

INDIVIDUAL DIFFERENCES IN THE GENERAL SPEED COMPONENT OF RESPONSE TIMES

Adriana Felisa Chávez De la Peña¹, Jeffrey N. Rouder¹ and Joachim Vandekerckhove¹

¹Department of Cognitive Sciences, University of California Irvine

Main argument:

1. Difference scores computed across different cognitive control tasks show weak correlations.
2. In contrast, the general speed observed in cognitive control tasks has a robust uni-factorial solution.
3. Our goal is to extend the PCA analysis to determine whether univariance is found in the shift, scale, or shape parameters of RT distributions.

Data sets explored

No	Tasks	Part	Trials	Cite
1	10	263	144-360	Rey-Mermet et al. (2018)
2	8	522	72-280	Enkavi et al. (2019)
3	3(2)	100	720	Hedge et al. (2018)
4	4	42	640-720	Hedge et al. (2018)
5	3	121	93-194	Von Bastian et al. (2015)
6	3	178	475-760	Whitehead et al. (2018)
7	3	194	516-1187	Whitehead et al. (2018)
8	3	210	568-600	Whitehead et al. (2018)
9	2	38	504	Pratte et al. (2010)

Cognitive control difference scores

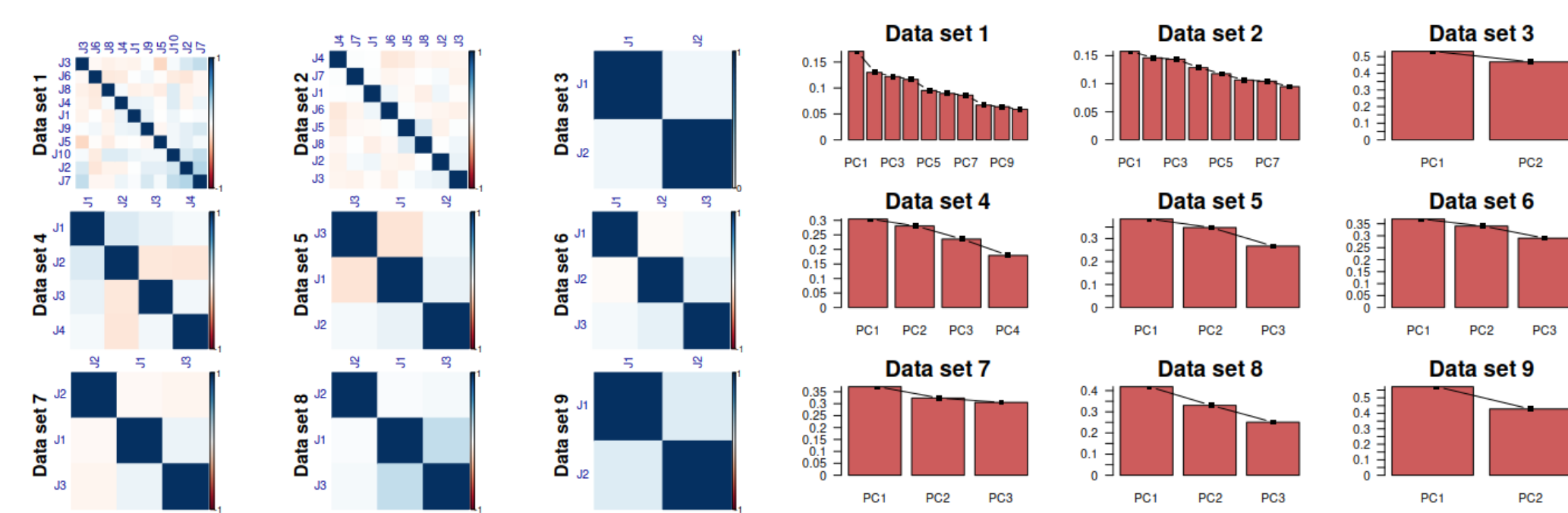


Figure 1. Individual differences in difference scores (Incongruent-Congruent). Left panel: Correlation matrices. Right panel: Scree plots.

