Taking dynamics seriously

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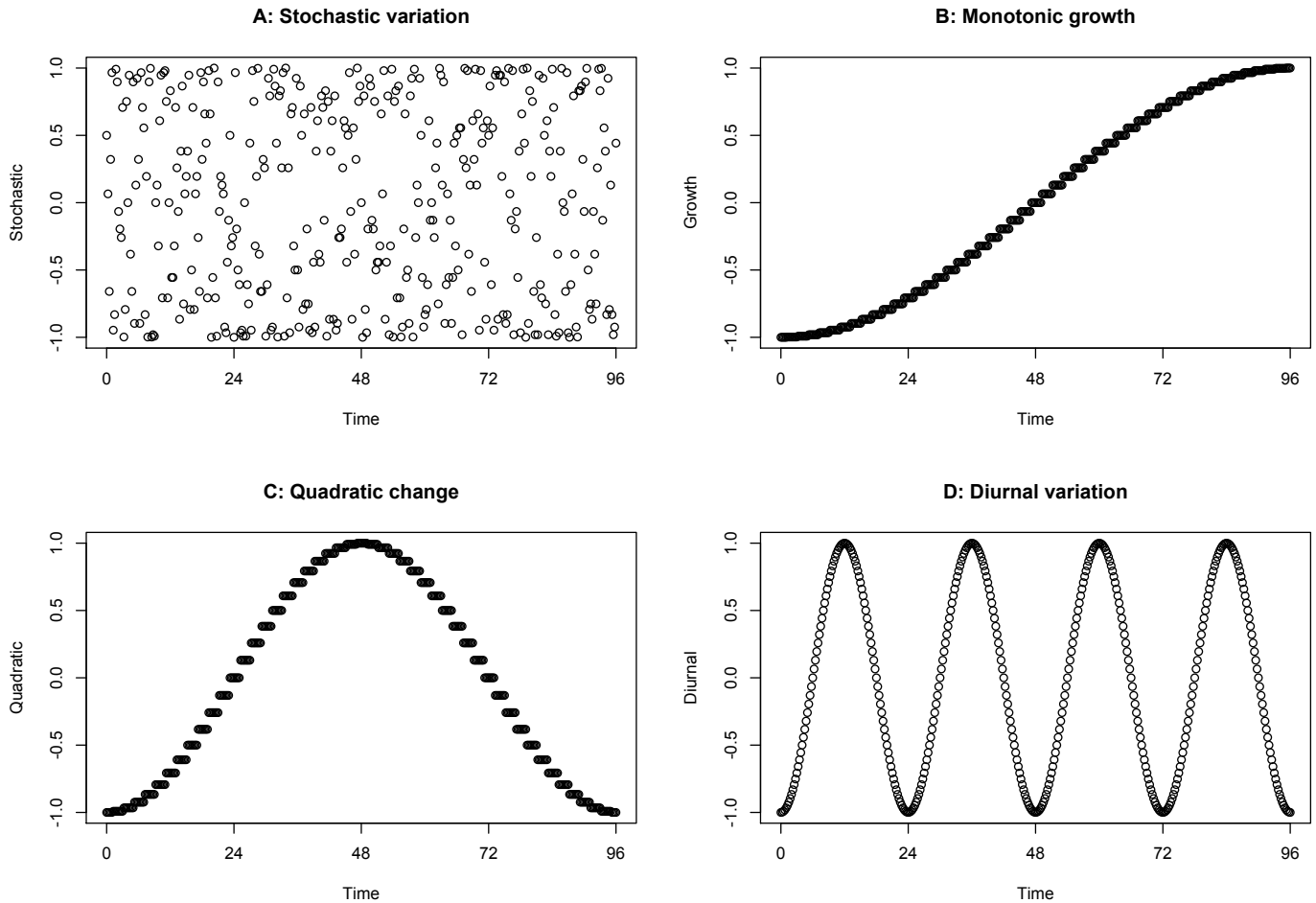
Outline

Some bold statements to get the discussion going

1. Many discussions of "dynamics" discuss Cattell's data box (Cattell, 1946, 1966) and the need to study variation over time within subjects.
2. Yes, people do vary over time and situations but this is not necessarily dynamic.
3. To be dynamic, time must be included in the model.
4. Stochastic variation is not dynamic.
5. Consider 4 distributions across time with equal variance and equal means.
6. 3 show dynamic variation, one just stochastic variation.

Four kinds of within subject relationships over time



From Revelle and Wilt (2021)

What is a dynamic system?

1. States change over time.
2. States show inertia
3. Ideally can be modeled
   - As a box diagram
   - As a set of difference or differential equations

