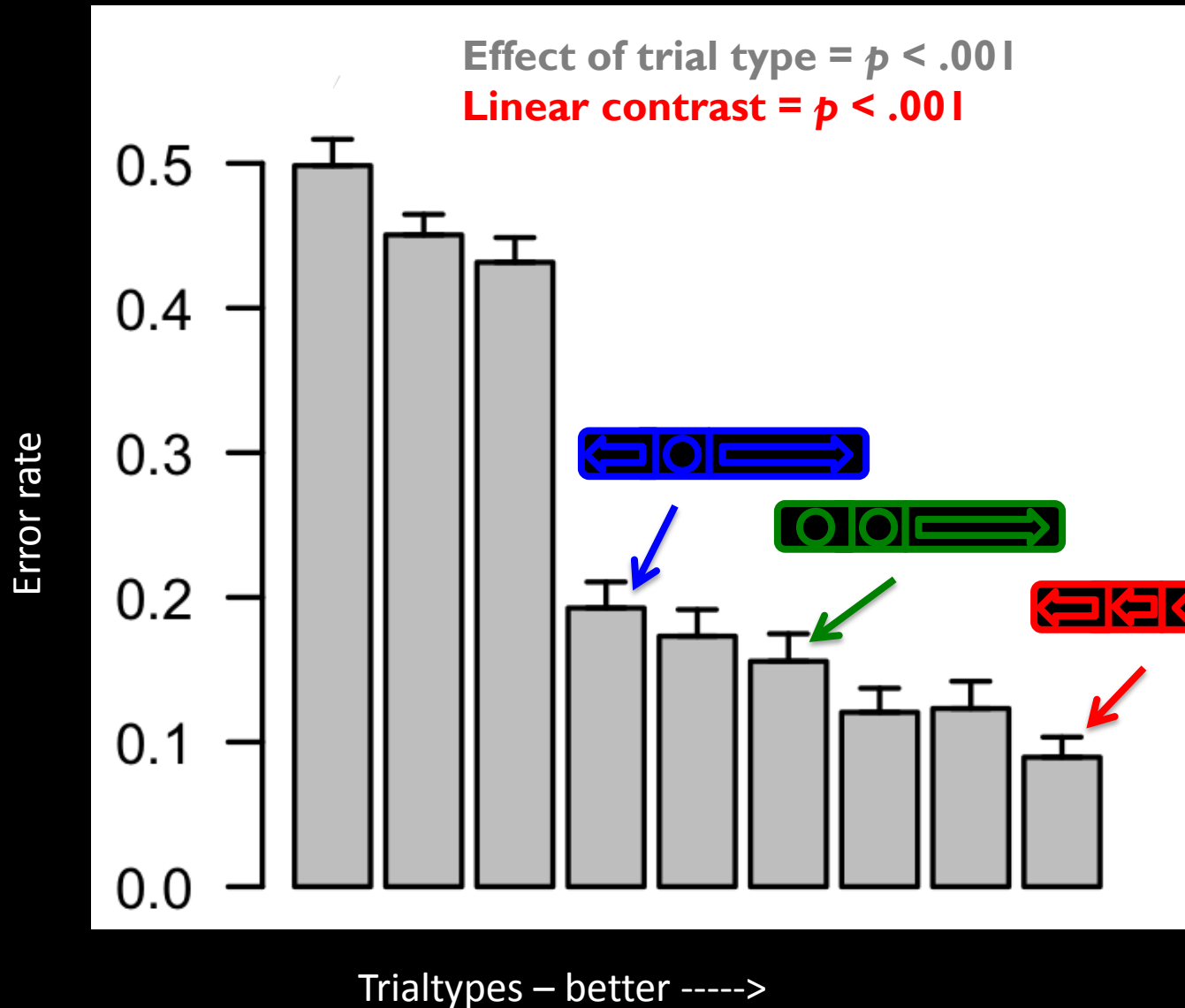
Drift diffusion