General speed has a unifactorial structure

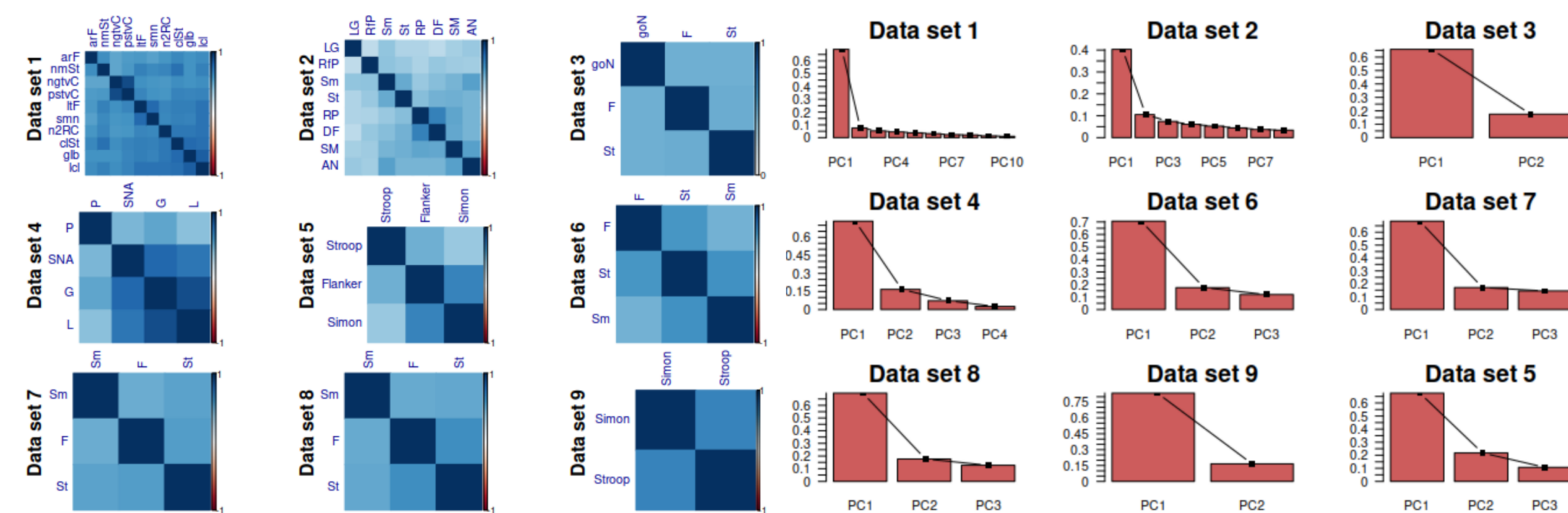


Figure 2. Individual differences in general speed (mean RT). Left panel: Correlation matrices. Right panel: Scree plots.

Ex-Gaussian distribution fit

We modeled the RT observed on trial k for participant i doing task j as a draw from an ExGaussian distribution:

$$Y_{ijk} \sim \text{Normal}(\mu_{ij} + \tau_{ijk}, \sigma_{ij}^2)$$

$$\tau_{ijk} \sim \text{Exp}\left(\frac{1}{\nu_{ij}}\right)$$

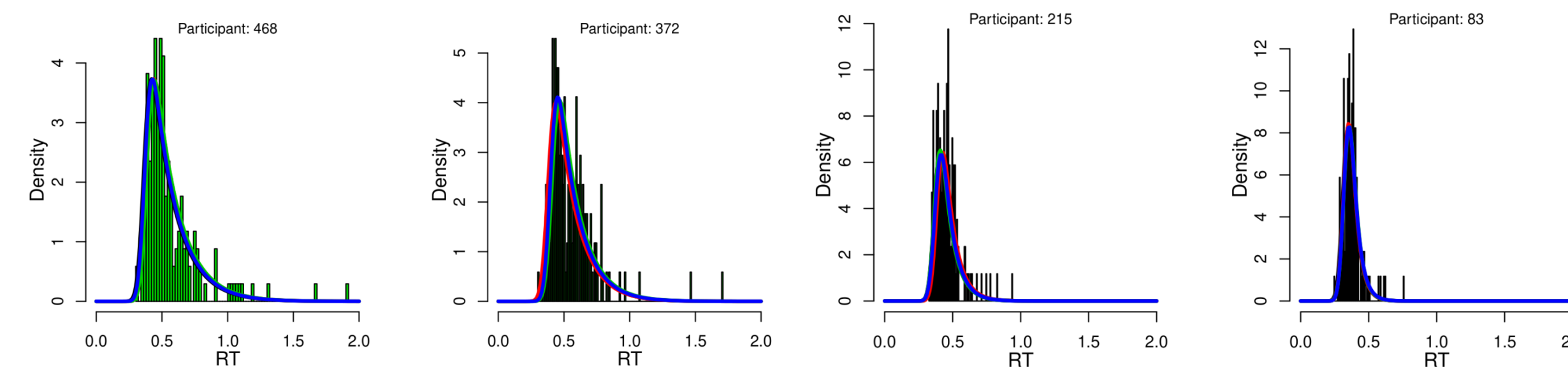


Figure 3. Observed RT against Posterior predicted RT distribution

We applied this model to a subset of 7 tasks and 100 participants from a larger data set [1].

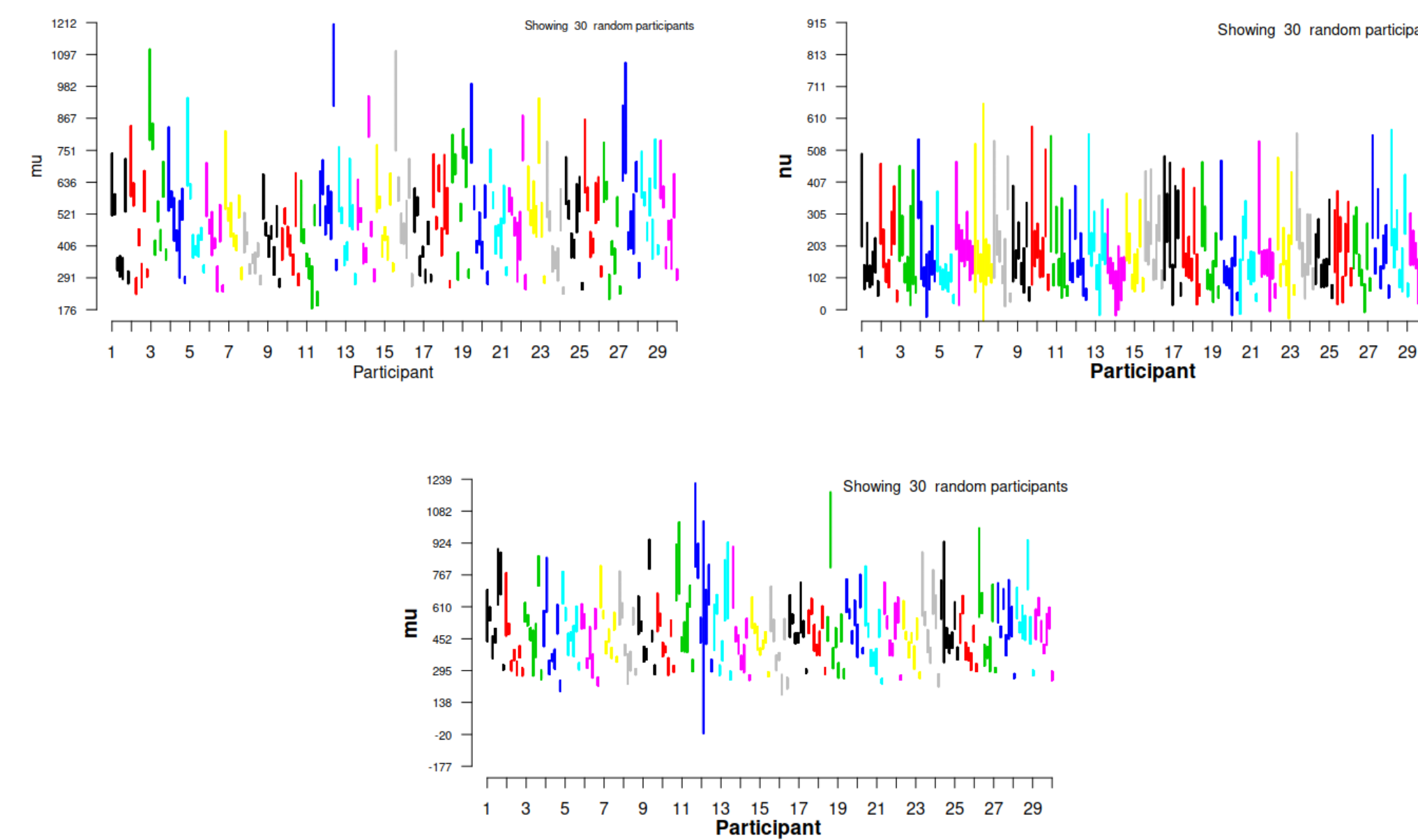


Figure 4. Individual posterior samples for μ_{ij} (left), ν_{ij} (center) and σ_{ij} (right). On all panels, change of colors separate participants, with a same-color line per task. We only show results for 30 random participants.

