Assessing US Personality Structure and Cross Cultural Comparisons

Vinita Vader[1], Xiaoyu Liu[1], & Sarah Donaldson[1]

[1] University of Oregon

Author Note

Abstract

Several studies have supported the replicability of the Big 5 model across cultures, languages and populations. First, this study looks at the factor structure of personality in a karge US sample. A parallel analysis suggested extracting 7 factors which were further subjected to a principal components analysis. Factors structures emerging from varimax and oblimin rotations were examined. Second, this study compared personality differences across gender (male vs. female) and regions (Great Britain vs. India) Two separate Between-Subjects ANOVAs were run to examine regional and gender differences in extraversion (Model 1) and in openness to experience (Model 2).

Keywords: Big 5, personality, parallel analysis, varimax, oblimin, cultural differences, gender differences

Assessing US Personality Structure and Cross Cultural Comparisons

Introduction

The Five Factor Model of personality structure (FFM) proposes that personality can be divided into five unique facets: Extraversion, Openness to Experience, Agreeableness, Conscientiousness, and Neuroticism. Typically, the Big Five Personality Inventory (BFI; **???**) has garnered support due to a strict extraction of these five factors. However, this has limited the scope of how personality has been understood across cultures. There is a need to understand the emic structures over imposing etic structures on datasets. We need to focus on how we could add a more stringent way of unearthing personality models. A more robust model would be the one that emerges through emic methods rather than etic methods. Using a large, open-source dataset, we will investigate whether the FFM remains true for U.S. participants. As an exploratory analysis, there is no prediction as to the number of factors that may emerge. The comparison of personality factors between genders and countries is important to our understanding of general human variation (**???**). Most gender comparisons report women scoring higher than men in extraversion (**???**; **???**). However most of this work has been done in white, U.S. samples, and when (**???**) collected a large, cross-cultural dataset, men were found to display higher levels of extraversion compared to women in 30 out of 37 countries examined (**???**). In only 5 countries (including the United States, Mexico, France, Austria, and Japan) women scored significantly higher than men (**???**), showing the importance of regional differences in gender-based personality comparisons. The trait of openness to experience (OE) reflects imagination, creativity, intellectual curiosity, and an appreciation for new, complex, aesthetic experiences (**???**). Gender comparisons on this trait are mixed world-wide. As an overall factor, very few gender differences are found (baer2008; **???**; **???**). It is only when this factor is broken down into sub-categories that gender differences emerge. For example, men tend to score higher on openness to ideas, while women have been found to score

higher than men on openness to aesthetics and feelings (**???**; **???**). Further, the extent of gender differences in openness differs by country, with larger differences found in countries with more traditional male and female gender roles, such as in eastern cultures (**???**). Therefore, comparing personality differences by gender and country can identify important cultural distinctions on typical gender stereotypes. This study investigated gender differences by country, comparing Great Britain (including England, Whales, and Scotland, but not Northern Ireland) to India. These countries are compared because they are represented in roughly even numbers in this dataset, and because of their cultural differences in gender stereotypes. Great Britain has had more open and accepting views of gender roles over a longer period of time compared to more conservative, traditional stereotypes upheld in many Indian cultures until relatively recently (**???**). For extraversion it is hypothesized that overall, males will score higher than females, however this gender difference will be greater in Indian participants compared to participants in Great Britain. There is no prediction about differences in extraversion between the two countries. For OE, it is predicted that gender differences will emerge in India, but not in Great Britain, with women scoring higher than men in India on this trait.

Methods

Procedure

The dataset for the analysis was obtained from $Open-SourcePsychometricsProject$ repository. This is the link to the website. Open Source Psychometric project.It contains data on the Big 5 personality variables ($Extraversion, Neuroticism, Agreeableness, Conscientiousness, OpennesstoExperience$) and demographics ($race, age, gender, country$). 6761 participants voluntarily responded to the questionnaires. We retained participants between the ages of 18 and 80 based on the strogheld assumption that personality develops at the age of 18. For the principal

components analysis, only participants from United states of America were used. Participants (*Females* = 4473, *Males*= 2288) in this study were between the ages, as mentioned previously, of 18 and 80 ($M = 30.07$, $SD = 12.77$). For the country and gender comparisons, we included participants from Great Britain and from India who identified as either male or female.