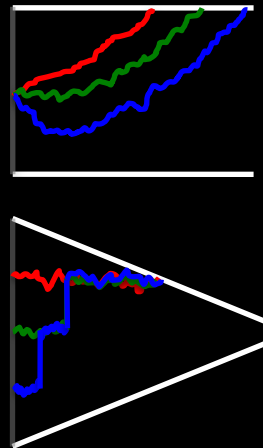
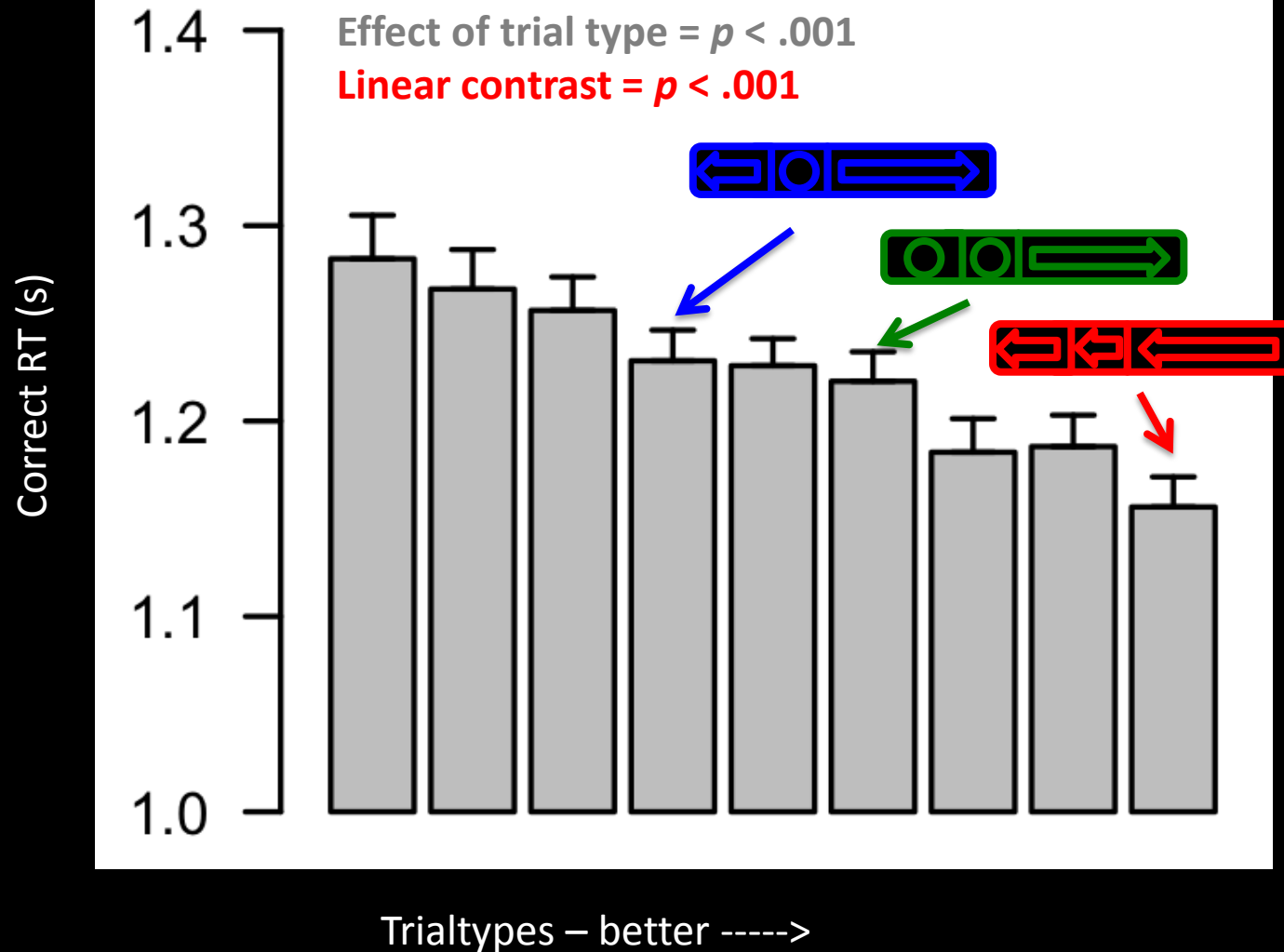
Predictions



