



# ANOVA IS DEAD



## Case studies in the power of mixed effects analysis

### Case 1 Priming

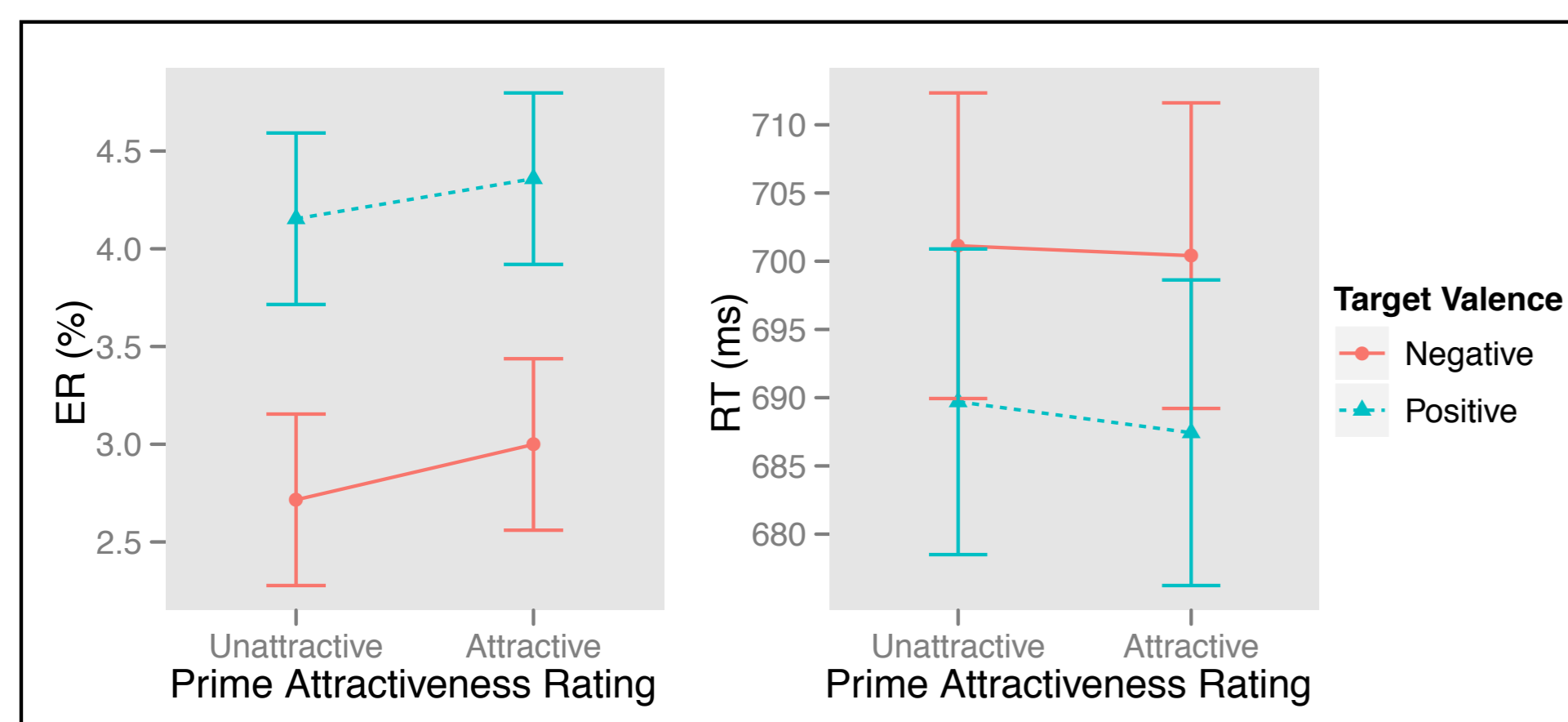
Do attractive faces prime processing of positive words?

To test this question, we asked Ss to perform a speeded classification of words as either positive or negative.

Target words were preceded by primes consisting of either attractive or unattractive human faces.