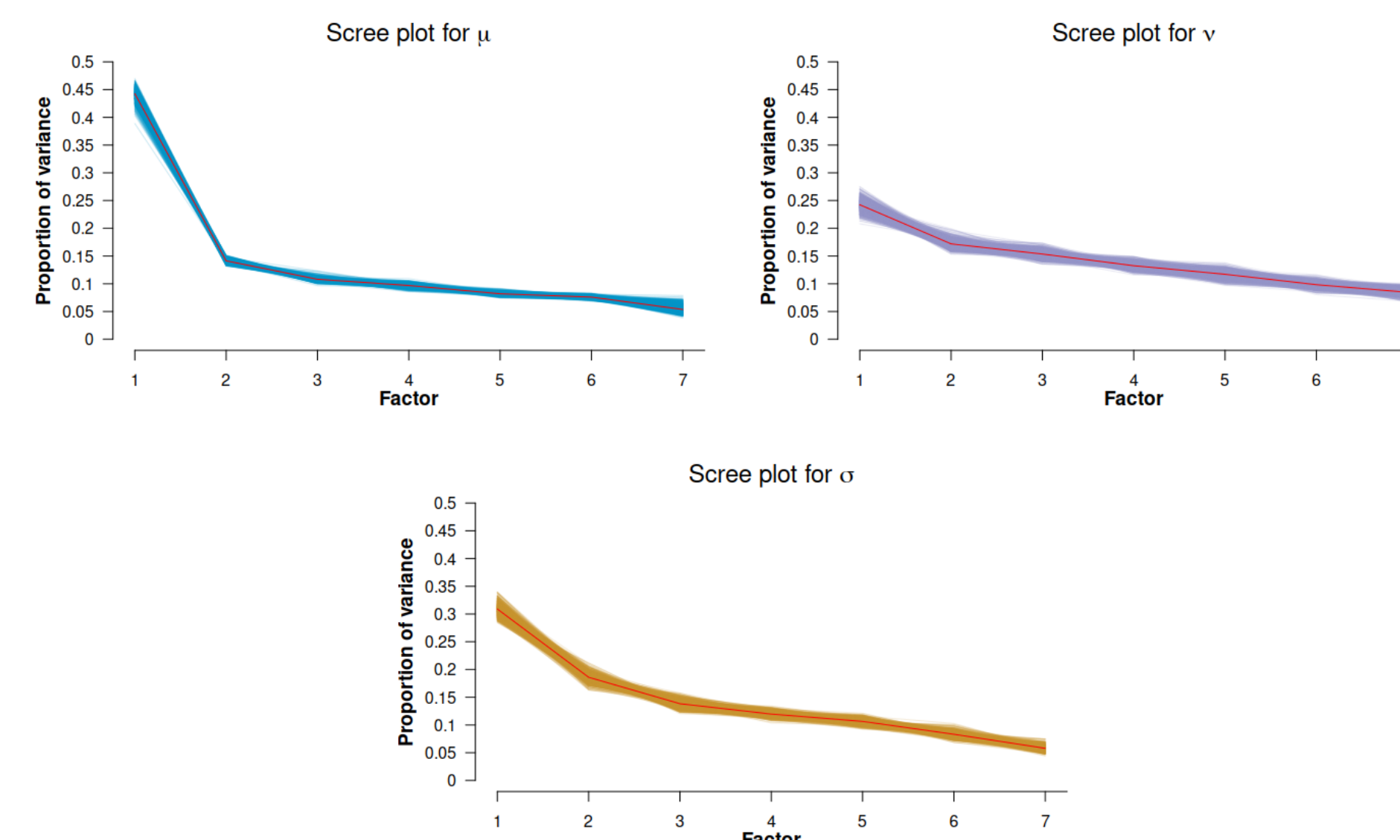


Figure 5. We conducted an iterative PCA revision for $n = 1000$ random posterior samples. The three panels present the overlapping Screeplots obtained across each iteration (left: μ_{ij} , center: ν_{ij} and right: σ_{ij}). The thin lines correspond to the average result.