Results



Results



Conclusion

- Early information contributes to later choice and RT
- Urgency cannot replace accumulation as an explanation of choice RT



Jasper
Winkel



Max
Keuken

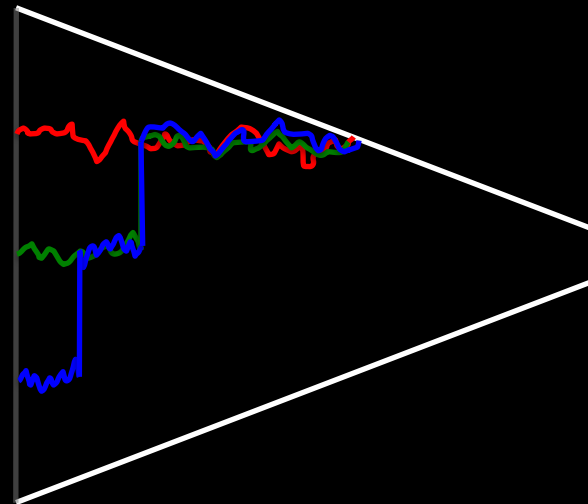
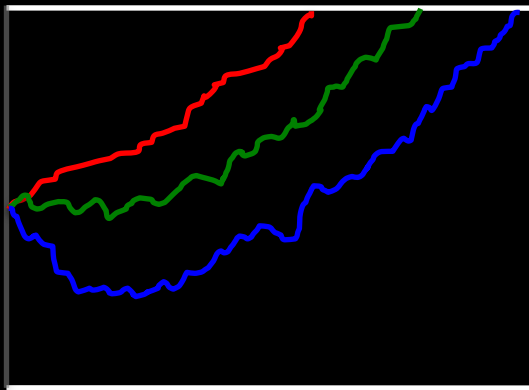


Leendert
van Maanen



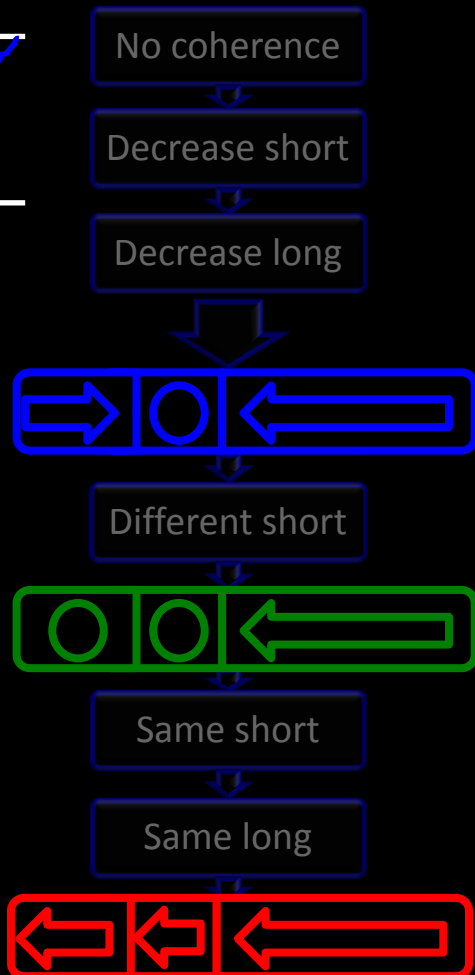
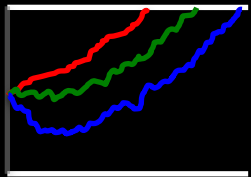
Eric-Jan
Wagenmakers

Thanks!