Data analysis

We used R (Version 4.0.2; R Core Team, 2019) and the R-packages *dbplyr* (Version 2.0.0; Wickham & Ruiz, 2019), *devtools* (Version 2.3.2; Wickham et al., 2020b), *dplyr* (Version 1.0.2; Wickham et al., 2020a), *forcats* (Version 0.5.0; Wickham, 2019a), *gapminder* (Bryan, 2017), *ggplot2* (Version 3.3.2; Wickham, 2016), *ggpubr* (Version 0.4.0; Kassambara, 2020a), *GPArotation* (Version 2014.11.1; Bernaards & I.Jennrich, 2005), *here* (Version 0.1; Müller, 2017), *janitor* (Version 2.0.1; Firke, 2020), *knitr* (Version 1.30; Xie, 2015), *MASS* (Version 7.3.53; Venables & Ripley, 2002), *papaja* (Version 0.1.0.9997; Aust & Barth, 2020), *paran* (Version 1.5.2; Dinno, 2018), *psych* (Version 2.0.9; Revelle, 2020), *purrr* (Version 0.3.4; Henry & Wickham, 2020), *readr* (Version 1.4.0; Wickham, Hester, & Francois, 2018), *rio* (Version 0.5.16; Chan, Chan, Leeper, & Becker, 2018), *rstatix* (Version 0.6.0; Kassambara, 2020b), *scales* (Version 1.1.1; Wickham & Seidel, 2019), *stringr* (Version 1.4.0; Wickham, 2019b), *tibble* (Version 3.0.4; Müller & Wickham, 2020), *tidyr* (Version 1.1.2; Wickham, 2020), *tidyverse* (Version 1.3.0; Wickham, Averick, et al., 2019), *tinytex* (Version 0.27; Xie, 2019), and *usethis* (Version 1.6.3; Wickham & Bryan, 2020) for all our analyses. Items were reverse scored if needed and total scores were obtained on the Big 5 variables for every participant. We obtained descriptive statistics for all the Big five variables. We used Principal components analysis to study the factor structure of the present data. Parallel analysis was computed to determine the number of factors to be extracted. These factors were further rotated using varimax and oblimin rotations.

```
##
## Note: parallel analysis suggests 7 components.
```

Results

Table 1 displays a summary of differences between males and females and Chronbach's alpha value for all Big 5 variables. There is a significant difference in all the variables for males and females except for Extraversion in this sample. We took a closer look at the error bars to see if there is any overlap. Figure 1 indicates a very high overlap for genders across Big 5 variables with an almost exact range for Extraversion. This indicates that there is not much difference in the levels of Big 5 in males and females in this sample. All the alpha values seem reasonably acceptable except for a low value for Openness. Parallel analysis (Horn's method) suggested 7 factors to be retained as seen in Figure 2. The seven factor solution was rotated using varimax and oblimin rotations. An examination of loadings matrix for varimax rotation Table 2 and structure matrix for oblimin rotation Table 3 indicate a clear emergence of the first three factors -Extraversion, Neuroticism, Agreeableness - indicating the respective items with highest loading on those factors. The last two factors - Conscientiousness and Openness - tend to split into multiple factors.

Discussion

Althought the t-test indicated significant differences overlaps seen in the errorbars indicate that no main differences can be seen in the plots. Openness and conscientiousness split into more factors which indicate a rather interesting groupings of variables into factors for this data. One could further look at inter item consistency values for these groups of 7 factors for the data.

References

Aust, F., & Barth, M. (2020). *papaja: Create APA manuscripts with R Markdown.* Retrieved from https://github.com/crsh/papaja

Bernaards, C. A., & I.Jennrich, R. (2005). Gradient projection algorithms and software for arbitrary rotation criteria in factor analysis. *Educational and Psychological Measurement, 65*, 676–696.