Classical dynamic box model

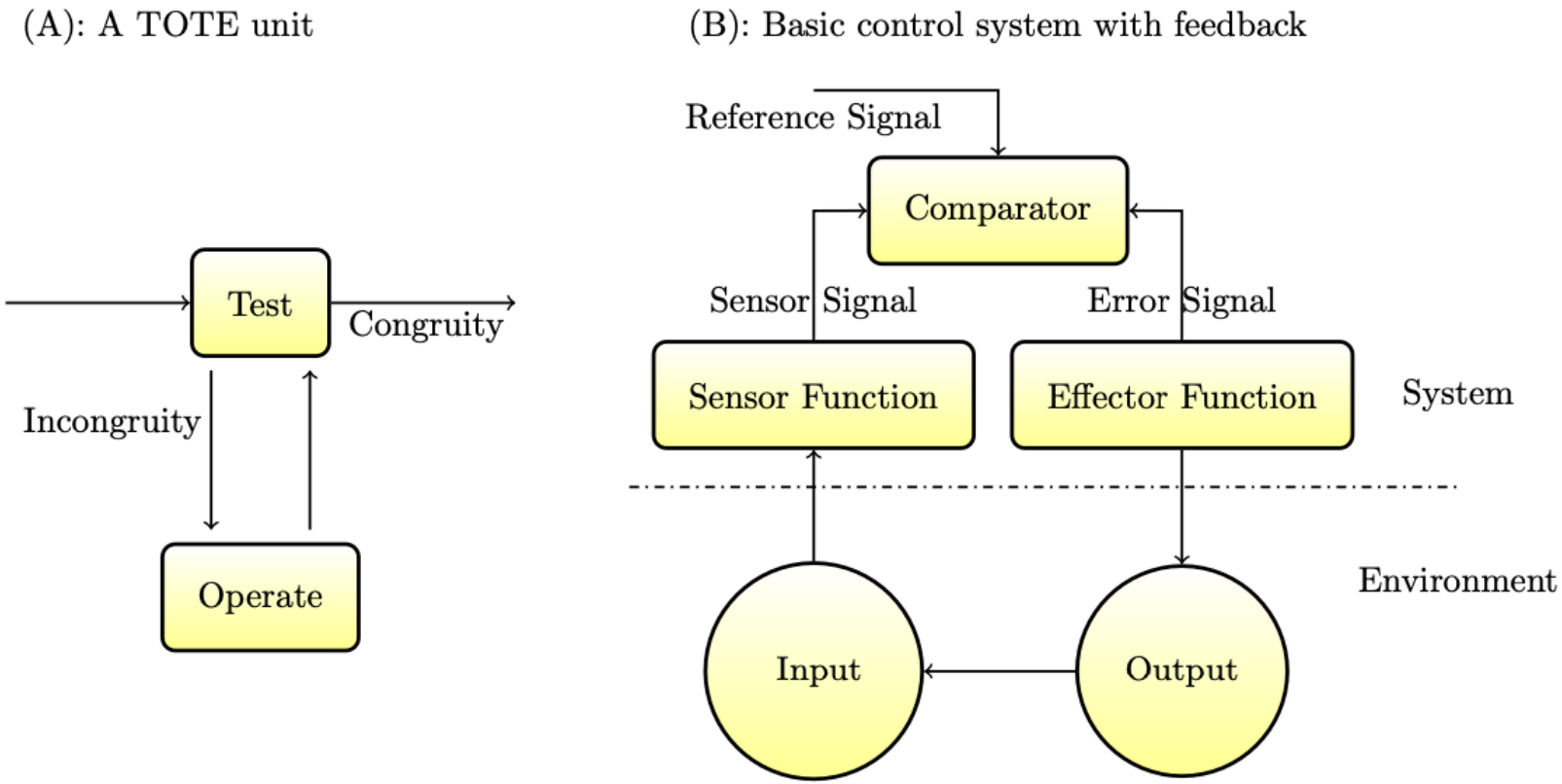


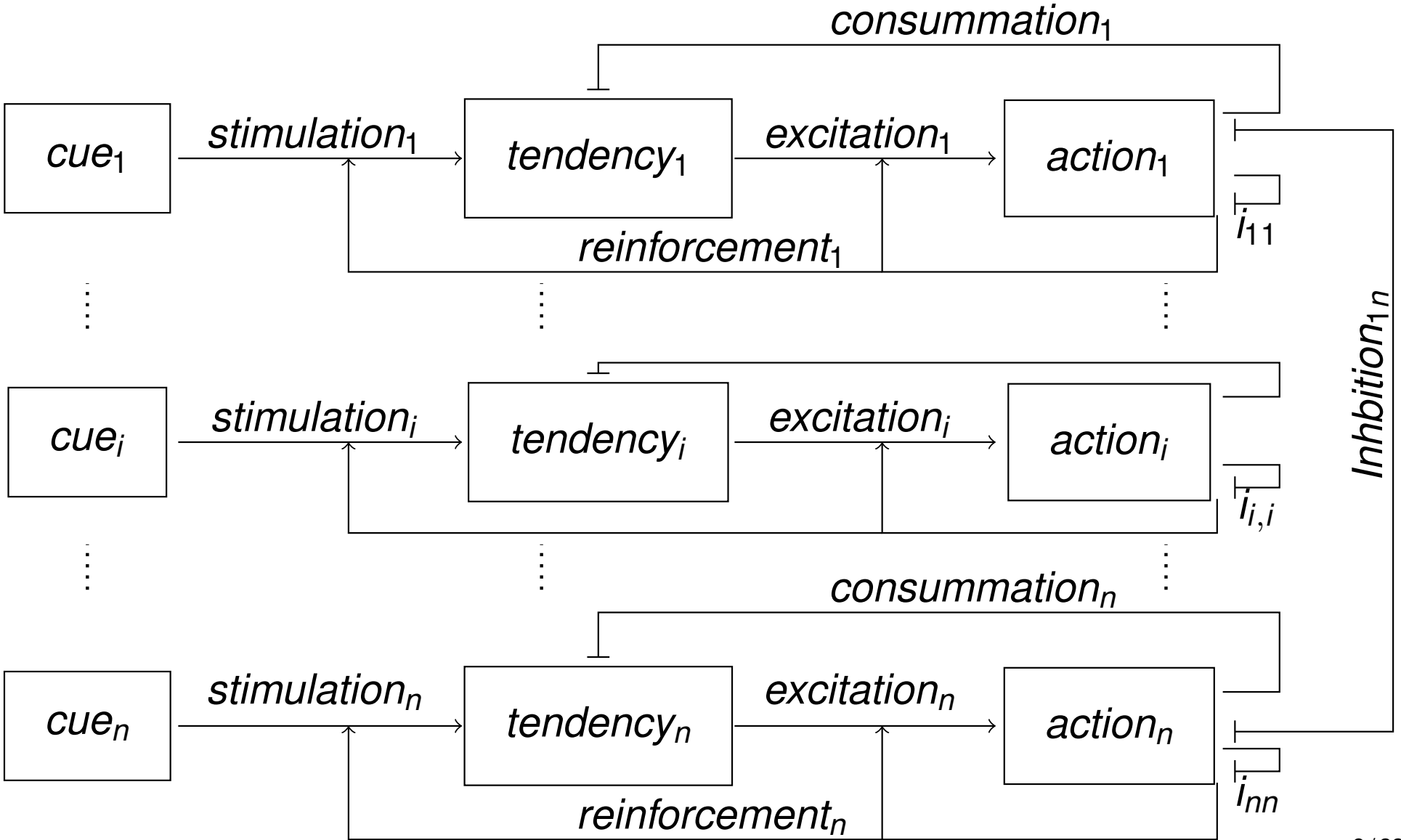
Figure 2. A): The basic Test-Operate-Test-Exit (TOTE) unit from Miller et al. (1960). B) The basic feedback loop with a comparator (adapted from Powers, 1973).