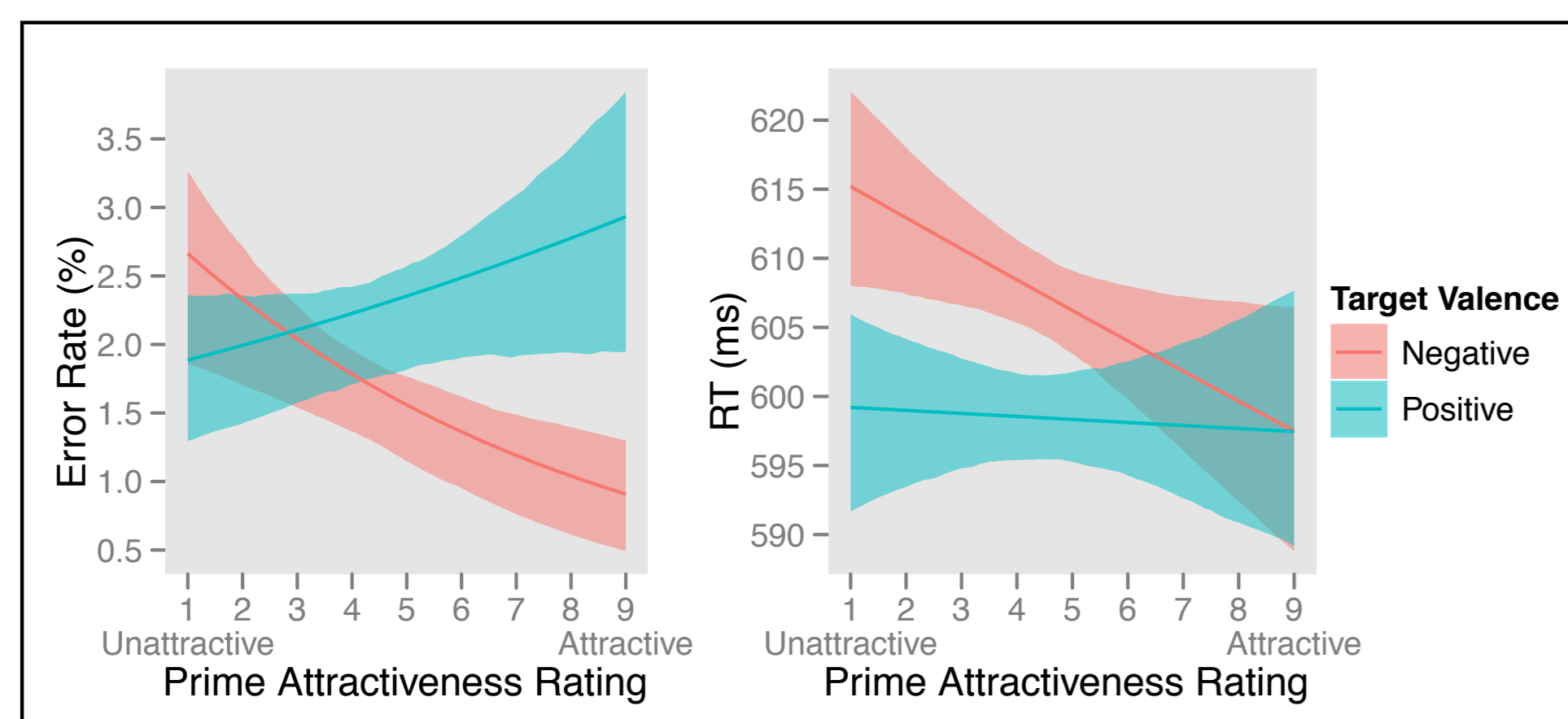
A pilot experiment pre-rated faces and words for attractiveness and valence, respectively, and the most extreme stimuli were used in the actual experiment.

Traditional ANOVA would treat words and faces each as a 2 level fixed effects, yielding the only main effects of word valence on error rates (ER) and response time (RT):



Mixed effects analysis permits:

- treatment of words and faces as random effects
- use of Ss' own attractiveness ratings of each face, which vary from Ss-to-Ss.
- analysis of trial-by-trial data
- proper analysis of error rates as binomially distributed random variables

