

Psychometric Evaluation of the Bangla Communication Scale through Classical Test
Theory and Item Response Theory

Nusrat Jahan¹, Mushfiqul Anwar Siraji², & Zinnatul Borak¹

¹ Department of Educational and Counselling Psychology, University of Dhaka

² Monash University, Department of Psychology, Jeffrey Cheah School of Medicine and
Health Sciences, Malaysia

8 Add complete departmental affiliations for each author here. Each new line herein
9 must be indented, like this line.

10 Enter author note here.

11 The authors made the following contributions. Nusrat Jahan: Conceptualization,
12 Project Management, Data Curation, Writing - Original Draft Preparation; Mushfiqul
13 Anwar Siraji: Conceptualization, Project Management, Formal Analysis & Data
14 Visualization, Writing - Original Draft Preparation; Review & Editing; Zinnatul Borak:
15 Conceptualization, Writing - Review & Editing.

16 Correspondence concerning this article should be addressed to Zinnatul Borak,
17 Department of Educational and Counselling Psychology, University of Dhaka, Dhaka 1000.
18 E-mail: institutional email of Bonhee mam

Abstract

19

20 One or two sentences providing a **basic introduction** to the field, comprehensible to a
21 scientist in any discipline.

22 Two to three sentences of **more detailed background**, comprehensible to scientists
23 in related disciplines.

24 One sentence clearly stating the **general problem** being addressed by this particular
25 study.

26 One sentence summarizing the main result (with the words “**here we show**” or their
27 equivalent).

28 Two or three sentences explaining what the **main result** reveals in direct comparison
29 to what was thought to be the case previously, or how the main result adds to previous
30 knowledge.

31 One or two sentences to put the results into a more **general context**.

32 Two or three sentences to provide a **broader perspective**, readily comprehensible to
33 a scientist in any discipline.

34 *Keywords:* keywords

35 Word count: X

Psychometric Evaluation of the Bangla Communication Scale through Classical Test Theory and Item Response Theory

Communication is a complex behaviour of exchanging information among individuals (Tanner, 2006). Communication plays a central role among adolescents in developing self-identity, social relationships and creates the foundation of collective social activity (Conti-Ramsden & Botting, 2008; Haslett & Bowen, 1989; Spencer, Clegg, & Stackhouse, 2013). Inadequate communication skill may cause poor peer relationship resulting long-term socio-emotional difficulties including social anxiety, stress, low self-esteem and poor academic performance (Brinton & Fujiki, 2004; Reed & Trumbo, 2020).

Often adults picture adolescents having inadequate and inept communication skills (Stern, 2005; Thurlow, 2003). Media representation of adolescents often includes “storm-and stress,” self absorbed and disengaged type behaviours (Porteous & Colston, 1980; Stern, 2005). As such adolescents are often labelled as “lazy” and “disrespectful” by the adults (Agenda & America, 1999). On the contrary adolescents are highly engaged in work, community services and extracurricular activities and also more aspiring to earn an college degrees (DeBard, 2004; Schneider & Stevenson, 1999). Such a discrepancy between the reality of adolescent’s image and adult’s perception of the adolescents might be attributed to the mismatch of communication skills. The communication pattern of adolescents might not necessarily same as the adults. In addition to face to face communication, adolescents are vastly exposed to different virtual communication platforms. This may cause them to face more complex social challenges than the adults (Thurlow, 2003). “Communication capital” expresses the potential of civic-engagement that incorporates developing social relationships and influences collective social activity. The more communication capital an individual has the easier the instances of civic engagement become.

Understanding the adolescents’ communication skill vital as it is considered as the

“key skill” in the education (Thurlow, 2001) and employment market (Olszewski, Panorska, & Gillam, 2017). In the western society, adolescents are now facing high unemployment (Lindsay et al., 2014). Lack of adequate communication skill is one of the root causes of this high unemployment (Lindsay et al., 2014). Similarly, lack of proper communication skill often promotes the propensity of anti-social behaviours and risk of exclusion from schools (Clegg, Stackhouse, Finch, Murphy, & Nicholls, 2009; Conti-Ramsden & Botting, 2004).

To promote better understanding of subject contents assessing the communication skill among adolescents is highly required. For this purpose “Communication Skill” sub-skill set (Barkman & Machtmes, 2002) was developed in 2002 as a part of The National On-line Youth Life Skills Evaluation System (Mincemoyer, Perkins, & Munyua, 2005) and since then it has been extensively used (Fitzpatrick, Gagne, Jones, Lobley, & Phelps, 2005).

This study has two objectives: (a) To explore and validate the latent construct of “Bangla Communication Scale” using (b) To gather concurrent validity evidence (c) To increase the precision of the scale using Item Response Theory guided analysis ##
Methods

Participants

A cross-sectional survey was used to collect data from a large sample of students of grade 8-12 ($n = 300$) from 8 schools following convenience sampling method. T. For estimating the sample size for the CFA we followed the N:q rule (Comrey & Lee, 1992; Schönbrodt & Perugini, 2013) which required 10 participants per parameters for trustworthiness of the result. Our sample size exceeds the requirement. Among 300 participants, 218 were female aged between 12 to 21 years (15.89 ± 1.46). 82 were male with an age range between 13 participants 23 years (16.62 ± 1.38). 282 (94%) participants belonged to middle socio-economic status. 13 (4.3%) and 5 (1.7%) participants belonged to

87 lower and upper socio-economic status-respectively.

88 **Procedure**

89 Prior to data collection necessary authorization from school's authority and assent
90 from the participating were obtained. Data collection was commenced between November
91 2021 to January 2022. The data collection took place in the classroom where students were
92 at first briefed about 'communication skill.' Next. they filled up their soci-demographics
93 information and responded to our Bangla Communication Scale. All personal information
94 (name, school,class) was codified and encrypted, producing a anonymous database.

