Perfectionism, Decision-making, and Post-error Slowing

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Introduction

Highly perfectionistic individuals engage in hypervigilant monitoring of outcomes and selectively attend to failure. Within an action-monitoring theory framework (e.g. Botvinick et al., 2001) perfectionistic individuals are expected to

- be more sensitive to error commissions
- engage in more cognitive control to avoid repeat errors

Pieters et al. (2007), Schrijvers et al. (2010), as well as Tops et al. (2013) used post-error slowing as a behavioral marker of action-monitoring, but it did not correlate with elevated perfectionism. Three key issues can potentially account for this:

1. More power may have been needed to detect a small effect
2. Typical measures of post-error slowing are affected by sequential effects
3. Many cognitive mechanisms can lead to post-error slowing

To address these issues, we tested whether post-error slowing was due to increased cognitive control and whether it could be related to perfectionism via a sequential sampling model framework.

Method

Participants: 29 undergraduate participants.

Design: A variant of the Simon Task (Simon & Wolf, 1963).

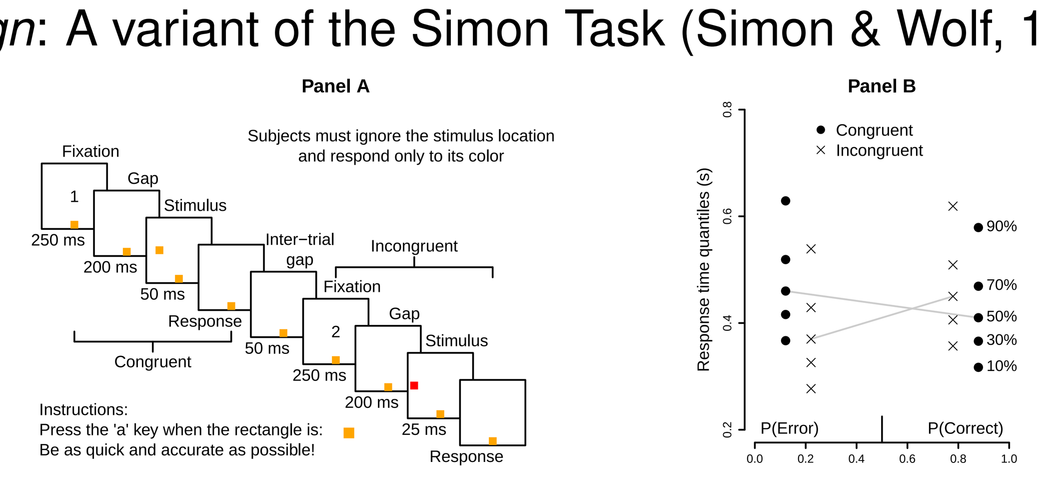
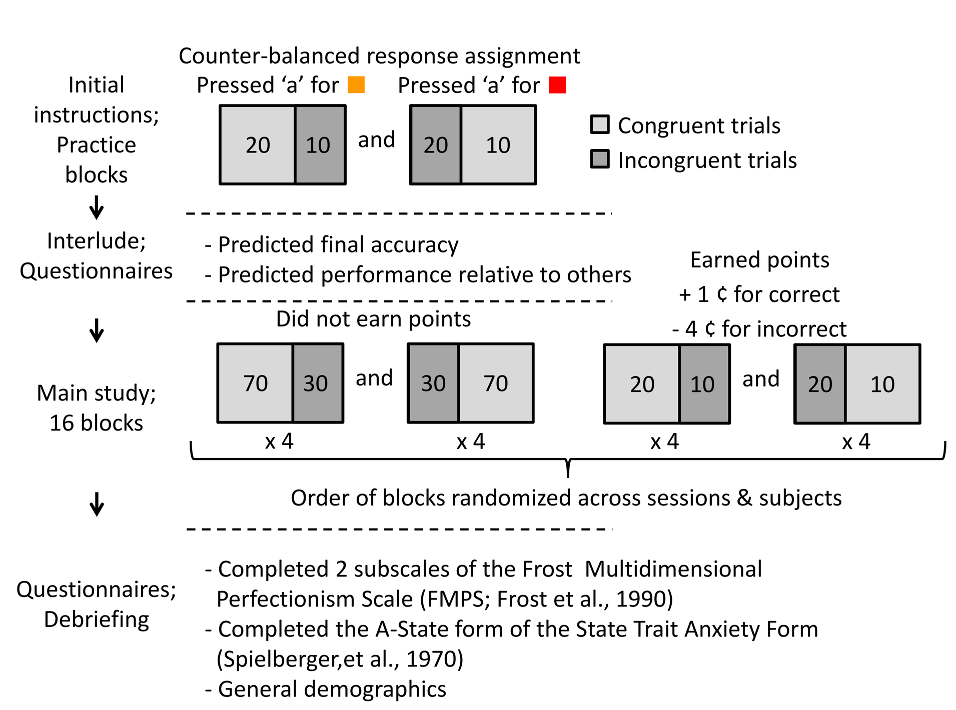


Figure 1: Panel A - structure of two trials. Panel B - predicted pattern of response times (RTs) and accuracy.