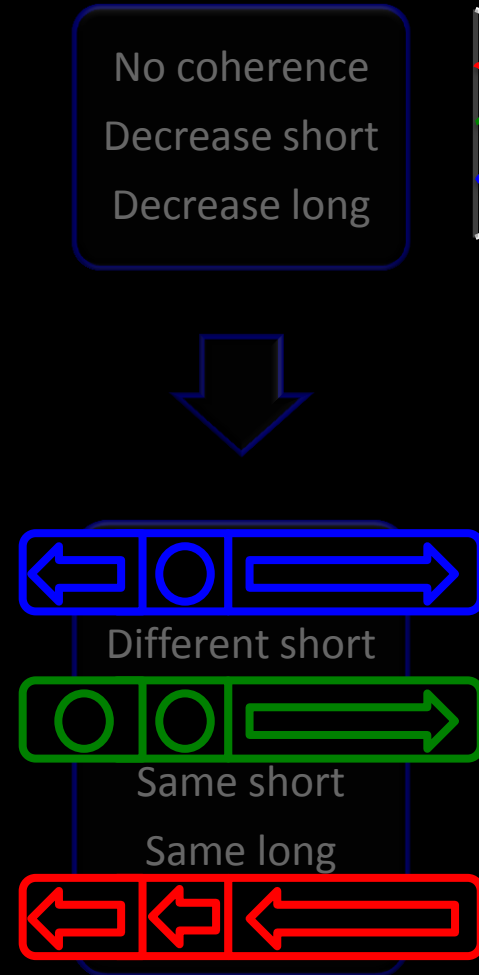
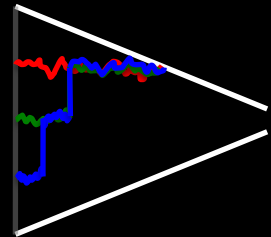


Predictions

Drift diffusion



Urgency gating



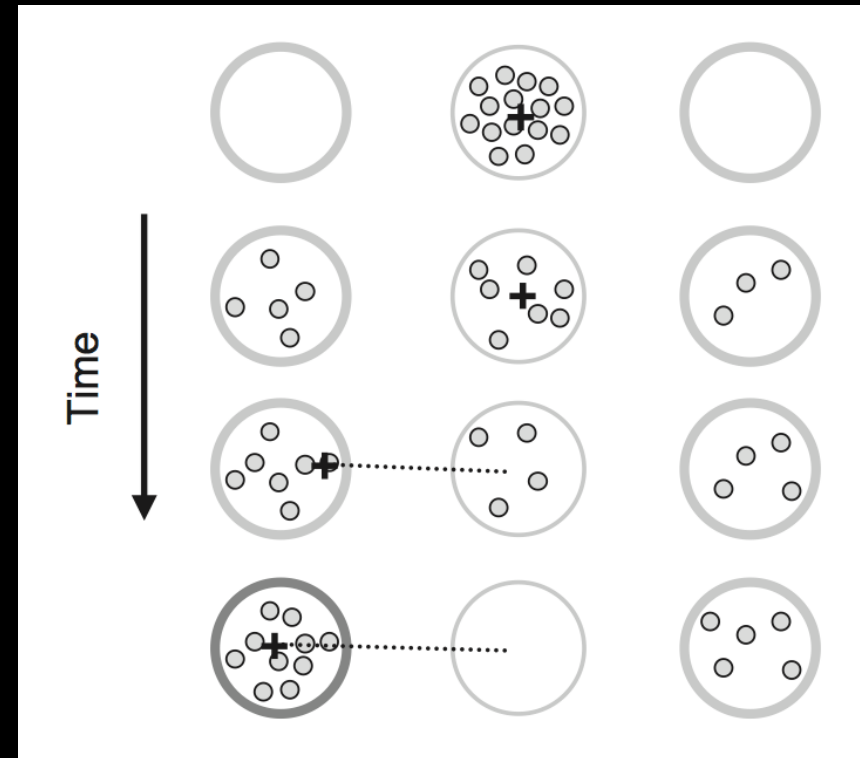
Trial types – Faster/Better

Discussion

- Conclusions:
- Early information contributes to later choice
- Urgency cannot replace accumulation as an explanation of choice RT
- Then why did the behavioral data suggest it can? (Cisek, 2009)

Discussion

- The task used:
Information accumulates on the screen
- Model uses 'current' (i.e. accumulated) info as input
- Experiment not suited to test the claims made



