

# Temperament, ability, and interests predict important real world choices

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Motivation as a basic personality process.

Organized by Luke Smillie and Joshua Wilt

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Personality, Motivation and Cognition Laboratory

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# Outline

- 1 Introduction and overview
  - Personality and Motivation
  - Beyond Affect, Behavior, Cognition and Desire: Temperament, Ability and Interests
  - A need for integrative studies
- 2 SAPA methodology
  - Conceptual overview
  - Technical Overview
- 3 Results
  - Analytical Technique
  - TAI and motivational choice

## The study of personality includes the study of motivation

- 1 Personality is the coherent patterning over time and space of Affect, Behavior, Cognition and Desire.
  - Items in most personality tests may be organized in terms of their relative emphasis on the ABCDs.
  - We have examined the coherency of ABCDs over short periods of time (e.g., the patterning of energetic and affective changes during the day over several weeks using text messaging).
  - We have also examined it cross sectionally to examine long time choice behavior with meaningful outcomes.
- 2 Personality and motivation
  - Traditional personality measures emphasize average levels of ABCDs.
  - Personality traits reflect sensitivities to motivationally salient stimuli.
    - Personality traits are the first derivatives of personality states in reaction to motivationally salient stimuli.
  - Short term: Affective reactions and goal directed behavior
  - Long term: Meaningful life choices: College major and occupation

# 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.

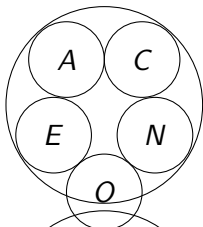


# Going beyond the ABCDs: Personality as Temperament, Ability, and Interests

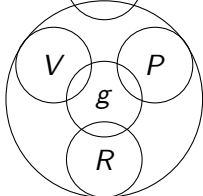
- ① Temperament: what we usually do
  - Identity, Reputation, and Actions
  - Affective, Cognitive and Behavioral reactions to situations: the “Big 5” (Goldberg, 1990), the “Giant 3” (Eysenck, 1990)
- ② Ability: What we can do
  - Measures of intellectual ability – life as an intelligence test (Deary, 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

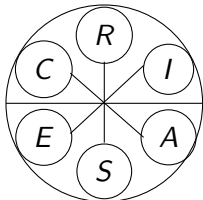
Temperament



Abilities



Interests



## Temperament

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

## Ability

- ①  $g$
- ②  $gf g_c$

## Interests

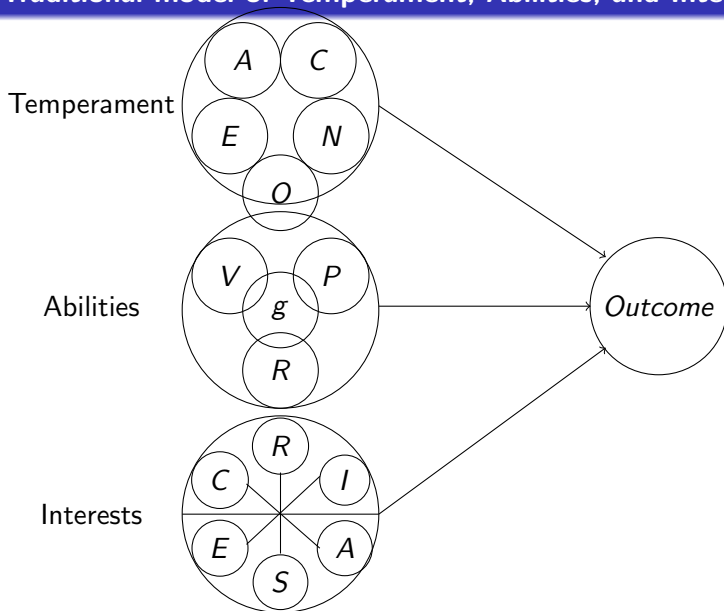
2 broad dimensions organizing 6-8 specific interests

- 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).
  - Unfortunately, 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 and motivated choice.
- 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 & Heggstad (1997)
  - Kuncel, Campbell & Ones (1998); Kuncel, Hezlett & Ones (2001); Kuncel, Crede & Thomas (2005)