95 **Materials**

96 **Communication Scale.**

97 **Bangla Communication Scale.** We translated the "Communication Scale" into
98 Bangla Language following International Test Commission (ITC) guidelines (Bartram et
99 al., 2018) to translate and adapt Communication scale. Two bilingual researchers (PhD in
100 Psychology) natives in Bangla translated the original English version to Bangla. Two
101 translated versions were then judged and synthesized by the authors. Subsequently, two
102 bilingual researchers (One PhD, one MS in Psychology) back-translated the Bangla scale
103 into English with no knowledge of the original work. The authors synthesized the two
104 back-translations and compared it with the original scale and made necessary amendments

105 **Item Analysis**

106 Scree plot, map and hull method (Figure 2) suggested a one factor solution. Horn's
107 parallel analysis (Horn, 1965) with 500 iterations indicated a two-factor solution. However,
108 the minimum average partial (MAP) method (Table ??) (Velicer, 1976) and Hull method

(Lorenzo-Seva, Timmerman, & Kiers, 2011) (Figure 2) suggested a five-factor solution. As a result, we tested both five-factor and six-factor solutions.

Measurement Invariance

To gather more information on our retained one-factor solution, we sought Item Response Theory (IRT). IRT complements the conventional classical test theory-based analysis by gathering information on item discrimination and item difficulty. IRT judges an item's quality by providing item information in the light of participants' trait level (θ). We gathered evidence on item quality as well as item fit, person fit and model by fitting a graded response model in RStudio with the "mirt" package (Chalmers, 2012) (Chalmers, 2012). We did a Monte Carlo simulation using "SimDesign" package (Chalmers & Adkins, 2020) with sample sizes varying from 50-350 and calculated average root mean squared error(RMSE) to estimate the optimal sample size for the graded response model with 23 items. The RMSE became stable for $n = 200$ to 300 (RMSE ranging between .25-.35). Our sample size within the estimated sample size for stability.

Marginal reliability is based on the true score model (Lord & Novick, 1968) and is an estimate of the overall reliability of a test based on the average conditional standard errors. Often it is close in value to coefficient alpha (and sometimes it may even be identical). Alpha provides a lower estimate of marginal reliability.

Results

Discussion

Ethical Consideration

All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical

132 standards. This article does not contain any studies with animals performed by any of the
133 authors.

134 **Data and code availability**

135 All code and data underlying this article is available on a public GitHub repository
136 (<https://github.com/masiraji/Communication>).

References

- Agenda, P., & America, U. S. of. (1999). Kids these days' 99: What americans really think about the next generation.
- Aust, F., & Barth, M. (2020). *papaja: Create APA manuscripts with R Markdown*. Retrieved from <https://github.com/crsh/papaja>
- Barkman, S., & Machtmes, K. (2002). Four-fold: A research model for designing and evaluating the impact of youth development programs. *News and Views*, 4(4), 4–6.
- Barnier, J., Briatte, F., & Larmarange, J. (2021). *Questionr: Functions to make surveys processing easier*. Retrieved from <https://CRAN.R-project.org/package=questionr>
- Bartram, D., Berberoglu, G., Grégoire, J., Hambleton, R., Muniz, J., & Vijver, F. van de. (2018). ITC Guidelines for Translating and Adapting Tests (Second Edition). *International Journal of Testing*, 18(2), 101–134. <https://doi.org/10.1080/15305058.2017.1398166>
- Brinton, B., & Fujiki, M. (2004). Social and affective factors in children with language impairment: Implications for literacy learning. *Handbook of Language and Literacy*, 130–153.
- Bryer, J., & Speerschneider, K. (2016). *Likert: Analysis and visualization likert items*. Retrieved from <https://CRAN.R-project.org/package=likert>
- Buchanan, E. M., Gillenwaters, A., Scofield, J. E., & Valentine, K. D. (2019). *MOTE: Measure of the Effect: Package to assist in effect size calculations and their confidence intervals*. Retrieved from <http://github.com/doomlab/MOTE>
- Butts, C. T. (2008). Network: A package for managing relational data in r. *Journal of Statistical Software*, 24(2). Retrieved from <https://www.jstatsoft.org/v24/i02/paper>
- Butts, C. T. (2020). *Sna: Tools for social network analysis*. Retrieved from

164 <https://CRAN.R-project.org/package=sna>

165 Chalmers, R. P. (2012). mirt: A multidimensional item response theory package for
166 the R environment. *Journal of Statistical Software*, 48(6), 1–29.

167 <https://doi.org/10.18637/jss.v048.i06>

168 Chalmers, R. P., & Adkins, M. C. (2020). Writing effective and reliable Monte
169 Carlo simulations with the SimDesign package. *The Quantitative Methods for*
170 *Psychology*, 16(4), 248–280. <https://doi.org/10.20982/tqmp.16.4.p248>

171 Chang, W., Cheng, J., Allaire, J., Sievert, C., Schloerke, B., Xie, Y., . . . Borges, B.
172 (2021). *Shiny: Web application framework for r*. Retrieved from

173 <https://CRAN.R-project.org/package=shiny>

174 Clegg, J., Stackhouse, J., Finch, K., Murphy, C., & Nicholls, S. (2009). Language
175 abilities of secondary age pupils at risk of school exclusion: A preliminary
176 report. *Child Language Teaching and Therapy*, 25(1), 123–139.

177 Comrey, A. L., & Lee, H. B. (1992). *A first course in factor analysis*, 2nd ed.
178 Hillsdale, NJ, US: Lawrence Erlbaum Associates, Inc.