The CTA as a formal model

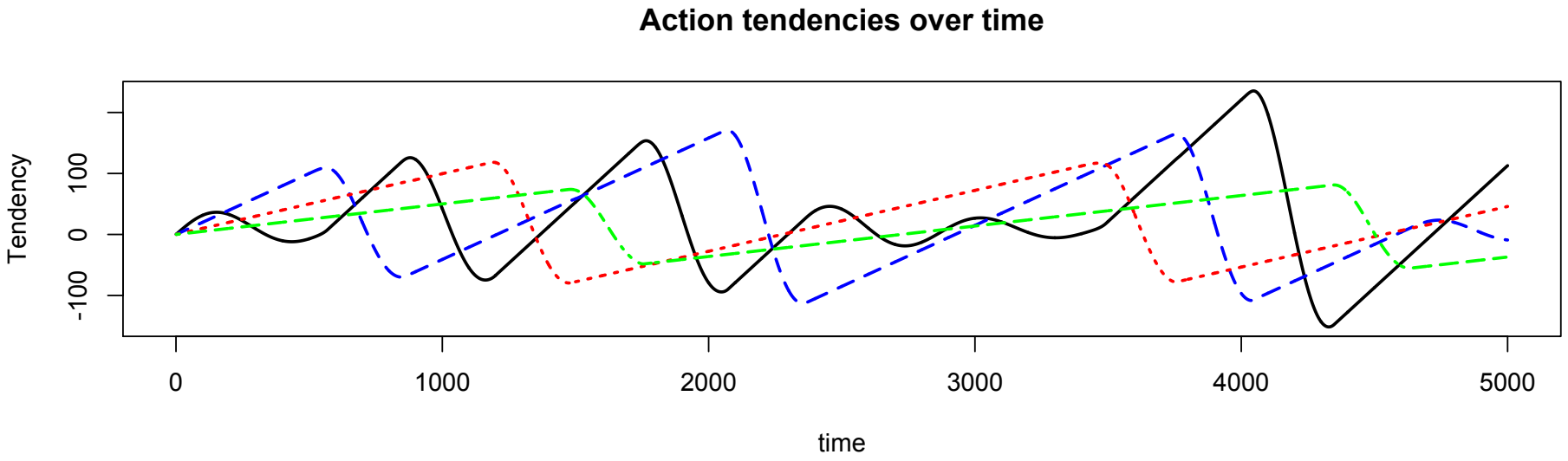
1. Inspired by the Dynamics of Action (Atkinson and Birch, 1970) who elaborated on Lewin and Zeigarnik (1927) who introduced inertia into motivational models.
2. First discussed as a reparameterization of DOA (Revelle, 1986) and then elaborated by Revelle and Condon (2015) to apply to within person, between person, and over development.
3. Revelle and Condon (2015) showed how the CTA model could model dynamics at three levels of analysis: within individuals (e.g. the rise and fall of emotions), between individuals (talking behavior in groups of individual), and between groups of individuals (choice of college major or occupation).
4. Included as the `cta` and `cta:15` functions in the *psych* package.