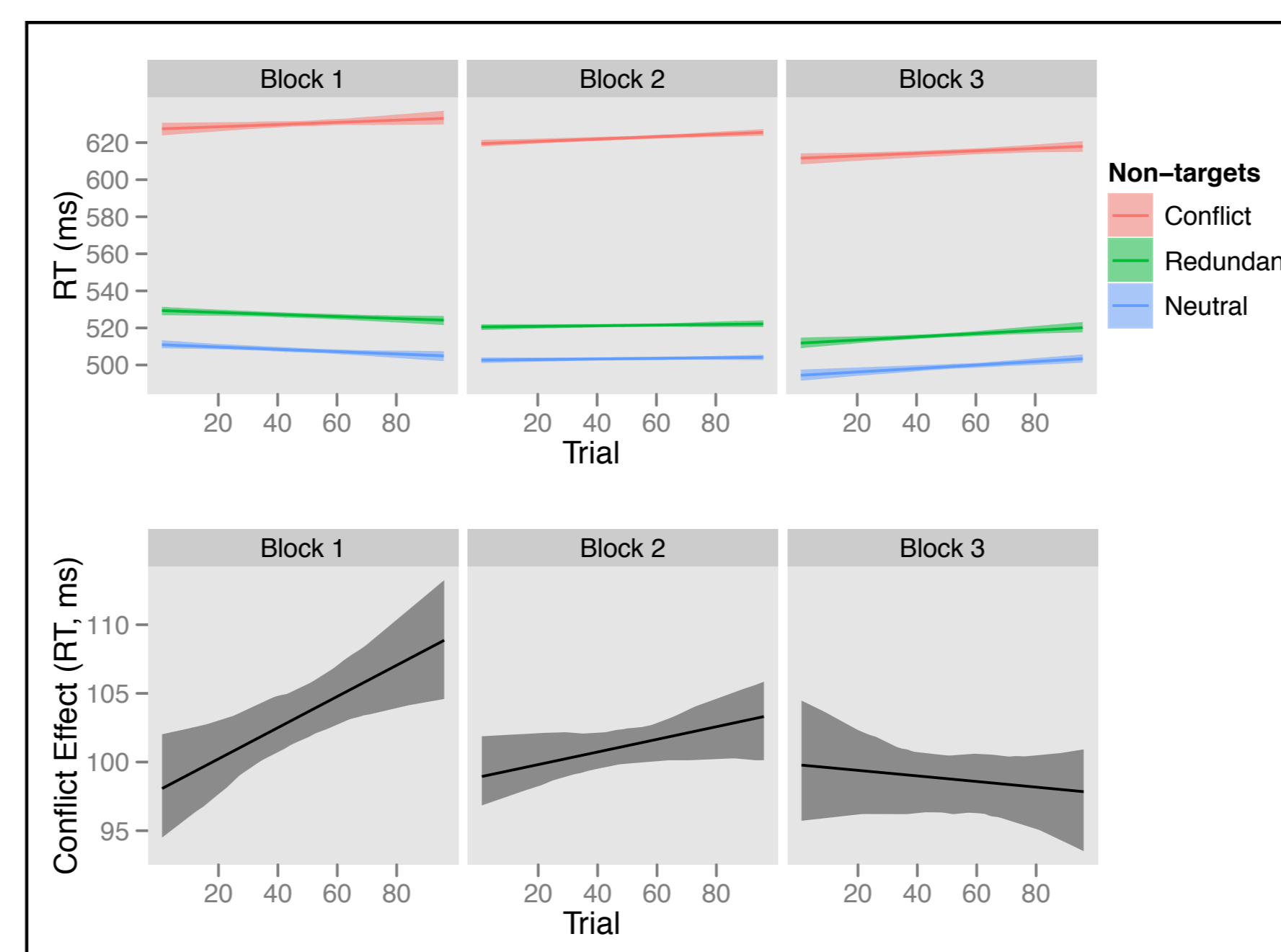
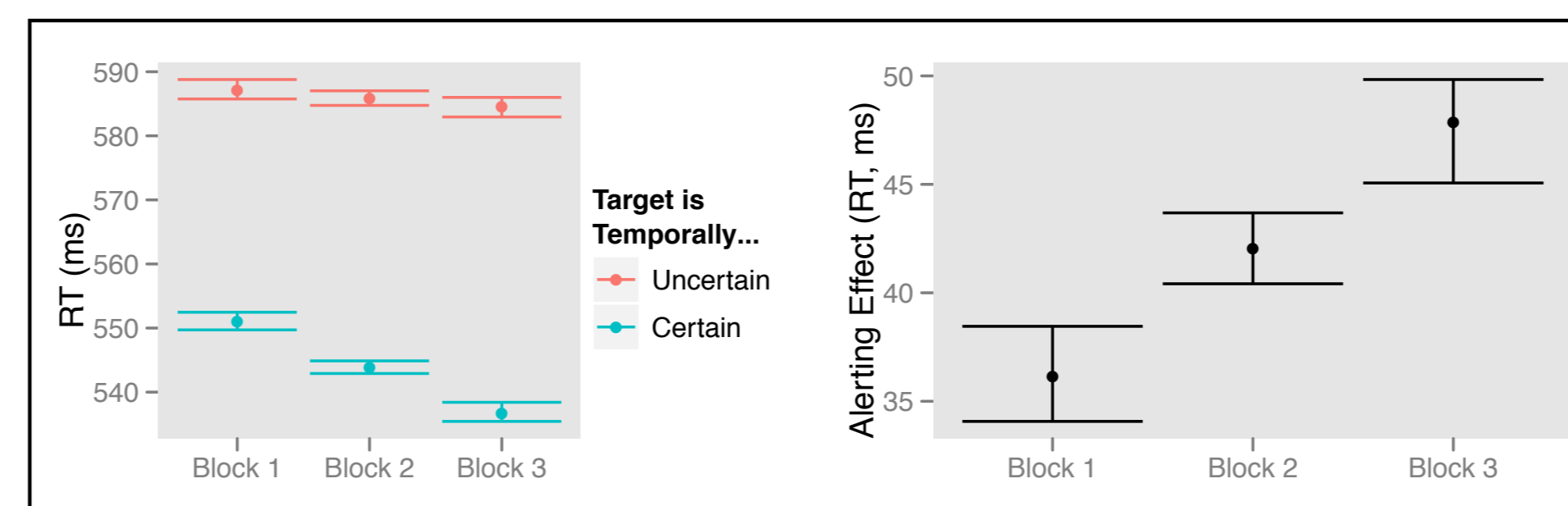