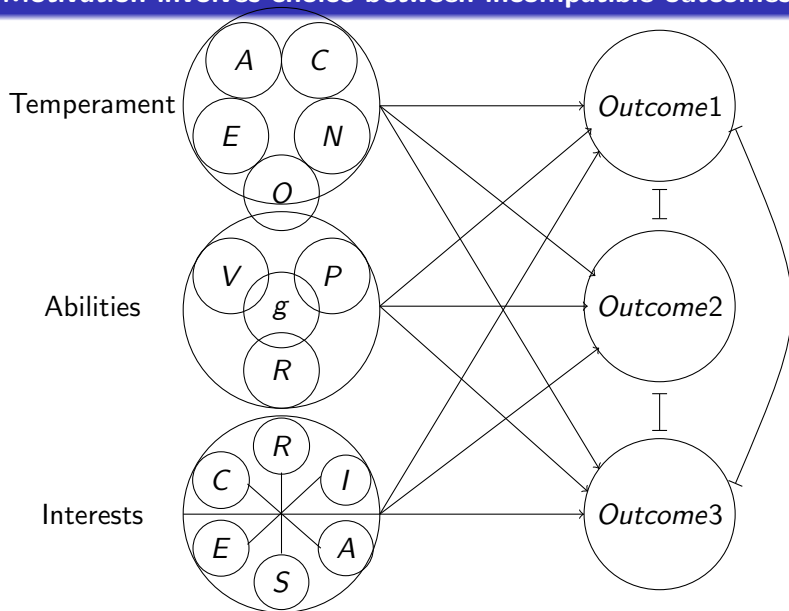
# Traditional model of Temperament, Abilities, and Interests



## Motivation involves choice

- 1 Motivational models emphasize intensity as well as direction
  - Performance models emphasize efficiency in any one task
  - How many resources are available for a particular task
- 2 Direction of behavior (aka resource allocation) emphasizes choice
  - Dynamic models of choice (the Dynamics of Action) from Atkinson & Birch (1970) or a reparameterization (the Cues-Tendency-Action model) by Revelle (1986) emphasize that behaviors inhibit each other.
  - For computer simulations of choice behavior using the Cues-Tendency-Action (CTA) model see Fua, Horswill, Ortony & Revelle (2009); Fua, Revelle & Ortony (2010)

## Motivation involves choice between incompatible outcomes



## 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
- 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  $\approx 50$  personality, 10 interest, and 14-16 ability items sampled from the larger pool.
  - Total pool of items  $> 1000$ 
    - $\approx 400$  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  $\approx 65,000$  participants

## Method

- 1 Synthetic Aperture Personality Assessment (Revelle, Wilt & Rosenthal, 2010) forms large covariance matrices by sampling items across people
  - $\approx 120/day$  participants 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
  - $\approx 200$  other temperamental items
  - 56-80 home brewed ability items
  - 92 Oregon Vocational Interest items (ORVIS)
- 3 Although  $> 200,000$  participants have been run in all, we will report only those data from the last 65,000
- 4 Demographic information included
  - Age, Gender
  - Level of education
  - College major and broad field (if appropriate)
  - Occupation (if appropriate)

# SAPA: what the subject sees

A			
ab	B		

# SAPA: what the subject sees

A			
ac		C	

# SAPA: what the subject sees

A			
ad			D

## SAPA: what the subject sees

	B		
	bc	C	

## SAPA: what the subject sees

	B		
	bd		D

# SAPA: what the subject sees

		C	
		cd	D



# SAPA: what the experimenter sees: A Synthetic matrix

A			
ab	B		
ac	bc	C	
ad	bd	cd	D

## SAPA: Technical overview

- ①  $n \times n$  synthetic covariance matrices are formed by giving  $p$  items 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  $\Rightarrow$  40,000 subjects per year
  - 700-1000 subjects/week
  - By varying  $p$ , one can prototype items rapidly.