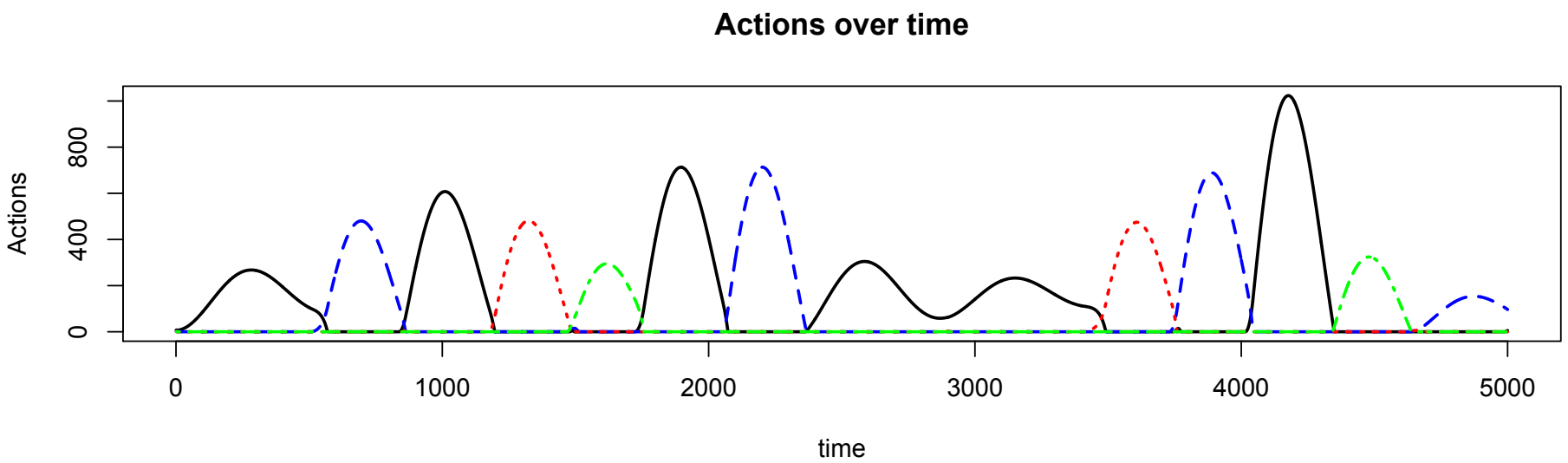
A more complicated model

$dt = Sc - Ca$ $dA = Et - Ia$



Simulation of four individuals in a conversation

