SPR Vancouver Poster Results

Relationship between within-person differences in error-related negativity and error positivity and correct-trial response-time means and variances in healthy participants

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Poster to be found on https://mclutz.com/#academics

M = mean; SD = standard deviation; ms = milliseconds; ERN = error-related negativity; Pe = error positivity; RT = response time; µV = microvolts; CrI = credible interval.

Overview

The purpose of these analyses was to determine whether ERN and Pe amplitudes predict correct-trial RTs over and above current-trial congruency.

These data are from 293 healthy participants (160 women, 133 men; ages: *M* = 21 years, *SD* = 3, range 18 to 45). All participants completed a modified version (arrow) of the Eriksen flanker task.

Model Selection

A total of 81 models were fit and compared. Multilevel location-scale models predicted correct-trial RTs from several independent variables. These models included combinations of the following effects on both the location (mean) and scale (variance) portions of the model. Each unique combination was tested on the location and scale portions.

Only predictor (independent variable) from the current trial

- Congruency: current congruent trial, current incongruent trial (all models included current-trial congruency)

Remaining predictors (independent variables) from the previous trial

- Previous-trial Accuracy: previous-trial correct, previous-trial incorrect
- Previous-trial ERN: ERN amplitudes from the previous trial
- Previous-trial Pe: Pe amplitudes from the previous trial
- Previous-trial Accuracy X Previous-trial ERN interaction
- Previous-trial Accuracy X Previous-trial Pe interaction

Leave-one-out cross-validation (LOO-CV) was used to compare model fit and identify the best fitting model. The best fitting model included the following predictors:

Location Portion: Current trial congruency + Previous-Trial Accuracy + ERN + Pe + Previous-trial Accuracy x ERN

Scale Portion: Current trial congruency + Previous-Trial Accuracy + ERN + Pe + Previous-trial Accuracy x Pe

Summary of Findings

The Sigma predictors refer to the scale portion of the model (within-person variance). Values for sigma are not back back-transformed they are on the log scale.

Predictors	*Estimates*	*CI (95%)*
Congruent Trial (Intercept)	376.86	373.65 – 380.07
Incongruent Trial (Intercept)	446.46	443.29 – 449.64
Congruent Trial: Accuracy (Previous Error)	14.82	13.17 – 16.49
Incongruent Trial: Accuracy (Previous Error)	5.13	3.72 – 6.55
Congruent Trial: ERN	-1.15	-1.23 – -1.07
Incongruent Trial: ERN	-1.33	-1.39 – -1.27
Congruent Trial: Pe	-0.06	-0.14 – 0.02
Incongruent Trial: Pe	0.24	0.18 – 0.30
Congruent Trial: Accuracy x ERN	-0.49	-0.79 – -0.20
Incongruent Trial: Accuracy x ERN	0.12	-0.11 – 0.34
Sigma: Congruent Trial (Intercept)	4.17	4.15 – 4.18
Sigma: Incongruent Trial (Intercept)	3.99	3.97 – 4.01
Sigma: Congruent Trial: ERN	-0.01	-0.01 – -0.01
Sigma: Incongruent Trial: ERN	-0.02	-0.02 – -0.01
Sigma: Congruent Trial: Accuracy (Previous Error)	0.06	0.04 – 0.07
Sigma: Incongruent Trial: Accuracy (Previous Error)	0.11	0.09 – 0.12
Sigma: Congruent Trial: Pe	0.00	0.00 – 0.01
Sigma: Incongruent Trial: Pe	0.01	0.01 – 0.01
Sigma: Congruent Trial: Accuracy x Pe	0.00	-0.00 – 0.01
Sigma: Incongruent Trial: Accuracy x Pe	0.00	0.00 – 0.01
N $_{subjid}$	293	
Observations	229452	

