# Using Factor Analytic Techniques and Network Analysis to Delineate Personality Structures Among Indian College Students

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## Abstract

The purpose of this research is to extend the universality of a common structure of human personality, the five-factor model, in the Indian context. The methods include factor analysis, orthogonal Procrustean rotation, and network analysis. Results supported small gender differences in mean values and overall personality structure. Factor and Network analyses established the structural stability of the FFM across cultures. The factor structure was validated using factor analysis; cross-cultural similarity of personality structure and intra-cultural consistency of the NEO-PI-R provides evidence for the robustness of the five factor model across cultures.

## Introduction

- The five-factor model (FFM) is viewed as the best delineation of the personality trait structure (e.g., Digman, 1990; MaCrae & Allik, 2002, etc.).
- The FFM states that most personality traits can be characterized in terms of five basic dimensions: Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A), and Consciousness (C).
- The Revised NEO Personality Inventory (NEO-PI-R) operationalizes the FFM (Costa & McCrae, 1992).
- Based on the consistent pattern of covariation from cross-cultural samples, there is evidence for the uniformity in the structure of individual differences across cultures and efforts have been made to prove the universality of this personality structure across populations (Allik, Realo, & McCrae, 2013).

## Method

- **Participants:** 1063 undergraduate students (males, n = 555; females, n = 508) attending six different colleges, all affiliated with the University of Mumbai, India participated in this study.
- **Educational Background:** Participants were first year (21%,), second year (31%, n=331), and third year (48%, n=504) college students from different academic disciplines: Arts (n = 127), Commerce (n = 528), and Science (n = 408).
- **Instruments:** NEO-PI-R (English version, Costa & McCrae, 1992)
- **Analyses:** These included MANOVA, Principal components analysis with varimax rotation and orthogonal Procrustes rotation, Structural Equation Modeling-Confirmatory Factor Analysis (SEM-CFA), and Network analysis (Epskamp, 2012). The R software was utilized for the analysis (R Core Team, 2017).

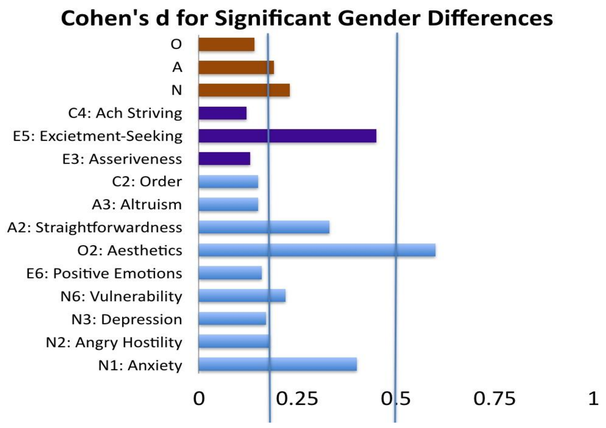
## Results

### Correlations among Five-Factors:

- The correlation between N and E (r = -.34, p <.001); N and C (r = -.46, p <.001), E and O (r = .44, p <.001) and E and C (r = .30, p <.001) are comparatively larger correlations.

### Gender and FFM

- MANOVA yielded gender differences on the FFM (Wilks $\Lambda$ = .962, approximately F (5, 1057) = 8.19, $p$ <.001).
- Gender differences emerged on Neuroticism, Openness, and Agreeableness with females scoring higher than males on N, A, and, O with small effect sizes.
- The comparison of a configural model ($\chi^2$ = 5016.95, df = 810) with loadings constrained equally across the genders model ($\chi^2$ = 5049.36, df = 835) resulted in no significant difference ($\chi^2$ = 32.41, df = 25, p = .15) indicating that the population represented by the sample has the same loadings across genders. The loadings of every facet on the major personality domain were not invariant for the two genders on the FFM.

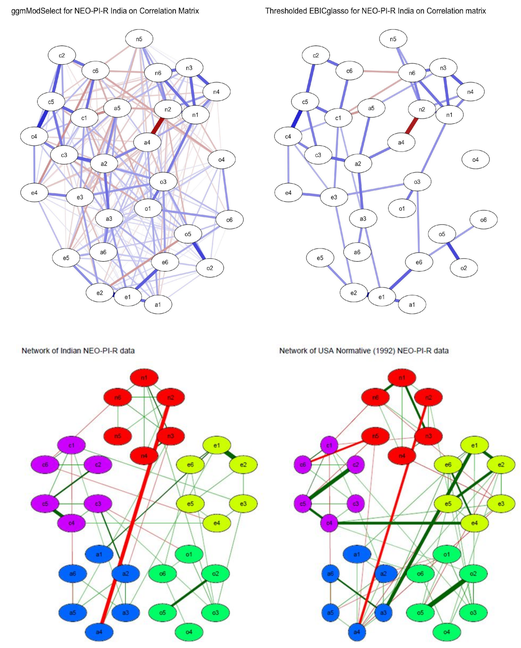



### Factor Analysis and Invariance across Cultures

- Initially, Principal Components Analysis resulted in Five-Factors with cross-loadings of A and E.
- The varimax rotated solution was further subjected to an **orthogonal Procrustes rotation** to a (a) Normative American Target Matrix; (b) Indian data (Belhekar, 2008) and (c) binary target matrix.
- The factor-wise congruence coefficients are N =.97, E=.95, O=.87, A=.96 and C=.98 with Overall Congruence = .95.