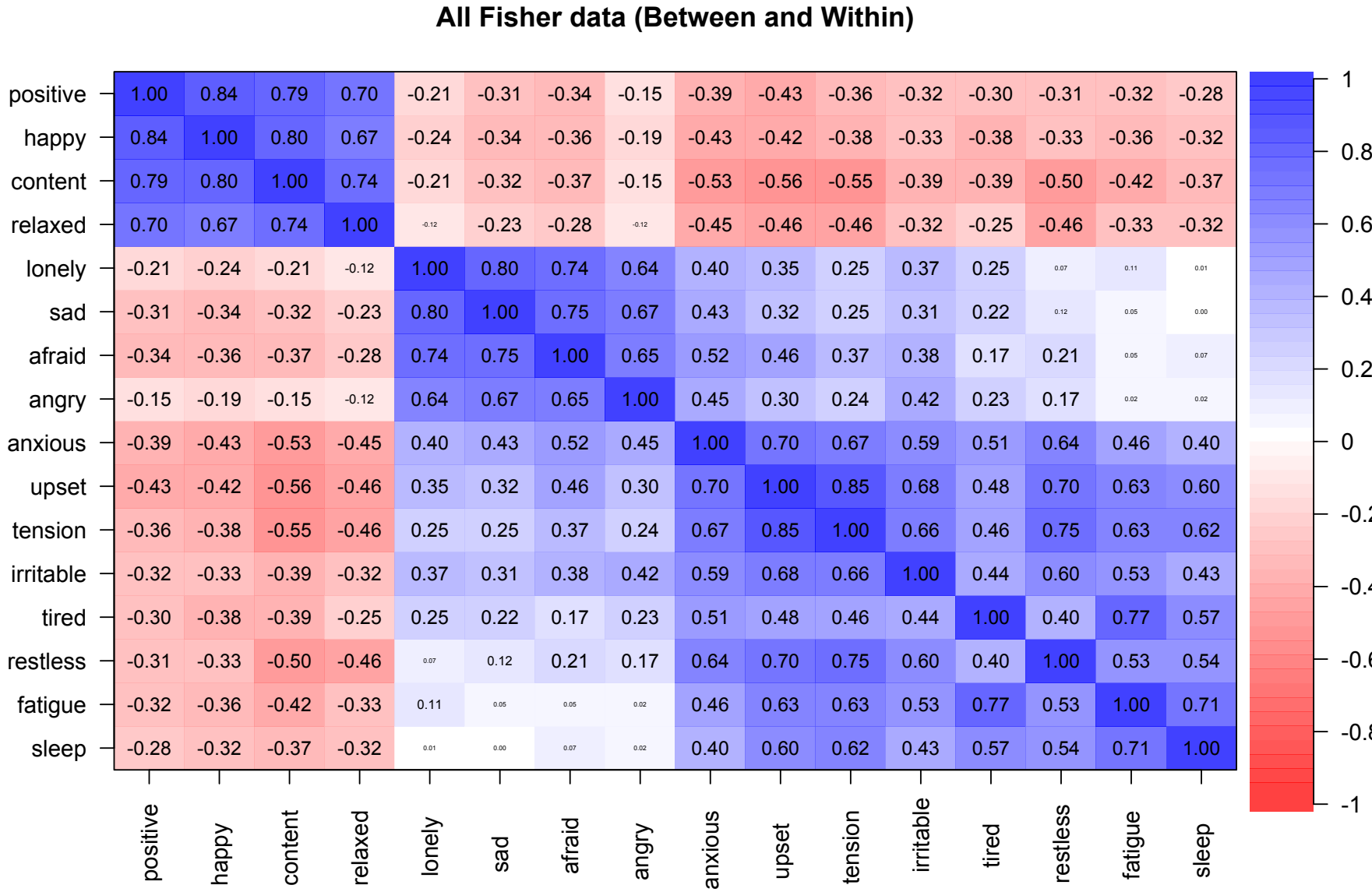




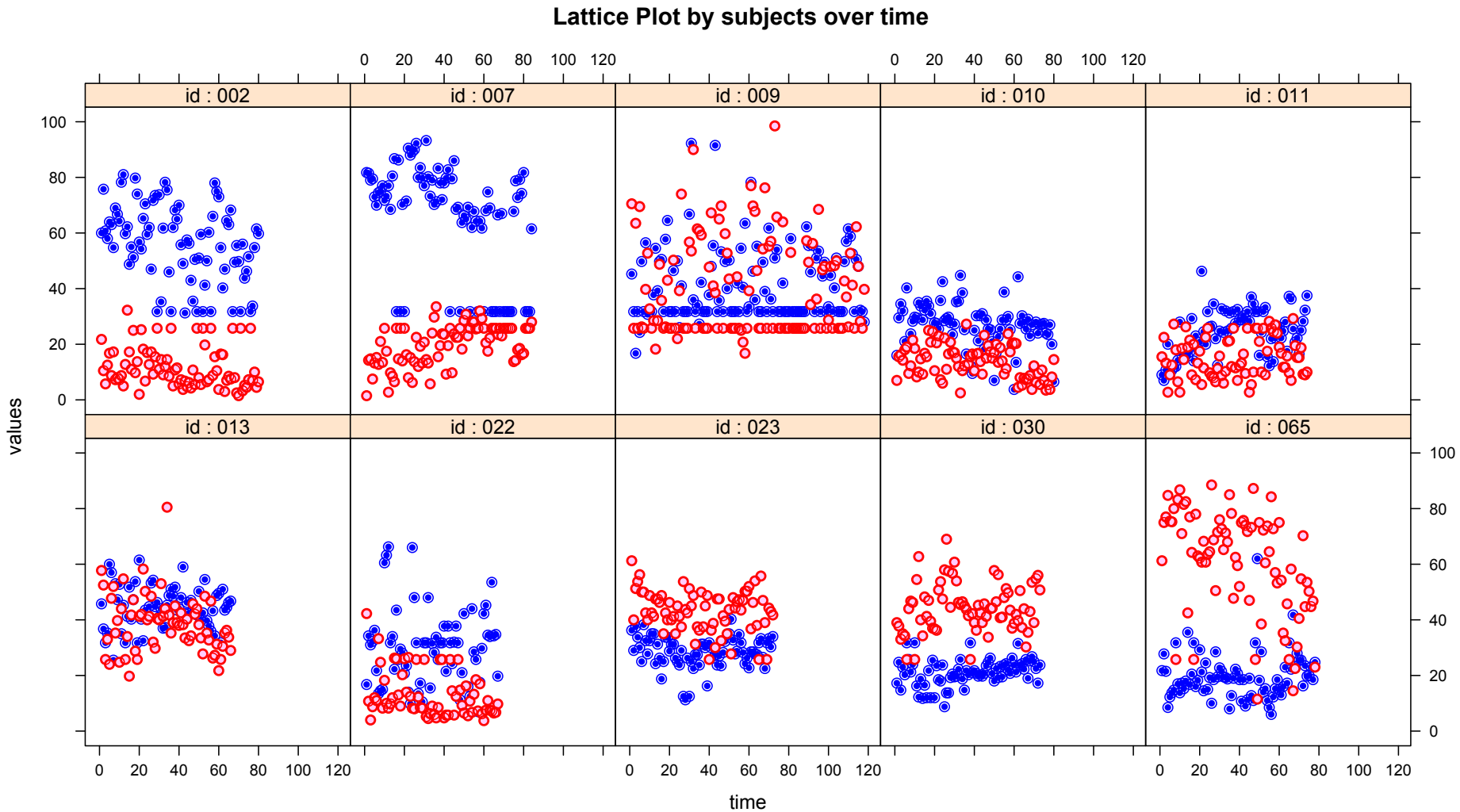
A simple example of within subject variation–the Fisher data set

