Personality structure beyond the Big 5:

Expanding the boundaries of personality research

William Revelle and David Condon

Personality, Motivation and Cognition Laboratory
Department of Psychology
Northwestern University
Evanston, Illinois USA

Presented at the EAPP experts meeting on The Structure of Personality
Dubrovnik, Croatia

September, 2012

Outline

Personality as the coherent patterning of the ABCDs

Personality is the study of the coherent patterning over time and space of affect, cognition, and desires as they lead to behavior.
That is, personality is the study of patterns over time of how what we *do* is the consequence of how we *feel*, what we *think*, and what we *want*.
This definition leads to studies of coherency over time within subjects as well as to studies of stable patterns of individual differences at any one time and studies of patterns of change over time. One of the consequences of differences in patterns may be found in the behavioral choices we make that reflect our long term patterns of affect, cognition and desires.
All of these areas are important issues for those of us who study personality.

Personality structure can be examined at four different levels

At least four levels of analysis of personality structure

1. Structure of personality within individuals across time
   - Dimensions of affect are not the same for all individuals.
2. Structure of personality between individuals at one time
   - Identity
   - Reputation
   - Behavior
3. Structure of personality between individuals over time
   - Does the structure change over time?
   - What is the structure of change?
4. Structure of personality differences between groups of individuals
   - People choose niches based upon their temperaments, abilities, and interests.
   - What are the structures of these niches?

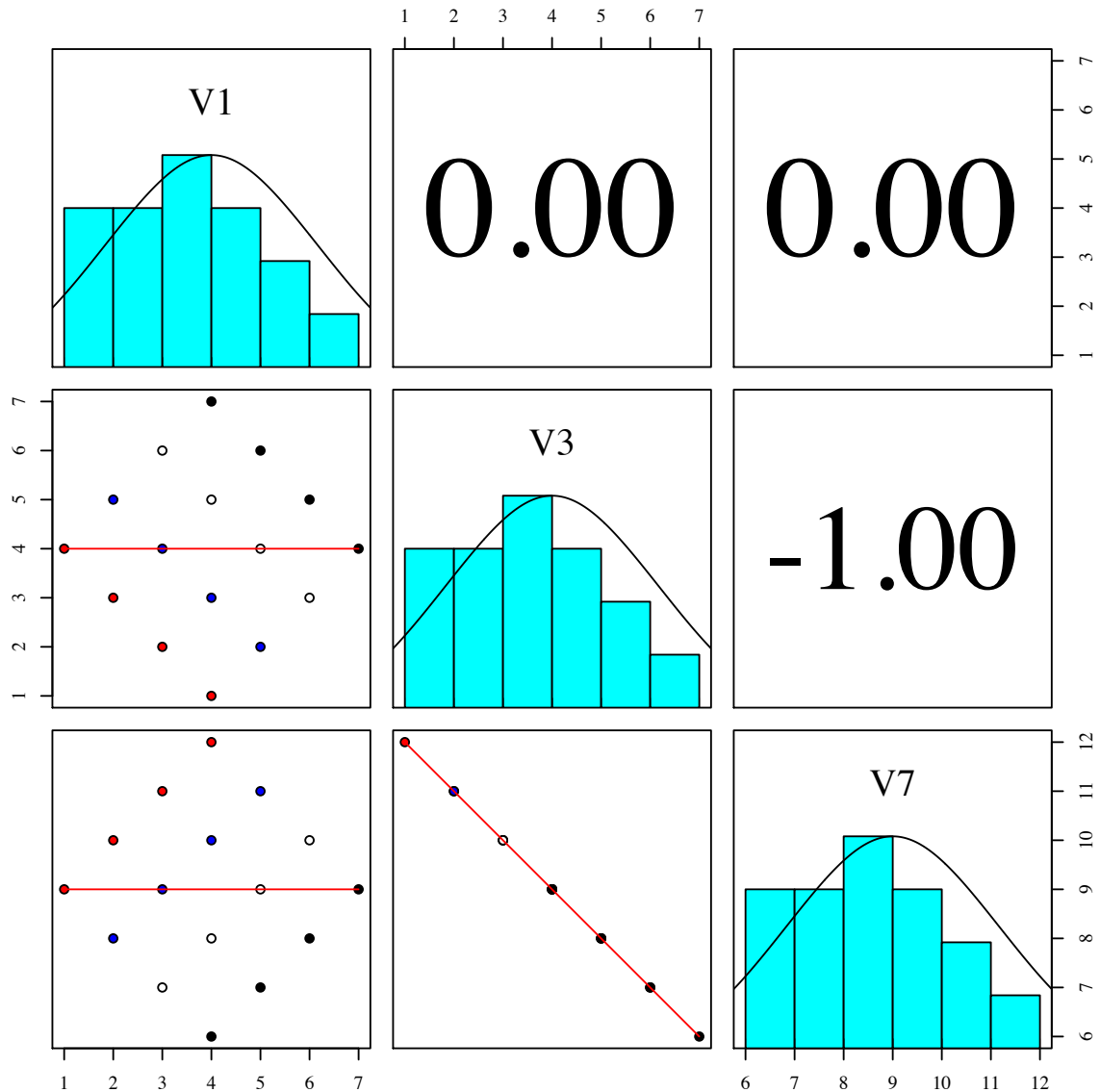
Multilevel analysis can yield surprising results

Although it is well known that the structure within a level does not imply anything about the structure at a different level, this distinction is frequently forgotten.

1. Various names for the phenomena:
   - Yule-Simpson paradox (Simpson, 1951; Yule, 1903)
   - The fallacy of ecological correlations (Robinson, 1950)
   - The within group–between group problem (Pedhazur, 1997)
   - Ergodicity (Molenaar, 2004)
2. Observed correlations may be decomposed into with group correlations and between group correlations
   - $r_{xy} = eta_{x_{wg}} * eta_{y_{wg}} * r_{xy_{wg}} + eta_{x_{bg}} * eta_{y_{bg}} * r_{xy_{bg}}$
   - $r_{xy_{wg}}$ is the within group correlation
   - $r_{xy_{bg}}$ is the between group correlation
   - $eta_{x_{wg}}$ is correlation of the data with the within group values
   - $eta_{x_{bg}}$ is correlation of the data with the between group values
3. We consider several examples of multi-level analysis.

Personality structure can be examined at four different levels

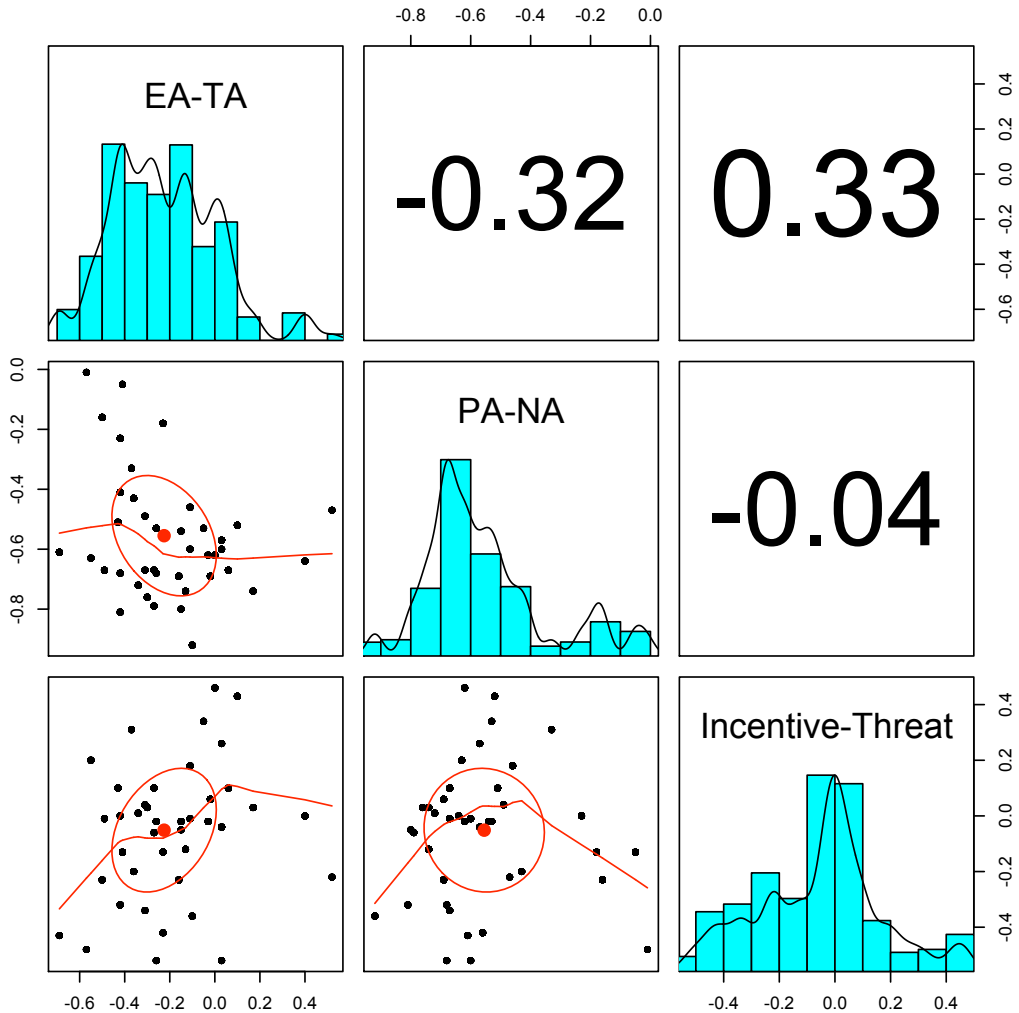
Observed correlations when $r_{wg} = \pm 1$ and $r_{bg} = \pm 1$



Previous results from the Telemetrics Lab demonstrate Level 1 effects

1. Personality and the structure of affect using the Motivational State Questionnaire (Revelle & Anderson, 1997) and the EPI (Eysenck & Eysenck, 1964) show
   - Independence of Positive Affect and Negative Affect between individuals cross sectionally
   - Low correlations of PA with Extraversion and NA with Neuroticism
2. Within subject correlation of PA and NA and Energetic Arousal and Tense Arousal varies a great deal
   - Measured multiple times per day within subjects across 2-4 weeks
   - Using daily diaries or Palm Pilots (Rafaeli, Rogers & Revelle, 2007)
   - Using cell phones and text messaging Wilt, Funkhouser & Revelle (2011)

Variability and between subject correlations of within subject measures (Wilt et al., 2011)



Level 2: The traditional analysis of Personality and Temperament

Hogan (1982) distinguishes between personality as identity and personality as reputation. To this we would add actions.

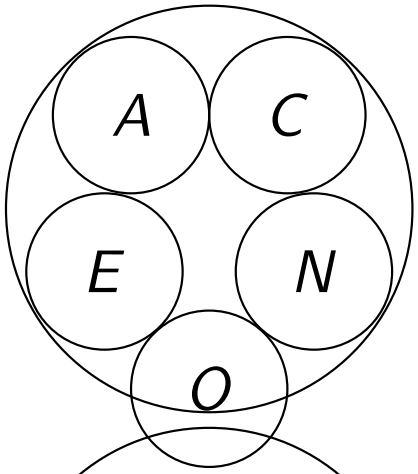
1. Identity
   - How we see ourselves
   - Studies of the structure of self report
2. Reputation
   - How others see us
   - Studies of the structure of peer report
3. Actions
   - What we actually do
   - Studies of the residues of our choices and our actions.
   - One important outcome is choice of college major.
   - Another is the choice of occupation.

Going beyond the ABCDs: Personality as Temperament, Ability, and Interests

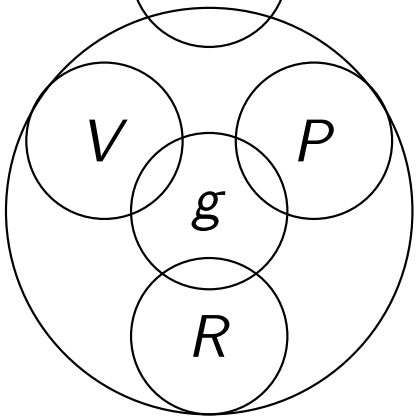
1. Temperament: what we usually do
   - Identity, Reputation, and Actions
   - Affective, Cognitive and Behavioral reactions to situations: the "Big 5" (Goldberg, 1990), the "Giant 3" (Eysenck, 1990)
2. Ability: What we can do
   - Measures of intellectual ability – life as an intelligence test (Deary, Penke & Johnson, 2010; Gottfredson, 1997; Horn & Cattell, 1966; Johnson & Bouchard, 2005)
3. Interests: What we like to do
   - 6 dimensions: Realistic, Investigative, Artistic, Social, Enterprising, Conventional (aka RIASEC Holland, 1996)
   - 2 dimensions (e.g., people vs. things/facts vs. ideas, Prediger & Vansickle, 1992) of interests

Traditional model of Temperament, Abilities, and Interests

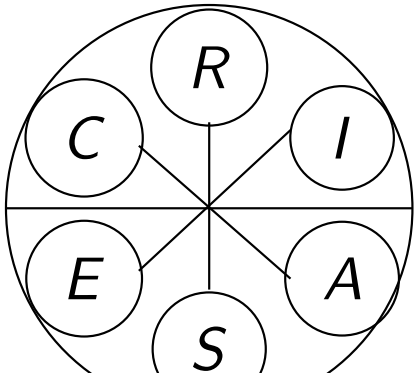
Temperament



Abilities



Interests



Temperament

2- 5 dimensions reflecting individual differences in Affect, Behavior, Cognition, Desire