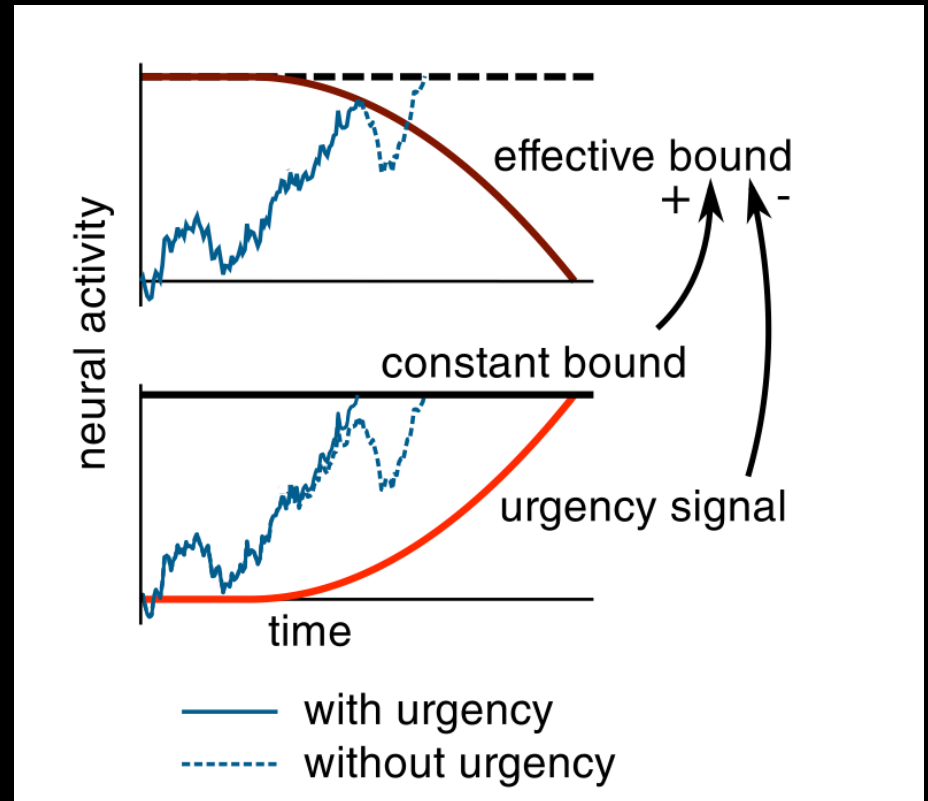
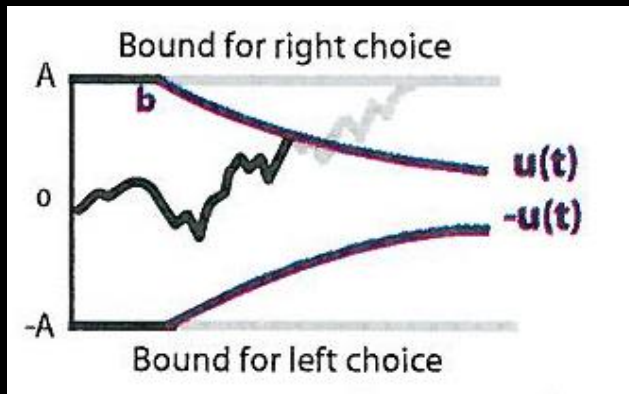
Discussion

- Urgency Gating Model cannot replace accumulation, but there is room for urgency in accumulation models.