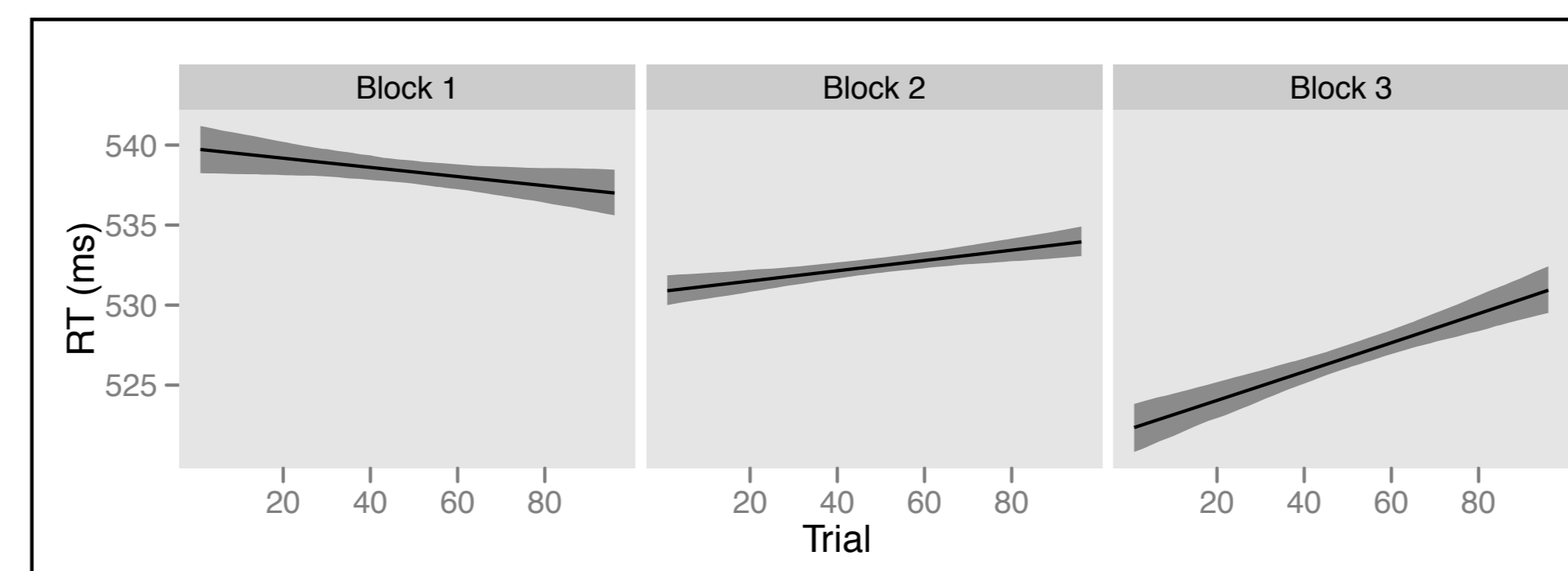