Ability

1. g
2. g_f g_c

Interests

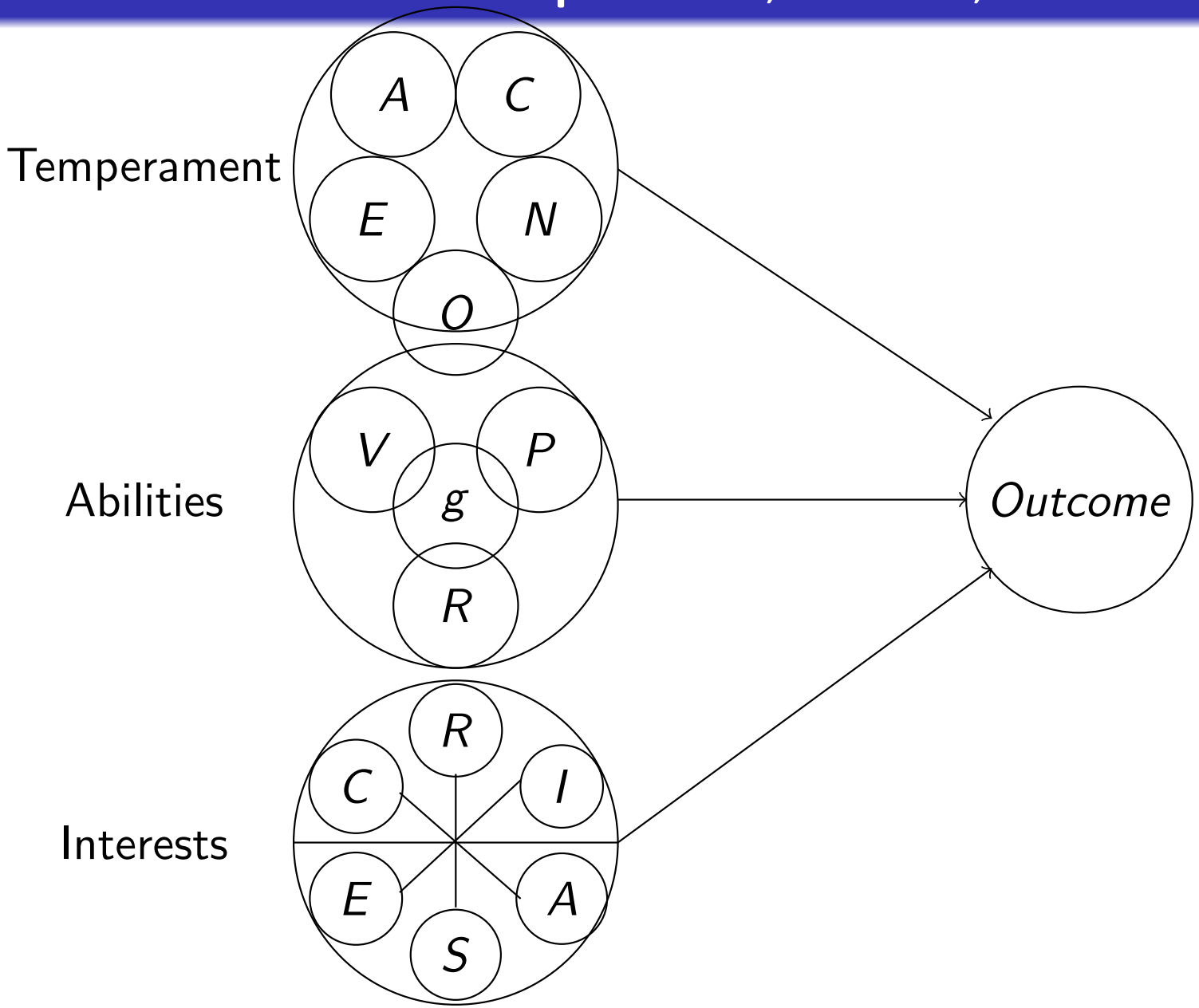
2 broad dimensions organizing 6-8 specific interests

1. People vs. Things
2. Facts vs Ideas

Personality as Temperament, Ability, and Interests

1. It has long been known that Temperament, Ability and Interests (TAI) are interrelated predictors of long term outcomes (Kelly & Fiske, 1950). Although not an issue in Europe, among most Americans, the following generalizations are true:
   - The study of interests has been relegated to vocational counselors
   - Ability has been studied by educational psychologists and Industrial Organizational psychologists.
   - Need to integrate these in a general theory of personality.
2. A few groups do try to integrate temperament and ability
   - These include Lubinski & Benbow (2000); Lubinski, Webb, Morelock & Benbow (2001); Lubinski & Benbow (2006)
   - Ackerman (1997), Ackerman & Heggestad (1997)
   - Kuncel, Campbell & Ones (1998); Kuncel, Hezlett & Ones (2001); Kuncel, Crede & Thomas (2005)
   - von Stumm, Chamorro-Premuzic & Ackerman (2011); DeYoung, Grazioplene & Peterson (2012)

Traditional model of Temperament, Abilities, and Interests



A need for integrative studies

- Prior work has shown that there is a need to integrate Temperament, Abilities and Interests.
- But how to do it?
- To integrate the areas requires large sample sizes, ease of data collection, and a diverse subject population.
- Some do this through meta analysis, some use broad based national samples.
- Is it possible for single labs to do integrative studies?

How to do integrative studies?

- Problem of small samples sizes based upon college undergraduates. Typical subject pools are neither large enough nor diverse enough.
- Expensive to get access to large and diverse populations
  - Exceptions include national and international survey samples using preselected items:
    - National Longitudinal Study of Youth (NLSY)
    - Program for International Student Assessment (PISA)
    - German Socio-Economic Panel (SOEP)
- Is it possible to do large based sampling with tailored items?
- Yes, use the web.

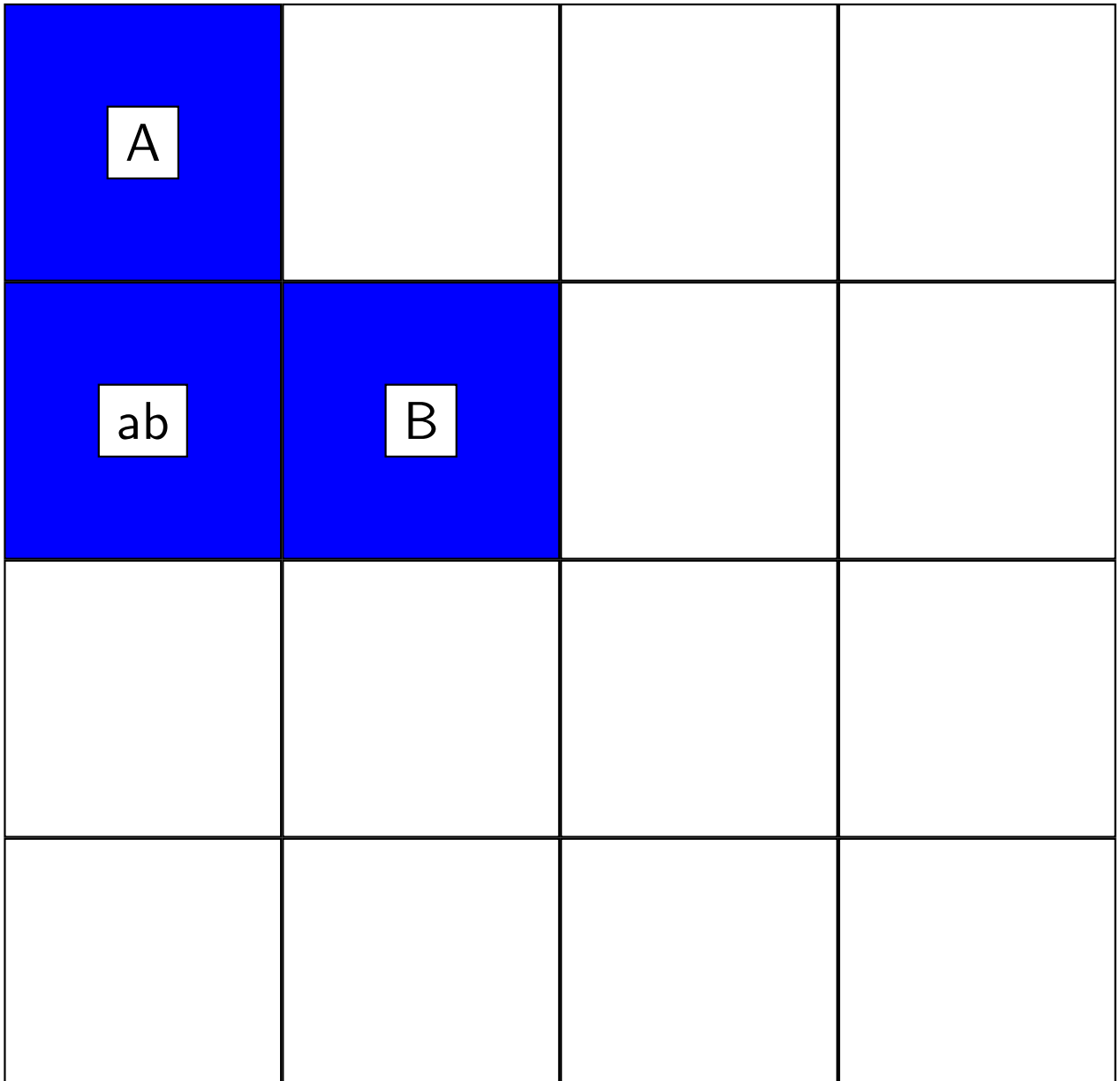
Synthetic Aperture Personality Assessment (SAPA)

- Using the web and open source materials to collect data on temperament, ability and interests
  - Synthetically form large covariance matrices from smaller subsets of items
  - Each subject given ≈ 50 personality, 10 interest, and 14-16 ability items sampled from the larger pool.
  - Total pool of items > 1000
    - ≈ 400 personality items primarily from International Personality Item Pool Goldberg (1999)
    - 92 interest items for Oregon Vocational Interest Scales (Pozzebon, Visser, Ashton, Lee & Goldberg, 2010)
    - 80 ability items (home brewed at NU)
    - Demographic items include age, sex, education, race, country, college major, occupation (if appropriate)
    - Resulting sample sizes $> 50,000 - 250,000$
- College major, occupational status and interest items added in 9/10
- Data to be summarized include $\approx 70,000$ participants

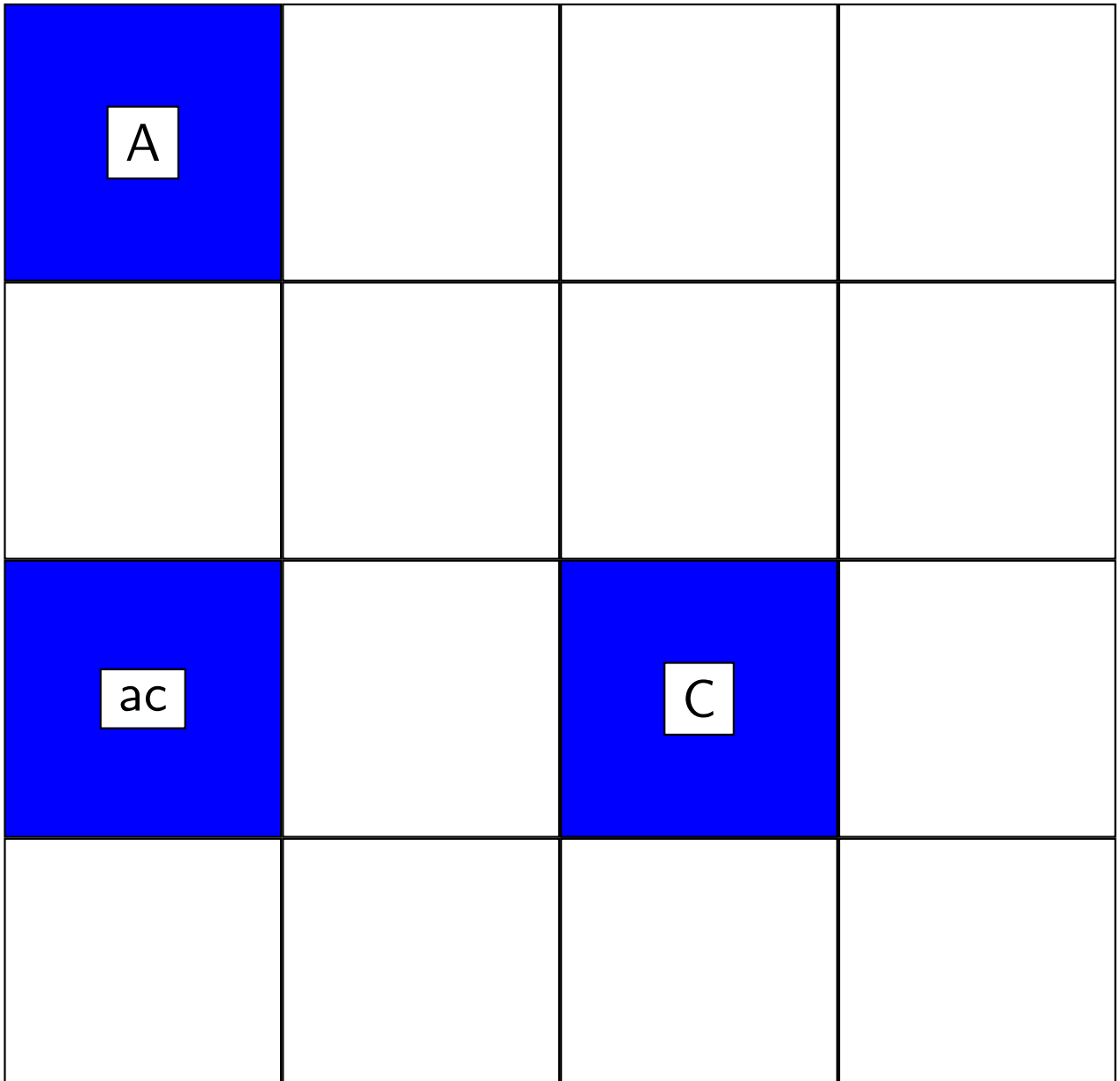
Method

1. Synthetic Aperture Personality Assessment (Revelle, Wilt & Rosenthal, 2010) forms large covariance matrices by sampling items across people
   - $\approx 120/day$ particpants are recruited to `test.personality-project.org`
   - Each participant is given 60-70 items
   - Total set of items being analyzed > 500
2. Item content being sampled
   - 100 "IPIP" Big 5 items
   - ≈ 200 other temperamental items
   - 56-80 home brewed ability items
   - 92 Oregon Vocational Interest items (ORVIS)
3. Although $> 230,000$ participants have been run in all, we will report only those data from the last 70,000
4. Demographic information included
   - Age, Gender, Level of education, country of residence
   - College major and broad field (if appropriate)
   - Occupation (if appropriate)