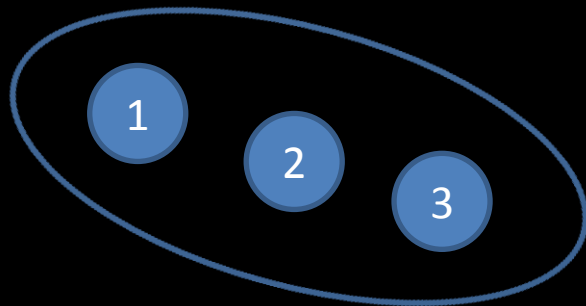
Ditterich, 2006

Kira & Shadlen, 2010

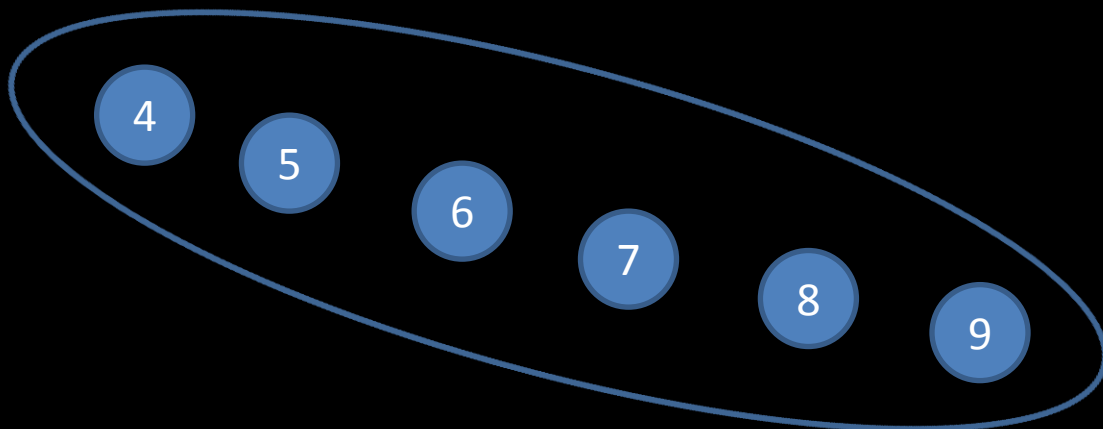
Drugowitsch et al., 2012



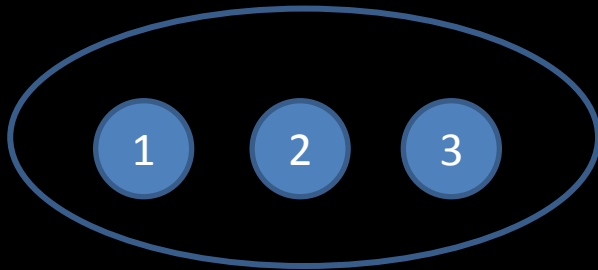
Results - caveat



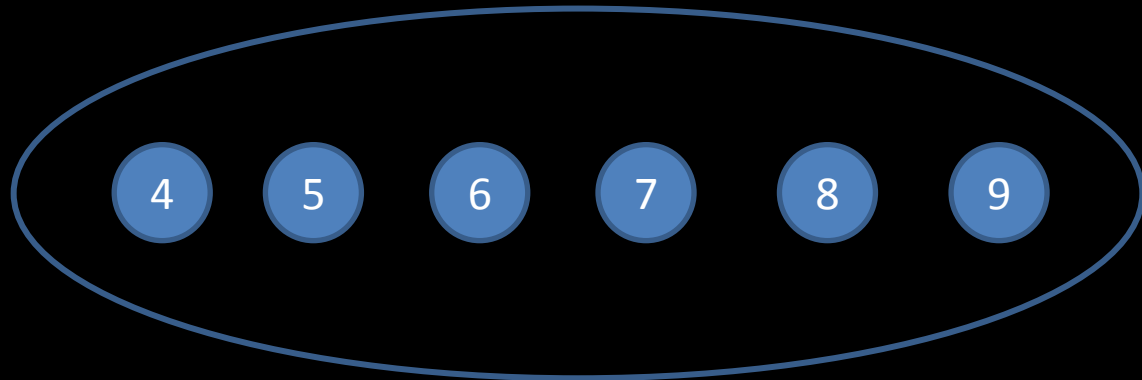
Drift diffusion predicts effect of trial type and monotonous relation within group