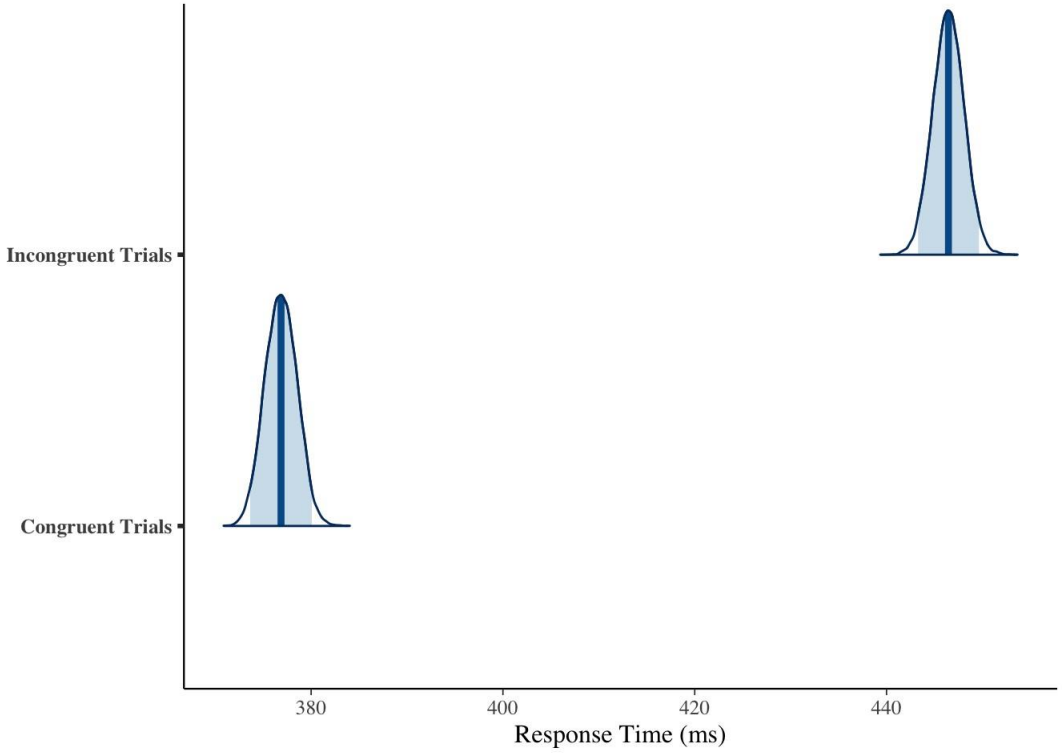
This model suppressed a population-level intercept for all predictors. This is why you see everything as being related to a congruent trial or an incongruent trial. If you look at the estimates for congruent and incongruent trial intercepts, these intercepts refer to the intercept for congruent trials and for incongruent trials *separately*. We can still compare across congruent and incongruent trials; this is just done using draws from the posterior distributions.

The coefficients above are raw.

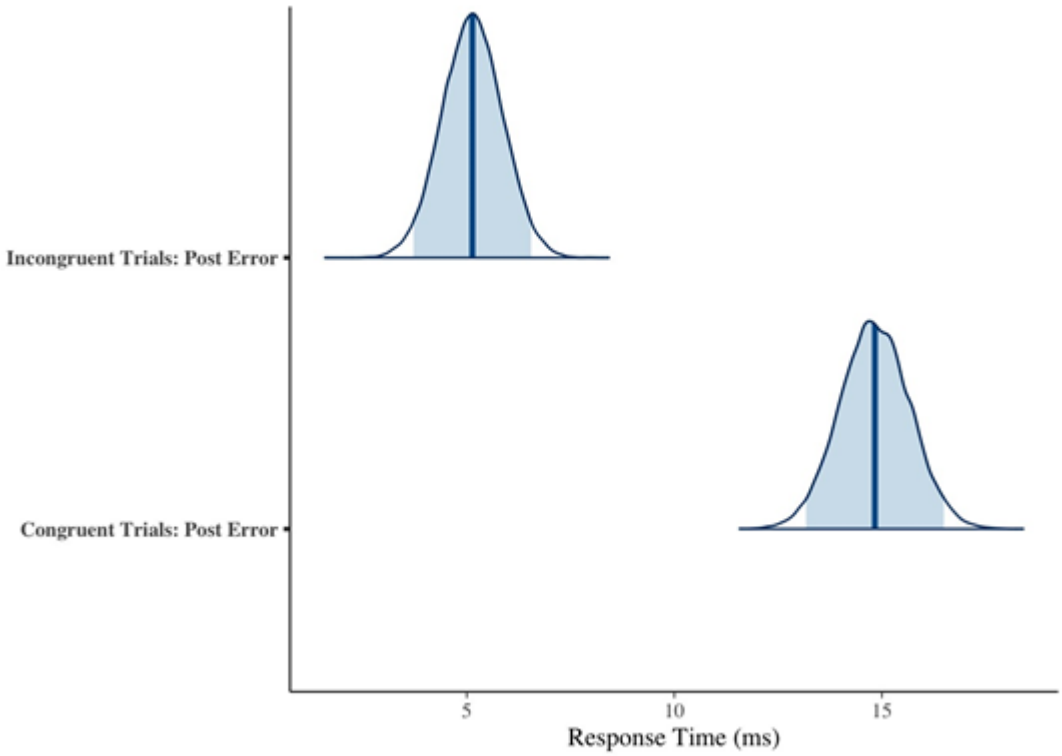
Concurrency effects are described in the figures below:

Location: Congruency Effect

Correct incongruent trials had longer RTs than congruent trials, 69.6 ms, 95% Credible Interval (CrI: 67.63, 71.55).

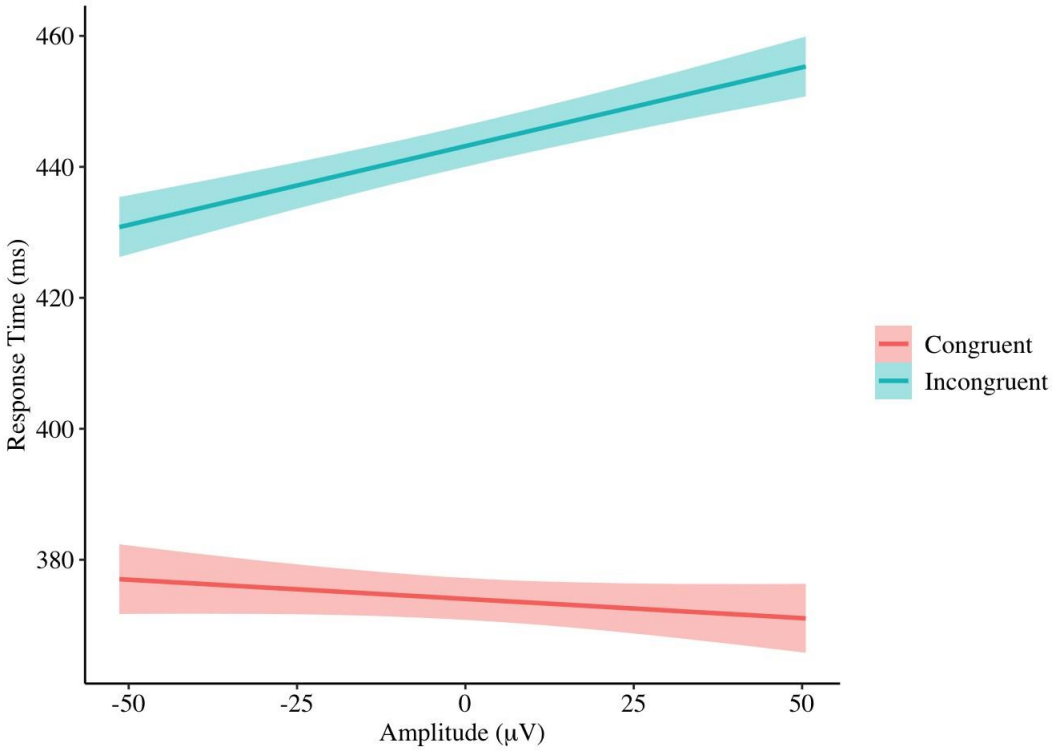


Error trials had longer RTs slowing than correct trials for incongruent (5.13 ms, 95% CrI:3.72, 6.55) and for congruent trials (14.83 ms, 95% CrI:13.17, 16.49).



Location: Pe

When the current trial was incongruent, larger previous-trial Pe amplitude was associated with longer RTs (0.24 ms, 95% CrI:0.18, 0.3). There was little impact of previous-trial Pe on RTs for congruent trials (-0.06 ms, 95% CrI:-0.14, 0.02).