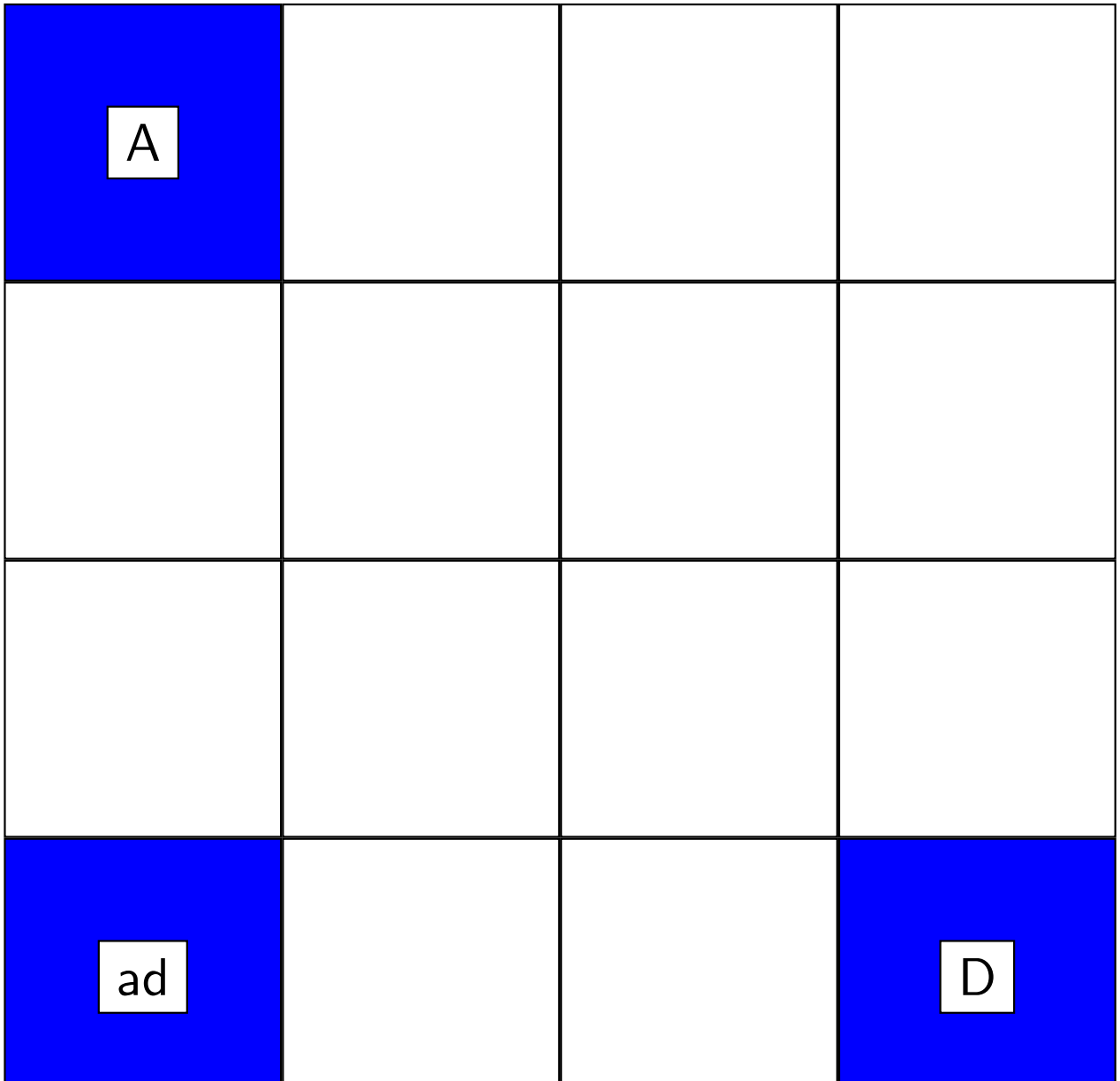
SAPA: what the subject sees



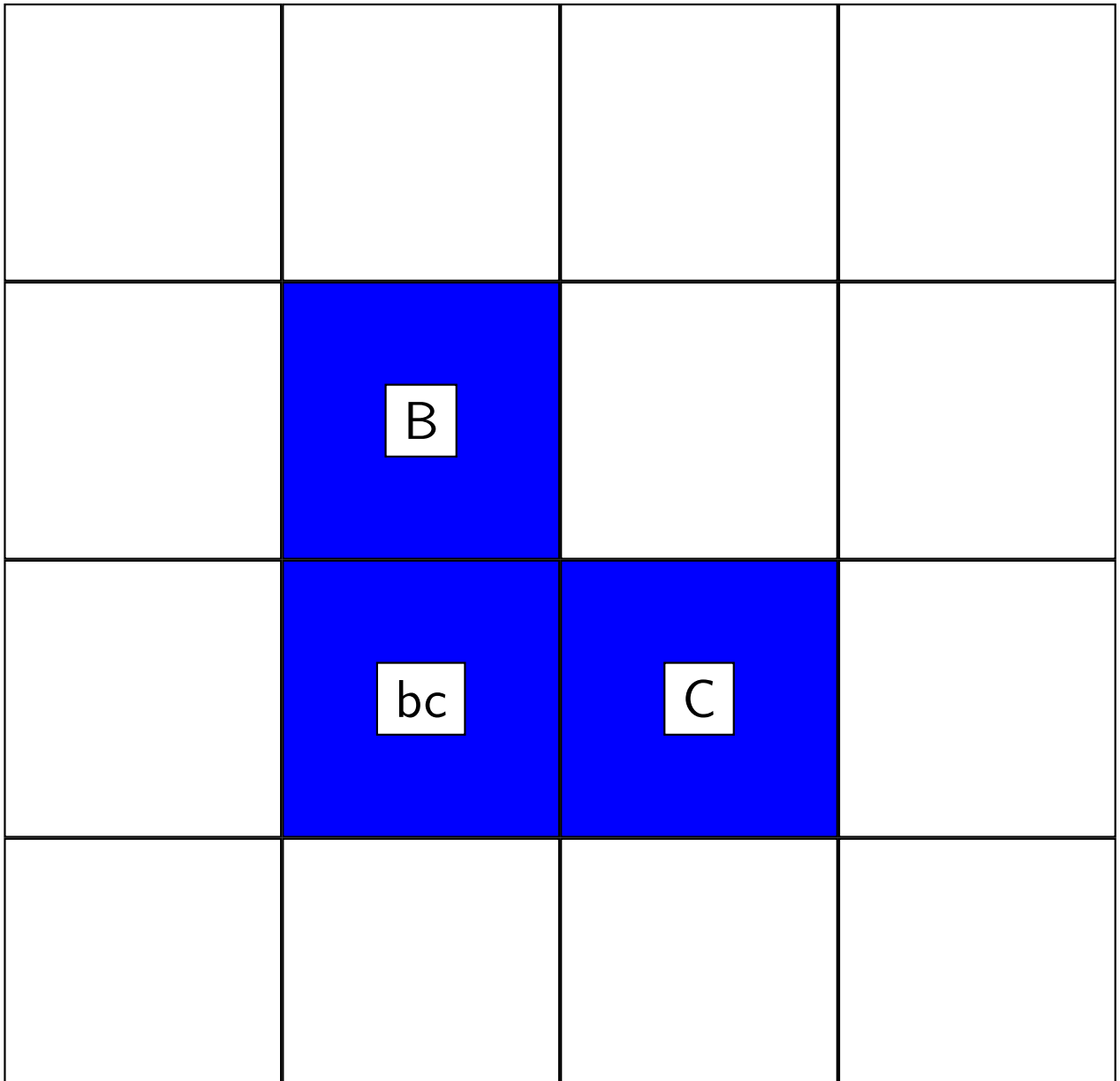
SAPA: what the subject sees



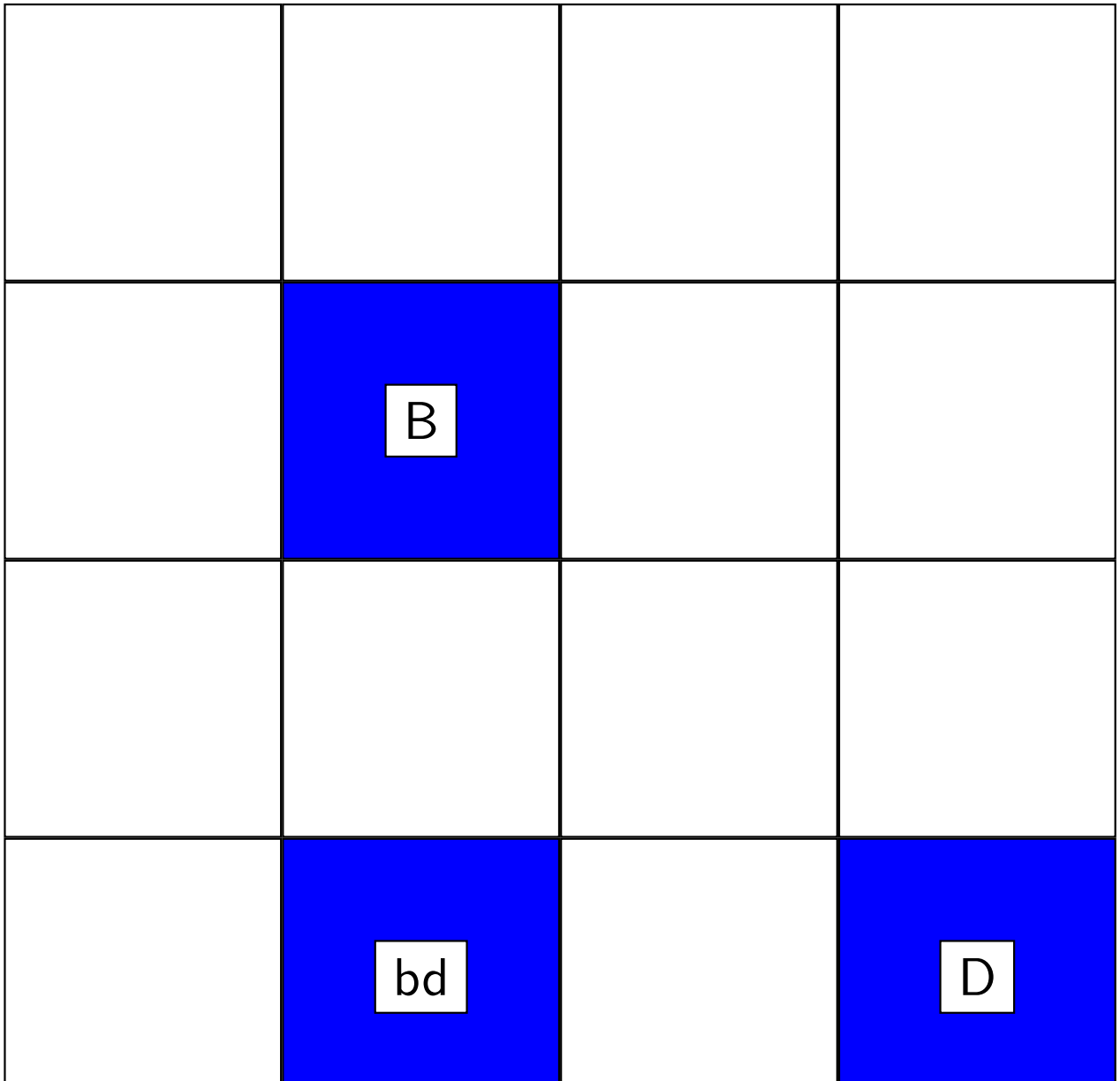
SAPA: what the subject sees



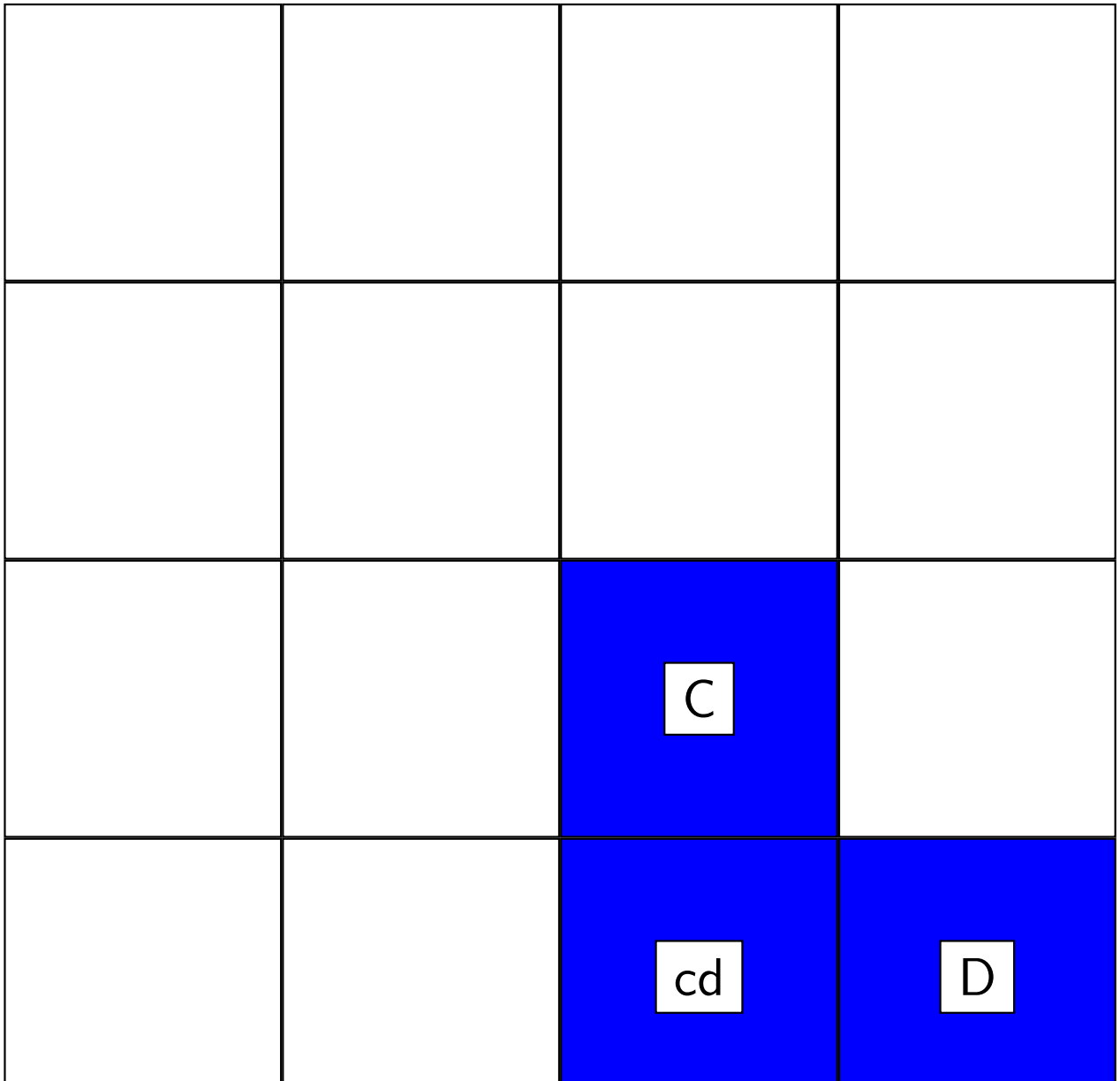
SAPA: what the subject sees



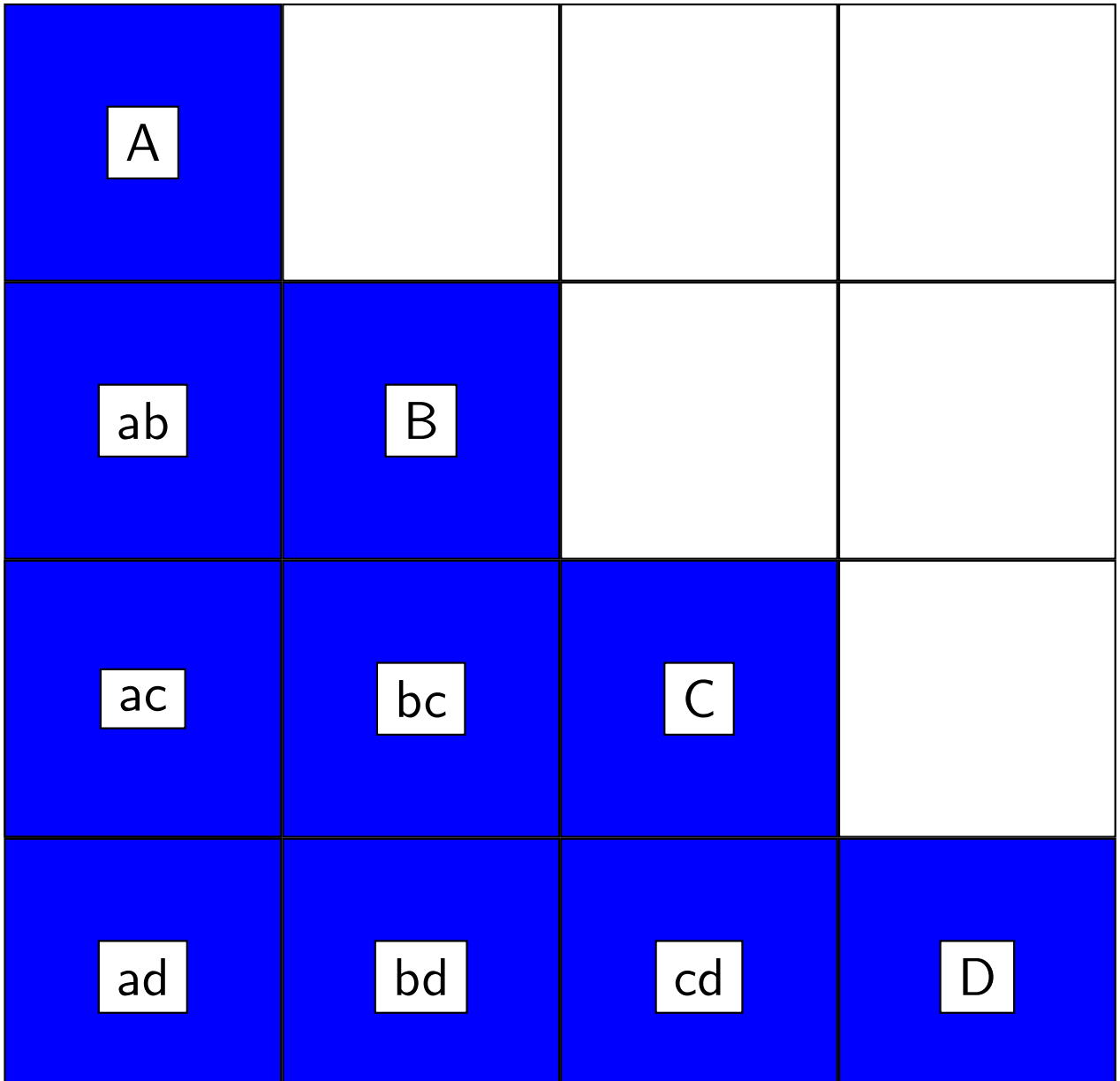
SAPA: what the subject sees



SAPA: what the subject sees



SAPA: what the experimenter sees: A Synthetic matrix



SAPA: Technical overview

1. n x n synthetic covariance matrices are formed by giving items with probability p to Np subjects
   - N Total number of subjects
   - n Total number of items in synthetic matrix
   - p Probability of any item being given
   - pN Number of subjects taking any one item
   - p^2N Number of subjects for any pair of items
2. Basic statistics
   - Data are Massively Missing at Random
   - Means and Variances are based upon pN subjects
   - Covariances are based upon p^2N subjects
3. Power of large samples and sampling of items
   - 100-150 people per day => 40,000 subjects per year
   - 700-1000 subjects/week
   - By varying p, one can prototype items rapidly.

Items were selected from the T A I domains

1. Temperament items from the International Personality Item Pool (IPIP) (Goldberg, Johnson, Eber, Hogan, Ashton, Cloninger & Gough, 2006)
   - 100 Big 5 items
   - 3-500 experimental items to clarify structure
2. 92 Vocational interest items from the Oregon Vocational Interest Survery (ORVIS) which is available as part of the IPIP
3. 80 ability items developed at Northwestern
   - Untimed (power) items
   - Item purification over several years

International Personality Item Pool (IPIP) Big 5: sample items

Conscientiousness Do things according to a plan.

Agreeableness Inquire about others' well-being.

Neuroticism/Stability Have frequent mood swings.

Openness Am full of ideas

Extraversion Make friends easily

Oregon Vocational Interest Scales: sample items

Adventure	Would like to be a professional athlete.
Altruism	Like to care for sick people.
Analytic	Would like to be a chemist.
Artistic	Create works of art.
Erudition	Would like to be a translator or interpreter.
Leadership	Like to make important things happen.
Organization	Would like to be the financial officer for a company.
Practical	Would like to care for cattle or horses.

Cognitive Ability items

1. Self reported values on standardized tests
   - SAT Verbal
