



HAL
open science

Generating stimulus anticipation from stimulus and prediction history

Isabelle Hoxha, Clark Bäker, Sylvain Chevallier, Stefan Glasauer, Michel Ange Amorim

► **To cite this version:**

Isabelle Hoxha, Clark Bäker, Sylvain Chevallier, Stefan Glasauer, Michel Ange Amorim. Generating stimulus anticipation from stimulus and prediction history. BC 2022 - Bernstein Conference, Sep 2022, Berlin, Germany. 10.12751/nncn.bc2022.049 . hal-03786876

HAL Id: hal-03786876

<https://hal.science/hal-03786876>

Submitted on 23 Sep 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Generating stimulus anticipation from stimulus and prediction history

Isabelle Hoxha^{1,2}, Clark Baker³, Sylvain Chevallier⁴, Stefan Glasauer⁵, Michel-Ange Amorim^{1,2}

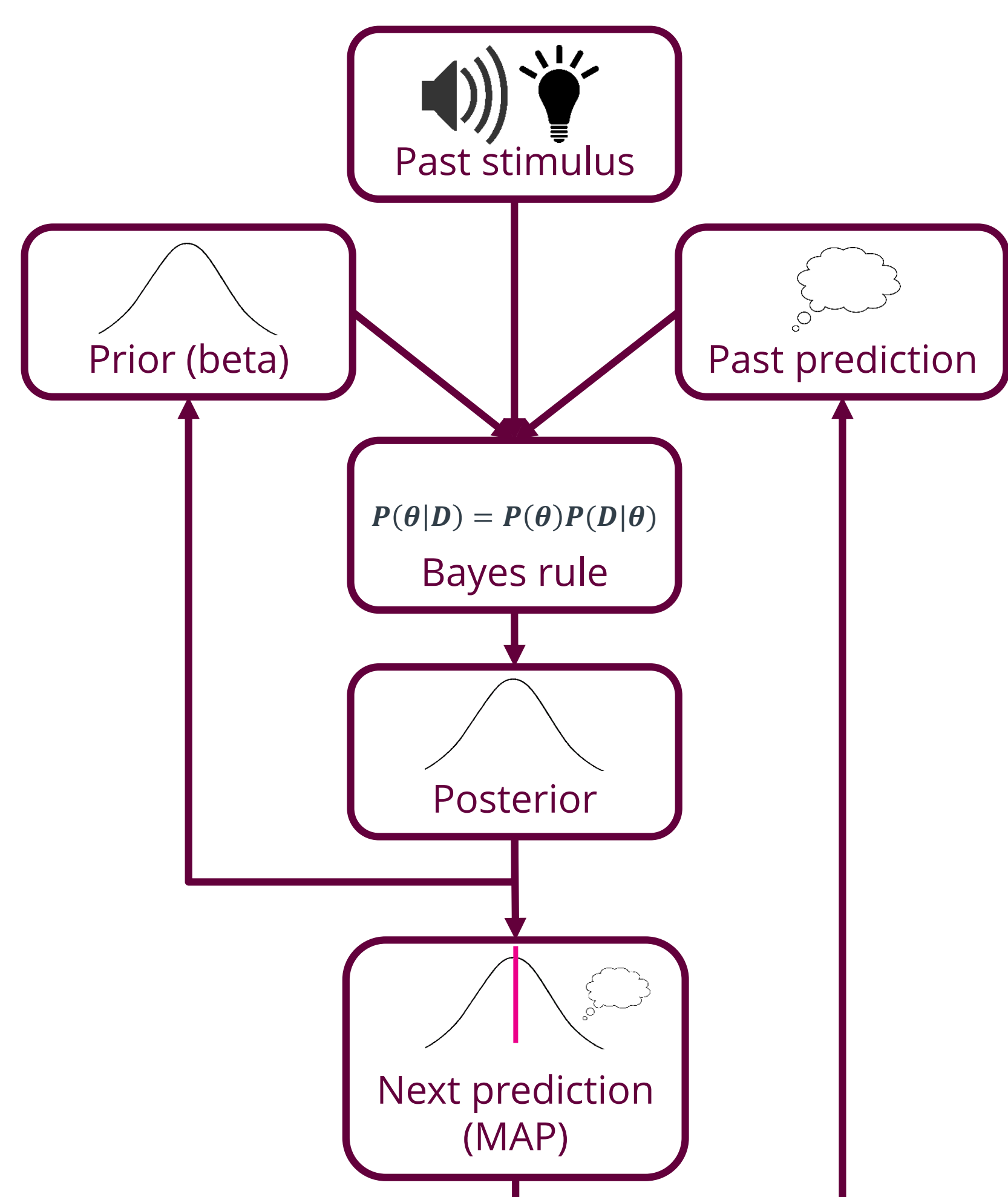
¹CIAMS, Université Paris-Saclay, 91405 Orsay Cedex, France; ²CIAMS, Université d'Orléans, 45067 Orléans, France; ³Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany; ⁴LISV, UVSQ, Vélizy-Villacoublay, France; ⁵Fachgebiet Computational Neuroscience, Brandenburgische Technische Universität Cottbus-Senftenberg, 01968 Senftenberg, Germany