Bryan, J. (2017). *Gapminder: Data from gapminder.* Retrieved from https://CRAN.R-project.org/package=gapminder

Chan, C.-h., Chan, G. C., Leeper, T. J., & Becker, J. (2018). *Rio: A swiss-army knife for data file i/o.*

Dinno, A. (2018). *Paran: Horn's test of principal components/factors.* Retrieved from https://CRAN.R-project.org/package=paran

Firke, S. (2020). *Janitor: Simple tools for examining and cleaning dirty data.* Retrieved from https://CRAN.R-project.org/package=janitor

Henry, L., & Wickham, H. (2020). *Purrr: Functional programming tools.* Retrieved from https://CRAN.R-project.org/package=purrr

Kassambara, A. (2020a). *Ggpubr: 'Ggplot2' based publication ready plots.* Retrieved from https://CRAN.R-project.org/package=ggpubr

Kassambara, A. (2020b). *Rstatix: Pipe-friendly framework for basic statistical tests.* Retrieved from https://CRAN.R-project.org/package=rstatix

Müller, K. (2017). *Here: A simpler way to find your files.* Retrieved from https://CRAN.R-project.org/package=here

Müller, K., & Wickham, H. (2020). *Tibble: Simple data frames.* Retrieved from https://CRAN.R-project.org/package=tibble

R Core Team. (2019). *R: A language and environment for statistical computing.* Vienna,
    Austria: R Foundation for Statistical Computing. Retrieved from
    https://www.R-project.org/

Revelle, W. (2020). *Psych: Procedures for psychological, psychometric, and personality
    research.* Evanston, Illinois: Northwestern University. Retrieved from
    https://CRAN.R-project.org/package=psych

Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with s* (Fourth). New
    York: Springer. Retrieved from http://www.stats.ox.ac.uk/pub/MASS4

Wickham, H. (2016). *Ggplot2: Elegant graphics for data analysis.* Springer-Verlag New
    York. Retrieved from https://ggplot2.tidyverse.org

Wickham, H. (2019a). *Forcats: Tools for working with categorical variables (factors).*
    Retrieved from https://CRAN.R-project.org/package=forcats

Wickham, H. (2019b). *Stringr: Simple, consistent wrappers for common string operations.*
    Retrieved from https://CRAN.R-project.org/package=stringr

Wickham, H. (2020). *Tidyr: Tidy messy data.* Retrieved from
    https://CRAN.R-project.org/package=tidyr

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., . . .
    Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*,
    4(43), 1686. https://doi.org/10.21105/joss.01686

Wickham, H., & Bryan, J. (2020). *Usethis: Automate package and project setup.* Retrieved
    from https://CRAN.R-project.org/package=usethis

Wickham, H., François, R., Henry, L., & Müller, K. (2020a). *Dplyr: A grammar of data
    manipulation.* Retrieved from https://CRAN.R-project.org/package=dplyr

Wickham, H., Hester, J., & Chang, W. (2020b). *Devtools: Tools to make developing r
    packages easier.* Retrieved from https://CRAN.R-project.org/package=devtools

Wickham, H., Hester, J., & Francois, R. (2018). *Readr: Read rectangular text data.* Retrieved from https://CRAN.R-project.org/package=readr

Wickham, H., & Ruiz, E. (2019). *Dbplyr: A 'dplyr' back end for databases.* Retrieved from https://CRAN.R-project.org/package=dbplyr

Wickham, H., & Seidel, D. (2019). *Scales: Scale functions for visualization.* Retrieved from https://CRAN.R-project.org/package=scales

Xie, Y. (2015). *Dynamic documents with R and knitr* (2nd ed.). Boca Raton, Florida: Chapman; Hall/CRC. Retrieved from https://yihui.org/knitr/

Xie, Y. (2019). TinyTeX: A lightweight, cross-platform, and easy-to-maintain latex distribution based on tex live. *TUGboat*, (1), 30–32. Retrieved from http://tug.org/TUGboat/Contents/contents40-1.html

Table 1

Summary statistics

variables	Female	Male	t	p	alpha
A	40.96	37.21	20.40	0.00	0.85
C	35.19	34.46	3.87	0.00	0.83
E	30.10	29.82	1.44	0.15	0.81
N	33.70	30.41	13.32	0.00	0.89
O	25.17	26.41	-14.19	0.00	0.49