Procedure:



Perfectionism Subscales:

1. The *Concern over Mistakes* subscale assesses overly critical feelings of failure to mistakes.
2. The *Doubts about Actions* subscale assesses perpetual doubts of work quality.

The model

We used a sequential sampling model known as the diffusion race model (Logan et al., 2014).

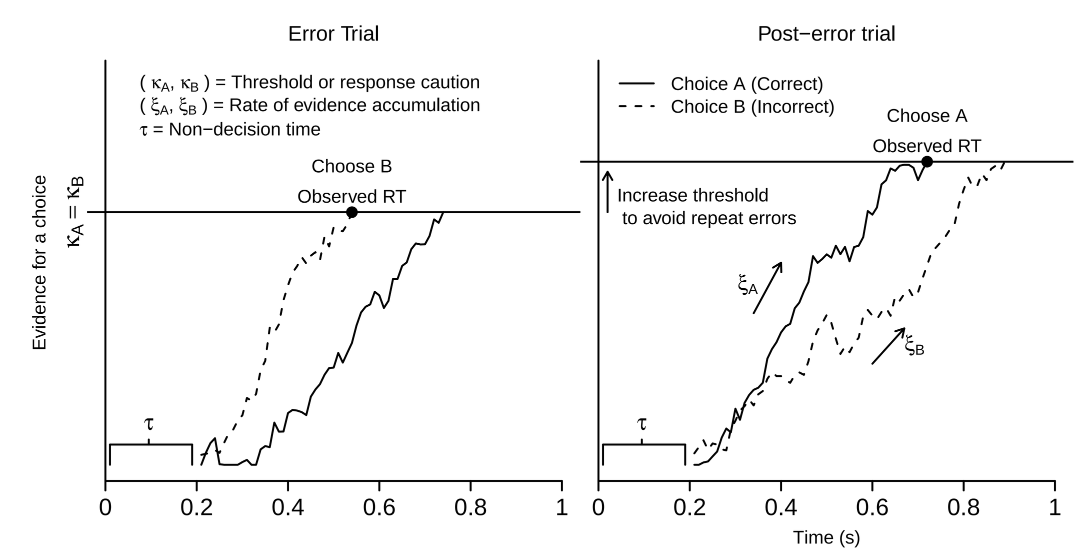


Figure 2: Panel A - structure of the diffusion race model. Panel B - modeling post-error slowing due to increased cognitive control.

To fit the cross-over pattern of the Simon task we use a mixture of two diffusion race processes.