Location: ERN

The location portion of the model included an ERN x Previous-trial Interaction. The description below is separate for congruent and for incongruent trials.

Congruent Trial

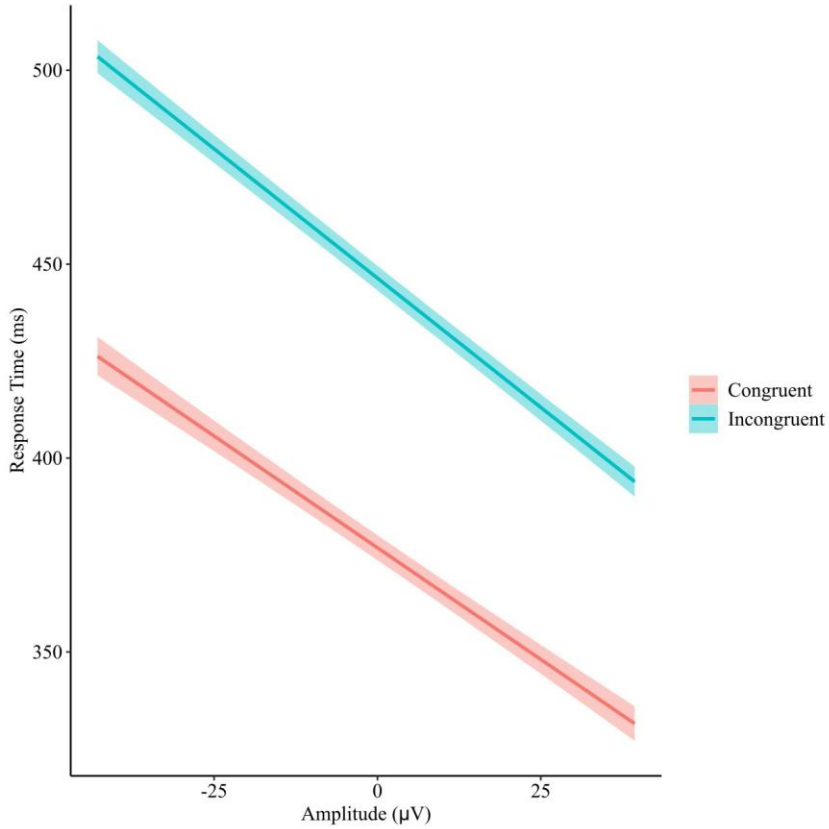
When previous trial was *correct*, larger previous-trial ERN was related to faster current-trial RTs (-1.15 ms, 95% CrI:-1.23, -1.07).

When the previous trial was *incorrect*, larger previous-trial ERN was related faster current-trial RTs (-1.64 ms, 95% CrI:-1.93, -1.64). This acceleration was faster than the acceleration was when current trials were preceded by correct trials (-0.49 ms, 95% CrI:-0.79, -0.2). You can see from the plots below that the half a millisecond acceleration does not have much of an impact on RTs, but it's there nonetheless.