179 Conti-Ramsden, G., & Botting, N. (2004). Social difficulties and victimization in
180 children with SLI at 11 years of age.

181 Conti-Ramsden, G., & Botting, N. (2008). Emotional health in adolescents with
182 and without a history of specific language impairment (SLI). *Journal of Child*
183 *Psychology and Psychiatry*, 49(5), 516–525.

184 Dahl, D. B., Scott, D., Roosen, C., Magnusson, A., & Swinton, J. (2019). *Xtable:*
185 *Export tables to LaTeX or HTML*. Retrieved from

186 <https://CRAN.R-project.org/package=xtable>

187 DeBard, R. (2004). Millennials coming to college. *New Directions for Student*
188 *Services*, 2004(106), 33–45.

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

- 191 Epskamp, S. (2019). *semPlot: Path diagrams and visual analysis of various SEM*
 192 *packages' output*. Retrieved from
 193 <https://CRAN.R-project.org/package=semPlot>
- 194 Epskamp, S., Cramer, A. O. J., Waldorp, L. J., Schmittmann, V. D., & Borsboom,
 195 D. (2012). qgraph: Network visualizations of relationships in psychometric data.
 196 *Journal of Statistical Software*, 48(4), 1–18.
- 197 Fitzpatrick, C., Gagne, K. H., Jones, R., Lobley, J., & Phelps, L. (2005). Life skills
 198 development in youth: Impact research in action. *Learning*, 72, 77.
- 199 Fox, J., & Weisberg, S. (2019). *An R companion to applied regression* (Third).
 200 Thousand Oaks CA: Sage. Retrieved from
 201 <https://socialsciences.mcmaster.ca/jfox/Books/Companion/>
- 202 Fox, J., Weisberg, S., & Price, B. (2020). *carData: Companion to applied regression*
 203 *data sets*. Retrieved from <https://CRAN.R-project.org/package=carData>
- 204 Golino, H., & Christensen, A. P. (2021). *EGAnet: Exploratory graph analysis – a*
 205 *framework for estimating the number of dimensions in multivariate data using*
 206 *network psychometrics*.
- 207 Haslett, B., & Bowen, S. P. (1989). Children's strategies in initiating interaction
 208 with peers.
- 209 Henry, L., & Wickham, H. (2020). *Purrr: Functional programming tools*. Retrieved
 210 from <https://CRAN.R-project.org/package=purrr>
- 211 Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis.
 212 *Psychometrika*, 30(2), 179–185. <https://doi.org/10.1007/BF02289447>
- 213 Iannone, R. (2016). *DiagrammeRsvg: Export DiagrammeR graphviz graphs as SVG*.
 214 Retrieved from <https://CRAN.R-project.org/package=DiagrammeRsvg>
- 215 Iannone, R. (2020). *DiagrammeR: Graph/network visualization*. Retrieved from
 216 <https://CRAN.R-project.org/package=DiagrammeR>
- 217 Iannone, R., Cheng, J., & Schloerke, B. (2021). *Gt: Easily create presentation-ready*

- 218 *display tables*. Retrieved from <https://CRAN.R-project.org/package=gt>
- 219 Irribarra, D. T., & Freund, R. (2014). *Wright map: IRT item-person map with*
- 220 *ConQuest integration*. Retrieved from <http://github.com/david-ti/wrightmap>
- 221 Johnson, P., & Kite, B. (2020). *semTable: Structural equation modeling tables*.
- 222 Retrieved from <https://CRAN.R-project.org/package=semTable>
- 223 Johnson, P., Kite, B., & Redmon, C. (2020). *Kutils: Project management tools*.
- 224 Retrieved from <https://CRAN.R-project.org/package=kutils>
- 225 Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A. M., & Rosseel, Y. (2021).
- 226 *semTools: Useful tools for structural equation modeling*. Retrieved from
- 227 <https://CRAN.R-project.org/package=semTools>
- 228 Kassambara, A. (2019). *Ggcorrplot: Visualization of a correlation matrix using*
- 229 *'ggplot2'*. Retrieved from <https://CRAN.R-project.org/package=ggcorrplot>
- 230 Kowarik, A., & Templ, M. (2016). Imputation with the R package VIM. *Journal of*
- 231 *Statistical Software*, 74(7), 1–16. <https://doi.org/10.18637/jss.v074.i07>
- 232 Krivitsky, P. N. (2021). *Statnet.common: Common r scripts and utilities used by*
- 233 *the statnet project software*. The Statnet Project (<https://statnet.org>).
- 234 Retrieved from <https://CRAN.R-project.org/package=statnet.common>
- 235 Lindsay, S., Adams, T., Sanford, R., McDougall, C., Kingsnorth, S., & Menna-Dack,
- 236 D. (2014). Employers' and employment counselors' perceptions of desirable skills
- 237 for entry-level positions for adolescents: How does it differ for youth with
- 238 disabilities? *Disability & Society*, 29(6), 953–967.
- 239 Lorenzo-Seva, U., Timmerman, M., & Kiers, H. (2011). The Hull Method for
- 240 Selecting the Number of Common Factors. *Multivariate Behavioral Research*, 46,
- 241 340–364. <https://doi.org/10.1080/00273171.2011.564527>
- 242 Michalke, M. (2020a). *koRpus.lang.en: Language support for 'koRpus' package:*
- 243 *english*. Retrieved from <https://reaktanz.de/?c=hacking&s=koRpus>
- 244 Michalke, M. (2020b). *Sylly: Hyphenation and syllable counting for text analysis*.