Introduction

Perceptual decisions depend not only on the stimulus, but also on prior expectations, which impact behavior at the single-decision level [1,2,3]. Since predictions are mainly unconscious [4], a generative model of predictions could enhance our understanding of single decisions.

Previous studies have shown that predictions depend on past events [5]. These effects have been modelled through psychometric curves and Bayesian inference [6,7], but only considered past stimuli. Here we assume that the prediction depends on past predictions and stimuli.

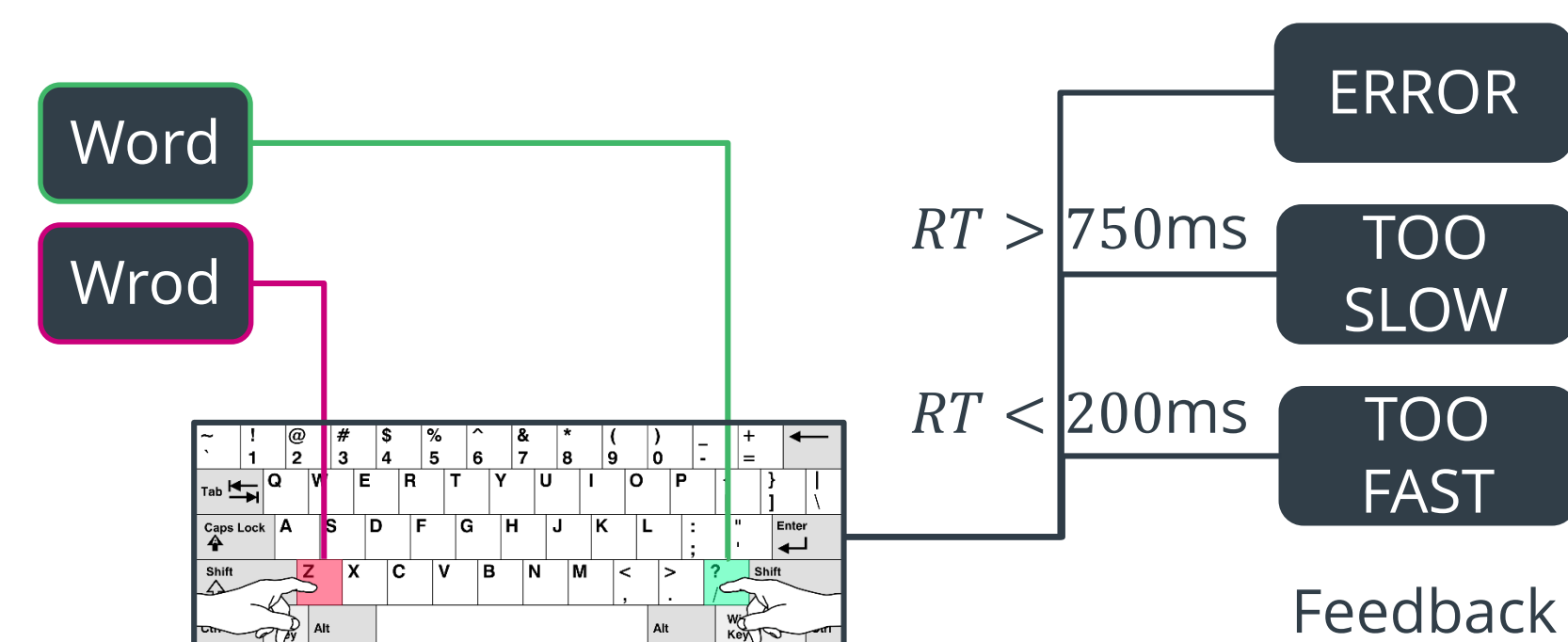
Methods: Bayesian inference



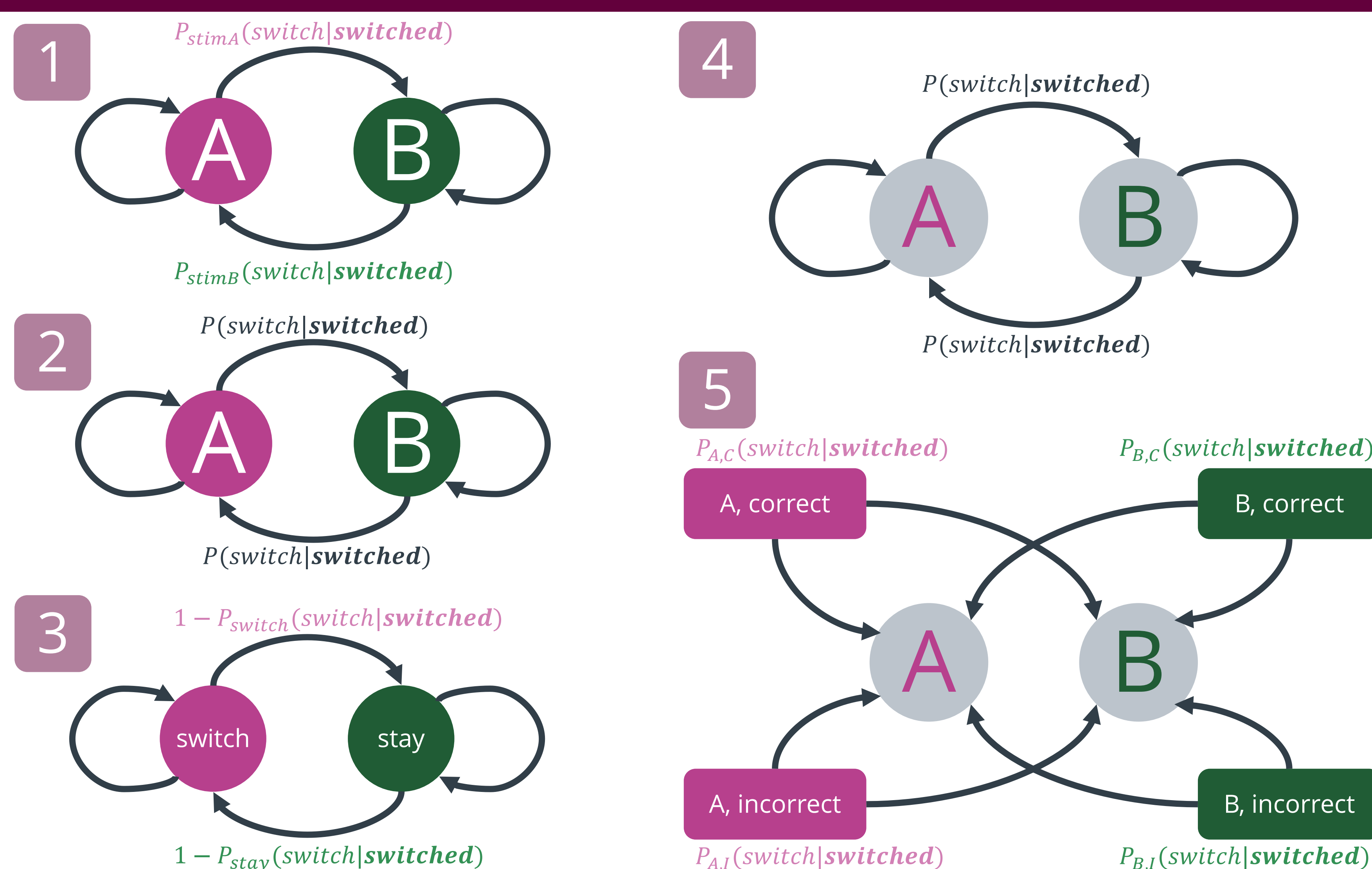
Methods: Paradigm

Dataset collected and published by Wagenmakers et al. (2008) [8]