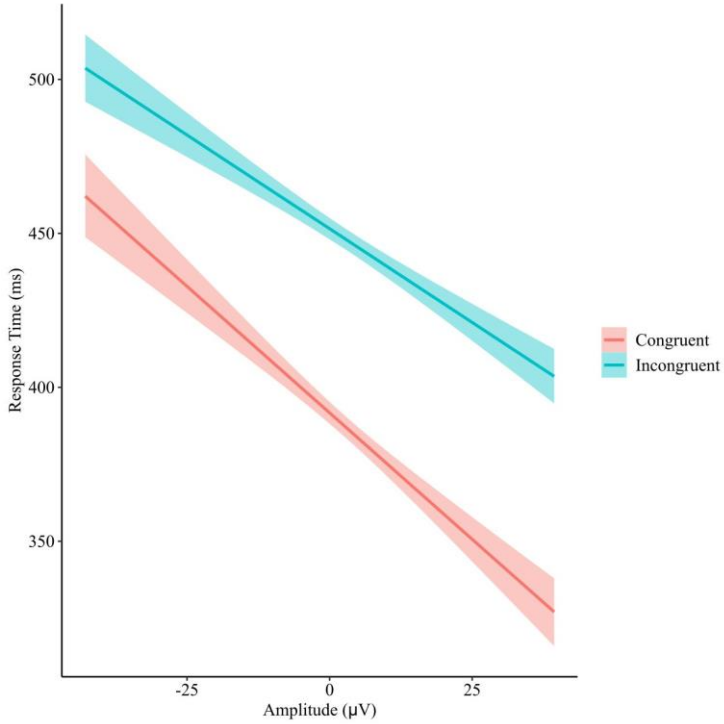
Incongruent Trial

Larger previous-trial ERN was related to faster current-trial RTs (-1.33 ms, 95% CrI:-1.39, -1.27), *but* unlike the effect for congruent trials, whether the previous-trial was correct or incorrect did not moderate the relationship between previous-trial ERN and current-trial RTs (0.12 ms, 95% CrI:-0.11, 0.34).

Post-Correct Trials



Post-Error Trials

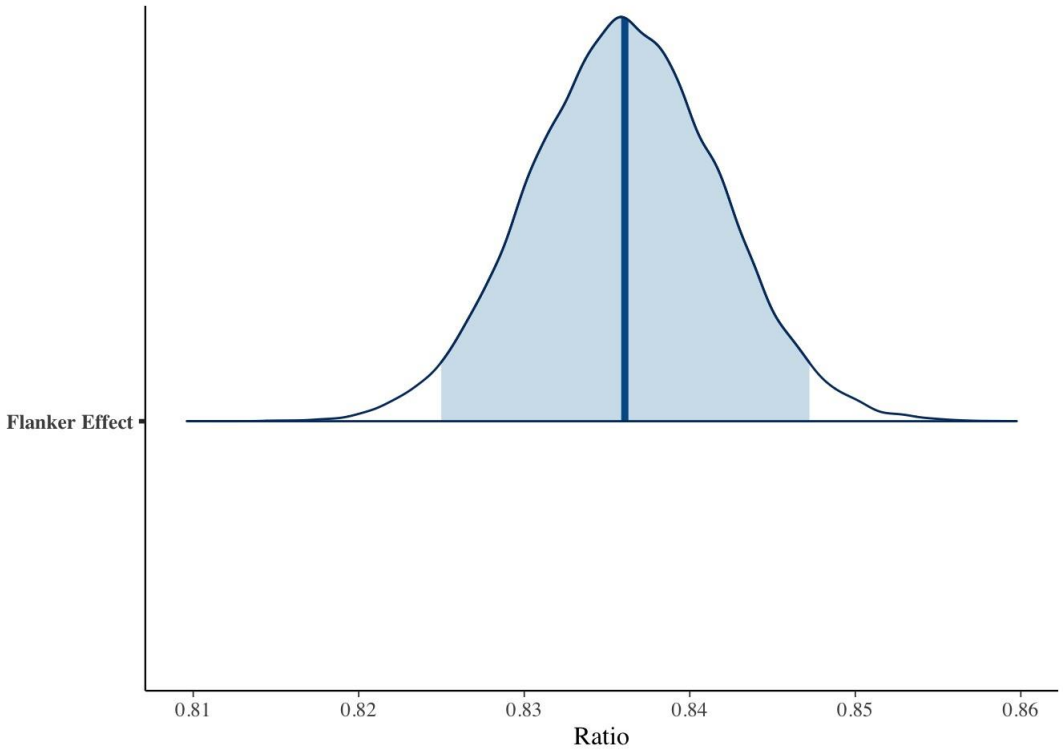


Scale: Congruency Effect

For parameters on the scale portion of the model, they are on the log scale. Parameters were exponentiated to transform them to a standard deviation scale. Comparisons are expressed as ratios,