Note. E = Extraversion, N = Neuroticism, A = Agreeableness, C = Conscientiousness, O = Openness/Intellect, t = t statistic value, p =p values for corresponding t values, a = Chronbach's alpha

Table 2

Varimax rotation loadings matrix

Items	RC1	RC2	RC4	RC3	RC5	RC7	RC6
E4r	0.81	-0.11	0.07	0.06	-0.03	-0.02	0.09
E5	0.77	-0.08	0.23	0.07	0.08	0.02	-0.07
E2	-0.76	-0.03	-0.12	-0.01	-0.01	0.05	-0.09
E7	0.76	-0.12	0.17	0.03	0.01	0.04	-0.12
E10r	0.75	-0.16	0.07	0.04	-0.02	-0.02	0.10
E1	0.74	-0.05	0.05	0.00	0.03	0.09	-0.19
E9	0.71	-0.06	-0.03	-0.04	0.09	0.12	-0.07
E3	0.68	-0.28	0.25	0.11	0.05	-0.01	-0.15
E6r	0.66	-0.05	0.16	0.04	0.15	0.04	0.23
E8r	0.65	-0.02	-0.07	-0.08	-0.03	0.07	0.09
N6	-0.06	0.79	0.01	-0.08	-0.07	-0.01	-0.10
N8	-0.02	0.77	-0.07	-0.14	-0.05	0.10	-0.08
N1	-0.09	0.76	0.09	-0.01	-0.06	-0.09	0.04
N9	-0.05	0.74	-0.19	-0.04	0.02	-0.02	-0.13
N7	-0.01	0.74	-0.07	-0.15	-0.03	0.11	-0.10
N3	-0.13	0.69	0.17	0.04	0.03	-0.06	-0.01
N10	-0.27	0.68	-0.05	-0.17	-0.01	0.03	0.14
N2r	-0.05	0.64	-0.04	0.06	-0.08	-0.18	0.34
N5	-0.07	0.60	-0.02	-0.07	-0.13	0.01	-0.20
N4r	-0.20	0.53	0.01	-0.13	-0.06	0.01	0.29
A4	0.02	0.04	0.82	0.03	0.00	0.05	-0.04
A9	0.08	0.09	0.75	0.04	0.04	0.10	-0.09
A5r	0.14	0.01	0.71	0.00	-0.02	-0.03	0.18
A6	-0.02	0.12	0.69	0.01	-0.09	0.07	-0.17
A7r	0.32	-0.08	0.68	0.00	-0.02	0.00	0.17
A8	0.12	-0.06	0.67	0.09	0.08	0.02	-0.12
A2	0.36	-0.07	0.59	-0.03	0.08	0.02	0.01
A1r	0.05	0.00	0.56	0.03	-0.01	-0.08	0.32
A3r	-0.13	-0.25	0.46	0.22	-0.13	0.00	0.15
A10	0.35	-0.20	0.45	0.10	0.14	0.11	-0.24
C6r	0.02	-0.15	-0.02	0.73	-0.15	0.04	0.16
C5	0.08	-0.09	0.06	0.72	-0.03	0.02	-0.12
C2r	-0.03	-0.09	-0.07	0.71	-0.25	0.09	0.12
C9	0.06	0.04	0.09	0.65	0.12	-0.10	-0.16
C7	-0.05	0.10	0.03	0.65	0.17	-0.07	-0.11
C4r	0.07	-0.35	0.05	0.64	-0.04	0.01	0.10
C1	0.00	-0.09	0.00	0.61	0.31	-0.08	-0.10
C8r	0.08	-0.20	0.15	0.52	0.13	-0.07	0.20
C3	-0.06	-0.01	0.08	0.43	0.42	0.05	-0.10
O7	0.07	-0.16	0.00	0.07	0.70	0.06	0.05
O1	0.05	-0.03	-0.04	-0.05	0.62	0.12	0.27
O5	0.22	-0.08	-0.03	0.09	0.52	0.39	-0.05
C10	-0.01	-0.01	0.04	0.45	0.50	-0.05	-0.10
O6	-0.11	0.05	-0.09	0.02	-0.09	-0.81	-0.13
O3	0.06	0.09	0.07	-0.10	0.17	0.80	0.02
O4r	0.03	-0.09	0.10	-0.10	0.30	0.37	0.53
O2r	0.05	-0.20	-0.01	-0.05	0.46	0.30	0.52