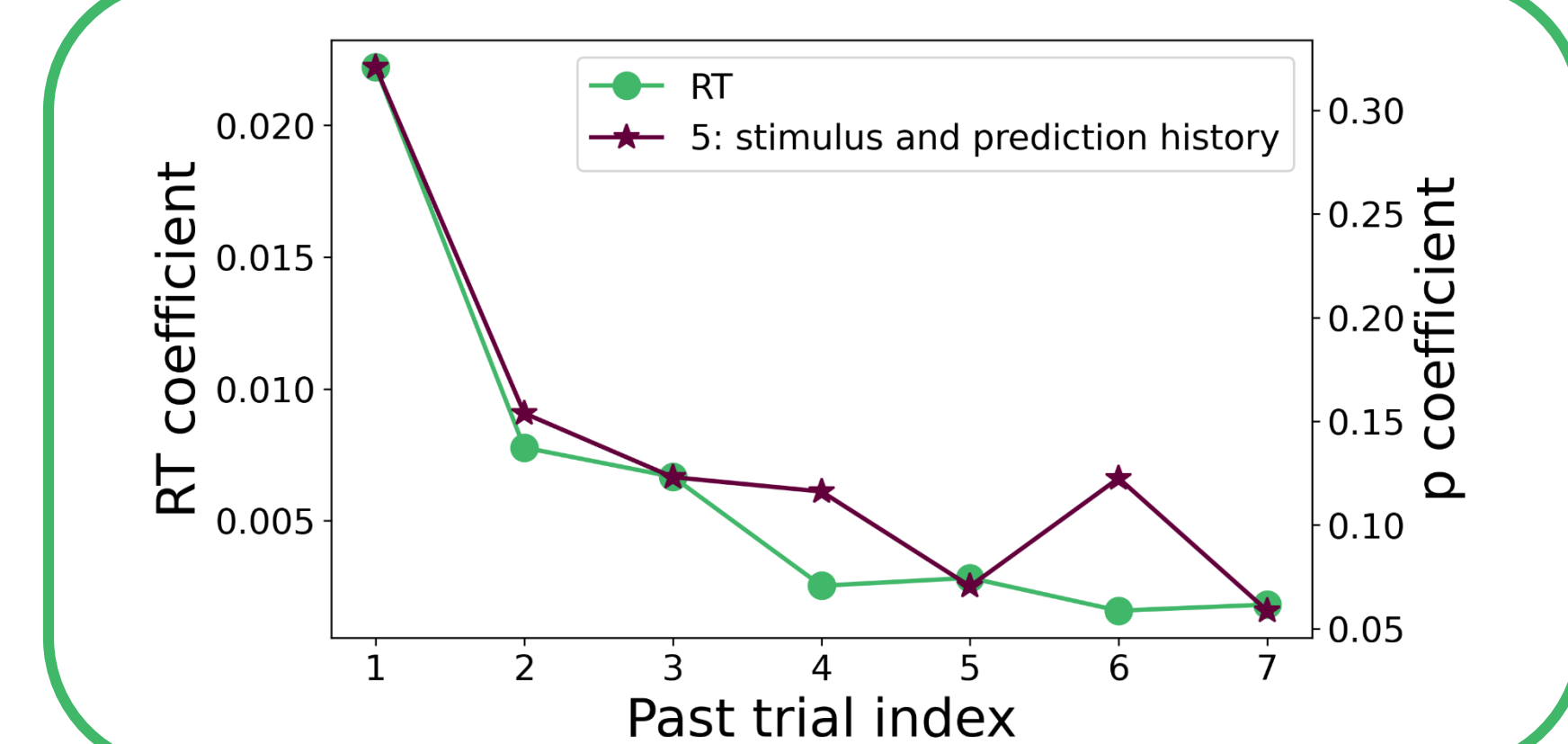
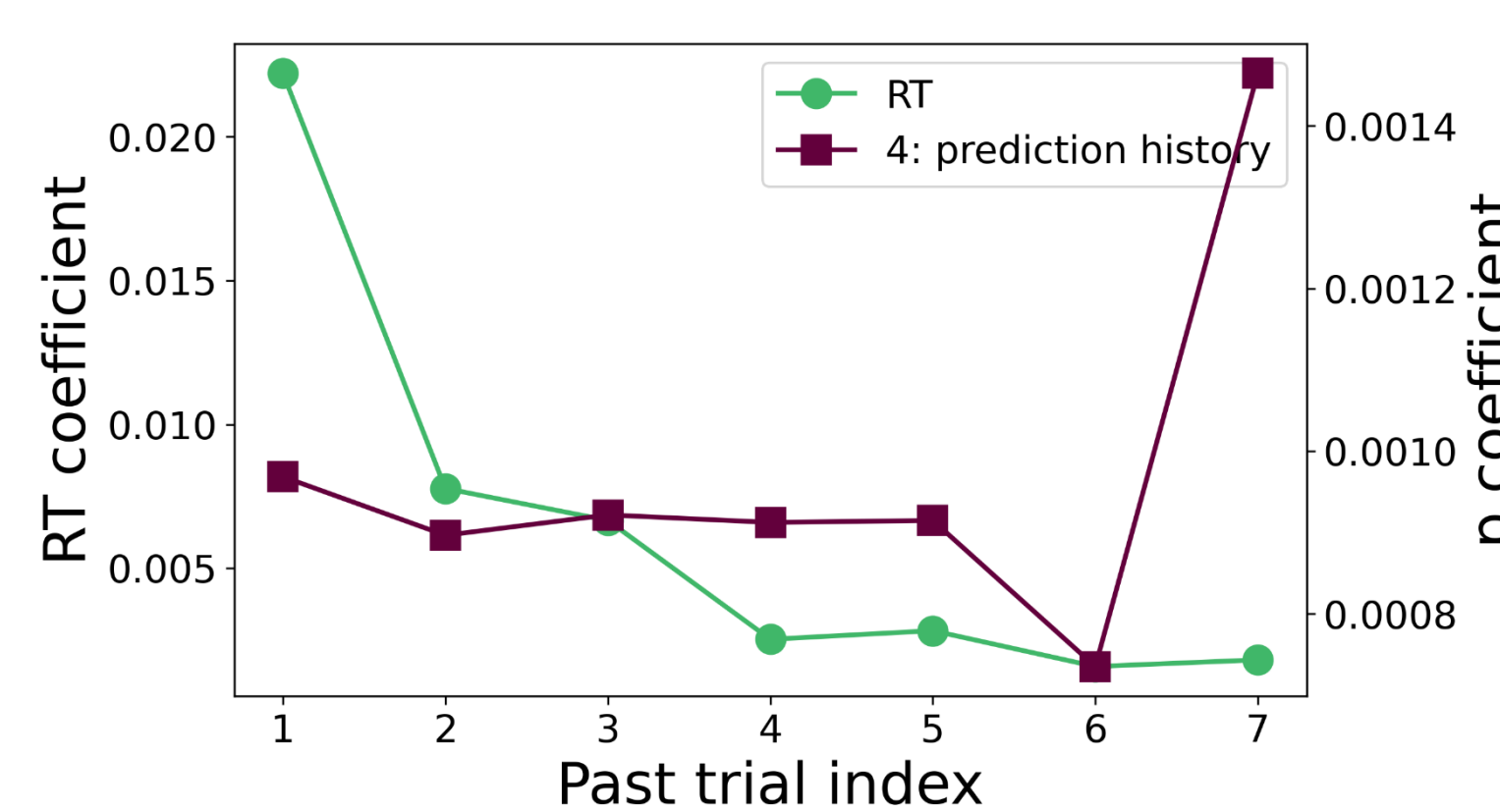