   - SAT Quantitative
   - ACT
2. Open source items developed for the SAPA project

Analytic	Alphanumeric sequences
Matrix	Analogous to Raven's matrices
3 D rotation	Difficulty created by number of rotations
Verbal	Basic vocabulary
Full IQ	Weighted sum score of the parts

Analytical approach: All analyses done in R

1. R: An international collaboration `http://R-cran.org`
2. R: The open source - public domain version of S+
3. R: Written by statistician (and all of us) for statisticians (and the rest of us)
4. R: Not just a statistics system, also an extensible language.
   - This means that as new statistics are developed they tend to appear in R far sooner than elsewhere.
   - For example, a recent issue of *Psychological Methods* had at least three articles with examples or supplementary work done in R
   - R facilitates asking questions that have not already been asked.
5. Special functions for SAPA have been written in R and are included in the **psych** package (Revelle, 2012).

Analytical reporting

1. Given the sample sizes, statistical significance is not an issue, but rather the size of the effects.
2. Correlation is an appropriate effect size measure
   - Correlations between continuous variables are reported as Pearson r
   - Correlations between dichotomous variables are reported as tetrachoric correlations
   - Correlations between continuous and dichotomous are reported as biserial
   - These last two correlations make assumptions of normal distributions of latent traits
3. Data displays are graphical techniques for showing the complex, multivariate structure of the data
   - Correlation strength reported as a "heat map" with positive correlations shaded as progressively darker shades of blue, negative correlations as darker shades of red.
   - Some multidimensional plots

Demographic characteristics of the sample

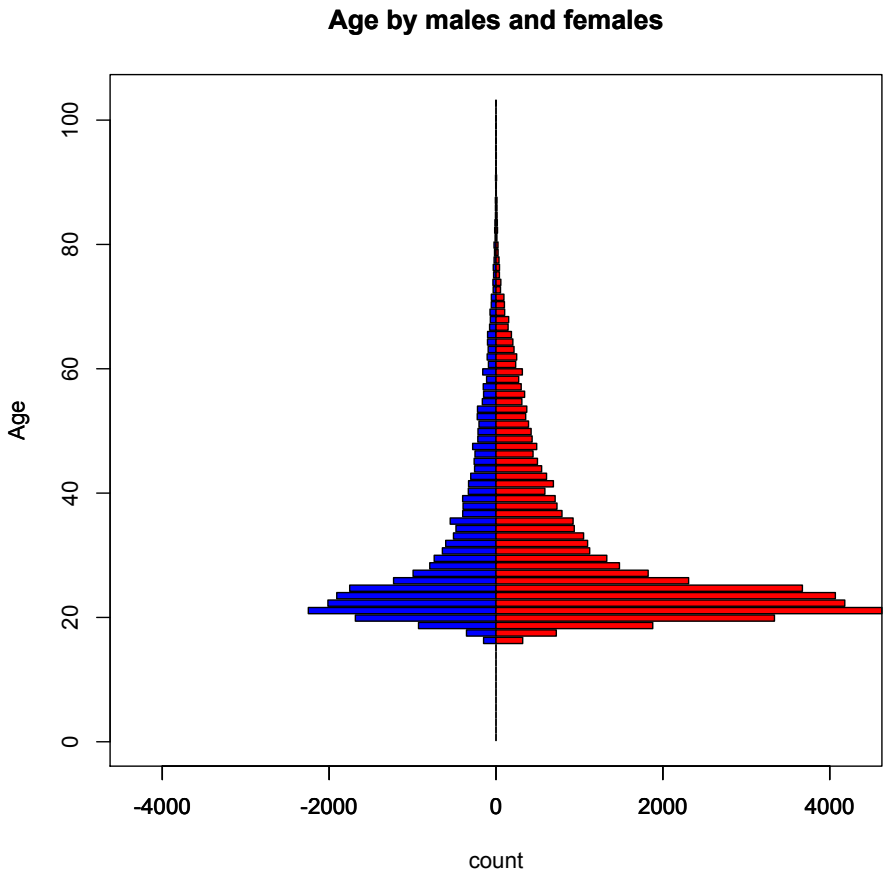


Table : Characteristics of the sample

	Male	Females
	23,973	47,038
	34%	66%
	Mean	Median
Age	26.3	22.0
BMI	25.1	23.7
education	2.39	2.0
Parental Ed	2.97	3.0
SATQ *	612	620
SATV*	613	630
ACT*	25.74	26.0

*self reported

Spatial distribution of the sample

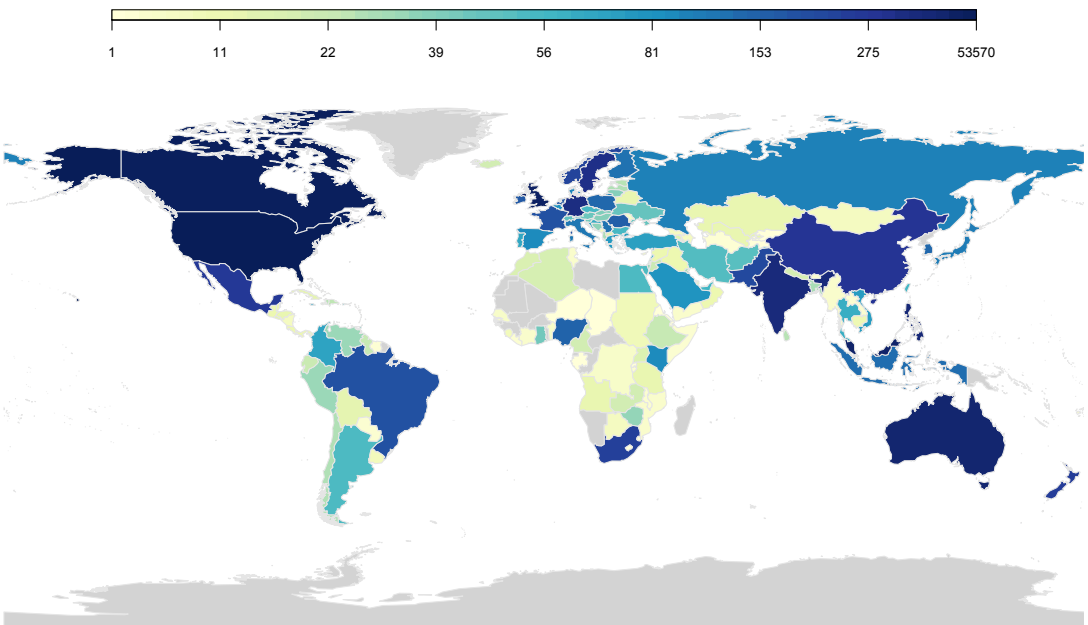


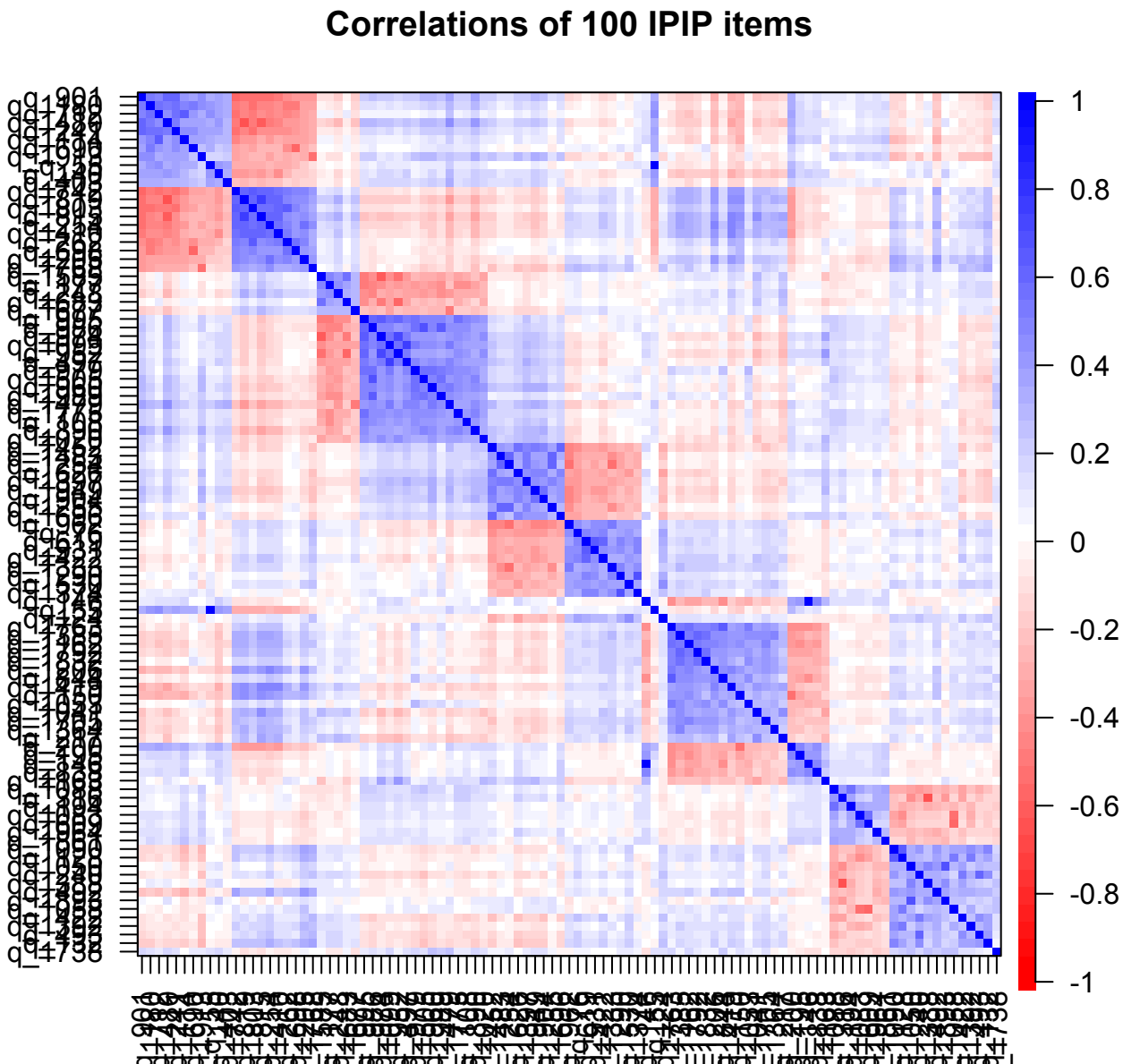
Table : Country of origin of the sample

US	54,144
Canada	3,288
UK	1,638
Malaysia	1,374
Australia	1,360
Philippines	767
India	738
Germany	385
Sweden	358
Singapore	302
19 others >	100

