

1 Psychometric Validation of the Bangla Communication Scale in a Bagladeshi
2 Adolescents Sample

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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
23 scientists in related disciplines.

24 One sentence clearly stating the **general problem** being addressed by this
25 particular 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
29 comparison to what was thought to be the case previously, or how the main result adds
30 to previous 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
33 to a scientist in any discipline.

34 *Keywords:* keywords

35 Word count: X

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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).

Data collection

The project received institutional ethics clearance from Department of Educational and Counselling Psychology (Project ID: —). Prior to data collection required authorization from school's authority and assent from the participating were obtained. Necessary explanations were given in oral and written forms. It was also mentioned in the explanatory statement that their participation was voluntary and that they could withdraw from participation any time without being penalized. Data collection was commenced between November 2021 to January 2022. The data collection took place in the classroom where students were at first briefed about 'communication skill.' Next, they filled up their socio-demographics information and responded to Bangla Communication Scale. All personal information (name, school, class) was codified and encrypted, producing a anonymous database. We at first collected data from 300 participants for

our Study-1 and in our Study-2 we collected data from another 281 participants. Along with Bangla Communication Scale a subset of our Study-2 sample 160 also responded to Bangla Beck Hopelessness Scale(Beck, Weissman, Lester, & Trexler, 1974)

Study-1: Translations and Exploratory Factor Analysis

Study-1 had two objectives. First we translated the 23 items of the Communication Scale (Barkman & Machtmes, 2002) from English to Bangla. Second, we conducted an Exploratory Factor Analysis (EFA) to identify the latent structure of the scale.

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. There was no missing data. Participants were recruited following convenience sampling technique. For exploring the initial factor structure the recommended sample size is 250-300 (Comrey & Lee, 1992; Schönbrodt & Perugini, 2013). Among 300 participants, 218 were female aged between 12 to 18 years (15.87 ± 1.41). 82 were male with an age range between 13 participants 18 years (16.55 ± 1.18). 282 (94%) participants belonged to middle socio-economic status. 13 (4.3%) and 5 (1.7%) participants belonged to lower and upper socio-economic status-respectively.

Materials.

Communication Scale.

Communication Scale (Barkman & Machtmes, 2002) is a sub-skill set of The National On-line Youth Life Skills Evaluation System (Mincemoyer et al., 2005). It has 23 items with a 5 Point Likert Type response scale (0=Never, 1=Rarely, 2=Sometimes, 3=Often, 4=Always). The total score range is 0-92 where a higher score would indicate

higher communication skills among adolescents (age range 12-18). The internal consistency of the total scale, Cronbach α was .79

Bangla Communication Scale.

We followed the International Test Commission guidelines (Bartram et al., 2018) while translating the Communication Scale in Bangla. At first two bilingual researchers did the forward translation. These two forward translations were synthesized by the authors. Another four bilingual researchers did the backward translation of the synthesized Bangla Communication Scale. The authors again synthesized the back-translations, compared it with original scale and made necessary amendments.

Analytic strategies. We used R (version 4.1.0) (R Core Team, 2021), including several R packages (Chalmers, 2012; Revelle, 2021; Rosseel, 2012; Siraji, 2021), for our analyses. Prior to the data analysis normality assumptions were checked. Our data violated both univariate and multivariate normality. As such we used polychoric correlation matrix and 'principal axis' factor extraction method to conduct the exploratory factor analysis (Watkins, 2020). An oblique rotation method was employed. A posterior sampling adequacy was estimated using KMO statistics (Kaiser, 1974). TO identify the optimum number of factors required to explain the latent structure of our scale we used Scree plot (Cattell, 1966), Horn's parallel analysis (Horn, 1965), Hull method (Lorenzo-Seva, Timmerman, & Kiers, 2011) and Minimum average partials method (MAP) (Velicer, 1976). Lastly, to identify the simple structure, we followed the following guidelines (i) no factors with fewer than three items (ii) no factors with a factor loading <0.3 (iii) no items with cross-loading greater than .3 across factors (Child, 2006; Mulaik, 2009; Watkins, 2020)

Results & Discussion.

Sampling adequacy.

Kaiser-Meyer-Olkin (KMO) (Kaiser, 1974) statistics was used to check the sampling

adequacy. The overall KMO value for 23 items was 0.74, which was above the cut-off value of .50, indicating an adequate sample.

Descriptive statistics and item analysis.

Table1 reports univariate descriptive statistics for the 23 items. All items were skewed and violated univariate normality assessed by The Shapiro-Wilk test indicated all the items violated normality assumptions (Shapiro & Wilk, 1965). Mardia's Test of multivariate normality (Mardia, 1970) yielded Multivariate skew = 4030.49 ($p < 0.001$) and multivariate kurtosis = 15.1 ($p < 0.001$) indicating the violation of multivariate normality as well. As such we used polychoric correlation matrix which is more robust towards these violations. Our initial item analysis yielded internal consistency coefficient ordinal alpha = 0.79. Alpha drop statistics (Table1) showed no substantial increase of ordinal alpha if any item is deleted and ranged between 0.8-0.8. As such we subjected all items to EFA.