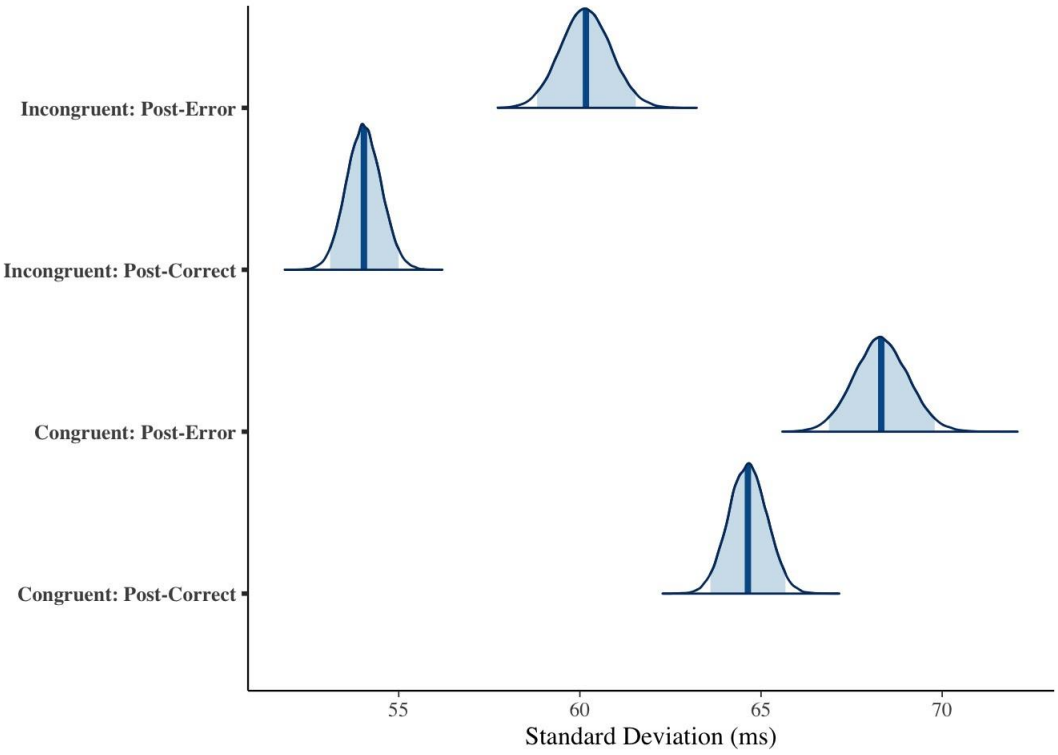
rather than linear differences, because differences were first computed on the log scale— e.g., exp(incongruent – congruent) = exp(incongruent)/exp(congruent).

For the congruency effect, the standard deviation for *correct* incongruent trials was smaller than for *correct* congruent trials (0.84, 95% CrI Ratio:0.82, 0.85). This means that the standard deviation of incongruent trials was about 0.16% (i.e., 1 - 0.84) smaller than the standard deviation of congruent



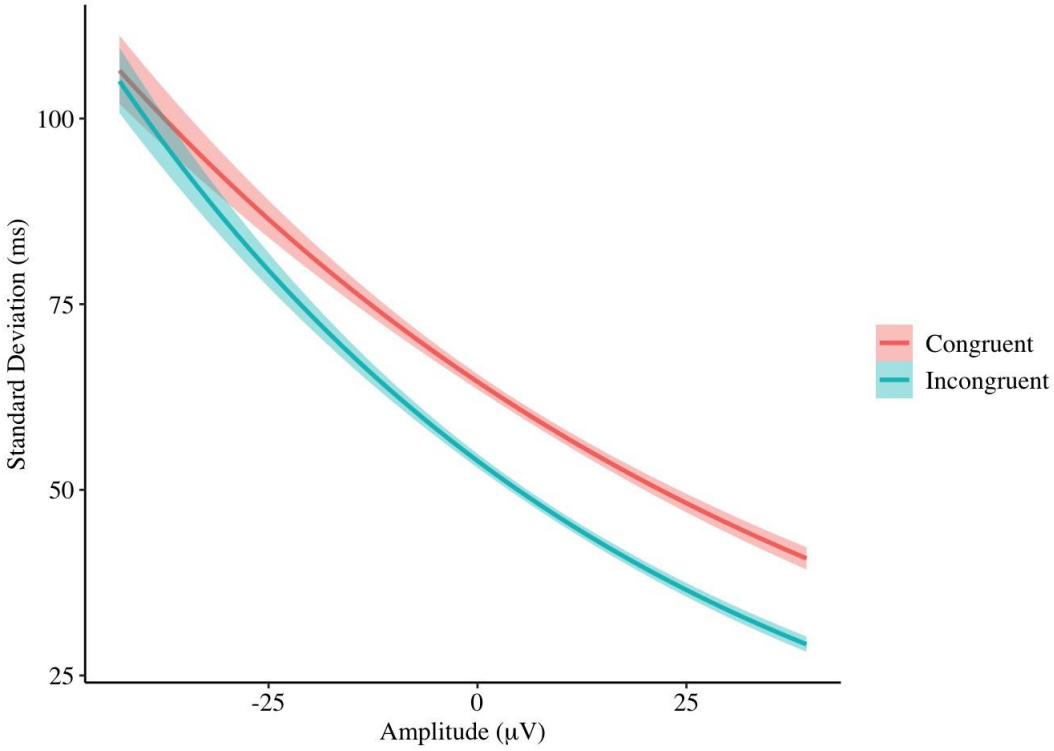
trials.