Analysis of Temperament, Ability, Interests

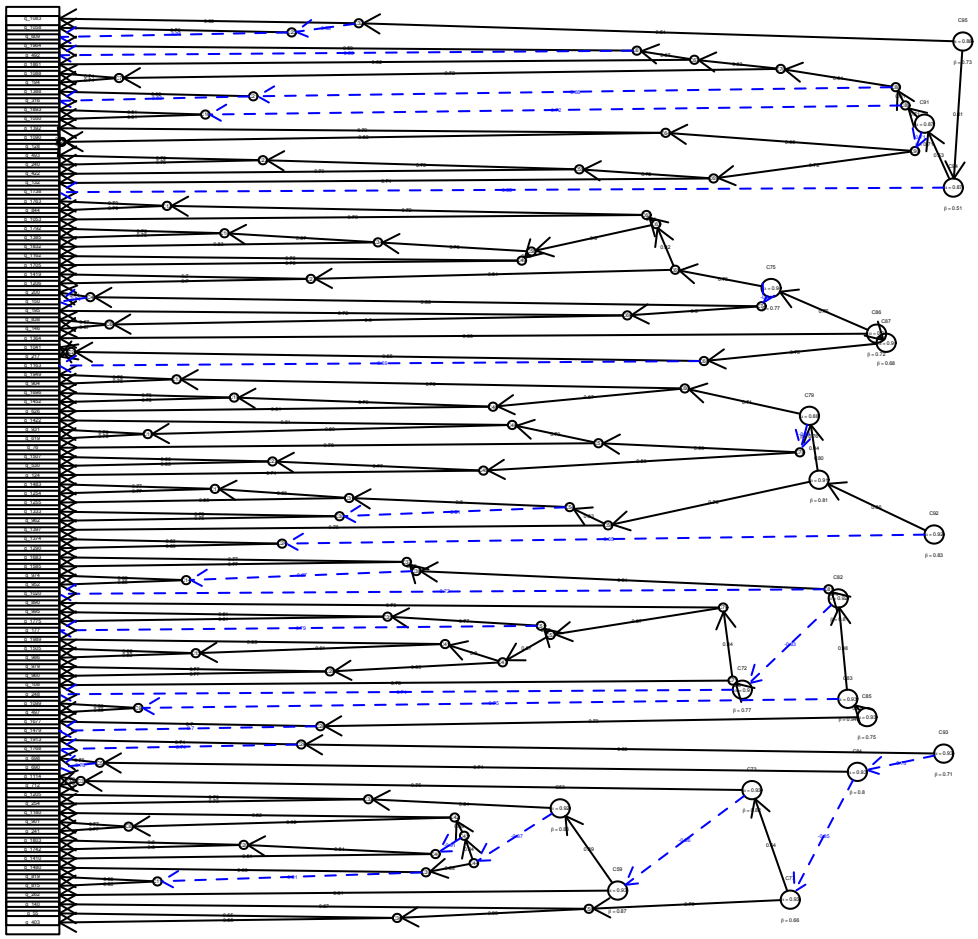
1. Big 5 scale scores used an Item Response Theory (IRT) algorithm
   - With complete data, IRT and simple sum scores are almost identical.
   - SAPA data are Massively Missing at Random and are better estimated using IRT techniques.
     - Two parameter model: item difficulty, item location
     - One parameter model: item difficulty
2. Ability measures
   - SATV, SATQ, SATW and ACT were self reported
   - iq measure was based upon IRT analysis and scoring