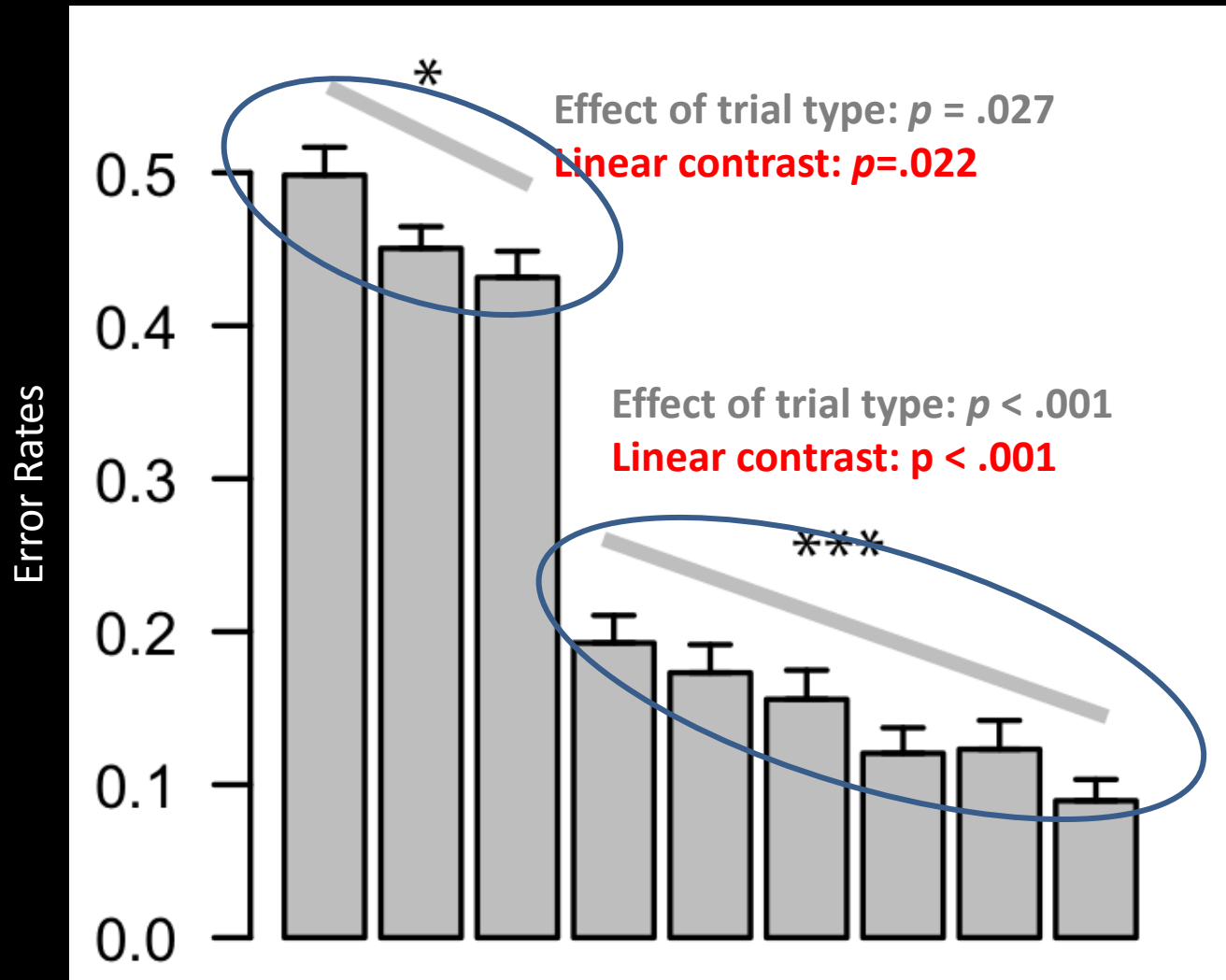
Results - caveat



Urgency gating predicts no effect of trial type or monotonous relation within group