## 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.

## 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

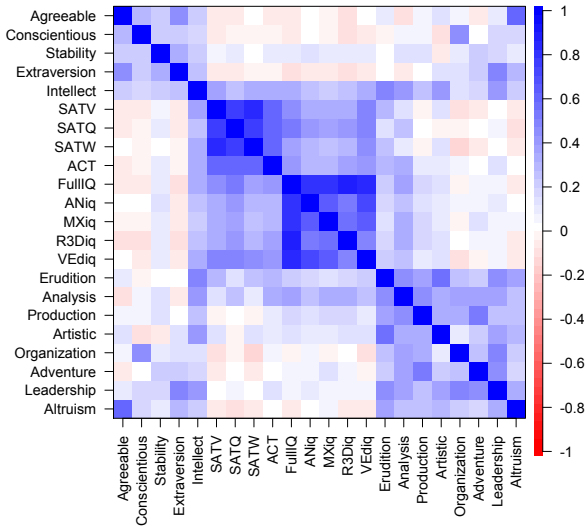
## Analysis of Temperament, Ability, Interests

- 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



# Temperament, Ability and Interests

Temperament, Ability and Interests



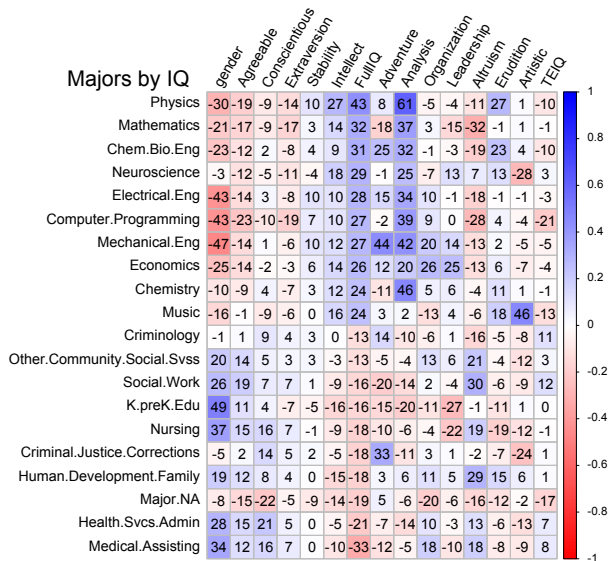
## Choice of college major reflects temperament, abilities and interests

- 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

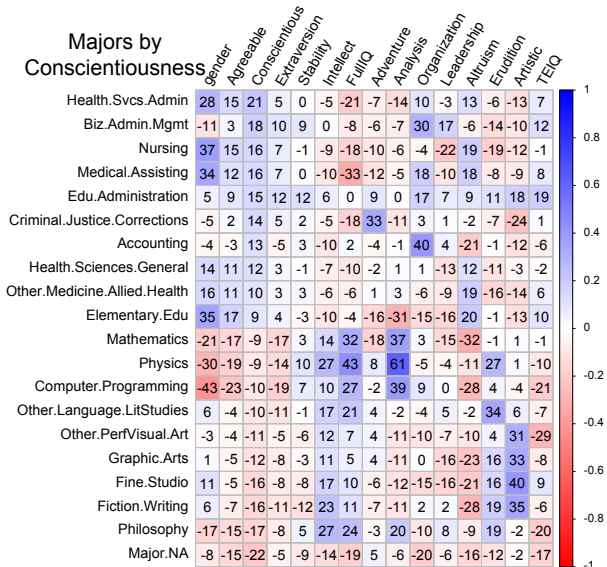
## Choosing majors as selection, optimization, and compensation

- 1 Traits and abilities are independent at individual level
  - This is seen in the plot of all the TAI variables based upon individual
- 2 Majors draw for certain constellations of traits
  - Selection, Optimization, and Compensation (Baltes & Baltes, 1990)
  - Sorting of majors by TAI dimensions
- 3 Choice of major selects for constellations
  - This is seen in the plot of the personality dimensions at the aggregate level of majors