Heat map of the 100 Big 5 items suggests a 5 cluster structure

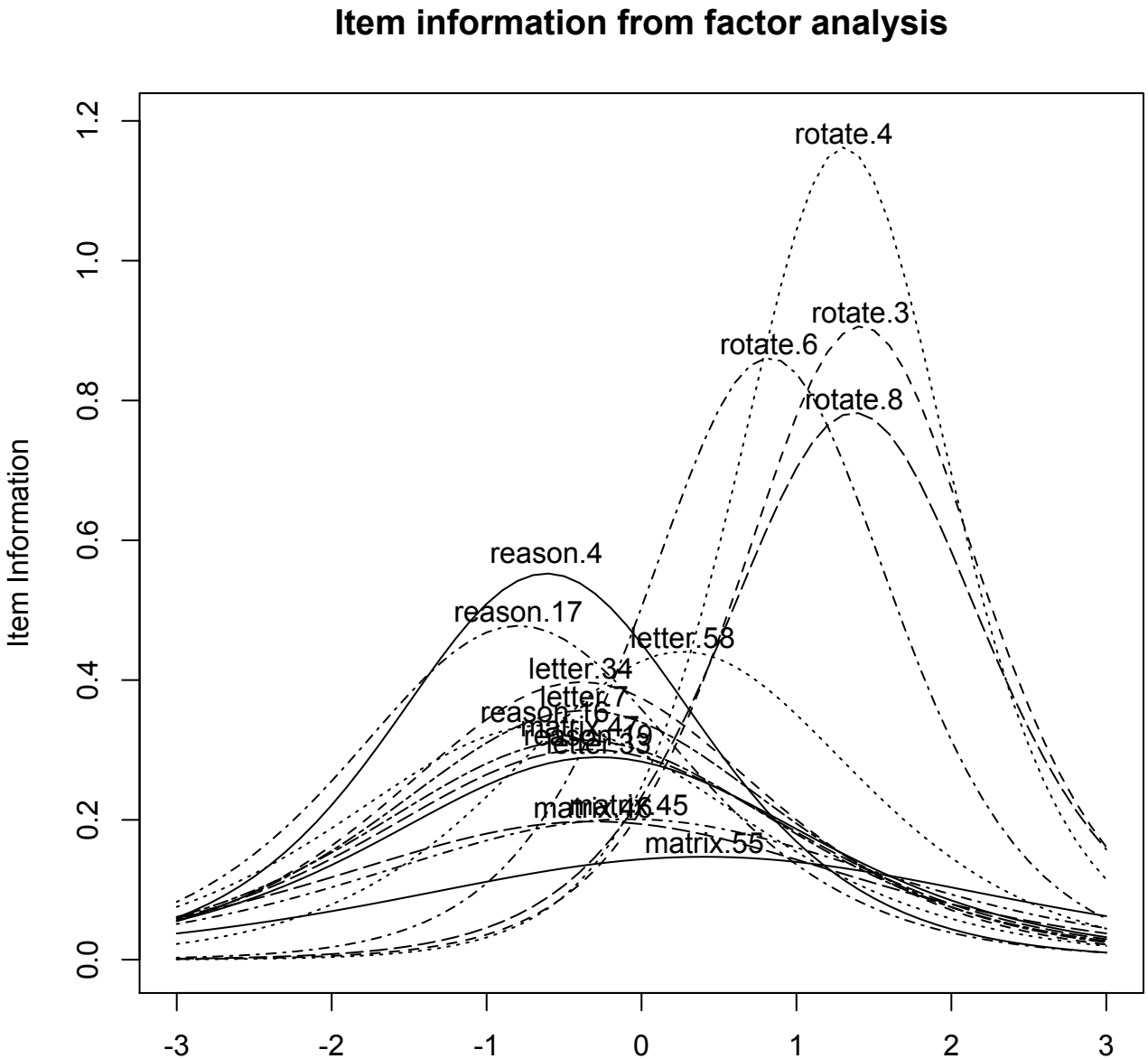


Cluster analysis of the 100 Big 5 items shows a 5 cluster structure

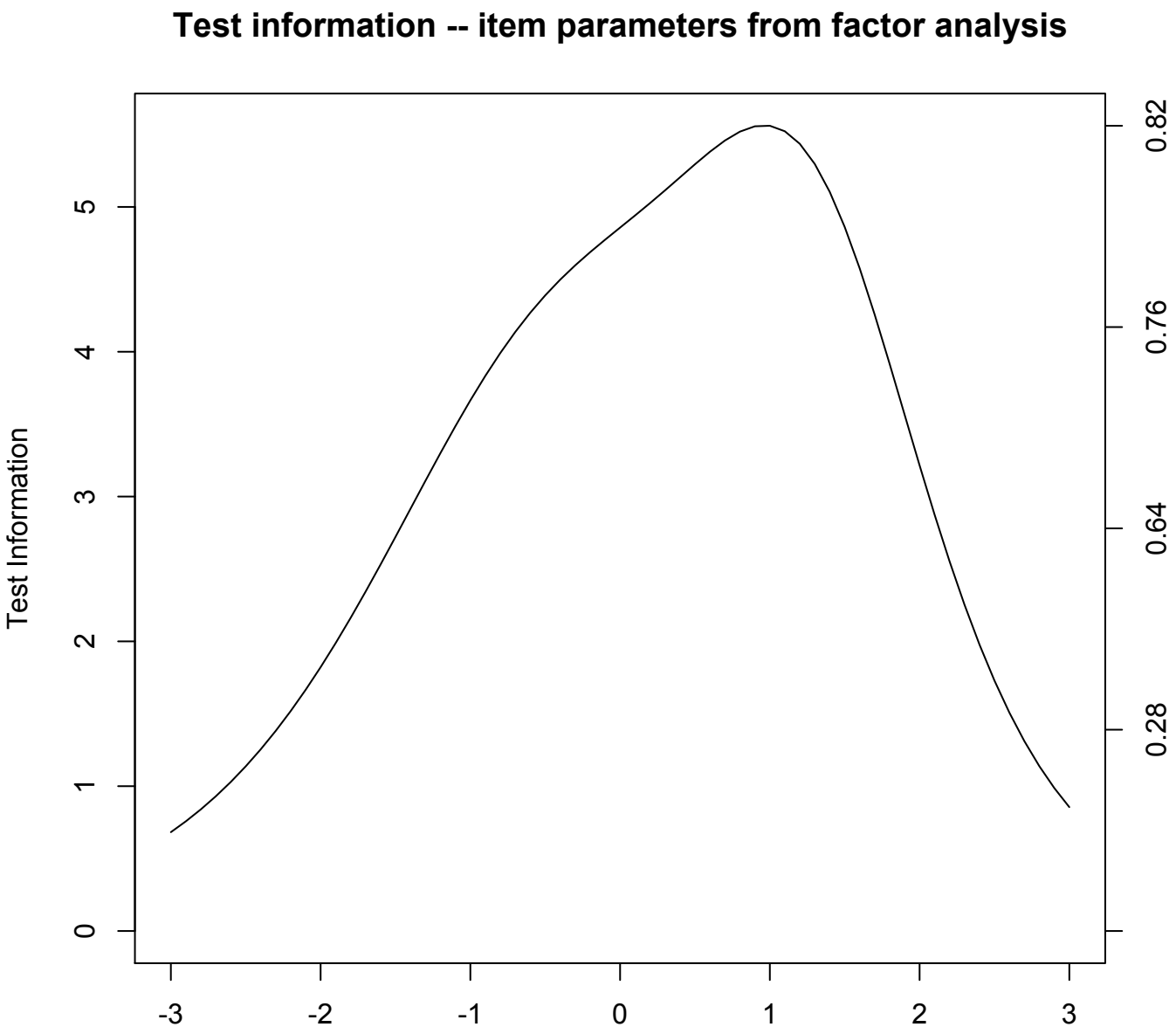
ICLUST of 100 Big 5 items



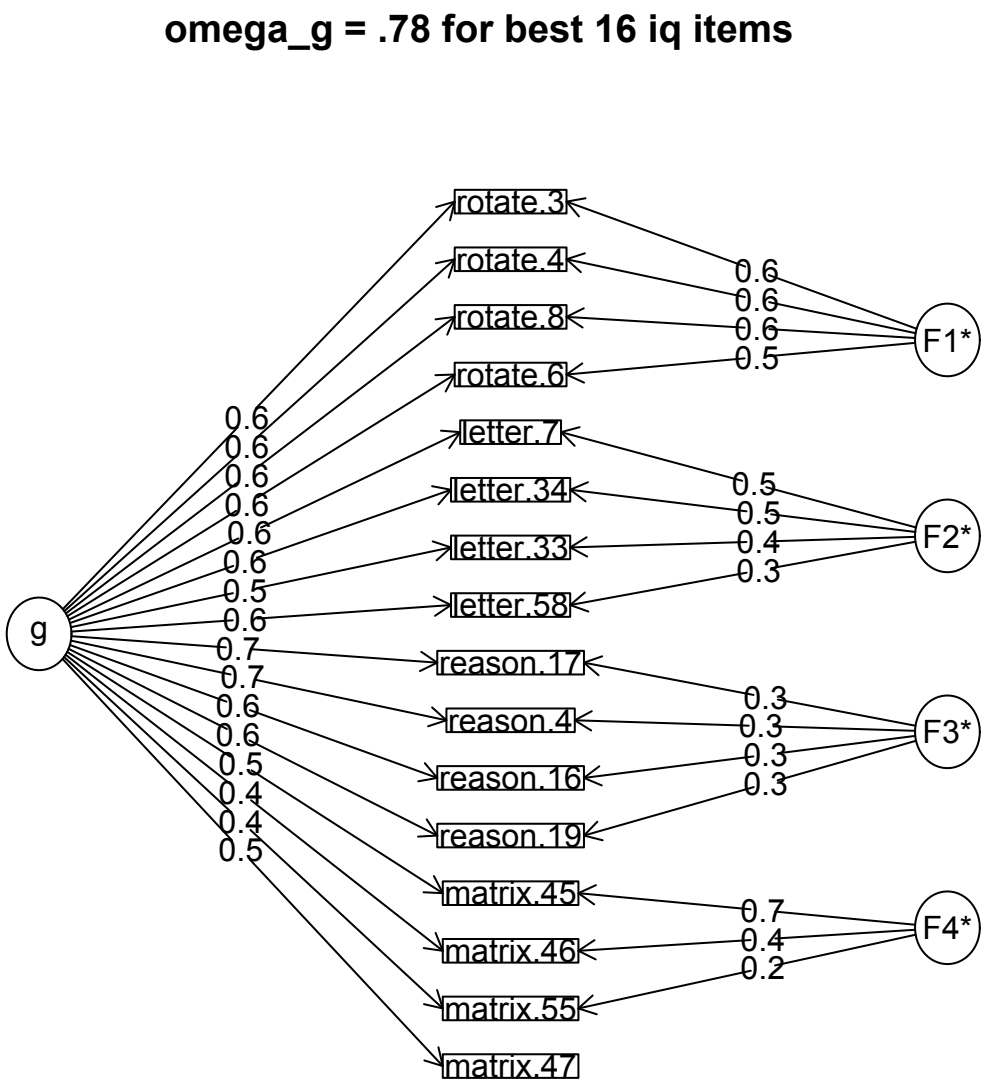
IRT parameters for best 16 IQ items



Test information for the best 16 iq items



Best 16 ability items show a clear g + group factor structure

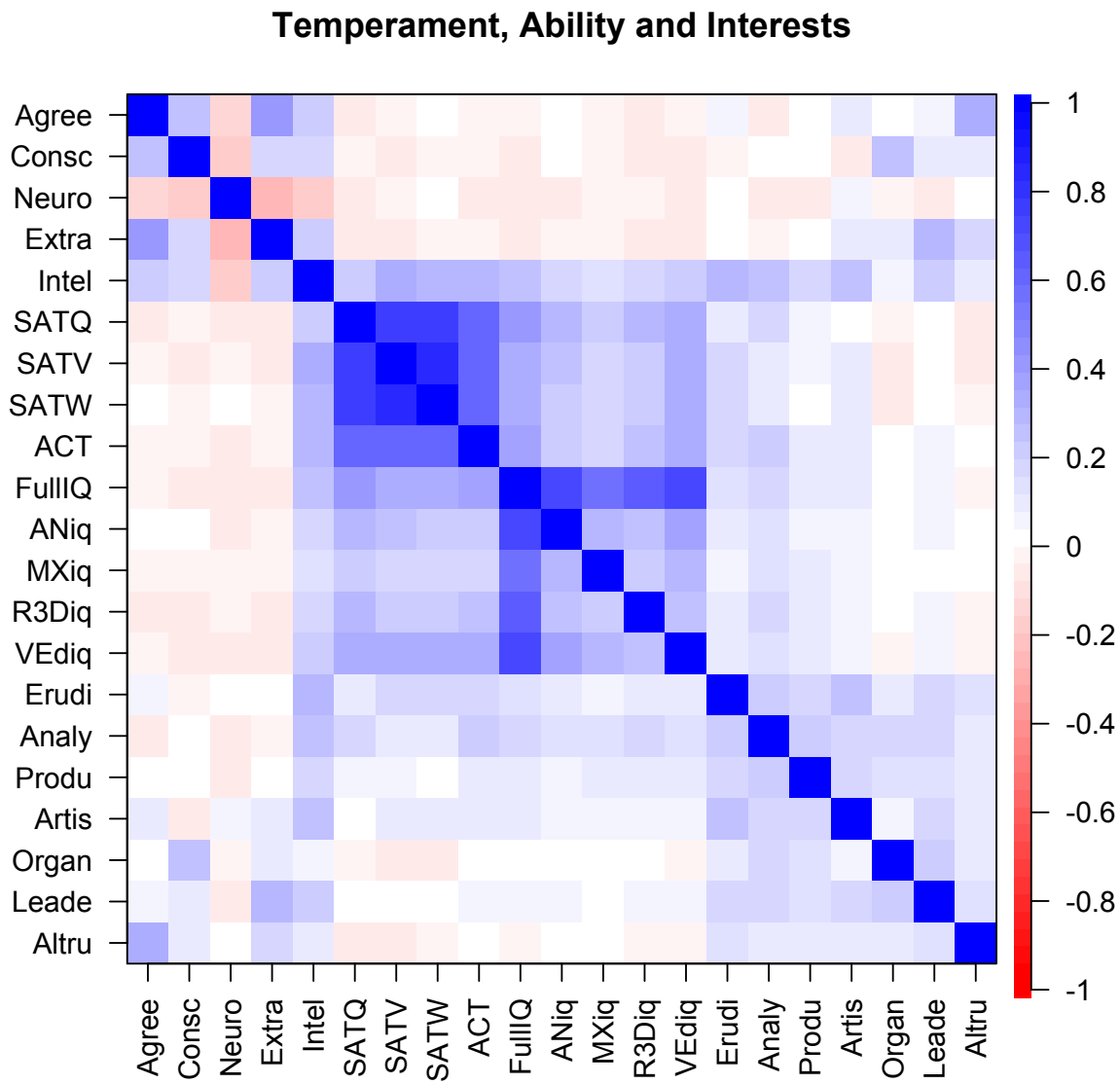


The relationships of Temperament, Ability and Interests across subjects

1. The three broad domains show low to moderate within domain correlations
   - Strongest within the ability domain (.31)
   - Lower correlations in the temperamental domain (.22)
   - Even lower inter-interest correlations (.13)
2. On average, the three broad domains show low across domain relationships
   - Openness-Intellect correlates with all the IQ measures
   - Openness-Intellect correlates with most interest measures
   - Agreeableness and Altruism, Conscientious and Organization, Extraversion and Leadership

	Temperament	Ability	Interests
Temperament	0.22		
Ability	0.06	0.31	
Interests	0.06	0.05	0.13

Temperament, Ability and Interests from SAPA

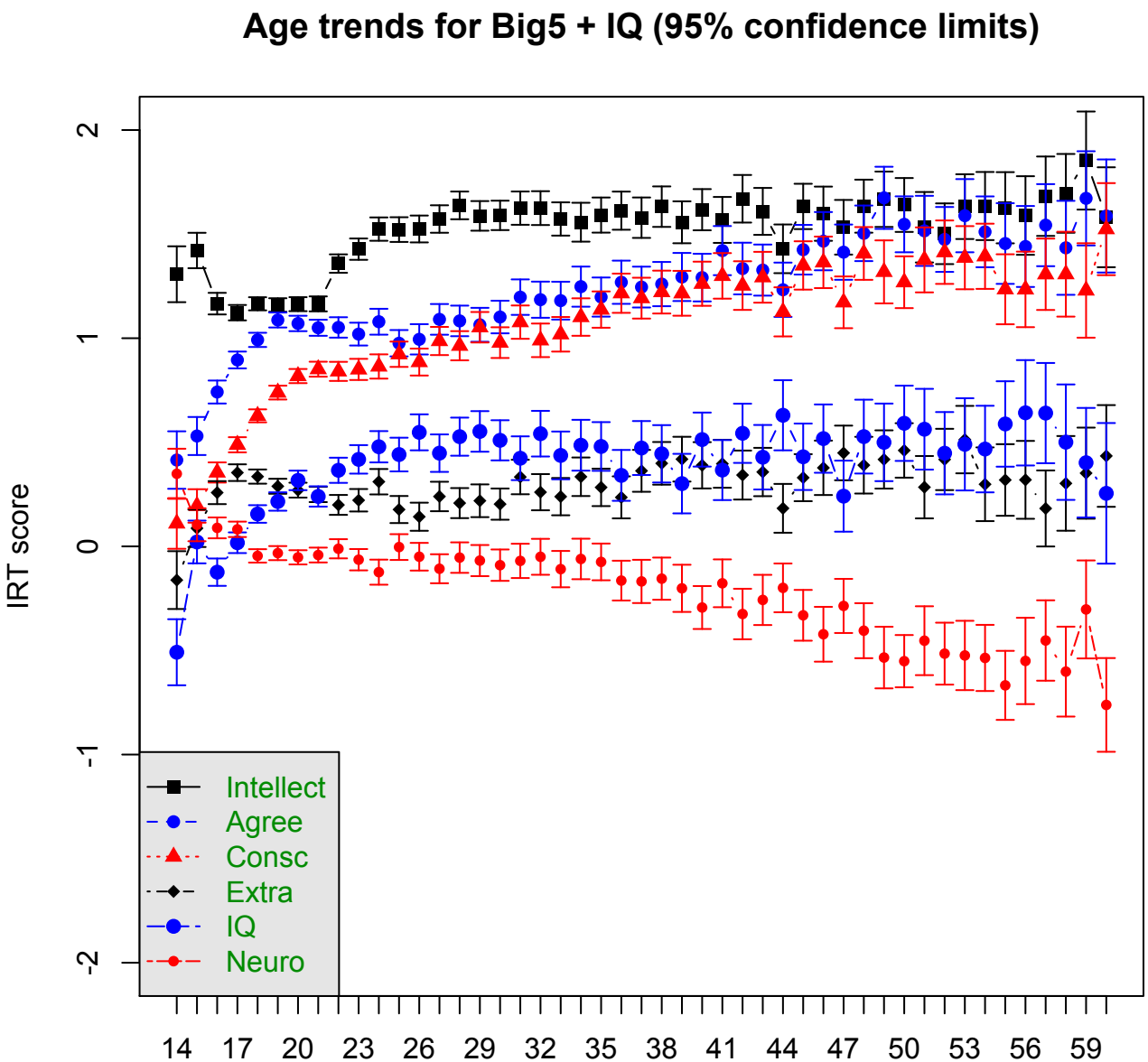


Level 3 considers trends across time

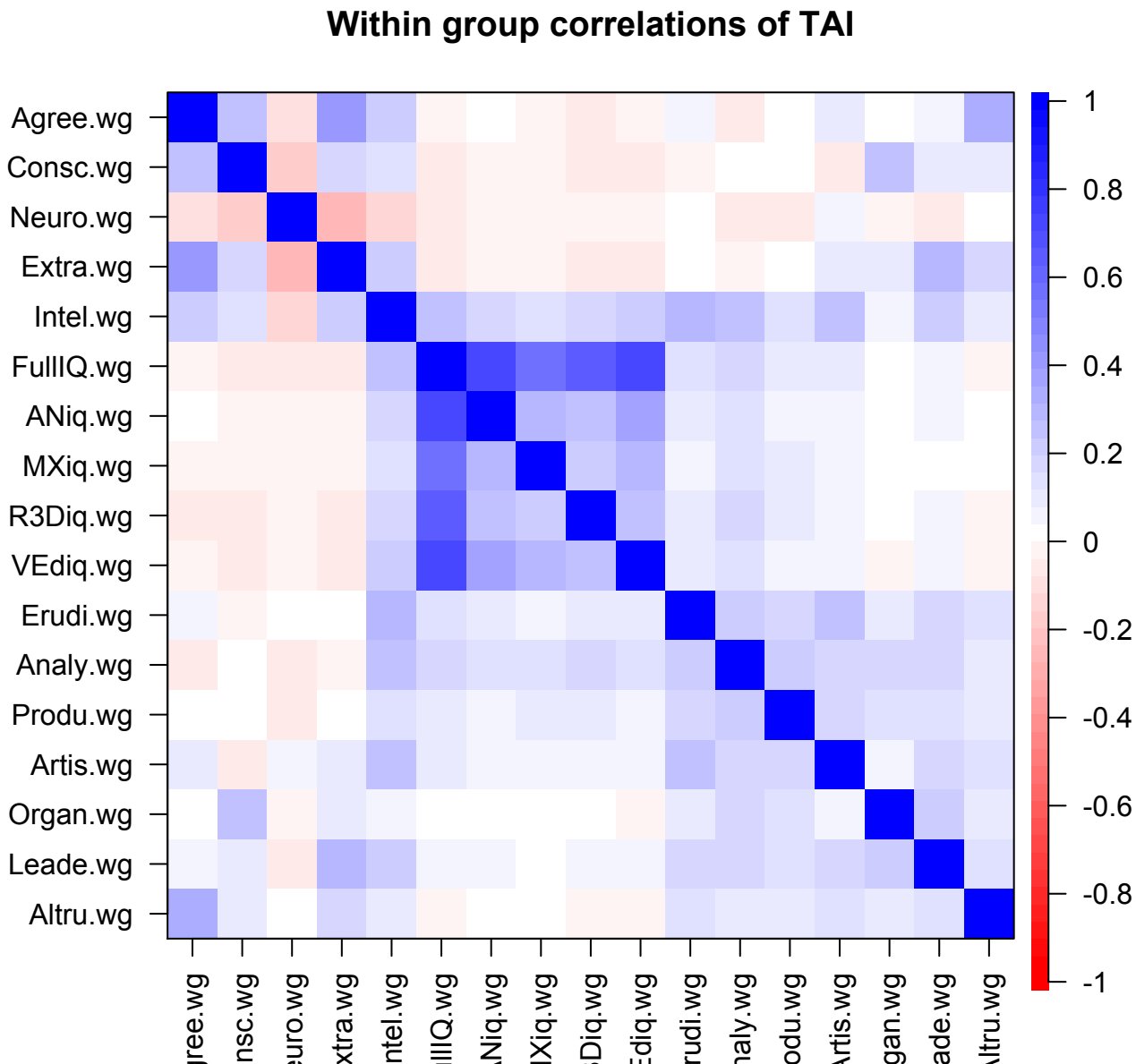
Measures over time can be either cross sectional or longitudinal

1. For the SAPA set, we can examine cross sectional differences in TAI
   - The means will partly reflect various sampling biases
   - (Consider the openness of a 90 year old filling out a web based survey).
2. The age trends we show agree with other cross sectional studies.
3. The across age correlations show how temperament, ability and interests covary over age

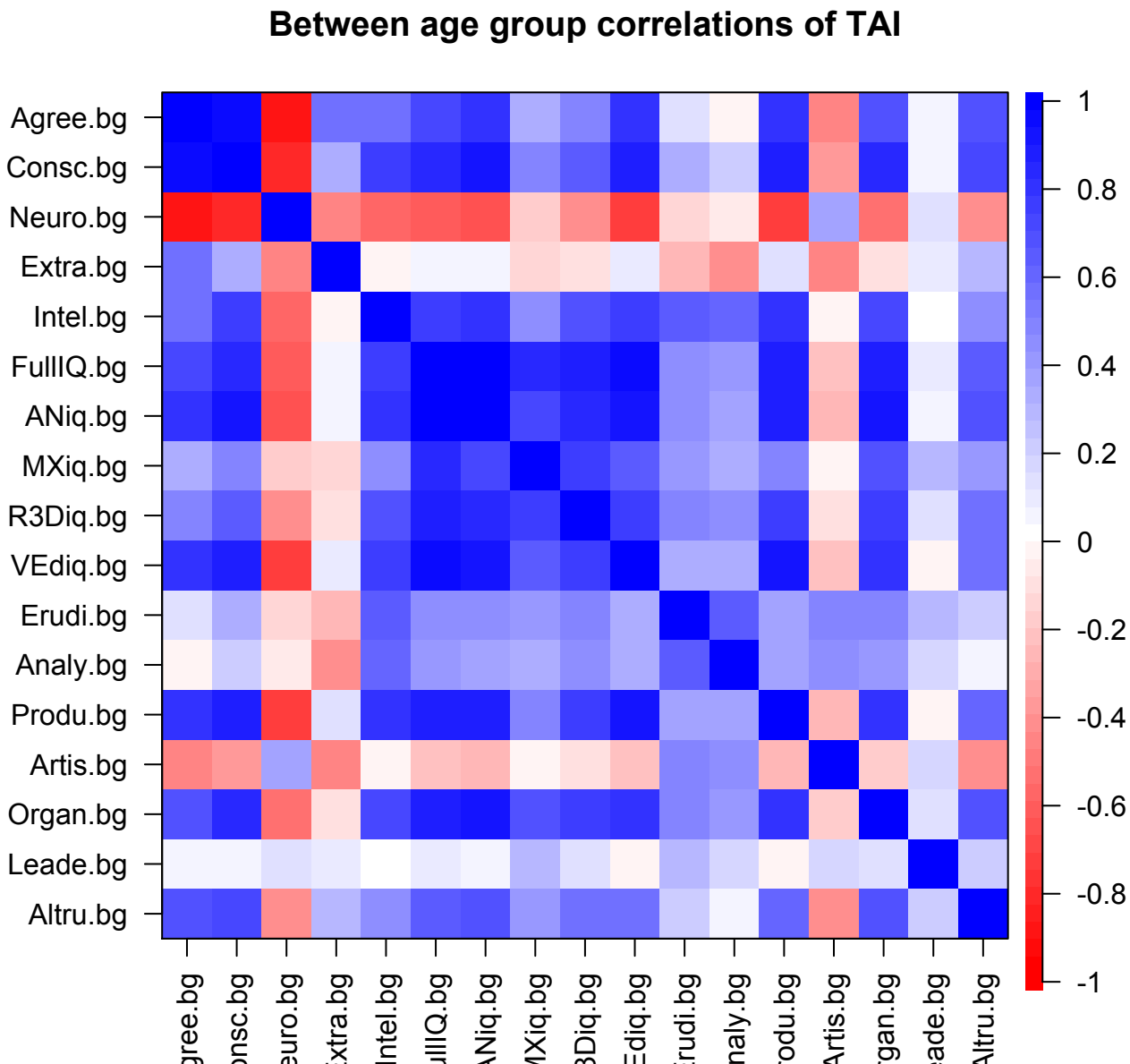
Big 5 + IQ estimates change across age groups



Structure of TAI within age groups is the standard finding



Structure of TAI across age groups shows a very different pattern



Level 4: the personality of groups

Level 4 is the analysis of personality of groups. This is how the composition of groups differ in the average personality characteristics of their members.