Retrieved from <https://reaktanz.de/?c=hacking&s=sylly>

Michalke, M. (2021). *koRpus: Text analysis with emphasis on POS tagging, readability, and lexical diversity*. Retrieved from

<https://reaktanz.de/?c=hacking&s=koRpus>

Mincemoyer, C. C., Perkins, D. F., & Munyua, C. (2005). Measuring the impact of youth development programs: A national on-line youth life skills evaluation system. In *The forum for family and consumer issues* (Vol. 10, pp. 1–9).

Mock, T. (2021). *gtExtras: A collection of helper functions for the gt package*.

Retrieved from <https://github.com/jthomasmock/gtExtras>

Müller, K., & Wickham, H. (2021). *Tibble: Simple data frames*. Retrieved from

<https://CRAN.R-project.org/package=tibble>

Navarro-Gonzalez, D., & Lorenzo-Seva, U. (2021). *EFA.MRFA: Dimensionality assessment using minimum rank factor analysis*. Retrieved from

<https://CRAN.R-project.org/package=EFA.MRFA>

Neuwirth, E. (2014). *RColorBrewer: ColorBrewer palettes*. Retrieved from

<https://CRAN.R-project.org/package=RColorBrewer>

O’Hara-Wild, M. (2022). *Icons: SVG icons for r documents and apps*.

Olszewski, A., Panorska, A., & Gillam, S. L. (2017). Training verbal and nonverbal communication interview skills to adolescents. *Communication Disorders Quarterly*, 38(4), 206–218.

Ooms, J. (2021a). *Magick: Advanced graphics and image-processing in r*. Retrieved from <https://CRAN.R-project.org/package=magick>

Ooms, J. (2021b). *Rsvg: Render SVG images into PDF, PNG, PostScript, or bitmap arrays*. Retrieved from <https://CRAN.R-project.org/package=rsvg>

Pornprasertmanit, S., Miller, P., Schoemann, A., & Jorgensen, T. D. (2021).

Simsem: SIMulated structural equation modeling. Retrieved from

<https://CRAN.R-project.org/package=simsem>

Porteous, M., & Colston, N. (1980). How adolescents are reported in the british press. *Journal of Adolescence*, 3(3), 197.

R Core Team. (2020). *Foreign: Read data stored by 'minitab', 's', 'SAS', 'SPSS', 'stata', 'systat', 'weka', 'dBase', ...* Retrieved from <https://CRAN.R-project.org/package=foreign>

R Core Team. (2021). *R: A language and environment for statistical computing*. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <https://www.R-project.org/>

Reed, V. A., & Trumbo, S. (2020). The relative importance of selected communication skills for positive peer relations: American adolescents' opinions. *Communication Disorders Quarterly*, 41(3), 135–150.

Revelle, W. (2021). *Psych: Procedures for psychological, psychometric, and personality research*. Evanston, Illinois: Northwestern University. Retrieved from <https://CRAN.R-project.org/package=psych>

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48(2), 1–36. Retrieved from <https://www.jstatsoft.org/v48/i02/>

Ryu, C. (2021). *Dlookr: Tools for data diagnosis, exploration, transformation*. Retrieved from <https://CRAN.R-project.org/package=dlookr>

Sarkar, D. (2008). *Lattice: Multivariate data visualization with r*. New York: Springer. Retrieved from <http://lmdvr.r-forge.r-project.org>

Schneider, B., & Stevenson, D. (1999). *The ambitious generation*. New Haven, CT: Yale University Press.

Schönbrodt, F. D., & Perugini, M. (2013). At what sample size do correlations stabilize? *Journal of Research in Personality*, 47(5), 609–612. <https://doi.org/10.1016/j.jrp.2013.05.009>

Siraji, M. A. (2021). *Tabledown: A companion pack for the book "basic & advanced*

- 299 *psychometrics in r*". Retrieved from <https://github.com/masiraji/tailedown>
- 300 Sjoberg, D. D., Whiting, K., Curry, M., Lavery, J. A., & Larmarange, J. (2021).
- 301 Reproducible summary tables with the gtsummary package. *The R Journal*, 13,
- 302 570–580. <https://doi.org/10.32614/RJ-2021-053>
- 303 Spencer, S., Clegg, J., & Stackhouse, J. (2013). Language, social class and
- 304 education: Listening to adolescents' perceptions. *Language and Education*,
- 305 27(2), 129–143.
- 306 Stauffer, R., Mayr, G. J., Dabernig, M., & Zeileis, A. (2009). Somewhere over the
- 307 rainbow: How to make effective use of colors in meteorological visualizations.
- 308 *Bulletin of the American Meteorological Society*, 96(2), 203–216.
- 309 <https://doi.org/10.1175/BAMS-D-13-00155.1>
- 310 Stern, S. R. (2005). Self-absorbed, dangerous, and disengaged: What popular films
- 311 tell us about teenagers. *Mass Communication & Society*, 8(1), 23–38.
- 312 Tanner, D. C. (2006). *An advanced course in communication sciences and disorders*.
- 313 Plural Pub Incorporated.
- 314 Thurlow, C. (2001). Talkin"bout my communication: Communication awareness in
- 315 mid-adolescence. *Language Awareness*, 10(2-3), 213–231.
- 316 Thurlow, C. (2003). Teenagers in communication, teenagers on communication.
- 317 *Journal of Language and Social Psychology*, 22(1), 50–57.
- 318 Velicer, W. (1976). Determining the Number of Components from the Matrix of
- 319 Partial Correlations. *Psychometrika*, 41, 321–327.
- 320 <https://doi.org/10.1007/BF02293557>
- 321 Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with s* (Fourth).
- 322 New York: Springer. Retrieved from <https://www.stats.ox.ac.uk/pub/MASS4/>
- 323 Wickham, H. (2007). Reshaping data with the reshape package. *Journal of*
- 324 *Statistical Software*, 21(12). Retrieved from
- 325 <http://www.jstatsoft.org/v21/i12/paper>