1. Aaron Fisher (2015) studied mood with 28 items over 60-120 days
2. We have used these data (for 10 subjects) in a tutorial on dynamics Revelle and Wilt (2019).
3. From the 28 items, we chose a subset to represent positive and negative affect as well as tension/fatique.

Items from Fisher show a clean overall structure



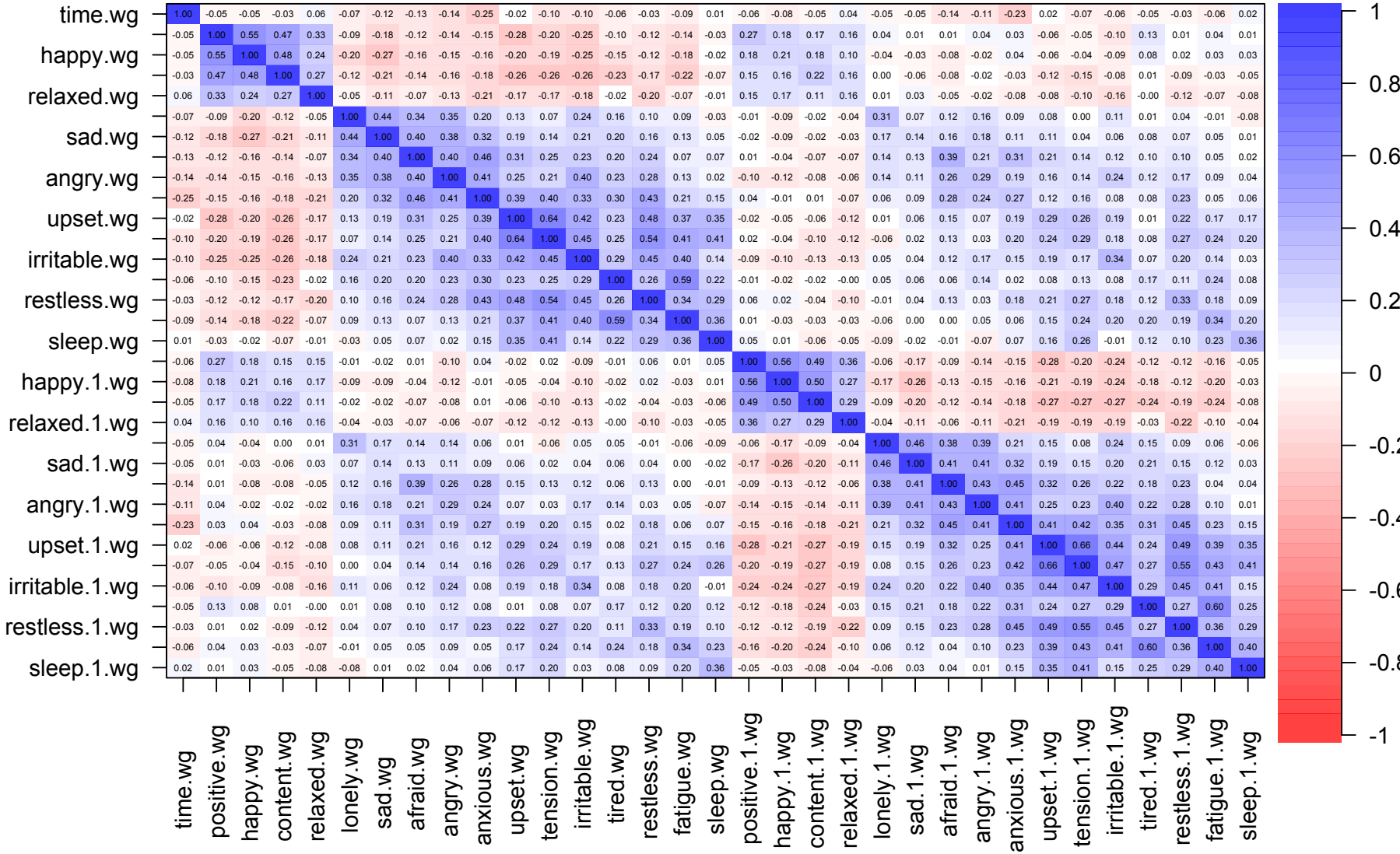
10 subjects over time from Fisher



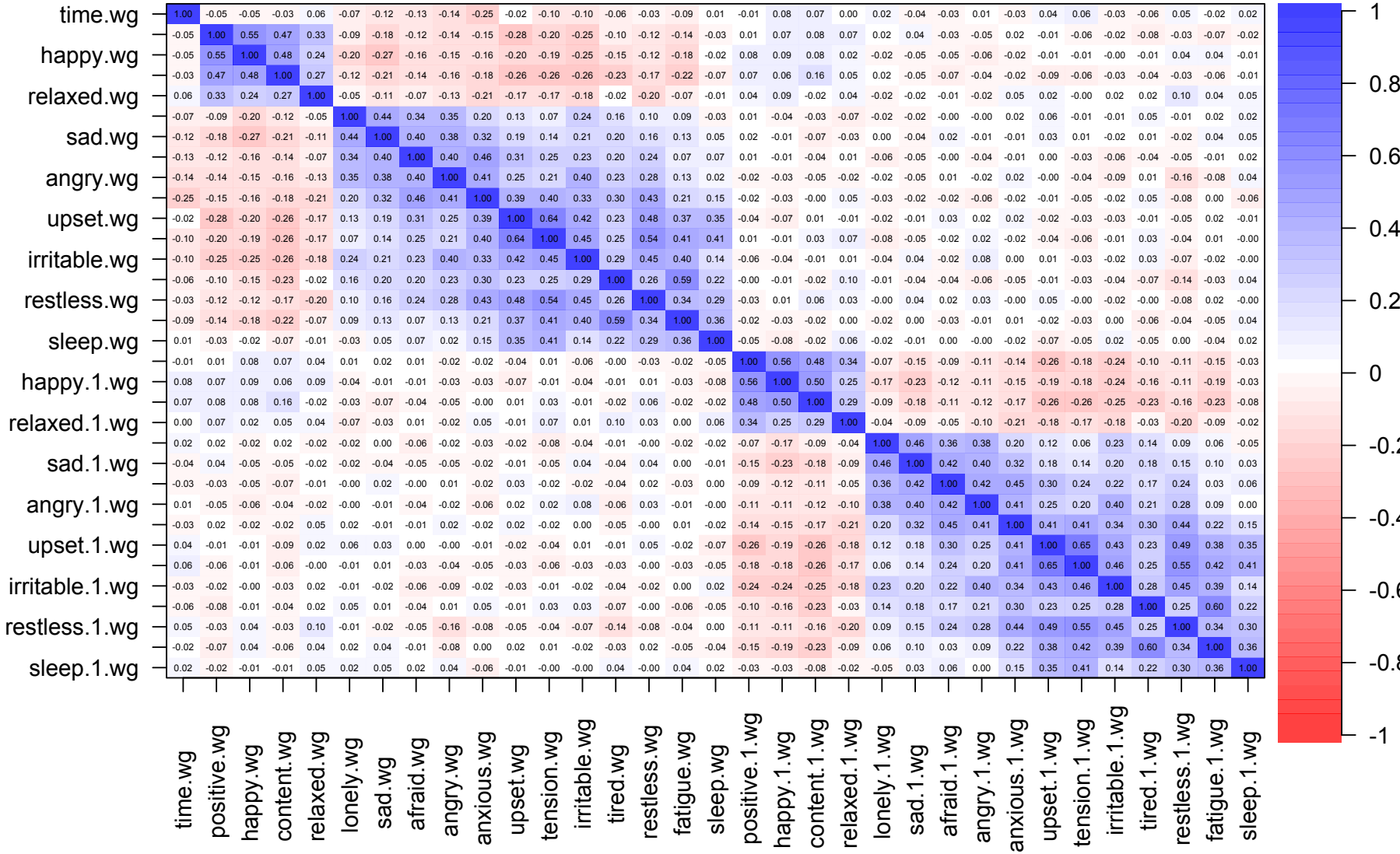
What is a dynamic system?

1. The Fisher data set seems to show changes in mean level over time
2. We examine the within subject correlations averaged over time
3. But this correlation does not vary if we randomize the time.
4. Dynamic processes will show inertia (day 1 is more similar to day 2 than to day 22)
5. To show temporal effects it is necessary to show the lagged correlations.
6. But the variation between days could be all situational. Random lags partly address this.