1. People differ in their temperaments, abilities and interests.
2. College majors differ in their social and intellectual challenges.
3. We can see this by examining the TAI mean scores for each of 84 majors.
   - Majors with more than 100 students
   - Data from students who had not declared majors were deleted.
4. Correlations can be found within and between these groups.
5. These level 4 between group correlations are not between people but of the means of the majors. This leads to the structure of group differences.

Choice of college major reflects temperament, abilities and interests

1. Undergraduate majors/concentration provide feedback to students based upon performance.
2. Performance reflects both ability and time spent on the task
   - Students choose majors which reinforce their talents
   - Interests grow in response to feedback
3. Although many students can do well in many majors, they end up choosing those majors that maximally meet their needs.
4. Multiple ways of displaying these data
   - Majors sorted by ability
   - Majors sorted by a particular temperament (e.g., conscientiousness)
   - Majors in a multi-dimensional space of abilities x temperament

Top and bottom 6 majors sorted by IQ

Table : Majors sorted by IQ

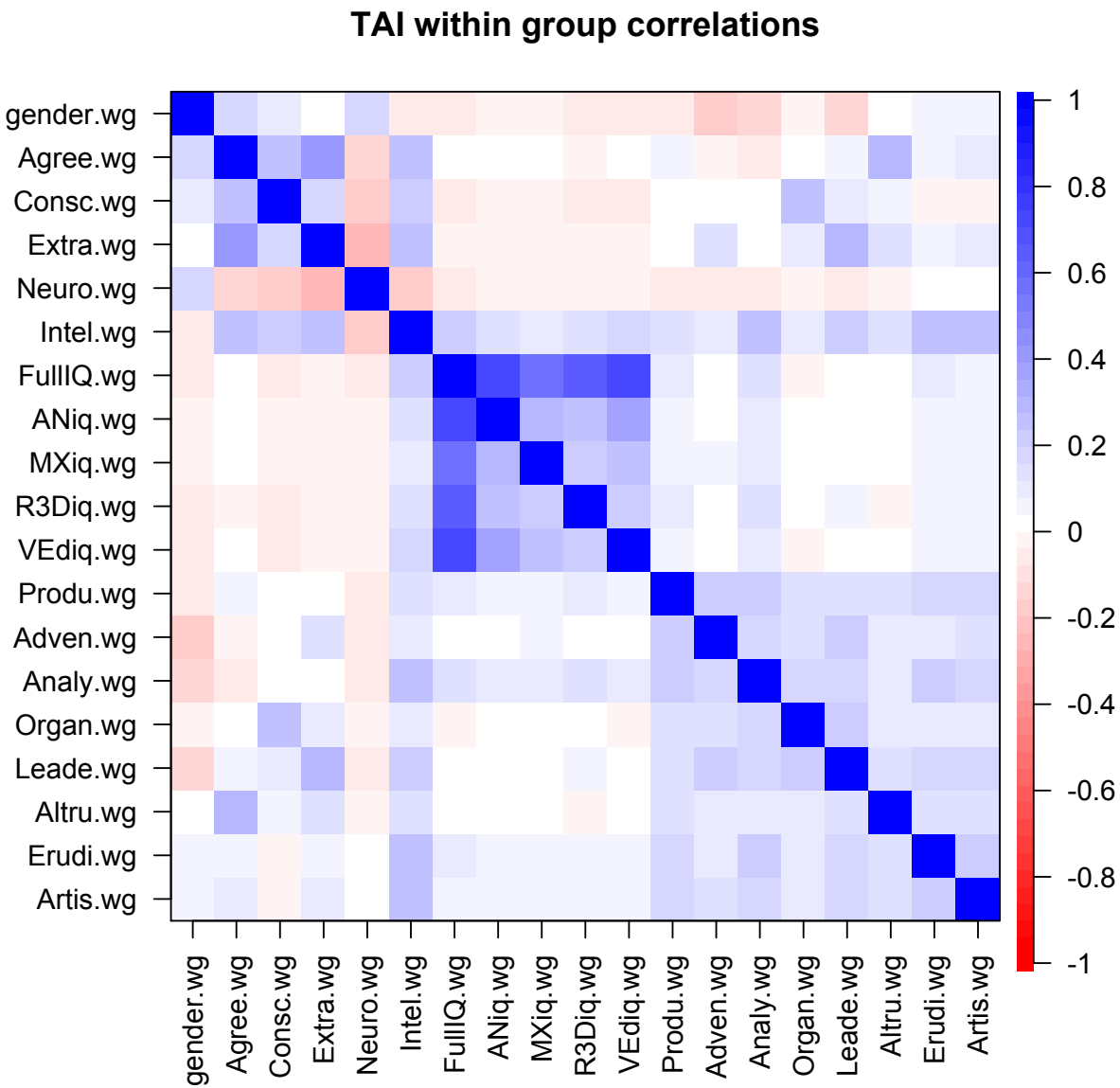
	FullIQ	Intel	Agree	Consc	Neuro	Extra
Physics	0.91	0.80	-0.60	-0.35	-0.29	-0.41
Neuroscinc	0.77	0.52	-0.39	-0.24	0.10	-0.36
Mathematcs	0.75	0.37	-0.50	-0.30	-0.05	-0.47
Glgcl.Scnc	0.73	0.16	-0.49	-0.24	-0.13	-0.48
Linguistcs	0.64	0.47	-0.27	-0.33	0.11	-0.32
Economics	0.63	0.34	-0.37	-0.09	-0.15	-0.08
...						
Social.Wrk	-0.40	-0.26	0.50	0.15	-0.01	0.19
Hmn.Dvlp.F	-0.40	-0.44	0.25	0.12	0.03	0.12
K.preK.Edu	-0.41	-0.46	0.28	0.03	0.19	-0.18
Crmnl.Js.C	-0.46	-0.17	0.02	0.29	-0.03	0.16
Hlth.Svc.A	-0.50	-0.18	0.34	0.51	0.01	0.15
Mdcl.Assst	-0.75	-0.27	0.26	0.40	0.02	0.16

Top and bottom 6 majors sorted by Agreeableness

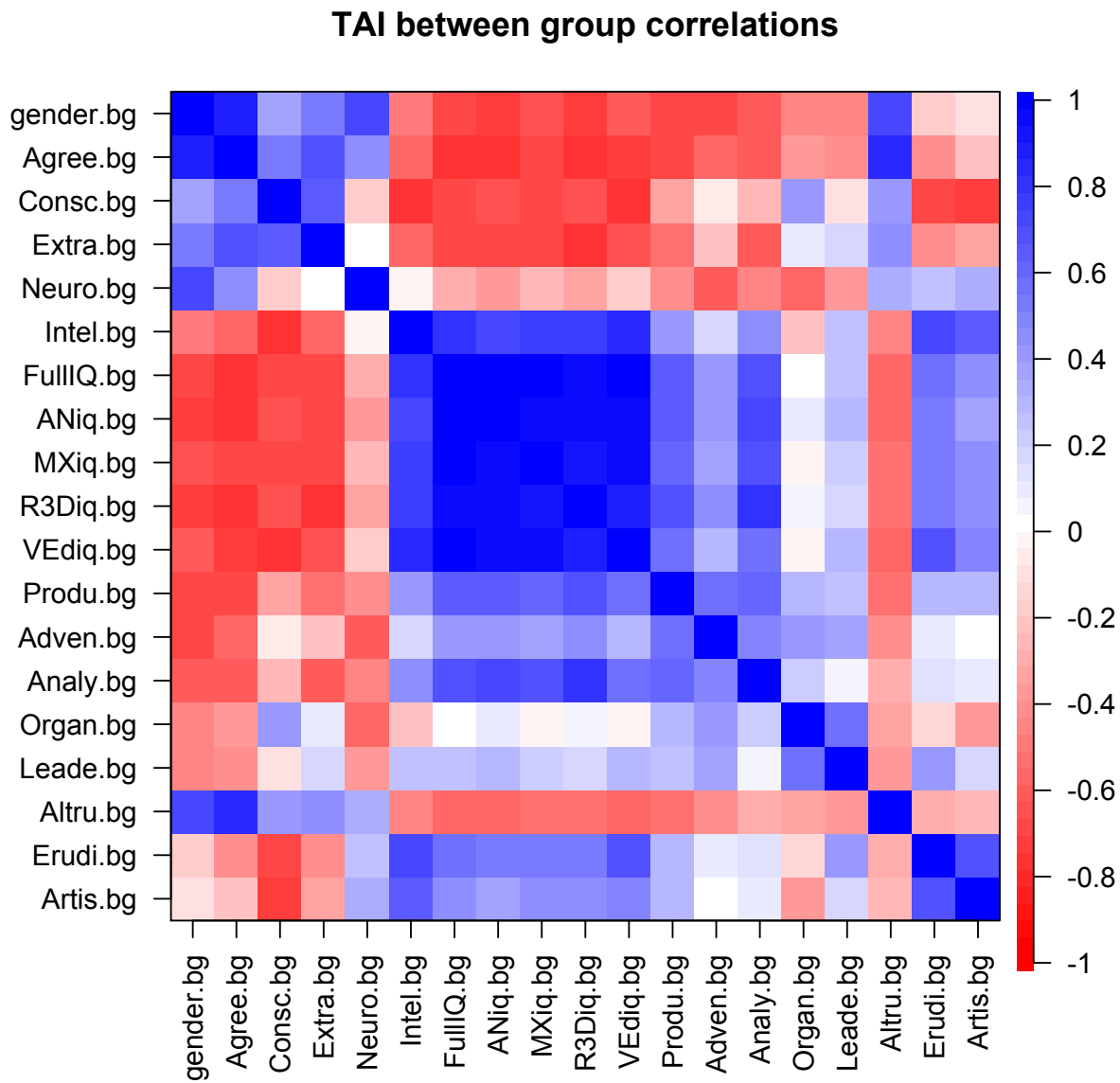
Table : Agreeableness

	Agree	Consc	Extra	Neuro	Intel	FullIQ
Social.Wrk	0.50	0.15	0.19	-0.01	-0.26	-0.40
Othr.C.S.S	0.40	0.09	0.08	-0.04	-0.13	-0.29
Elmntry.Ed	0.37	0.13	0.10	0.11	-0.29	-0.08
Special.Ed	0.37	0.09	0.13	-0.02	-0.23	-0.09
Hlth.Svc.A	0.34	0.51	0.15	0.01	-0.18	-0.50
K.preK.Edu	0.28	0.03	-0.18	0.19	-0.46	-0.41
...						
Indstrl.En	-0.46	-0.03	-0.05	-0.32	0.08	0.45
Mchncl.Eng	-0.46	-0.04	-0.18	-0.29	0.29	0.61
Glgcl.Scnc	-0.49	-0.24	-0.48	-0.13	0.16	0.73
Mathematcs	-0.50	-0.30	-0.47	-0.05	0.37	0.75
Physics	-0.60	-0.35	-0.41	-0.29	0.80	0.91
Cmptr.Prgr	-0.61	-0.34	-0.51	-0.15	0.26	0.49

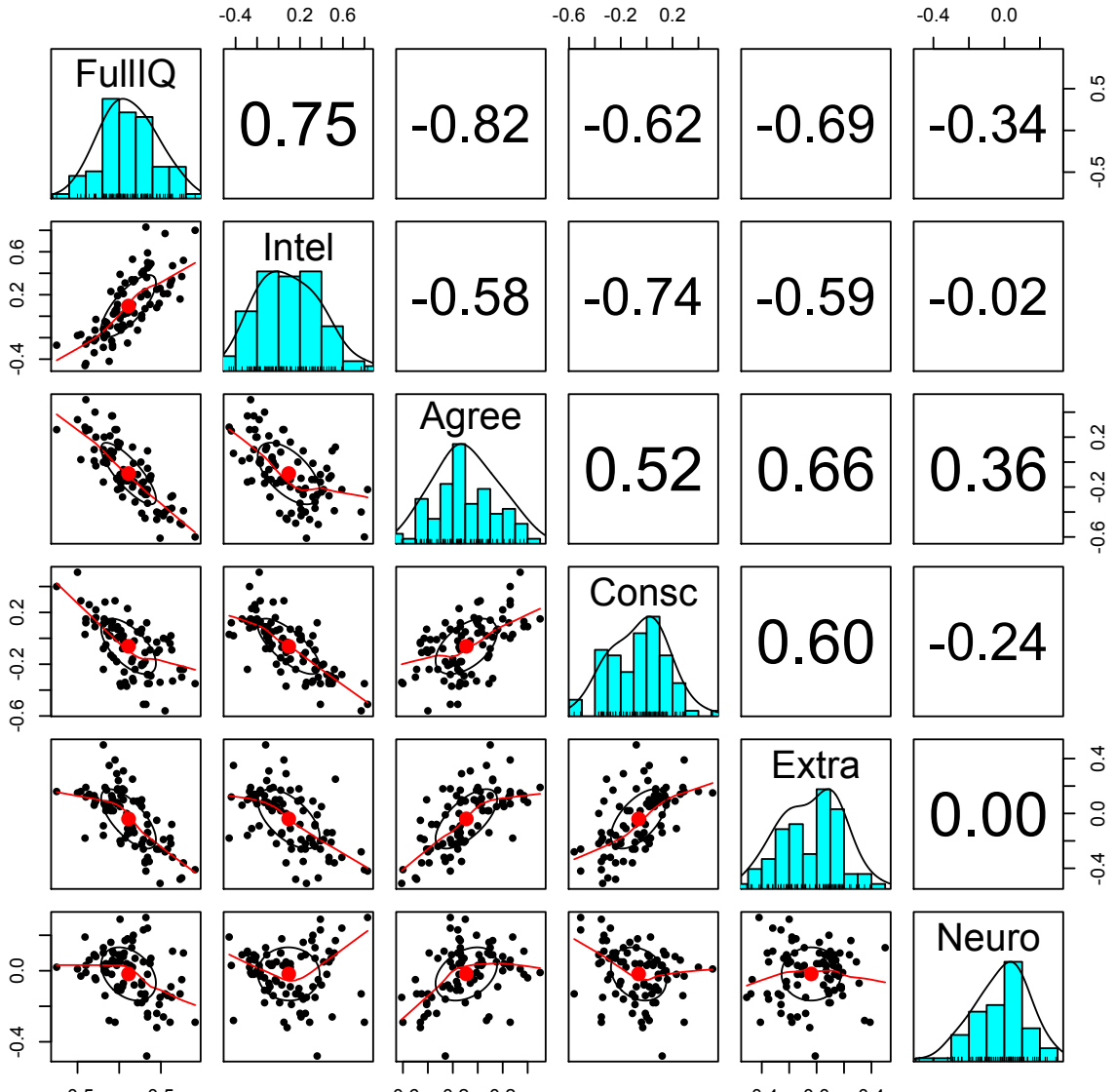
Structure of TAI within college majors is the standard structure