Correlational structure of Ex-Gaussian parameters

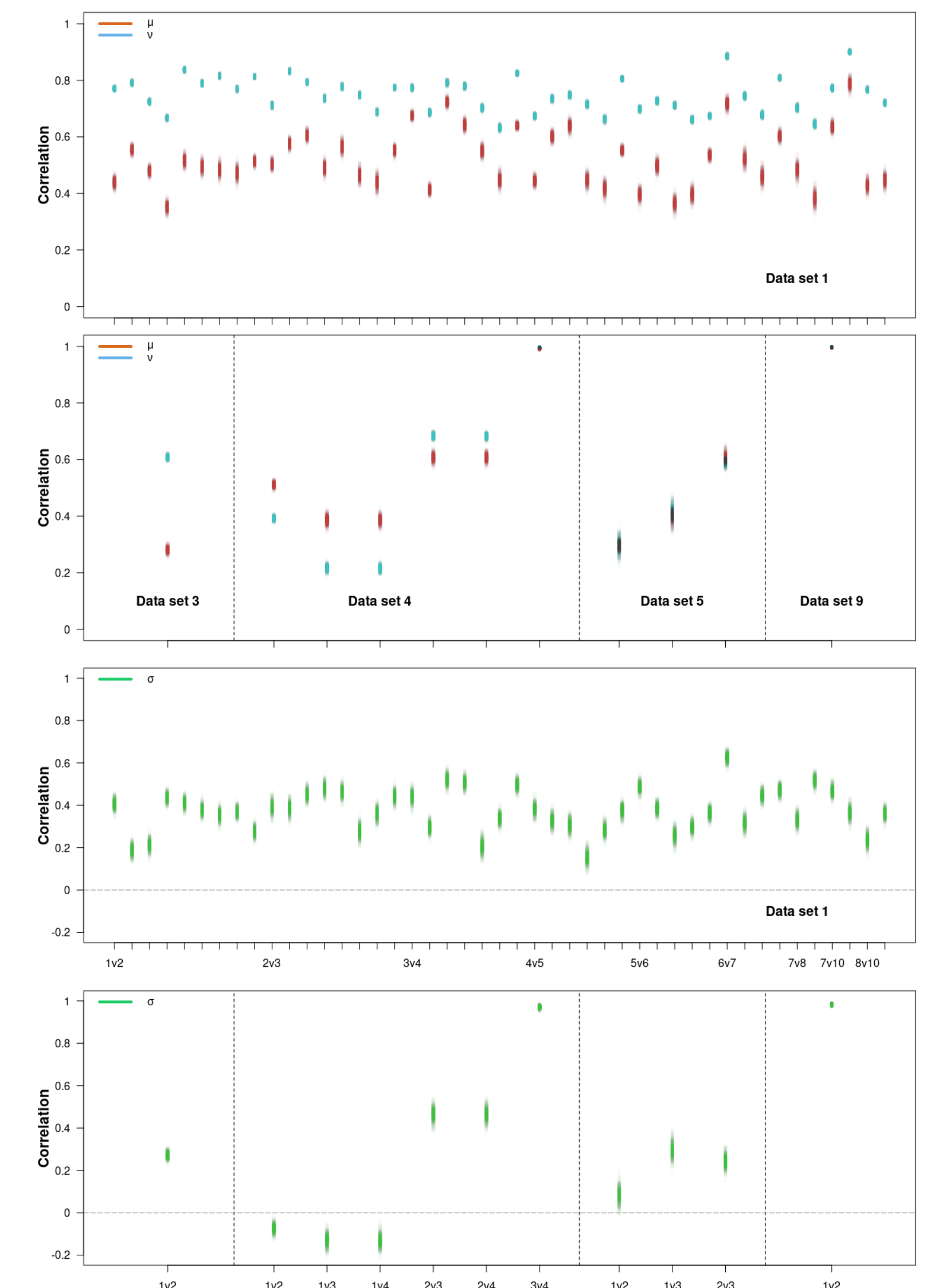


Figure 6. Distribution of between-task correlations computed across $n = 1000$ random posterior samples. The first two panels present the correlations obtained in terms of μ_{+j} and ν_{+j} , and the last two panels show the results for σ_{ij} .