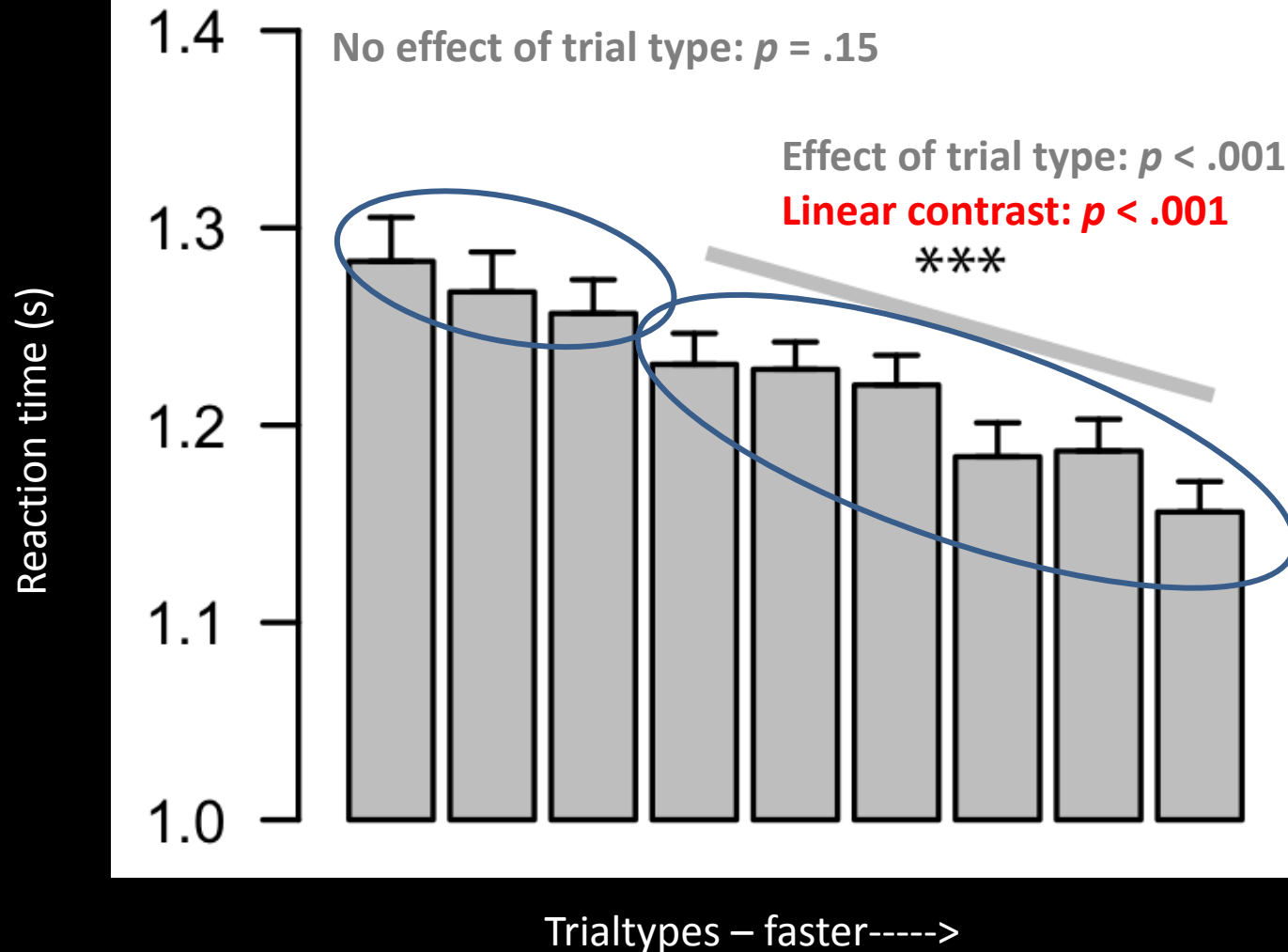


Results: verification



Trialtypes – better ----->

Results: verification



Methods (supplement I)

- Subjects performed a calibration task, so that each received the coherence at which they perform 80% of the trials correctly.
- Responses were made using force buttons, to allow us to measure response build-up based on sub-threshold evidence.

Methods (supplement II)

- Early information was provided for 70 or 120 ms, followed by 130 or 80 ms of no coherence.
- Most subjects did not perceive the early information, as shown by few early responses, and exit interviews. Incorporating awareness as between-subjects factor did not alter the pattern of effects.

Methods (supplement III)

- DDM

$$x(t + \Delta t) = x(t) + \mu(t) + c, \quad c \sim N(0, \sigma), \quad x(0) = a/2$$

- UGM

$$x(t) = t * (\mu(t) + c) + a/2, \quad c \sim N(0, \sigma)$$