Note. E = Extraversion, N = Neuroticism,

A = Agreeableness, C =

Conscientiousness, O = Openness/Intellect

Table 3

Oblimin rotation loadings matrix

Items	TC1	TC2	TC4	TC3	TC5	TC7	TC6
E4r	0.81	-0.20	0.16	0.07	0.04	0.05	0.05
E5	0.79	-0.18	0.32	0.08	0.16	0.10	-0.09
E7	0.78	-0.21	0.26	0.04	0.08	0.11	-0.15
E2	-0.76	0.06	-0.20	-0.02	-0.06	-0.03	-0.05
E10r	0.76	-0.24	0.15	0.07	0.04	0.05	0.07
E1	0.74	-0.13	0.13	-0.01	0.09	0.15	-0.22
E3	0.72	-0.37	0.34	0.14	0.14	0.05	-0.16
E9	0.71	-0.14	0.05	-0.05	0.13	0.20	-0.08
E6r	0.69	-0.14	0.23	0.05	0.19	0.14	0.21
E8r	0.64	-0.08	0.00	-0.08	-0.01	0.13	0.06
N6	-0.13	0.80	-0.02	-0.17	-0.11	-0.04	-0.14
N8	-0.10	0.78	-0.10	-0.23	-0.11	0.08	-0.11
N1	-0.16	0.76	0.06	-0.09	-0.10	-0.12	0.00
N9	-0.14	0.75	-0.22	-0.14	-0.02	-0.04	-0.16
N7	-0.09	0.75	-0.10	-0.24	-0.09	0.10	-0.13
N10	-0.34	0.71	-0.10	-0.24	-0.11	0.01	0.13
N3	-0.17	0.69	0.14	-0.03	0.01	-0.09	-0.03
N2r	-0.11	0.65	-0.05	0.01	-0.12	-0.21	0.28
N5	-0.14	0.62	-0.05	-0.14	-0.16	-0.03	-0.23
N4r	-0.25	0.55	-0.03	-0.16	-0.15	0.00	0.27
A4	0.10	0.01	0.82	0.06	0.03	0.05	-0.01
A9	0.14	0.05	0.76	0.06	0.08	0.10	-0.06
A5r	0.20	-0.03	0.72	0.04	-0.01	0.00	0.20
A7r	0.39	-0.13	0.71	0.05	0.00	0.04	0.18
A6	0.03	0.10	0.68	0.03	-0.06	0.05	-0.16
A8	0.19	-0.10	0.68	0.11	0.14	0.03	-0.10
A2	0.42	-0.13	0.62	-0.01	0.10	0.08	0.03
A1r	0.11	-0.02	0.57	0.07	-0.01	-0.06	0.33
A10	0.41	-0.26	0.49	0.12	0.22	0.14	-0.22
A3r	-0.07	-0.26	0.46	0.28	-0.06	-0.05	0.14
C6r	0.03	-0.19	0.04	0.76	0.06	-0.08	0.07
C2r	-0.03	-0.12	-0.01	0.74	-0.04	-0.06	0.02
C5	0.09	-0.14	0.12	0.72	0.19	-0.09	-0.19
C4r	0.11	-0.40	0.11	0.68	0.16	-0.07	0.04
C9	0.07	-0.01	0.14	0.62	0.32	-0.17	-0.21
C7	-0.04	0.05	0.07	0.61	0.35	-0.14	-0.16
C1	0.02	-0.15	0.05	0.58	0.48	-0.11	-0.11
C8r	0.12	-0.25	0.20	0.54	0.26	-0.10	0.17
O7	0.12	-0.21	0.01	0.03	0.70	0.19	0.14
C10	0.02	-0.06	0.07	0.39	0.61	-0.02	-0.08
O1	0.08	-0.06	-0.03	-0.10	0.56	0.26	0.34
O5	0.25	-0.14	0.00	0.04	0.56	0.48	0.00
C3	-0.03	-0.05	0.10	0.38	0.53	0.05	-0.08
O3	0.08	0.06	0.07	-0.13	0.16	0.83	0.05
O6	-0.15	0.08	-0.11	0.01	-0.11	-0.82	-0.14
O2r	0.11	-0.23	0.00	-0.05	0.40	0.42	0.58
O4r	0.07	-0.12	0.10	-0.09	0.23	0.45	0.58