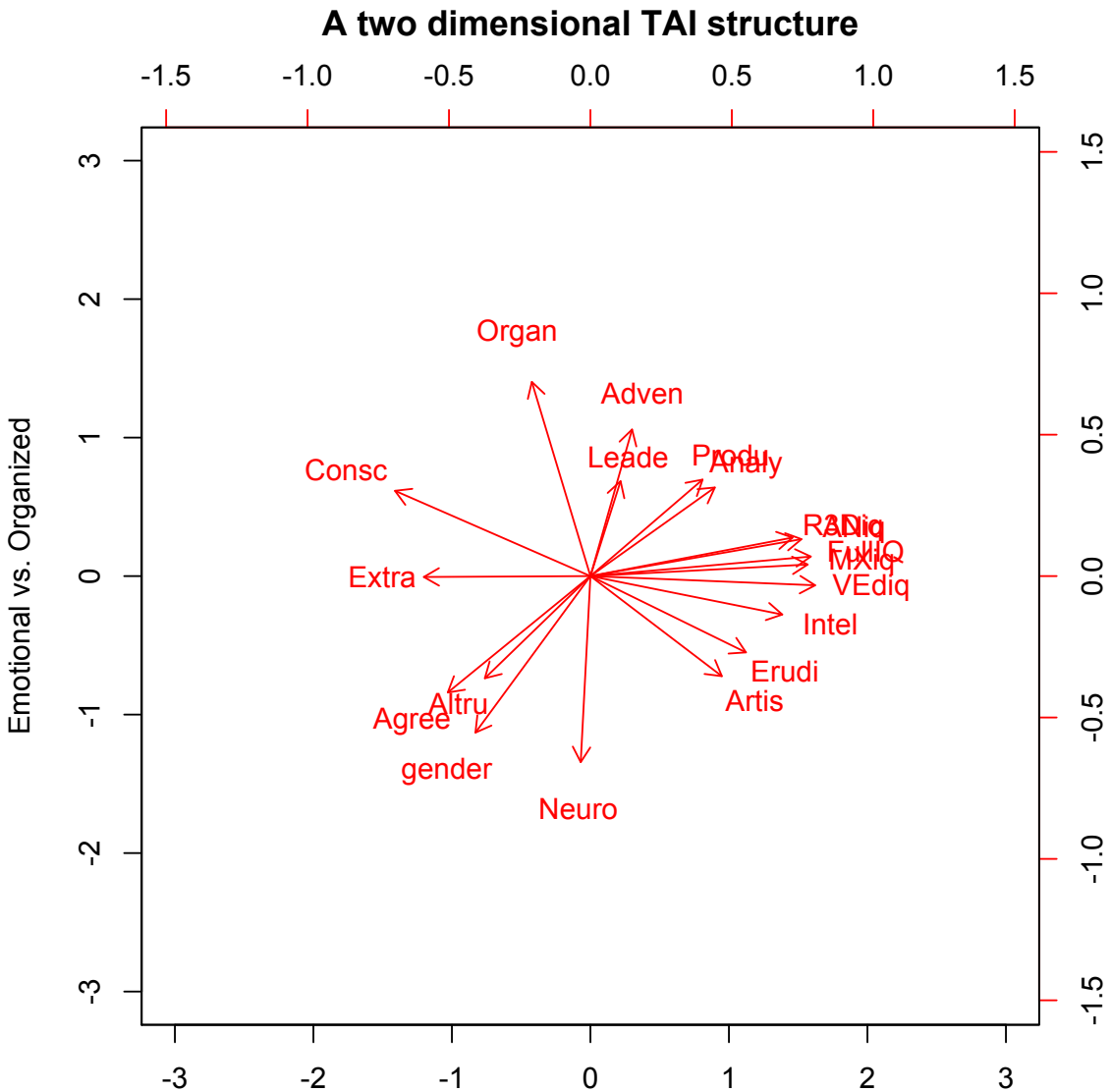
Structure of TAI between college majors is very different



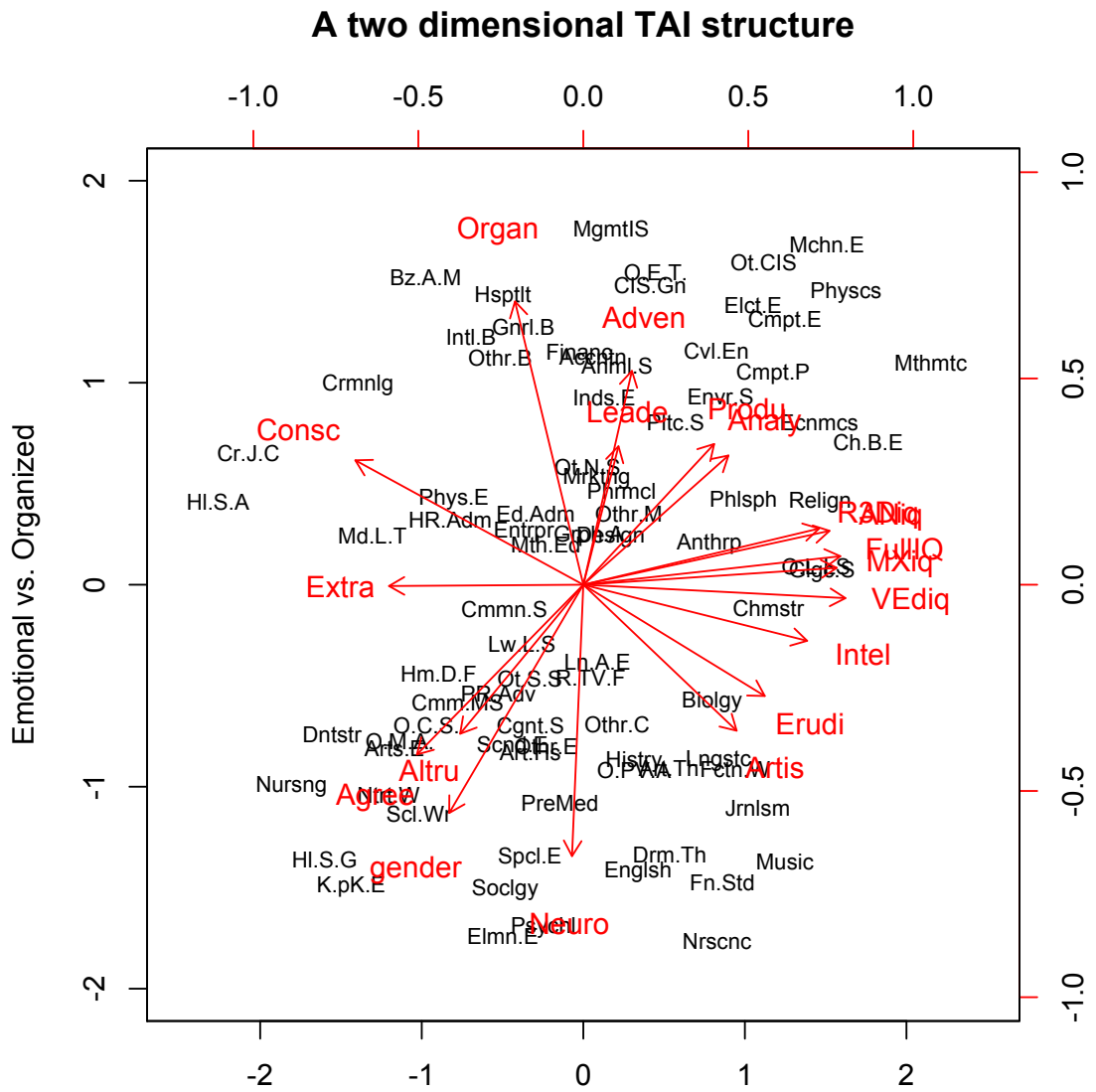
Scatter plot and unweighted between group correlations for ability and Big 5 Temperament



Factor structure of TAI based upon mean scores of college majors



A biplot of TAI and college majors locates majors in two space



The study of personality structure may be done at at least four levels

1. Level 1: The within individual structure of coherent patterns of Affect, Cognition, Desire and Behavior over time and space
   - Dimensions within individuals $\neq$ dimensions between individuals
2. Level 2: The normal between subject structure reflects individual differences in these patterns
   - Three broad domains of Temperament, Abilities and Interests with low but non zero interrelationships
3. Level 3: Structure between subjects over time reflects systematic development and change.
4. Level 4: Structure between self selected groups reflects the process of niche selection
   - Although people are assorting into groups based upon their individual characteristics the structure of personality traits at the group level $\neq$ the structure of individuals

An invitation for cooperation

1. We have demonstrated the advantages of large data sets in order to do analyses at multiple levels of analysis.
2. The use of telemetric techniques (e.g., SAPA) are easy to implement using open source computer languages and code.
3. We have developed open source ability items with the same motivation as the original International Personality Item Pool, with the hope of providing fellow researchers with a common set of measures.
4. We invite cooperation with other researchers either in developing similar SAPA sites, or in cooperative explorations using the current site.

Marko Marulič by Ivan Mestrovic

The Croatian writer, Marco Marulič, was probably the first person to use the term psychology. This statue is by Ivan Mestrovic.

Ackerman, P. L. (1997). Personality, self-concept, interests, and intelligence: Which construct doesn't fit? *Journal of Personality*, *65*(2), 171–204.

Ackerman, P. L. & Heggestad, E. D. (1997). Intelligence, personality, and interests: Evidence for overlapping traits. *Psychological Bulletin*, *121*(2), 219–245.

Deary, I. J., Penke, L., & Johnson, W. (2010). The neuroscience of human intelligence differences. *Nature Reviews Neuroscience*, *11*(3), 201–211.

DeYoung, C. G., Grazioplene, R. G., & Peterson, J. B. (2012). From madness to genius: The openness/intellect trait domain as a paradoxical simplex. *Journal of Research in Personality*, *46*(1), 63 – 78.

Eysenck, H. J. (1990). Biological dimensions of personality. In L. A. Pervin (Ed.), *Handbook of personality: Theory and research.* (pp. 244–276). New York, NY: Guilford Press.

Eysenck, H. J. & Eysenck, S. B. G. (1964). *Eysenck Personality Inventory*. San Diego, California: Educational and Industrial Testing Service.

Goldberg, L. R. (1990). An alternative "description of personality": The big-five factor structure. *Journal of Personality and Social Psychology*, *59*(6), 1216–1229.

Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. In I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe*, volume 7 (pp. 7–28). Tilburg, The Netherlands: Tilburg University Press.

Goldberg, L. R., Johnson, J. A., Eber, H. W., Hogan, R., Ashton, M. C., Cloninger, C. R., & Gough, H. G. (2006). The international personality item pool and the future of public-domain personality measures. *Journal of Research in Personality*, *40*(1), 84–96.

Gottfredson, L. S. (1997). Why g matters: The complexity of everyday life. *Intelligence*, *24*(1), 79 – 132.

Hogan, R. (1982). A socioanalytic theory of personality. *Nebraska Symposium on Motivation 1982, 55-89*.

Holland, J. L. (1996). Exploring careers with a typology: What we have learned and some new directions. *American Psychologist*, *51*(4), 397 – 406.

Horn, J. L. & Cattell, R. B. (1966). Refinement and test of the theory of fluid and crystallized general intelligences. *Journal of Educational Psychology*, *57*(5), 253 – 270.

Johnson, W. & Bouchard, T. J. (2005). The structure of human intelligence: It is verbal, perceptual, and image rotation (vpr), not fluid and crystallized. *Intelligence*, *33*(4), 393 – 416.

Kelly, E. L. & Fiske, D. W. (1950). The prediction of success in the VA training program in clinical psychology. *American Psychologist*, *5*(8), 395 – 406.

Kuncel, N. R., Campbell, J. P., & Ones, D. S. (1998). Validity of the graduate record examination: Estimated or tacitly known? *American Psychologist*, *53*(5), 567–568.

Kuncel, N. R., Crede, M., & Thomas, L. L. (2005). The validity of self-reported grade point averages, class ranks, and test scores: A meta-analysis and review of the literature. *Review of Educational Research*, *75*(1), 63–82.

Kuncel, N. R., Hezlett, S. A., & Ones, D. S. (2001). A comprehensive meta-analysis of the predictive validity of the graduate record examinations: Implications for graduate student selection and performance. *Psychological Bulletin*, *127*(1), 162 – 181.

Lubinski, D. & Benbow, C. P. (2000). States of excellence. *American Psychologist*, *55*(1), 137 – 150.

Lubinski, D. & Benbow, C. P. (2006). Study of mathematically precocious youth after 35 years: Uncovering antecedents for the

development of math-science expertise. *Perspectives on Psychological Science*, *1*(4), 316–345.

Lubinski, D., Webb, R., Morelock, M., & Benbow, C. (2001). Top 1 in 10,000: A 10-year follow-up of the profoundly gifted. *Journal of Applied Psychology*, *86*(4), 718–729.

Molenaar, P. C. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology, this time forever. *Measurement*, *2*(4), 201–218.

Pedhazur, E. (1997). *Multiple regression in behavioral research: explanation and prediction*. Harcourt Brace College Publishers.

Pozzebon, J. A., Visser, B. A., Ashton, M. C., Lee, K., & Goldberg, L. R. (2010). Psychometric characteristics of a public-domain self-report measure of vocational interests: The oregon vocational interest scales. *Journal of Personality Assessment*, *92*(2), 168–?

Prediger, D. J. & Vansickle, T. R. (1992). Locating occupations

on holland's hexagon: Beyond riasec. *Journal of Vocational Behavior*, *40*(2), 111 – 128.

Rafaeli, E., Rogers, G. M., & Revelle, W. (2007). Affective synchrony: Individual differences in mixed emotions. *Personality and Social Psychology Bulletin*, *33*(7), 915–932.

Revelle, W. (2012). *psych: Procedures for Personality and Psychological Research*. Evanston: Northwestern University. R package version 1.2.8.

Revelle, W. & Anderson, K. J. (1997). Personality, motivation and cognitive performance. Final report to the Army Research Institute on contract MDA 903-93-K-0008, Northwestern University:.

Revelle, W., Wilt, J., & Rosenthal, A. (2010). Personality and cognition: The personality-cognition link. In A. Gruszka, G. Matthews, & B. Szymura (Eds.), *Handbook of Individual Differences in Cognition: Attention, Memory and Executive Control* chapter 2, (pp. 27–49). Springer.

Robinson, W. S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review*, *15*(3), 351–357.

Simpson, E. H. (1951). The interpretation of interaction in contingency tables. *Journal of the Royal Statistical Society. Series B (Methodological)*, *13*(2), 238–241.

von Stumm, S., Chamorro-Premuzic, T., & Ackerman, P. (2011). Re-visiting intelligence–personality associations. In T. Chamorro-Premuzic, A. F. Furnham, & S. von Stumm (Eds.), *The Wiley-Blackwell Handbook of Individual Differences* (pp. 217–241). Wiley-Blackwell.

Wilt, J., Funkhouser, K., & Revelle, W. (2011). The dynamic relationships of affective synchrony to perceptions of situations. *Journal of Research in Personality*, *45*, 309–321.

Yule, G. U. (1903). Notes on the theory of association of attributes in statistics. *Biometrika*, *2*(2), 121–134.