### Case 2 Practice and fatigue

The Attention Network Test, a popular speeded 2-alternative choice task, obtains 3 measures of attention:

- **Alerting:** the effect of temporal uncertainty
- **Orienting:** the effect of spatial uncertainty
- **Conflict:** the effect of non-target stimuli that are either redundant with or conflict with the target

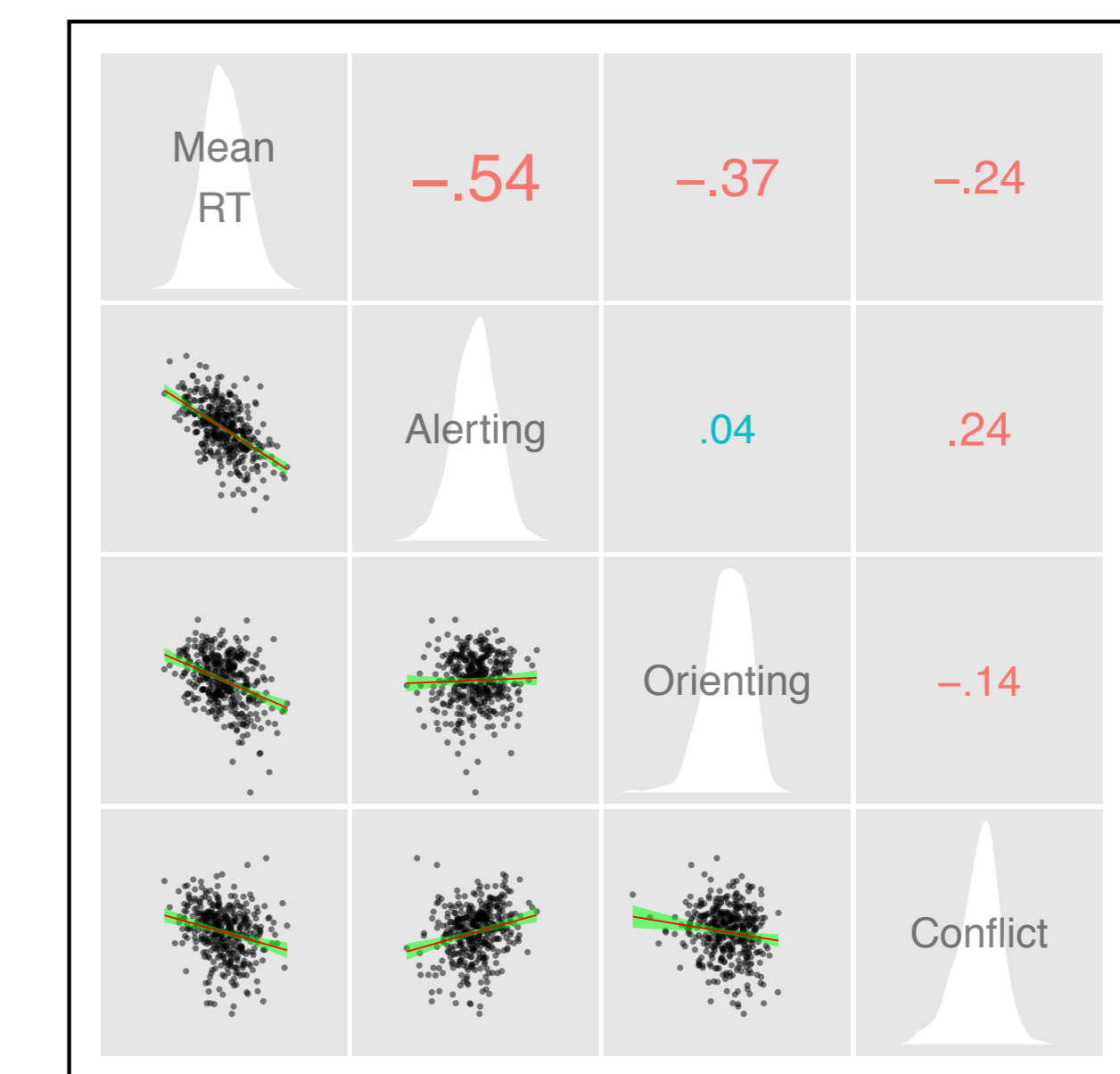
Mixed effects analysis permits analysis of each measure as it evolves through time. The effect of experimental block can be used as a proxy for practice. The effect of trials with block can be used as a proxy for fatigue.