Note. E = Extraversion, N = Neuroticism,

A = Agreeableness, C =

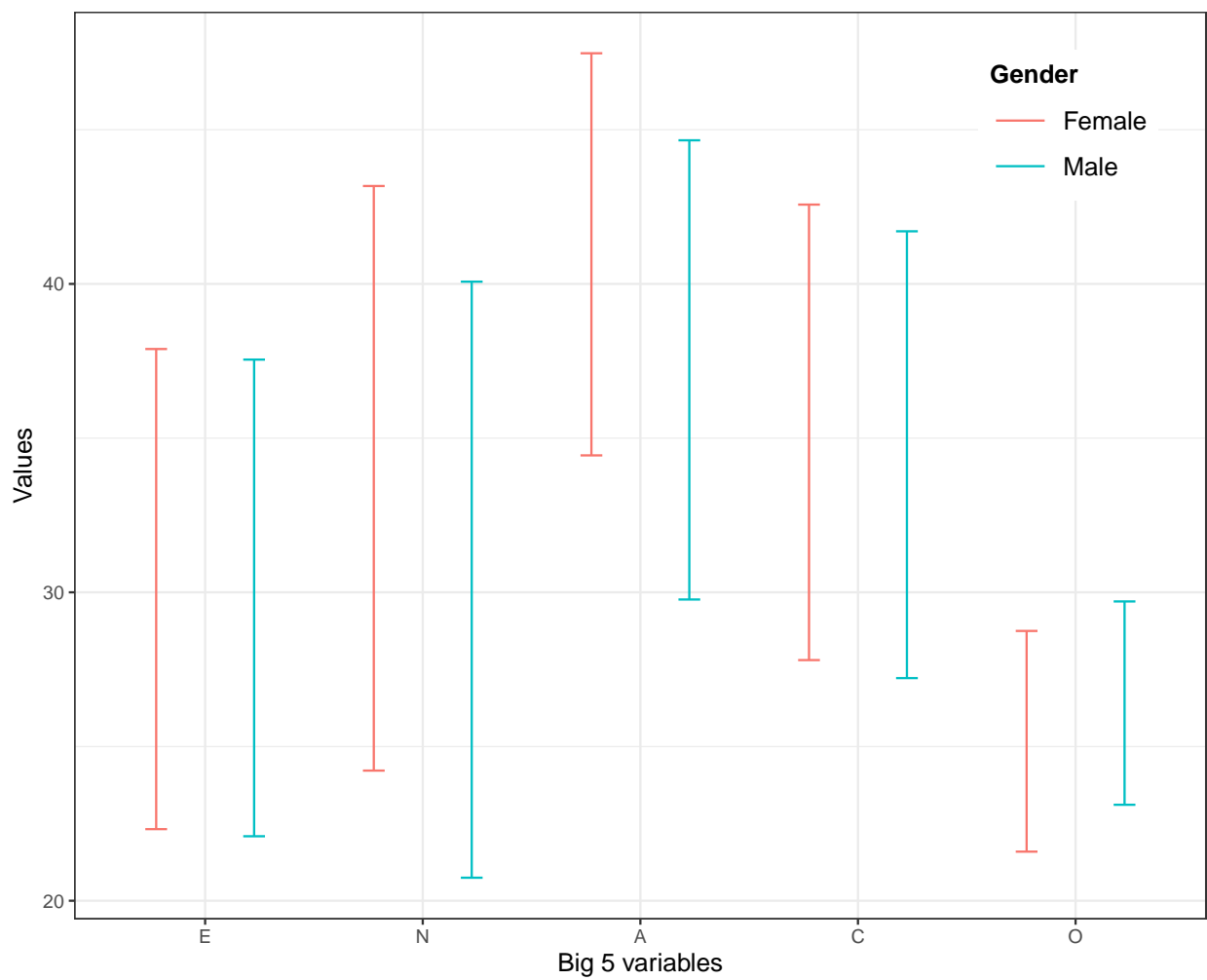Conscientiousness, O = Openness/Intellect