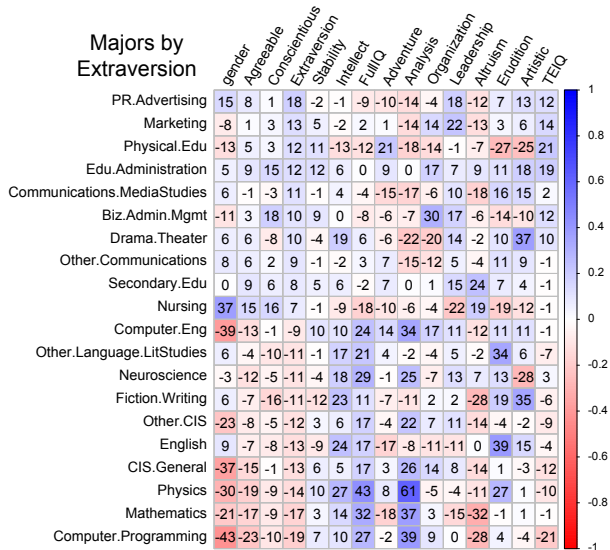
## College major sorted by Intelligence (top and bottom 10 majors)



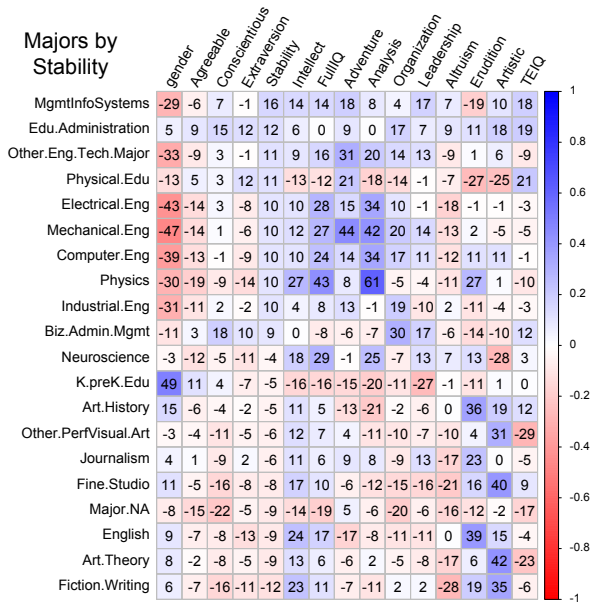
## College major sorted by Conscientiousness (top and bottom 10 )



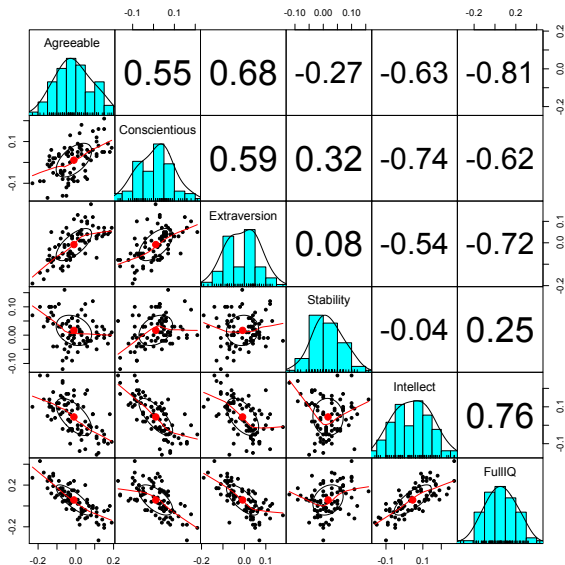
## College major sorted by Extraversion (top and bottom 10 majors)