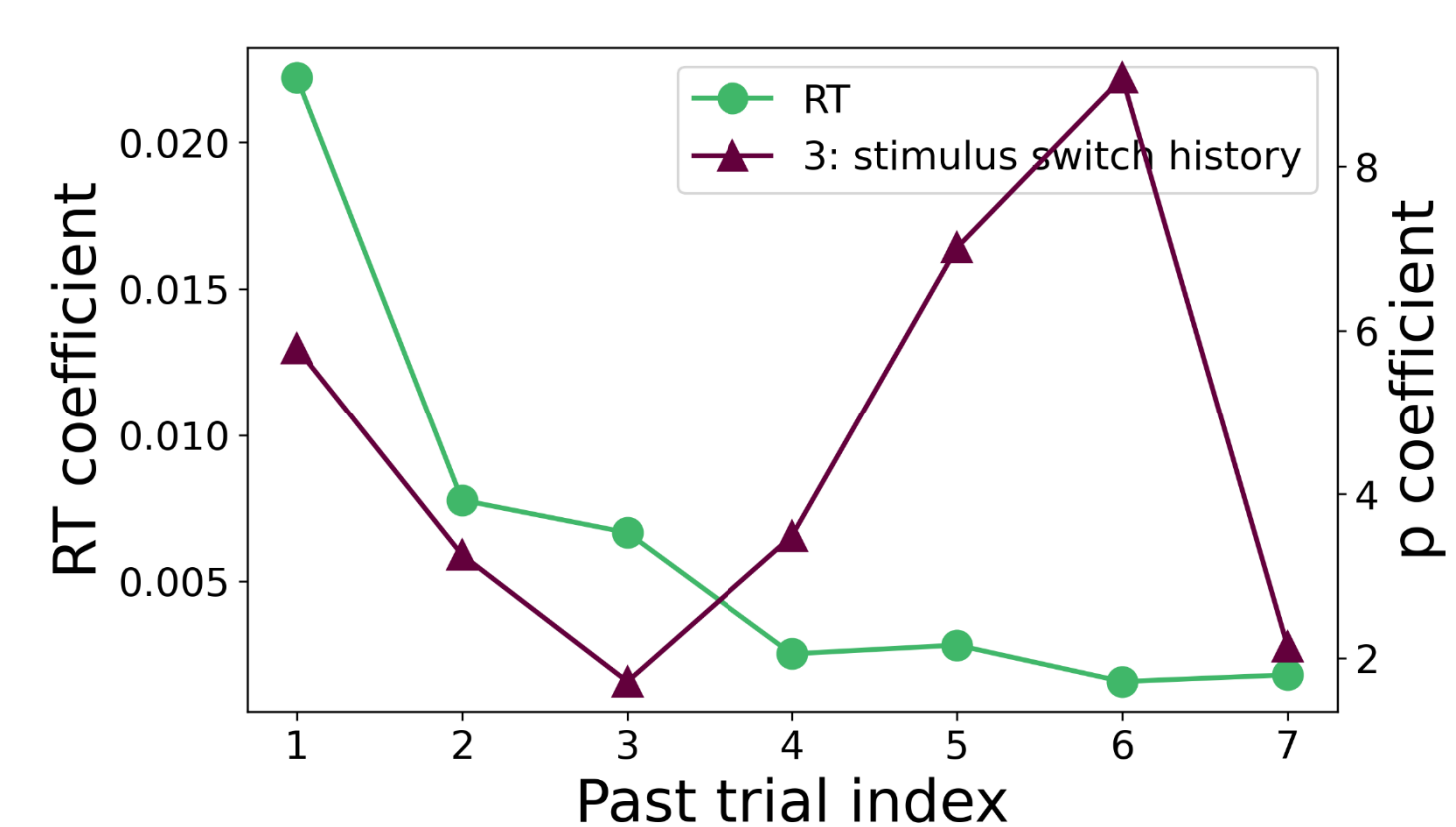
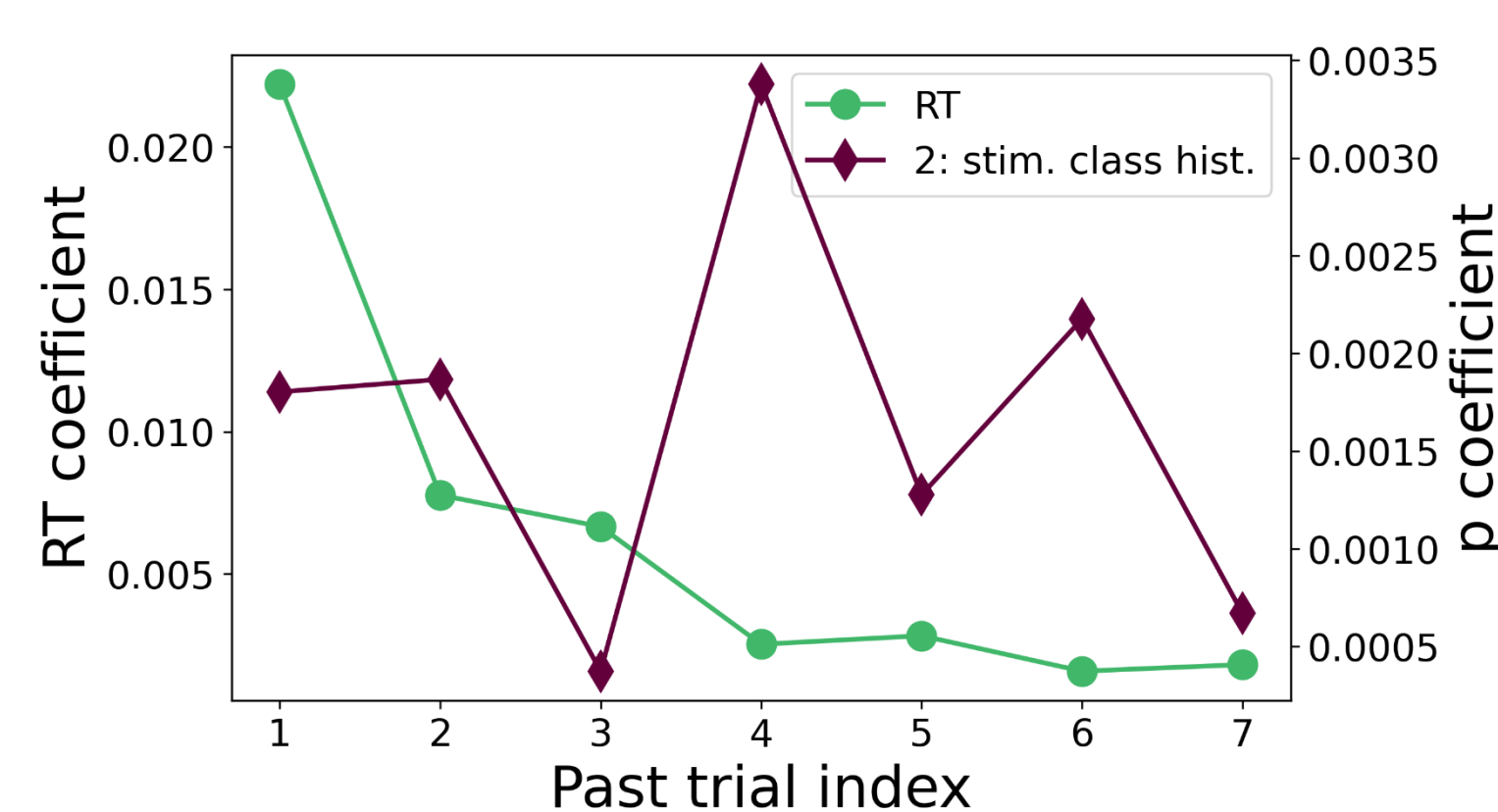
- Word vs. non-word classification task
- 17 human participants
- 2 train blocks × 15 trials + 20 blocks × 96 trials = 1950 trials per participant
- 3 levels of difficulty (based on frequency of word)