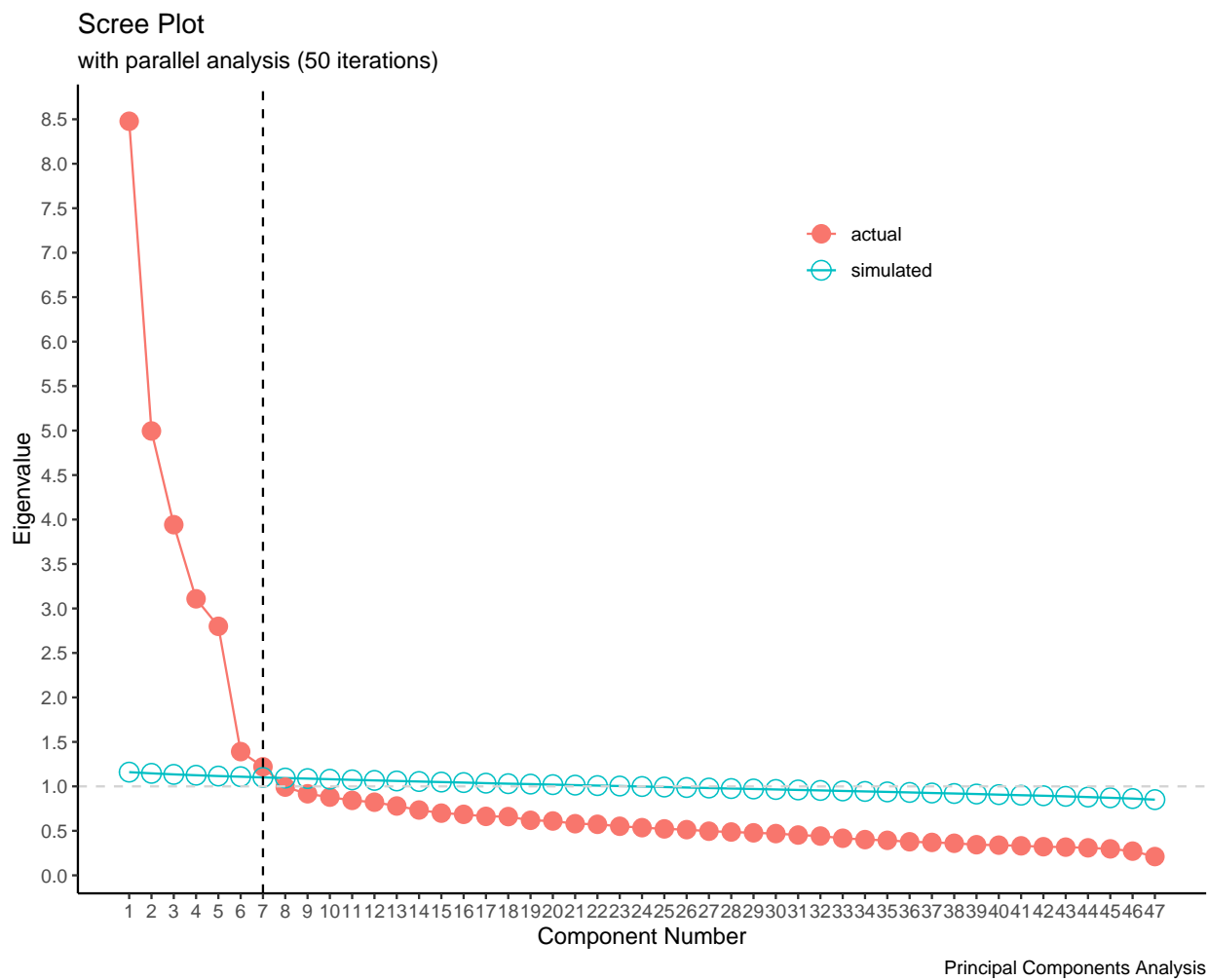*Figure 1*. Difference between Males and Females on Big 5 variables

Figure 2. Parallel analysis