Post-error trials were associated with greater variability than post-correct trials.



Scale: ERN

Larger previous-trial ERN was related to smaller within-person RT variance (congruent trials: 0.99, 95% CrI Ratio:0.99, 0.99; incongruent trials: 0.98, 95% CrI Ratio:0.98, 0.99)



Scale: Pe

There is a very small effect of Pe amplitude on RT variance.

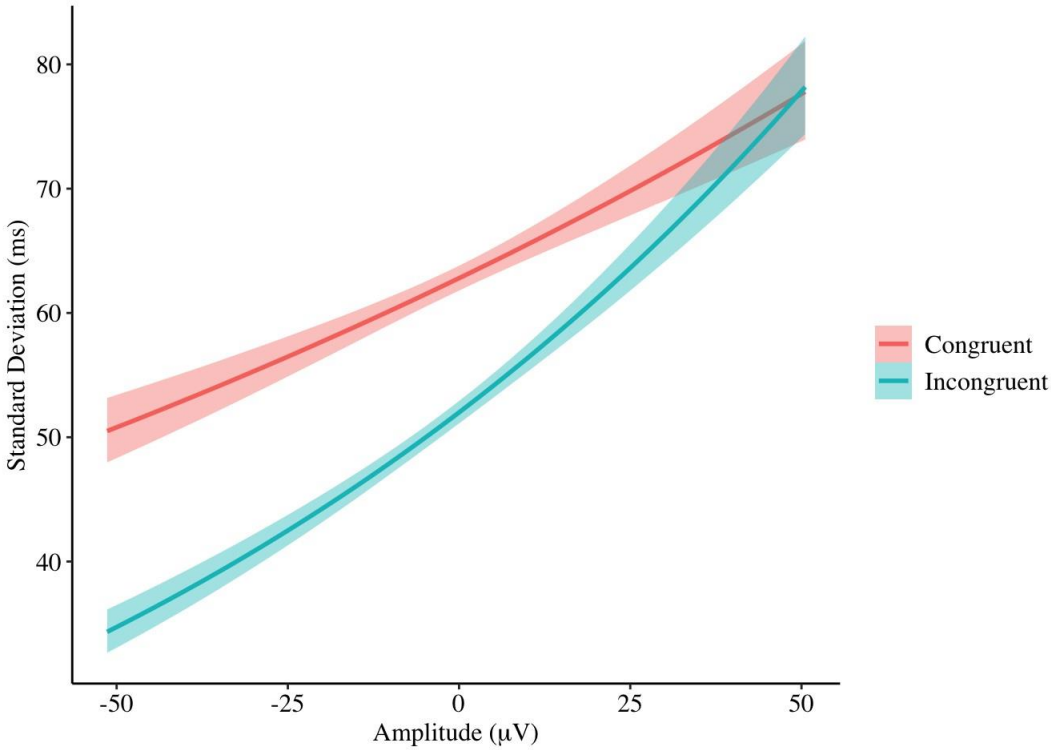
Congruent Trials

Larger previous-trial Pe is related to a very small increase in post-correct trial within-person RT variance (1.0042, 95% CrI Ratio:1.0033, 1.0052. The effect is similar for post-error trials (difference = 1.002, 95% CrI Ratio:0.9988, 1.0051).