### Network Analysis across Cultures

- Partial correlation networks with Bonferroni correction, plotted using the *qgraph* package in R, revealed an overall similarity across the Indian and the US data.
- A more parsimonious, regularized estimation model, **EBIC lasso**, compared with an unregularized selection method, GGM model, revealed a stable network structure in the given data. Centrality measures revealed a high betweenness for o6 (feelings) in the Openness dimension. The overall strength and closeness of the centralities did not vary drastically for the two models.




**Orthogonal Procrustes to American target**

| | N | E | O | A | C | CC |
|---|---|---|---|---|---|---|
| N1 | **.78** | -.05 | -.01 | .05 | -.08 | .99 |
| N2 | **.70** | -.04 | .05 | -.39 | -.03 | .99 |
| N3 | **.73** | -.07 | -.15 | .08 | -.24 | .97 |
| N4 | **.72** | -.11 | -.05 | .01 | -.15 | .99 |
| N5 | **.50** | .19 | .09 | -.29 | -.21 | .95 |
| N6 | **.69** | -.14 | -.17 | .01 | -.34 | .99 |
| E1 | -.11 | **.74** | .17 | .25 | .06 | .98 |
| E2 | -.20 | **.74** | -.11 | .08 | -.05 | .98 |
| E3 | -.32 | **.39** | .23 | -.33 | .35 | 1.00 |
| E4 | -.17 | **.39** | .14 | -.33 | .32 | .93 |
| E5 | -.04 | **.60** | .15 | -.16 | -.10 | .95 |
| E6 | -.15 | **.57** | .35 | .19 | .15 | .93 |
| O1 | .18 | .23 | **.59** | .02 | -.24 | .96 |
| O2 | .12 | .27 | **.46** | .20 | .20 | .89 |
| O3 | .33 | .27 | **.58** | .09 | .07 | .96 |
| O4 | -.24 | .13 | **.48** | -.01 | -.21 | .94 |
| O5 | -.09 | .12 | **.59** | -.03 | .34 | .93 |
| O6 | -.12 | .08 | **.65** | .05 | -.07 | .96 |
| A1 | -.22 | .32 | .05 | **.45** | .09 | .95 |
| A2 | .03 | -.22 | .26 | **.67** | .03 | .83 |
| A3 | -.05 | .33 | .35 | **.49** | .23 | .84 |
| A4 | -.20 | -.06 | -.20 | **.67** | -.01 | .96 |
| A5 | .22 | -.27 | -.04 | **.53** | -.16 | .94 |
| A6 | .26 | .32 | 0 | **.48** | -.05 | .90 |
| C1 | -.31 | .24 | .10 | -.15 | **.66** | .96 |
| C2 | -.07 | 00 | -.09 | .09 | **.69** | .98 |
| C3 | .02 | .01 | .14 | .29 | **.69** | .94 |
| C4 | -.14 | .15 | -.01 | -.14 | **.76** | .97 |
| C5 | -.35 | .10 | .03 | .02 | **.74** | .99 |
| C6 | -.21 | -.13 | -.17 | .11 | **.61** | .95 |
| CC | **.97** | **.95** | **.87** | **.96** | **.98** | **.95** |

## Discussion

- The greatest effect sizes seen in the differences between genders in the Excitement-seeking and the Aesthetics facets demonstrate that men in this sample seem more driven to take risks whereas women are more involved in the artistic and creative endeavors.
- An evolutionary explanation for this would indicate that selection pressures propel men to engage in more risky and exciting behaviors than women.
- The social learning paradigm would suggest that these results reflect the higher parental investment in boys in the Indian culture and the encouragement/reinforcement for them to engage in risky behaviors; whereas girls are expected to express themselves more traditionally through conventional and aesthetic means.
- Analysis of gender differences indicated no gender difference on 18 facets, small effect sizes for the remaining facets that were significant, and structural invariance of FFM across gender.
- Structure invariances across cultures were established through factor analysis and structural stability was determined by network similarity.
- The utility of orthogonal Procrustes rotation is demonstrated for the FFM.
- The regularized and unregularized estimation methods reveal a stable network between the nodes from varying dimensions. This is an important observation for personality research wherein we assume that the five dimensions vary independently but are in fact interrelated in a way that the behavior of one subfacet (node) could have a strong influence on the rest of the nodes.
- Neuroticism, Conscientiousness, and Openness facets are grouped together whereas Agreeableness and Extraversion facets are mixed supporting a circumplex structure of these factors.
- Results of the study provide an increased cross-cultural understanding of the FFM and future research should examine the unique cultural manifestations of the common dimensions

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