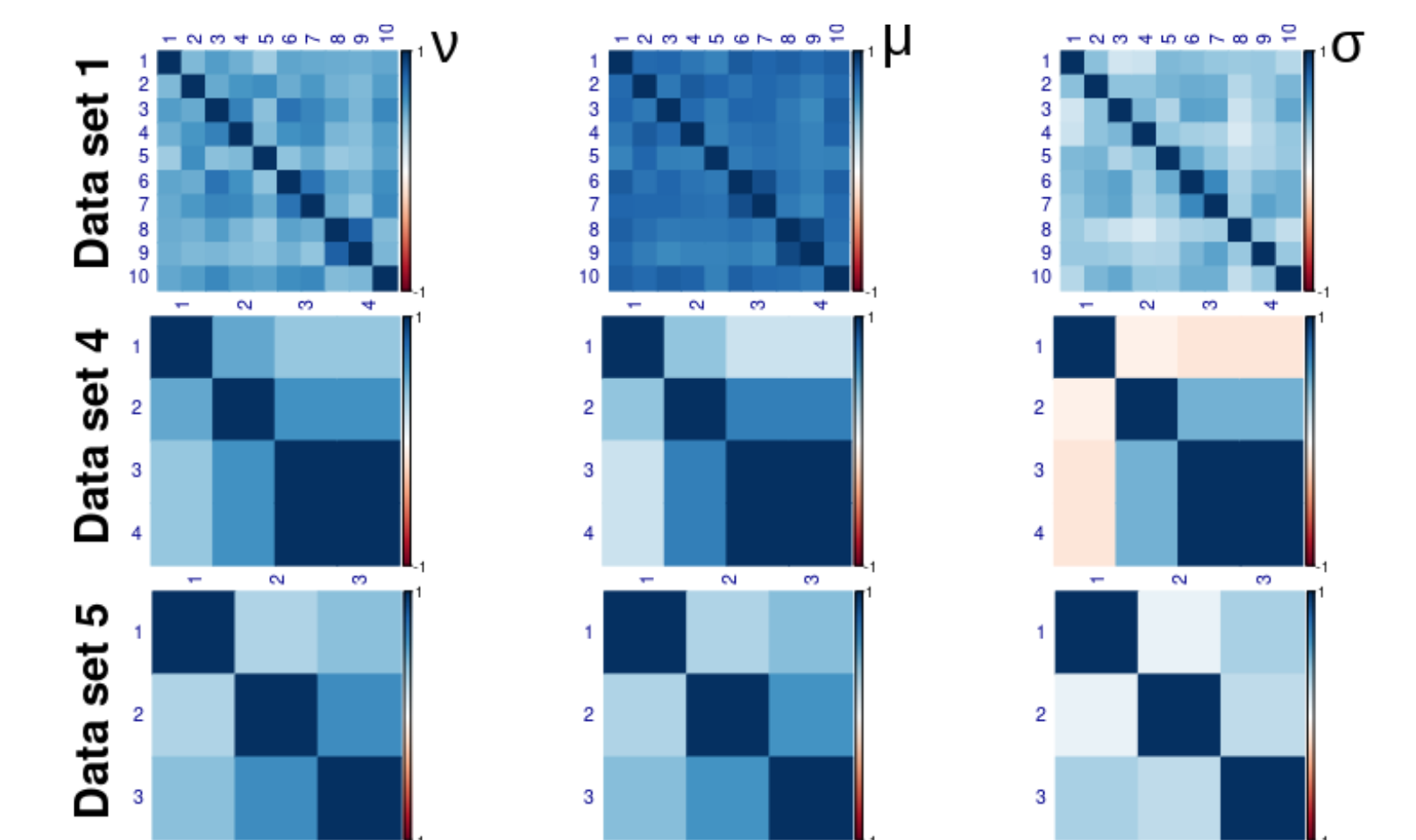


Figure 7. Correlations between the posterior mean computed across the μ_{ij} , ν_{ij} and σ_{ij} parameters estimated across different data sets.

Acknowledgements

This project was supported by NSF #1850849 and #2051186.
 Github: https://github.com/Adrifelcha/RT-struct_and_dist.
 Contact info: achavezd@uci.edu Lab website: cidlab.com