- Wickham, H. (2011). The split-apply-combine strategy for data analysis. *Journal of Statistical Software*, 40(1), 1–29. Retrieved from <http://www.jstatsoft.org/v40/i01/>
- Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. Springer-Verlag New York. Retrieved from <https://ggplot2.tidyverse.org>
- Wickham, H. (2019). *Stringr: Simple, consistent wrappers for common string operations*. Retrieved from <https://CRAN.R-project.org/package=stringr>
- Wickham, H. (2021a). *Forcats: Tools for working with categorical variables (factors)*. Retrieved from <https://CRAN.R-project.org/package=forcats>
- Wickham, H. (2021b). *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. (2019). *Readxl: Read excel files*. Retrieved from <https://CRAN.R-project.org/package=readxl>
- Wickham, H., François, R., Henry, L., & Müller, K. (2021). *Dplyr: A grammar of data manipulation*. Retrieved from <https://CRAN.R-project.org/package=dplyr>
- Wickham, H., Hester, J., & Bryan, J. (2021). *Readr: Read rectangular text data*. Retrieved from <https://CRAN.R-project.org/package=readr>
- Wilke, C. O. (2020). *Cowplot: Streamlined plot theme and plot annotations for 'ggplot2'*. Retrieved from <https://CRAN.R-project.org/package=cowplot>
- Xiao, N. (2018). *Ggsci: Scientific journal and sci-fi themed color palettes for 'ggplot2'*. Retrieved from <https://CRAN.R-project.org/package=ggsci>
- Xie, Y., Cheng, J., & Tan, X. (2021). *DT: A wrapper of the JavaScript library 'DataTables'*. Retrieved from <https://CRAN.R-project.org/package=DT>
- Zeileis, A., Fisher, J. C., Hornik, K., Ihaka, R., McWhite, C. D., Murrell, P., . . .

353 Wilke, C. O. (2020). colorspace: A toolbox for manipulating and assessing colors
354 and palettes. *Journal of Statistical Software*, 96(1), 1–49.

355 <https://doi.org/10.18637/jss.v096.i01>

356 Zeileis, A., Hornik, K., & Murrell, P. (2009). Escaping RGBland: Selecting colors
357 for statistical graphics. *Computational Statistics & Data Analysis*, 53(9),
358 3259–3270. <https://doi.org/10.1016/j.csda.2008.11.033>

359 Zhu, H. (2021). *kableExtra: Construct complex table with 'kable' and pipe syntax*.

360 Retrieved from <https://CRAN.R-project.org/package=kableExtra>

Table 1

| Items | Mean | SD | Skew | Kurtosis | Shapiro-Wilk Statistics | Item-Total Correlation |
|-------|------|------|-------|----------|-------------------------|------------------------|
| CS01 | 2.97 | 1.02 | -0.65 | -0.43 | 0.84* | 0.20 |
| RCS02 | 2.51 | 1.18 | -0.26 | -0.96 | 0.89* | 0.26 |
| CS03 | 2.94 | 1.09 | -0.72 | -0.44 | 0.84* | 0.35 |
| CS04 | 2.47 | 1.23 | -0.42 | -0.79 | 0.89* | 0.33 |
| RCS05 | 2.50 | 1.31 | -0.48 | -0.87 | 0.87* | 0.08 |
| CS06 | 2.82 | 0.97 | -0.62 | -0.01 | 0.87* | 0.40 |
| CS07 | 2.70 | 1.16 | -0.63 | -0.59 | 0.86* | 0.41 |
| CS08 | 2.92 | 1.07 | -0.87 | 0.00 | 0.84* | 0.36 |
| CS09 | 3.60 | 0.76 | -2.24 | 4.73 | 0.56* | 0.18 |
| CS10 | 3.08 | 0.97 | -0.81 | -0.18 | 0.82* | 0.34 |
| CS11 | 3.17 | 1.00 | -1.07 | 0.40 | 0.78* | 0.52 |
| CS12 | 2.58 | 1.19 | -0.40 | -0.83 | 0.89* | 0.43 |
| CS13 | 3.22 | 1.12 | -1.35 | 0.81 | 0.72* | 0.29 |
| CS14 | 2.82 | 1.10 | -0.79 | -0.06 | 0.86* | 0.43 |
| CS15 | 3.34 | 0.82 | -1.19 | 1.19 | 0.76* | 0.51 |
| CS16 | 2.63 | 1.26 | -0.45 | -1.00 | 0.87* | 0.28 |
| CS17 | 2.20 | 1.33 | -0.04 | -1.22 | 0.89* | 0.36 |
| CS18 | 2.86 | 1.07 | -0.76 | -0.11 | 0.85* | 0.38 |
| CS19 | 2.03 | 1.23 | -0.08 | -0.93 | 0.91* | 0.44 |
| CS20 | 2.73 | 1.00 | -0.44 | -0.47 | 0.88* | 0.52 |
| CS21 | 2.79 | 1.08 | -0.66 | -0.25 | 0.87* | 0.56 |
| CS22 | 3.00 | 1.06 | -0.94 | 0.26 | 0.82* | 0.44 |
| CS23 | 2.31 | 1.22 | -0.12 | -0.91 | 0.90* | 0.05 |

Table 2

Measurement Invariance analysis on CFA sample (n=262) across native and non-native English speakers.