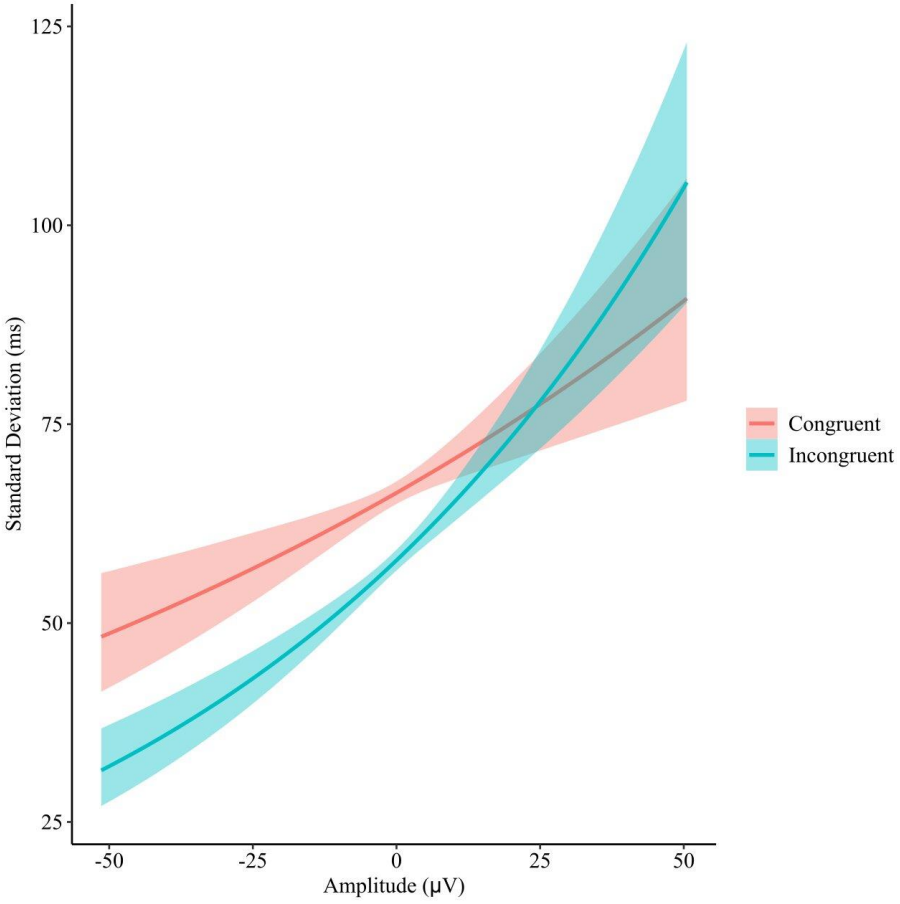
Incongruent Trials

Larger previous-trial Pe is related to a small increase in post-correct trial within-person RT variance (1.0081, 95% CrI Ratio:1.0072, 1.009). The effect is a little accelerated for post-error trials (difference = 1.0038, 95% CrI Ratio:1.0007, 1.0069).

Post-Correct trials



Post-Error Trials



Take Home

ERPs seem to improve the prediction of RTs over and above current-trial congruency and previous-trial accuracy. The effects *seem* small, but remember they are not standardized. The range of person-specific standard deviations for ERN was 2.5 to 7.6. So, some people have more variability than others in changes in variability. What predicts someone's own variability is worth exploring (and can be done using these models): stay tuned for the manuscript!

RT Mean Scores

We show the expected flanker effect of slower RTs for incongruent trials than for congruent trials. We also show the typical post-error slowing effect.

Larger previous-trial Pe amplitude was associated with longer RTs, and this was specific to incongruent trials.

Larger previous-trial ERN was related to faster congruent-trial RTs following correct trials, and even more so following error trials (although the effect was small). Similarly, larger previous-trial ERN was related to faster incongruent-trial RTs, but the effect was similar for post-correct and post-error trials.

RT Within-Person Variance

RT variances was smaller for incongruent than for congruent trials, and post-error trials were associated with greater variability than post-correct
trials.

Larger previous-trial ERN was related to smaller RT variance.

Larger previous-trial Pe was related to greater RT variance for congruent trials. This effect was also observed for incongruent trials, but the acceleration was bigger for post-error trials than for post-correct trials.