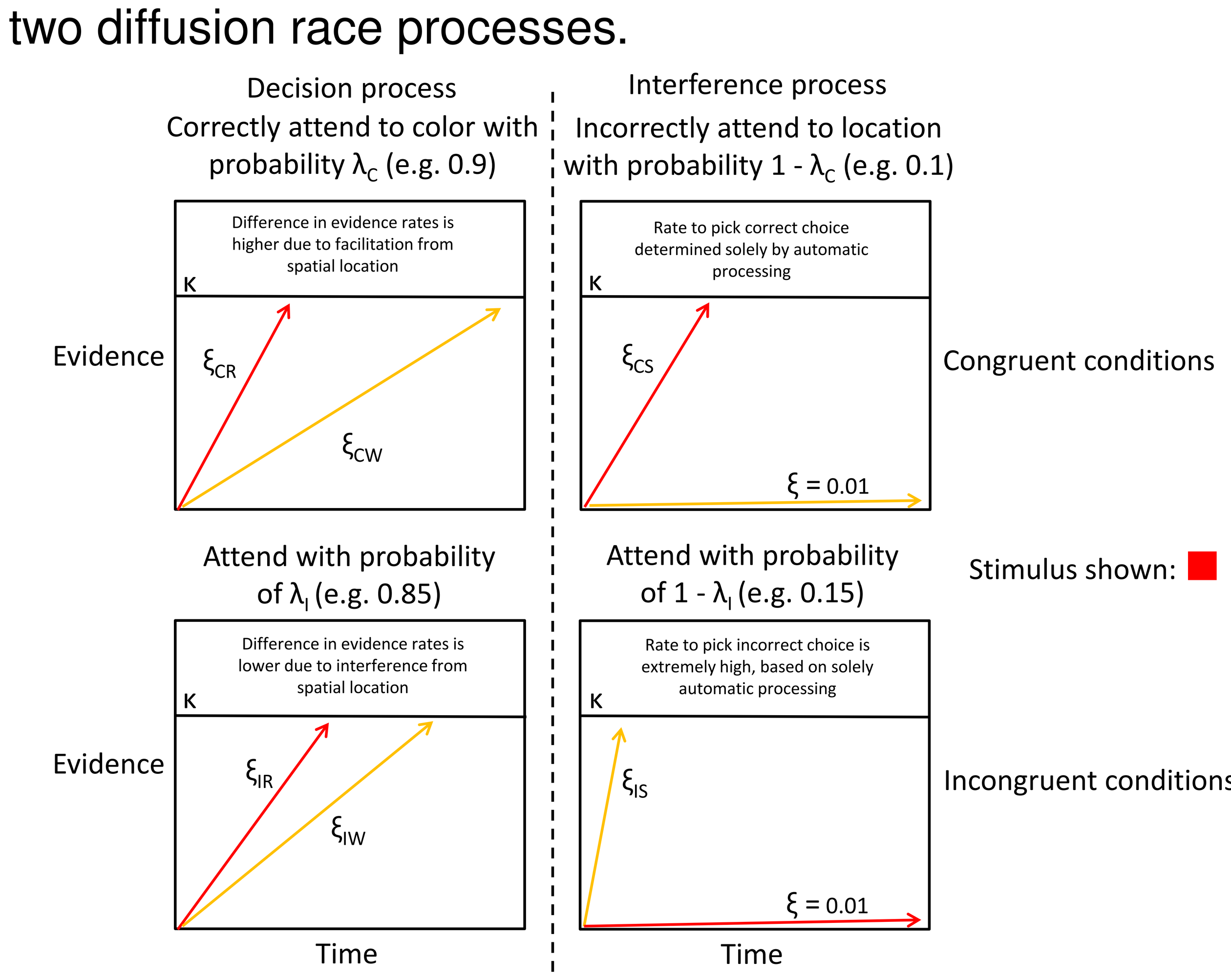


Figure 3: Structure of the mixture model to account for data patterns in the Simon task.

We also included mechanisms to account for ancillary effects such as fatigue, learning, guessing, or changes in motivation.

Table 1: *Full set of free parameters in the final model*.

Threshold		Drift rate (Decision process)		Drift rate (Interference process)	
κ	Overall response caution	ξ_{CR}	Correct choices (Congruent)	ξ_{CS}	Spatial location (Congruent)
κ_P	Shift for post−error	ξ_{CW}	Incorrect choices (Congruent)	ξ_{IS}	Spatial location (Incongruent)
κ_{b1}	Gradual shift for session 1	ξ_{IR}	Correct choices (Incongruent)	ξ_{S2}	Shift for session 2
κ_{b2}	Gradual shift for session 2	ξ_{IW}	Incorrect choices (Incongruent)	ξ_{SM}	Shift for pay−offs
κ_M	Shift for pay−offs	ξ_{b1}	Gradual shift for session 1		Mixture probabilities
	Non−decision components	ξ_{b2}	Gradual shift for session 2	λ_{CD}	Decision process (Congruent)
κ_τ	Residual latency	ξ_2	Shift for session 2	λ_{ID}	Decision process (Incongruent)
κ_μ	Mean for slow guesses	ξ_M	Shift for pay−offs	λ_{CS}	Interference process (Congruent)
				λ_{IS}	Interference process (Incongruent)

- Data for individual subjects were fit using Bayesian estimation and posterior predictive checks were generated.
- A multivariate-normal regression with summed scores from the inventories as covariates was fit to select parameter point estimates.

Results

The model had good fit to the cross-over pattern of data for the Simon task. The model fit a majority (∼80%) of post-error median response times.