| | Chi-Square | df | CFI | TLI | RMSEA | RMSEA 90% Lower CI | RMSEA 90% Upper | Chi-Square Difference | df difference* | p | N/A |
|------------|------------|--------|------|------|-------|--------------------|-----------------|-----------------------|----------------|----|-------|
| Configural | 245.13 | 238.00 | 0.99 | 0.99 | 0.01 | 0.00 | 0.04 | 0.08 | - | - | - |
| Metric | 280.35 | 254.00 | 0.98 | 0.97 | 0.03 | 0.00 | 0.04 | 0.08 | 13.481a | 16 | 0.637 |
| Scalar | 290.78 | 270.00 | 0.98 | 0.98 | 0.02 | 0.00 | 0.04 | 0.08 | 13.002b | 16 | 0.673 |
| Residual | 303.44 | 287.00 | 0.98 | 0.98 | 0.02 | 0.00 | 0.04 | 0.09 | 14.008c | 17 | 0.667 |

Note. a = Metric vs Configural; b = Scalar vs Metric; c = Residual vs Scalar; * = df of model comparison

Table 3

Correlation matrix of the main variables

| | 1 | 2 | 3 |
|---------------------|-------|--------|------|
| 1 Communication | | | |
| 2 Hopelessness | -.16* | | |
| 3 Life Satisfaction | -.02 | .02 | |
| 4 SE | .04 | -.58** | -.07 |

Note. **p < .001

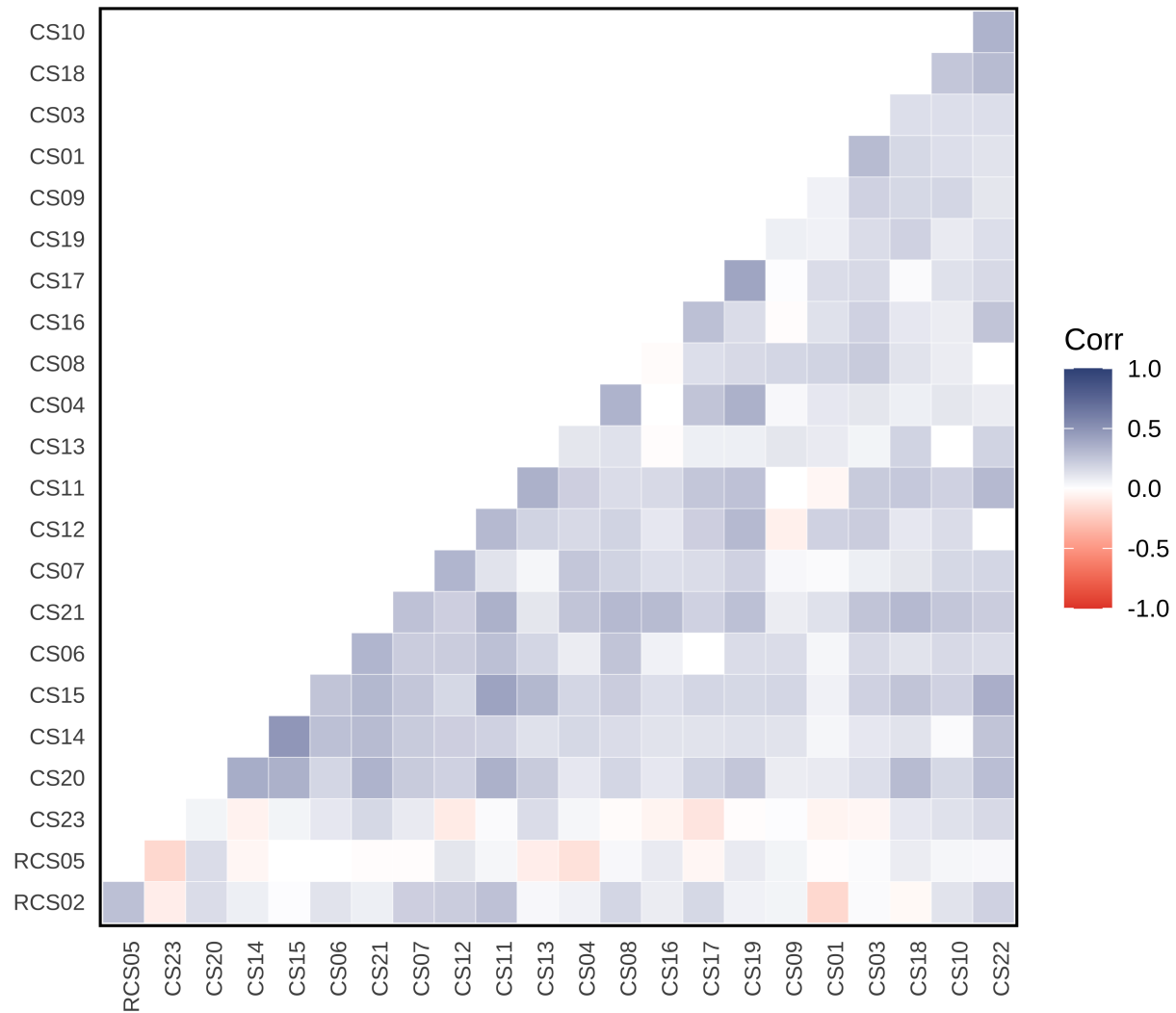


Figure 1. Inter item polychoric correlation coefficients for the 48 items. 4.9 % inter-item correlation coefficients were higher than .30