Pooled within subject correlations of Fisher data and lagged one data

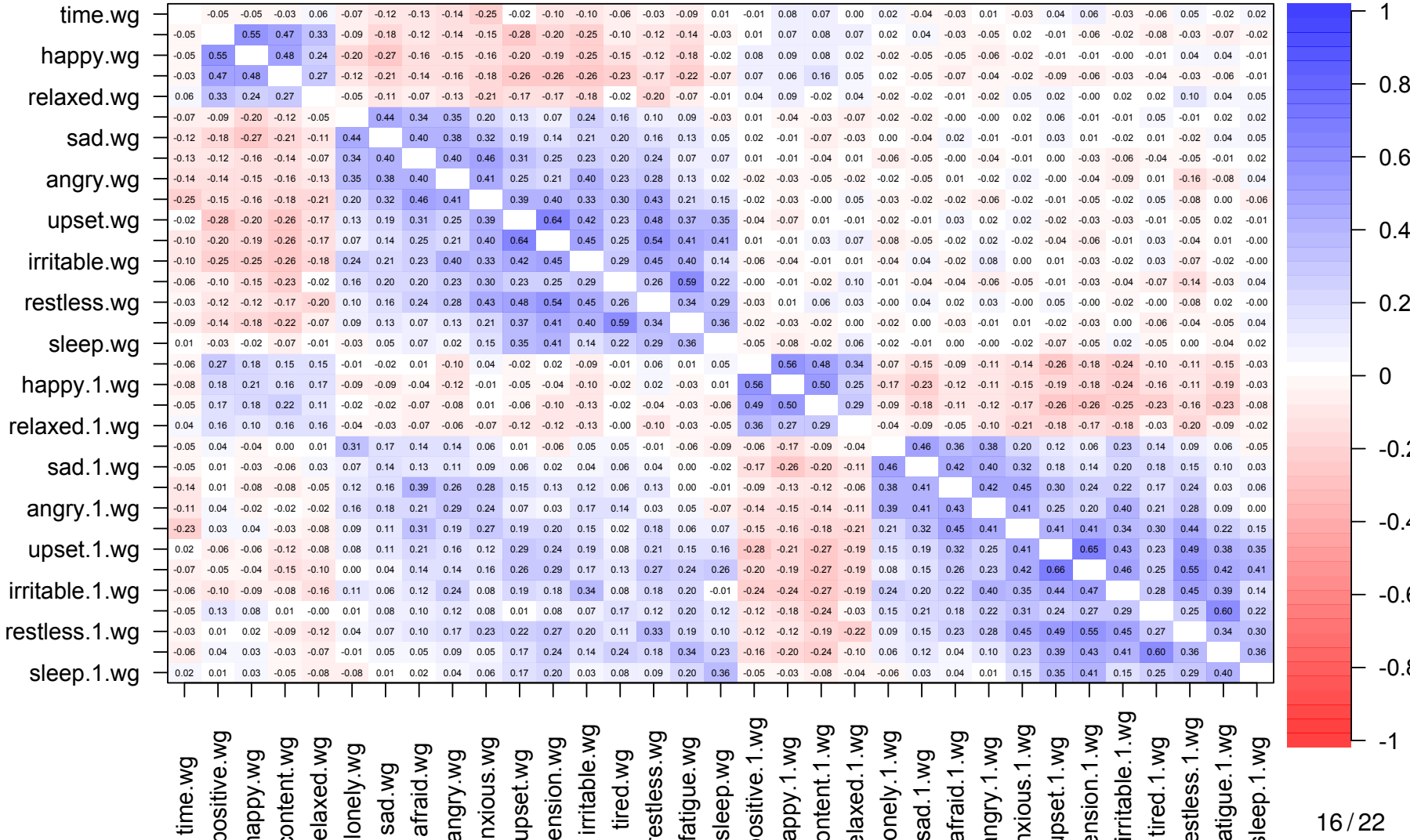


Pooled within subject correlations of Fisher data and random lagged data



Combine into one graphic. Note that only the lagged correlations differ

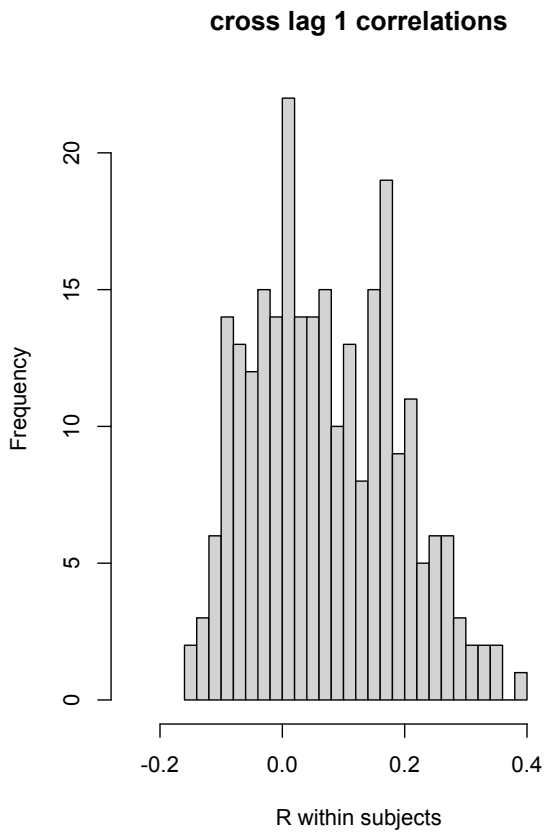
Lag 1 below the diagonal, random lags above the diagonal

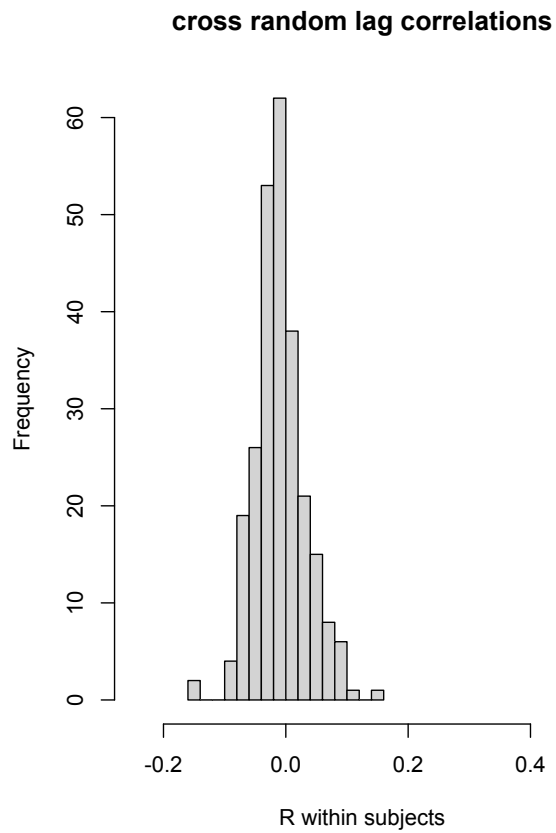


The effect of lags

1. Is it the lag, or is it the situation?
2. Show the lag1 correlations and compare to random lags.
3. But the lag 1 correlations could reflect inertia of situations