Results: Predictions emerge from past stimuli and predictions



Future is history: predictions computed from past stimuli and predictions correlate with behavior more strongly than predictions computed from past stimuli only



- The models based on the class of past stimuli only (models 1 and 2) do not correlate with response times
- The model based on past stimulus switches (model 3) relies both on recent and more ancient stimulus history
- The model based on past predictions only (model 4) relies too much on older events when response times rely more heavily on more recent past events.
- The model based on both past stimuli and predictions (model 5) correlates with response times.

1. M. Wöstmann, L. Waschke, J. Obleser, Prestimulus neural alpha power predicts confidence in discriminating identical auditory stimuli. *Eur J Neurosci.* 49, 94–105 (2019), 10.1111/ejn.14226
 2. N. M. Petro, N. N. Thigpen, S. Garcia, M. R. Boylan, A. Keil, Pre-target alpha power predicts the speed of cued target discrimination. *NeuroImage.* 189, 878–885 (2019), 10.1016/j.neuroimage.2019.01.066
 3. N. Yamagishi, D. E. Callan, S. J. Anderson, M. Kawato, Attentional changes in pre-stimulus oscillatory activity within early visual cortex are predictive of human visual performance. *Brain Research.* 1197, 115–122 (2008), 10.1016/j.brainres.2007.12.063
 4. C. Koch, K. Preusschoff, Betting the house on consciousness. *Nat Neurosci.* 10, 140–141 (2007), 10.1038/nn0207-140
 5. A. Abrahamyan, L. L. Silva, S. C. Dakin, M. Carandini, J. L. Gardner, Adaptable history biases in human perceptual decisions. *Proc Natl Acad Sci USA.* 113, E3548–E3557 (2016), 10.1073/pnas.1518786113
 6. I. Frund, F. A. Wichmann, J. H. Macke, Quantifying the effect of intertrial dependence on perceptual decisions. *Journal of Vision.* 14, 9–9 (2014), 10.1167/14.7.9
 7. A. J. Yu, J. D. Cohen, Sequential effects: Superstition or rational behavior? *Adv Neural Inf Process Syst.* 21, 1873–1880 (2008), PMID: 26412953
 8. E.-J. Wagenmakers, R. Ratcliff, P. Gomez, G. McKoon, A diffusion model account of criterion shifts in the lexical decision task. *Journal of Memory and Language.* 58, 140–159 (2008).