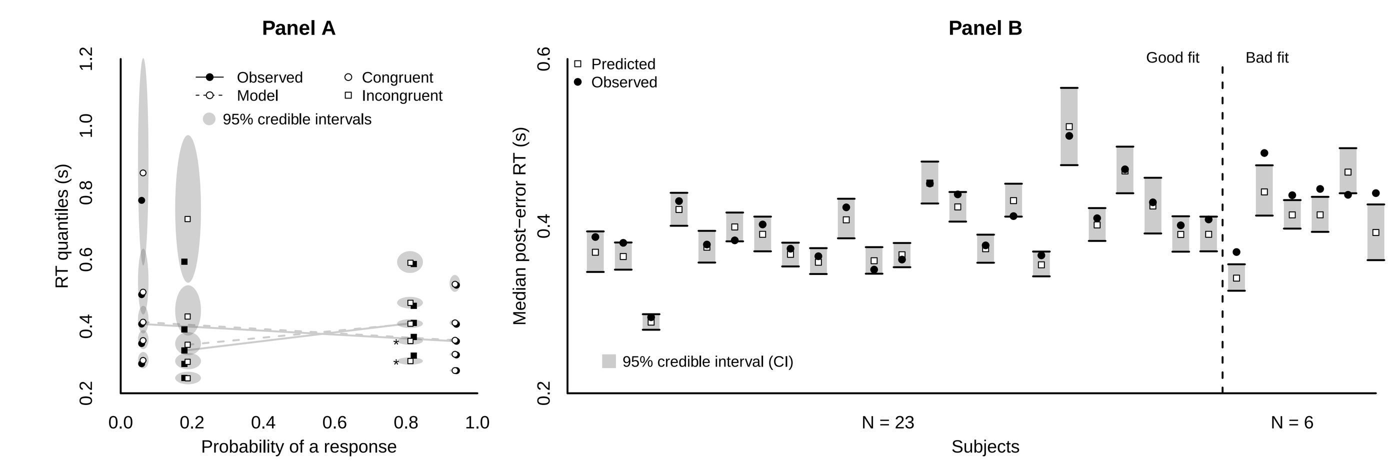


Figure 4: Panel A - RT quantiles and accuracy by congruency. Panel B - Median response times for post-error trials.

Critically, though unrelated to increased perfectionism, there was a reliable post-error increase in threshold across subjects. However, 40% of the sample had more repeat errors than predicted by the model (and therefore contrary to the predictions of increased cognitive control).

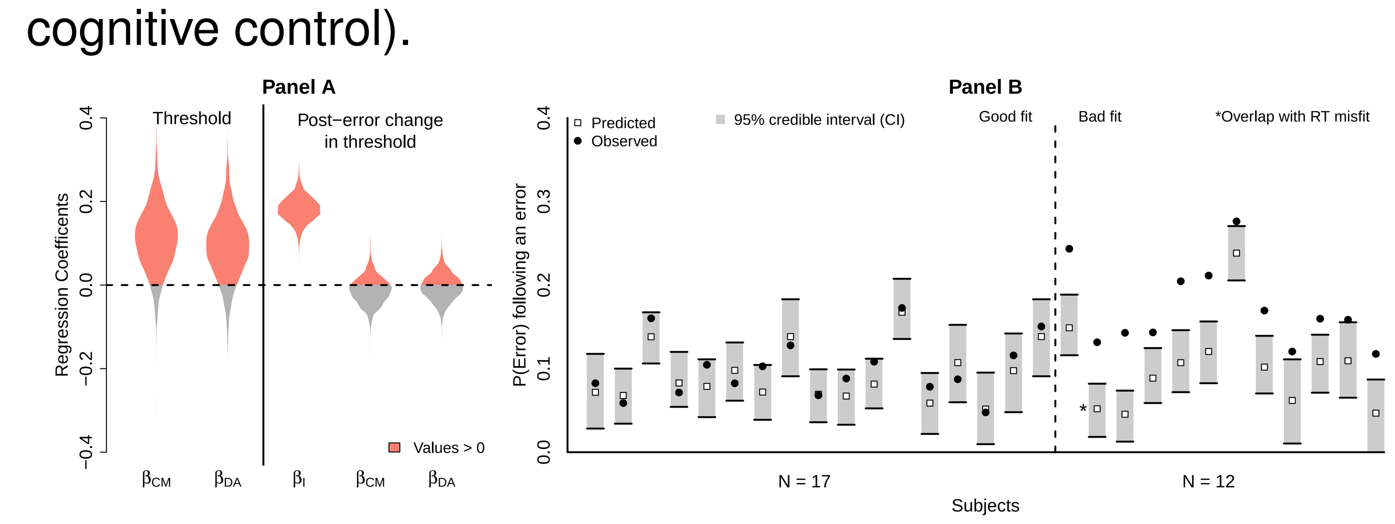


Figure 5: Panel A - Select results from multivariate-normal regression. Panel B - Proportion of repeat errors.

Discussion

Our study indicates that...

1. Post-error slowing will not represent increased cognitive control for all subjects.
2. Post-error slowing due to alternate mechanisms has no theoretically-based reason to correlate with perfectionism, which could explain the lack of any significant correlations in previous studies.

Future research replicating the specific experimental design used by Pieters et al. (2007), Schrijvers et al. (2010), and Tops et al. (2013) is necessary to fully determine whether post-error slowing is a viable behavioral marker to assess the mechanisms underlying perfectionism.

Acknowledgments

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