The cross lag corretations show some structure





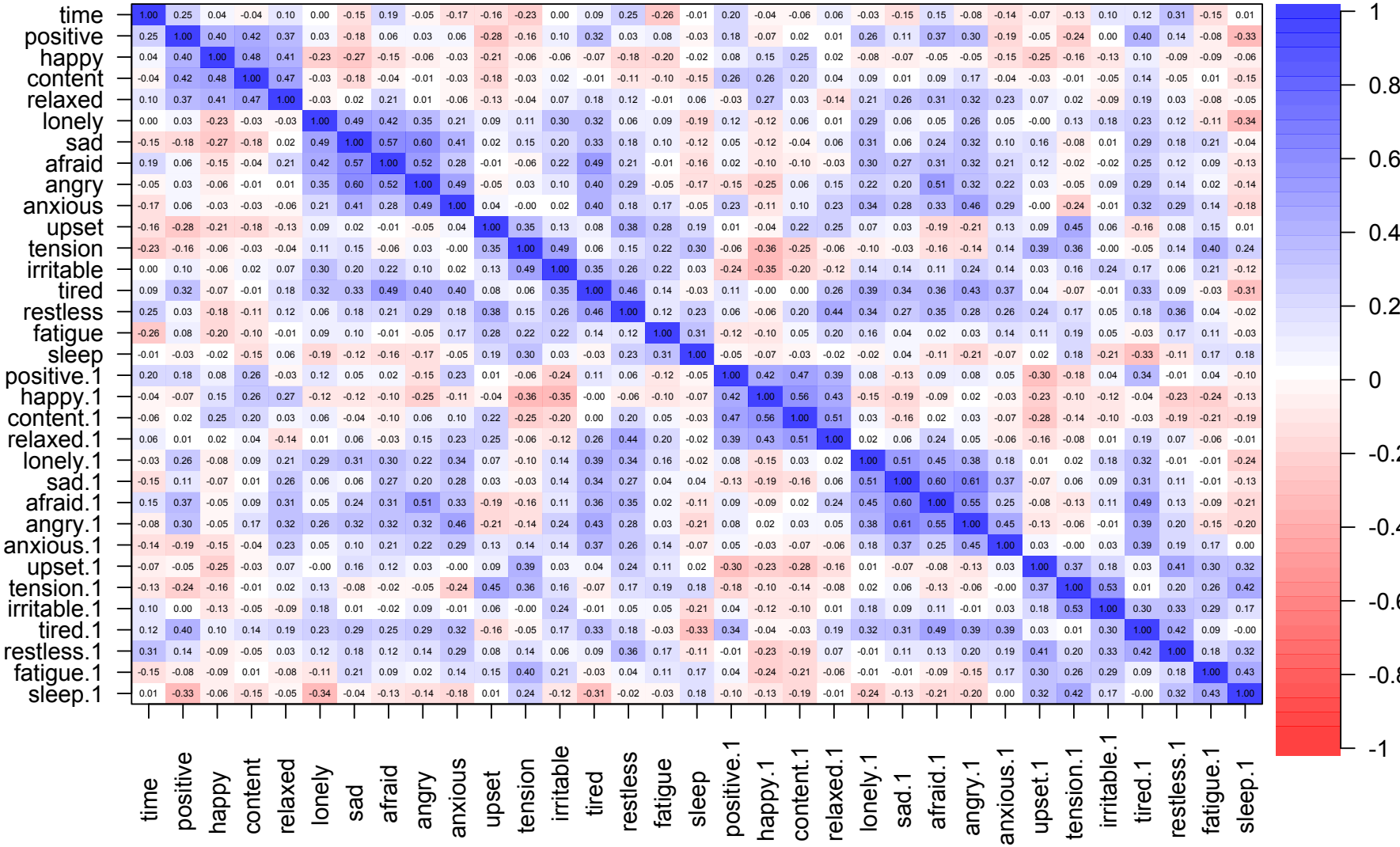
Dynamics at the subject level

1. Examine the within person standard deviation of the correlations.

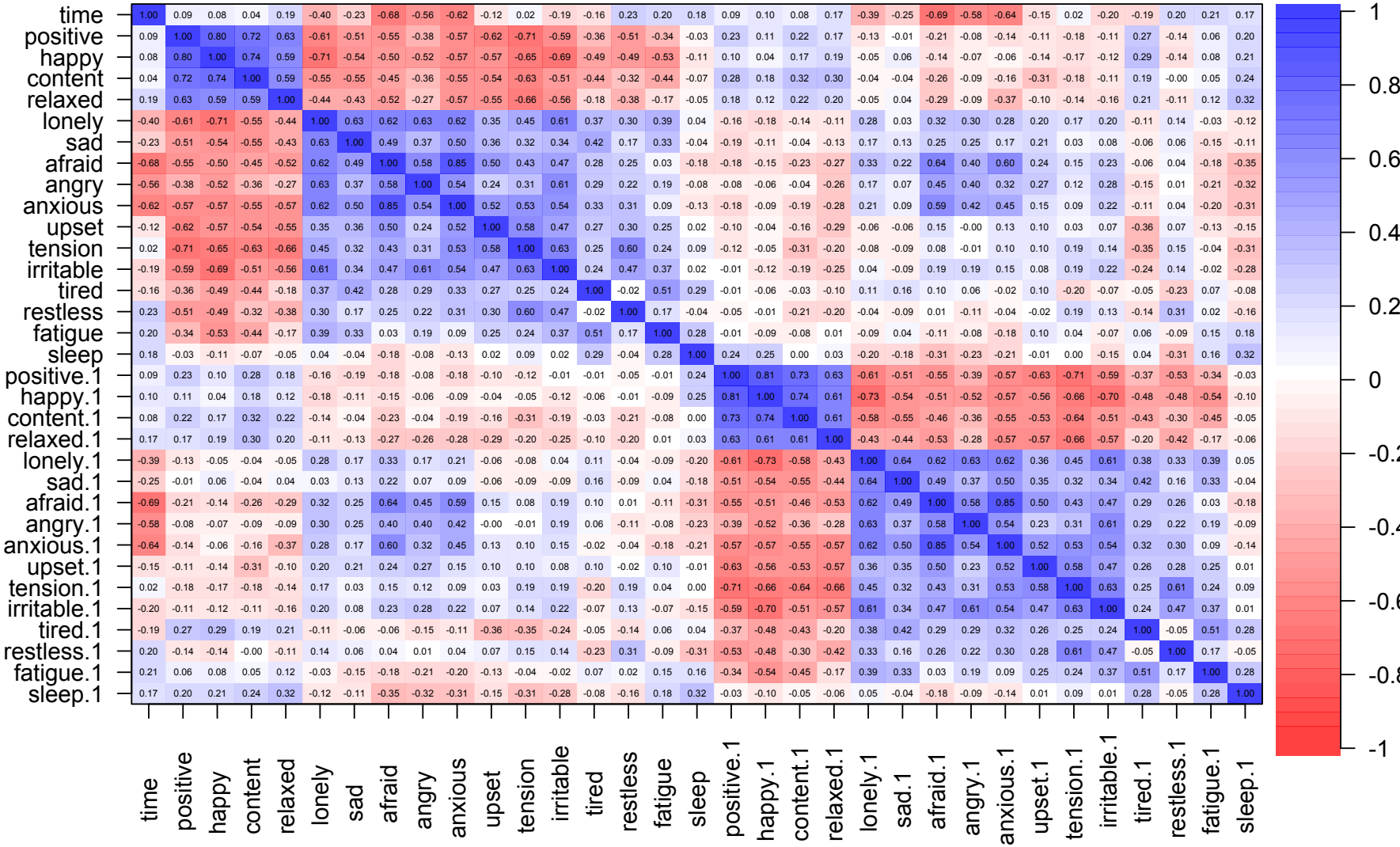
002	007	009	010	011	013	022	023	030	065
0.23	0.28	0.20	0.27	0.27	0.24	0.28	0.22	0.33	0.35

2. Show the participants with the least (09) and most (065) variance of correlations.

Within subject correlations for subject 009



Within subject correlations for subject 065



Summary

1. People change over time and space.
2. We need to go beyond simply saying people differ across situations and within situations.
3. We can model the change process by considering the inertia of affect, cognition, and desires.

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