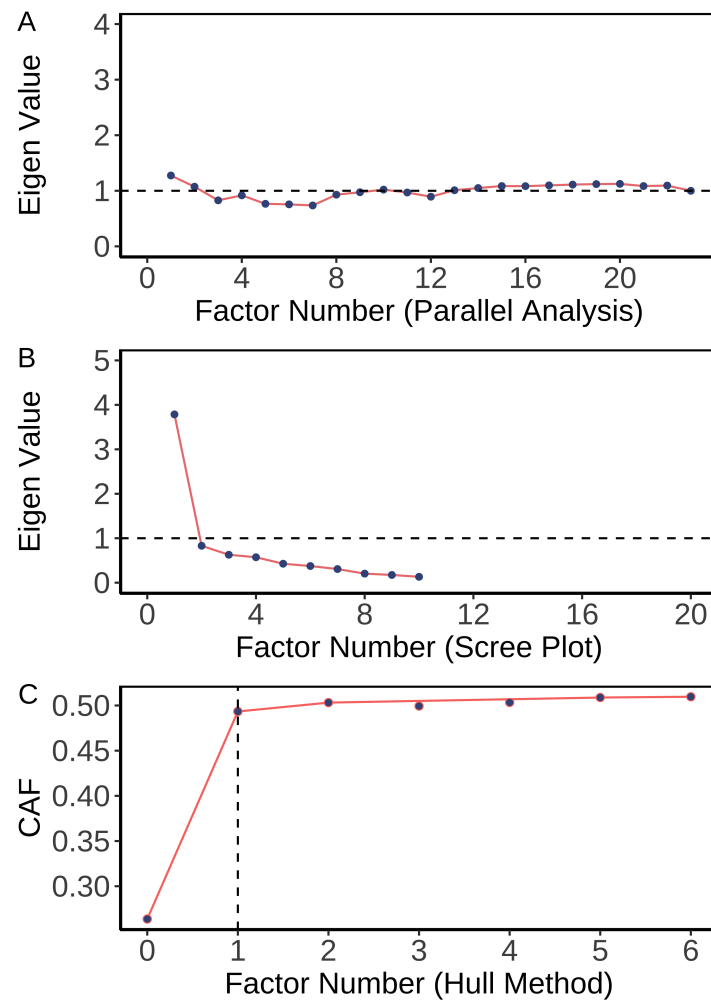


Figure 2. Factor Identification Methods (A) Parallel analysis indicated the optimal number of factors were two. (B) Scree plot suggested One factor. (C) Hull method indicated 1 factors were required to balance the model fit and number of parameters.

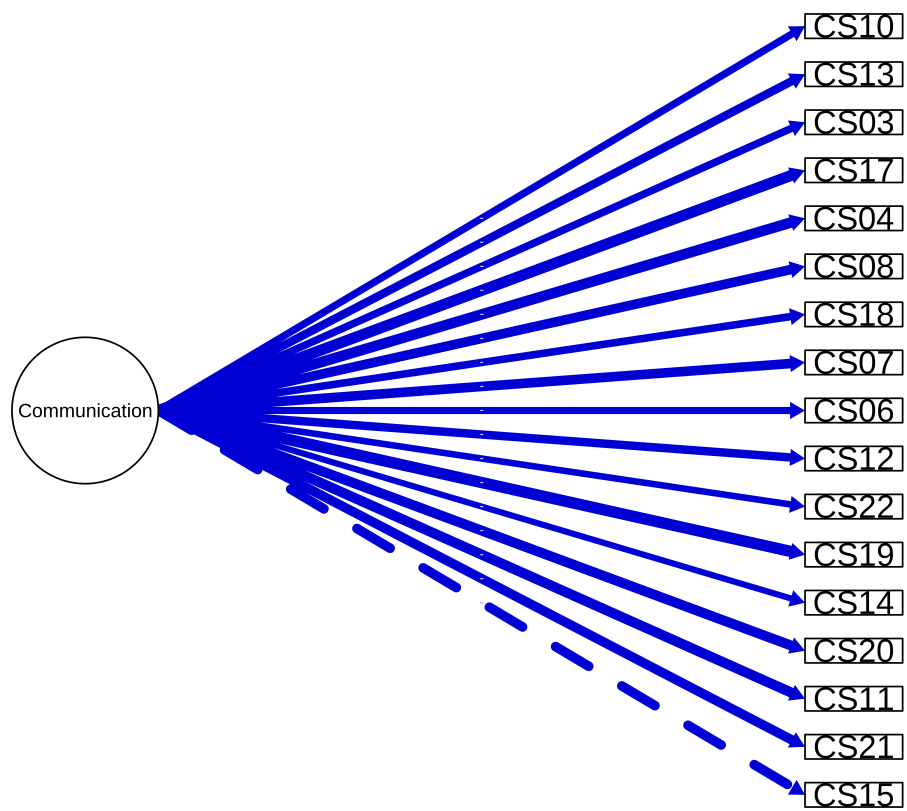


Figure 3. CFA Plot.