### Case 3 Correlation done right

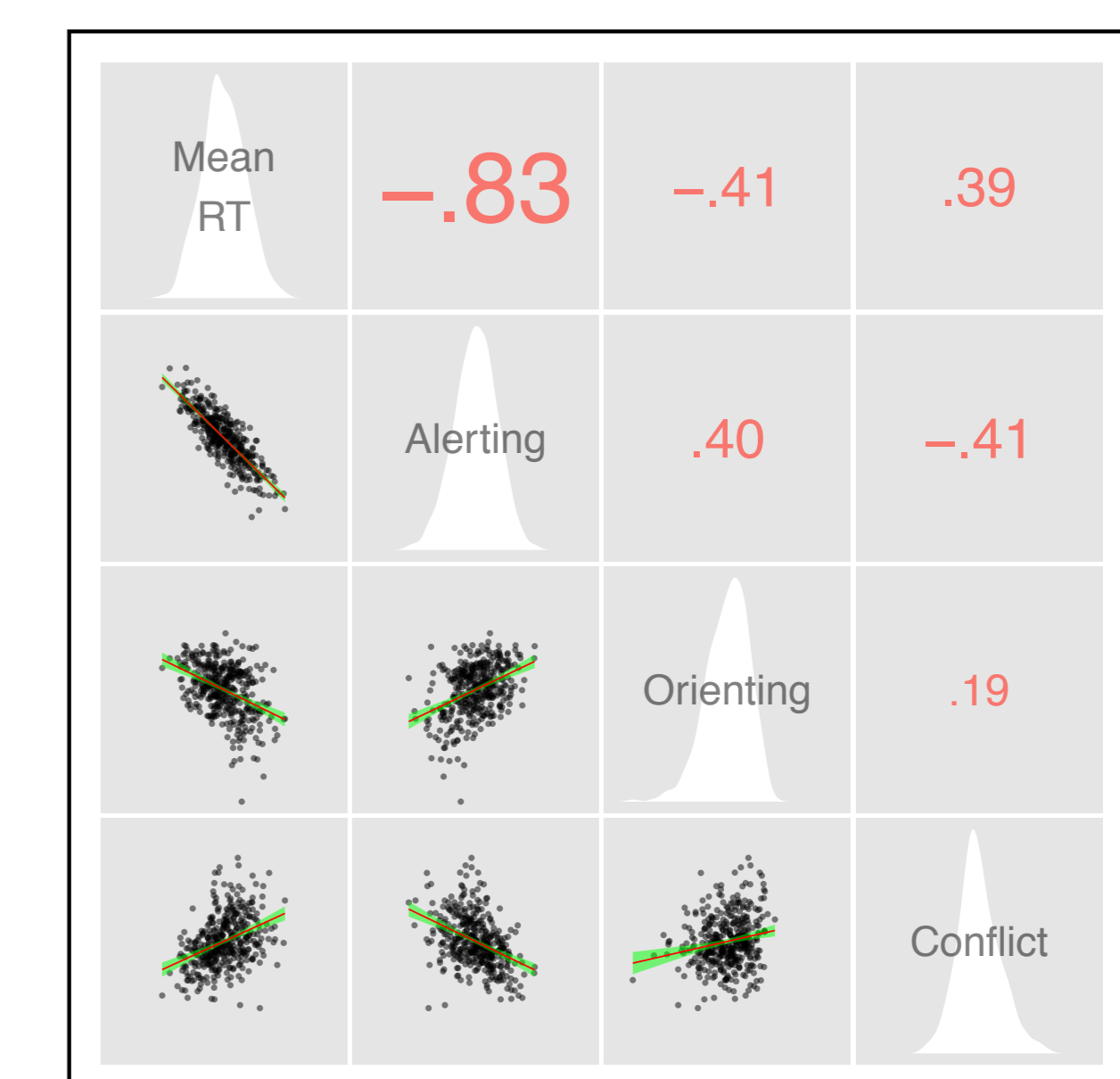
Continuing consideration of the Attention Network Test, of great theoretical interest is the correlations amongst the 3 measures of attention.

Traditional analyses would seek computation of a single score on each measure for each participant, which would then be submitted to simple correlation analyses that can be summarized by a correlation matrix:



The problem with this approach is that it ignores the trial-by-trial measurement error that can cause an individual observed score to vary from its true value.

Mixed effects analysis permits consideration of this measurement error when computing correlations, adjusting scores towards the mean in proportion to their reliability:



## Mixed effects analysis is a flexible, powerful tool that should replace ANOVA completely