## College major sorted by Stability–Neuroticism (top and bottom 10 )

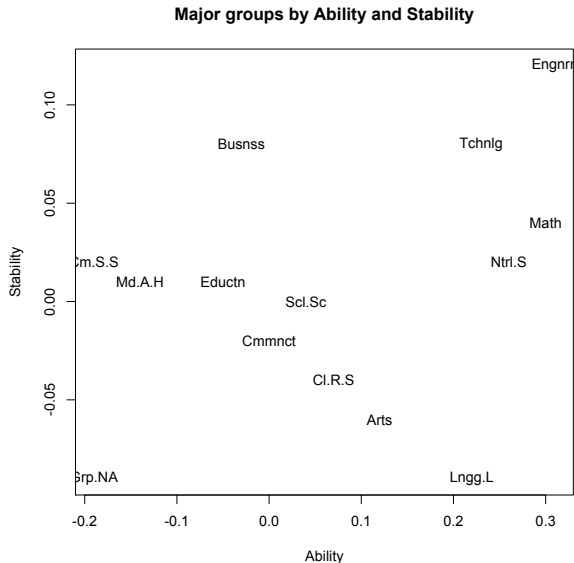


# The relationship of personality and ability at the aggregate level

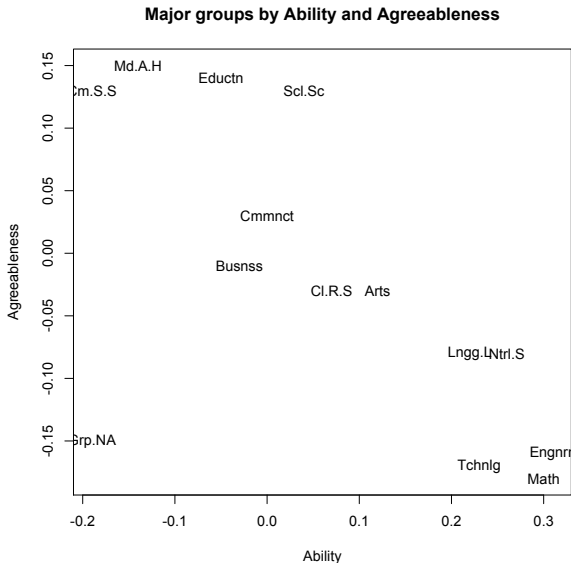




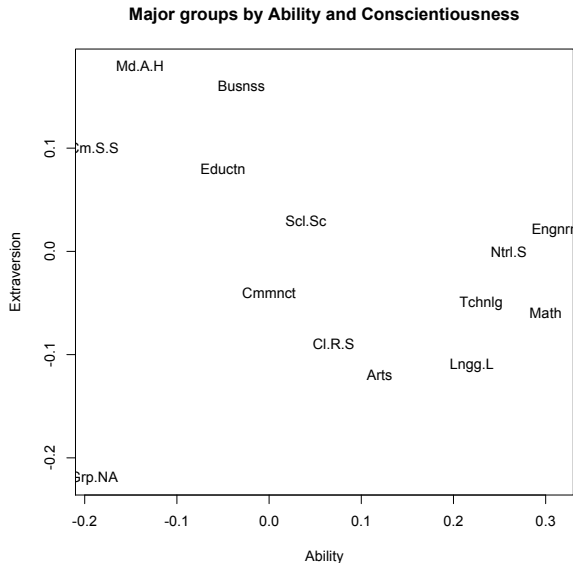
# Major groups by Ability and Stability



# Major groups by Ability and Agreeableness



# Major groups by Ability and Conscientiousness



## Why are Ability and Temperament measures negatively correlated at the group level?

- 1 Compensatory selection will lead to a negative correlation
  - Are Physicists selected to be disagreeable but smart
  - Are educators selected to be low on ability but highly agreeable?
- 2 Selection does not need to be compensatory, but merely extreme.
  - If group A is selected for high ability, the mean score on other traits should be average
  - If group B is selected for on Agreeableness, the mean scores on ability should be average
  - This leads to a negative correlation between Ability and Agreeableness at the group level.
- 3 Feedback mechanisms are likely: people select into fields based upon differences in characteristics of the fields.
  - What motivational interventions can we do to make STEM majors seem more agreeable?

## Conclusion

- ① Motivational choice can be seen in real world choices of college major
  - Other examples include occupational choice
- ② Using web based data techniques (e.g., SAPA), it is possible to do integrative studies of Temperament, Ability and Interests
- ③ Motivational choice reflects selection and compensation of temperament ability, and interests
  - Majors that require high ability do not necessarily draw for socially adaptive traits
  - Majors that require social skills do not necessarily draw for high ability

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