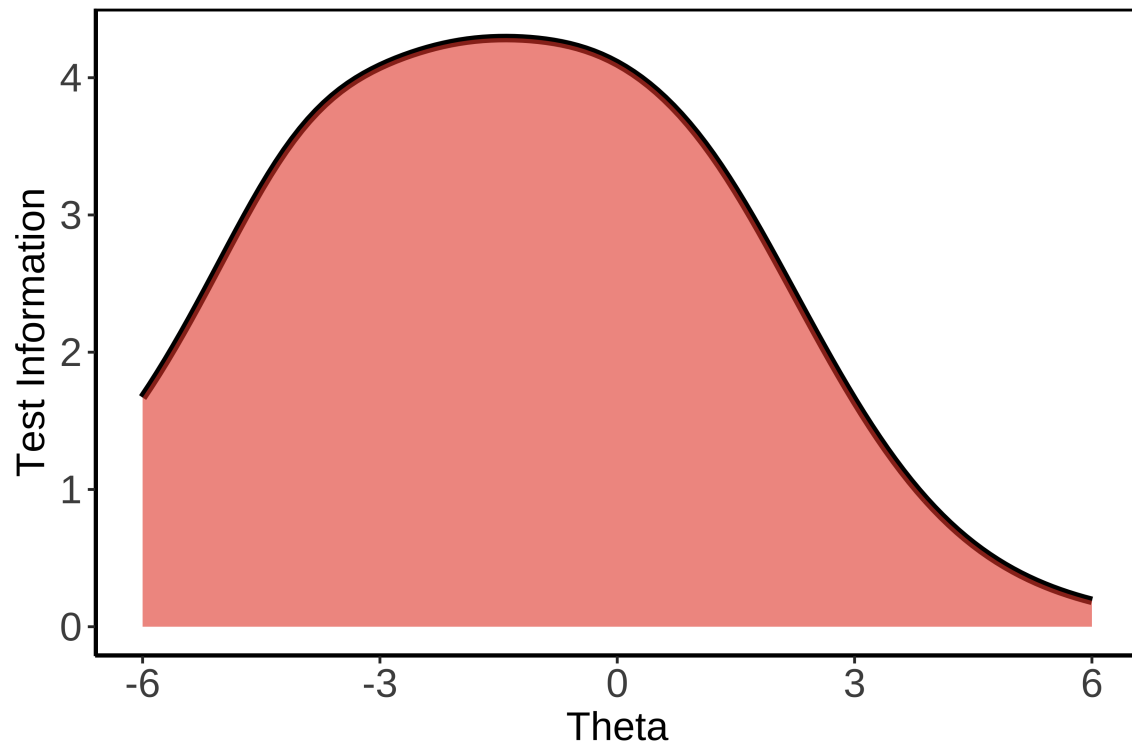


Figure 4. TIC.

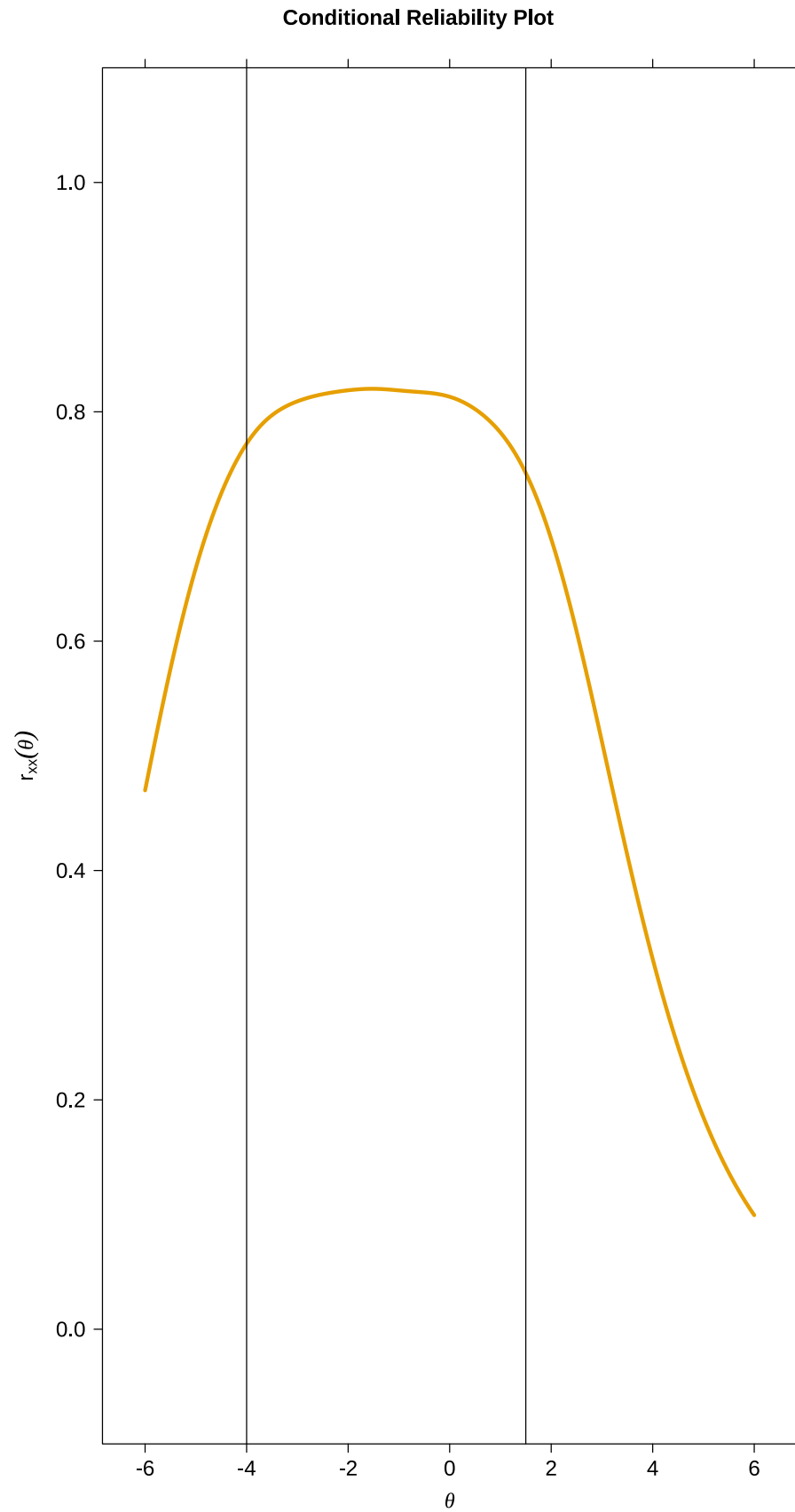


Figure 5. Conditional Reliability.