Supplementary Table 1 and Figure 1 depict the inter-item correlation coefficients of BCS. Bartlett's test of sphericity (Bartlett, 1954), $\chi^2 (253) = 1,073.81$, $p < .001$ indicated the inter-item correlations are significantly different than zero. However, only 9.88% of the inter-item correlation coefficients were greater than absolute value of .30 in the obtained matrix. The corrected item-total correlations range was 0.05- 0.56 (Table1).

Exploratory factor analysis.

To identify optimum number of factor required to express the latent structure adequately we at first used the Scree-plot (Cattell, 1966). The Scree-plot suggested one factor solution. One factor solution was also supported by MAP method (Velicer, 1976) and Hull method (Lorenzo-Seva et al., 2011). Minimum average partial (MAP) method expects the average squared off-diagonal values of the calculated partial correlation matrix to be minimum when the correct number of factors are extracted (Velicer, 1976). In our data set this value reached the minimum after extracting the first factor (Supplementary Table 2). Hull method tried to find an optimal number of factors to

balance model fit and the number of parameters and offered one factor solution in our data set (Figure 2).

The initial solution of the fitted one factor model had six items with poor factor loadings (Item 1, 2, 5, 9, 16, 23). We discarded these items from the model and run another EFA. This iteration of EFA yielded a one factor simple structure with 17 items. The one factor solution explained 20.87% of the total variance. Cronbach's alpha coefficient has a tendency to deflate the estimates for Likert type data as the calculation is based on pearson-correlation matrix which requires data with continuous measurement level (Gaderrmann, Guhn, & Zumbo, 2012; Zumbo, Gaderrmann, & Zeisser, 2007). For better estimates of reliability we reported ordinal alpha using polychoric-correlation (Zumbo et al., 2007). The internal consistency reliability coefficient for this model was, ordinal $\alpha = .81$.

Study 2 Confirmation of Factor Structure and Psychometric Properties of Bangla Communication Scale

This study had four objectives. First, we confirmed the one factor solution of our scale obtained in Study-1 and estimated the reliability of the scale. Second, to gather convergent validity evidence of BCS. Third, we established gender-based measurement invariance of Bangla Communication Scale. Lastly, we assessed item discrimination, item difficulty and precision of BCS using Item Response Theory Based Analysis

Method

Participants. A second group of 282 students of grade 8-12 from eight schools participated in Study-2. They were recruited using convenience sampling method. One participant's data were excluded for missing data. In the complete dataset of 281 139 were female aged between 14 to 18 years (16.78 ± 1.06). 143 were male with an age

range between 13 participants 18 years (16.96 ± 1.17). 246 (87%) participants belonged to middle socio-economic status. 34 (12%) and 2 (0.7%) participants belonged to lower and upper socio-economic status-respectively. To assess the sampling adequacy we followed the N:q rule (Bentler & Chou, 1987; Kline, 2013) where 10 participants per item is required to earn trustworthiness of the result. Our sample size exceeded the requirement as we had 17 items.

A subset of Study-2 sample 160 responded to both Bangla Beck Hopeless Scale and Bangla Communication Scale. Among them 98 were female aged between 14 to 18 years (16.61 ± 1.12). 63 were male with an age range between 15 participants 18 years (16.6 ± 1.21). 138 (86%) participants belonged to middle socio-economic status. 21 (13%) and 2 (1.2%) participants belonged to lower and upper socio-economic status-respectively

Measures.

Bangla Rotter's I-E Scale.

To confirm the latent structure of Bangla Communication scale, we used the one factor solution with 17 items obtained in our Study 1.

Bangla Beck Hopelessness Scale.

Beck Hopelessness Scale(BHS) is composed of 20 items with a dichotomous response scale(True/False) (Beck et al., 1974). It captures three major dimensions of hopelessness: Feelings about the future, loss of motivation and expectations (Balsamo, Carlucci, Innamorati, Lester, & Pompili, 2020). This scale has nine reversed coded items (items 1, 3, 5, 6, 8, 10, 13, 15, 19) and yield a total score (range 0-20) where a higher score indicates higher disposition towards hopelessness. In this study we have used the Bangla Hopelessness scale (Uddin, Faruk, Khanam, & Uddin, n.d.). Bangla Beck Hopelessness Scale retained all 20 items of the original scale and following the same scoring method. Internal consistency K-R coefficient for bangla Beck Hopelessness

Scale in out Study-2 sample was 0.76

Analytic strategies. We conducted a categorical confirmatory factor analysis (CFA) with Weighted Least Square with mean and variance adjusted (WLSMV) estimator. The CFA was conducted using 'Lavaan' package in RStudio (Rosseel, 2012). To assess the model fit we followed the popular suggestions of Hu and Bentler (1999): Comparative fit index (CFI) and the Tucker Lewis index (TLI): good fit $\geq .95$, acceptable fit $\geq .90$; the root mean square error of approximation (RMSEA): good fit $< .06$, acceptable fit $< .08$; and the standardized root mean square (SRMR) good fit $< .08$, acceptable fit $< .10$.

Measurement invariance (MI) between boys and girls was analysed by using structure equation modelling paradigm. Measurement invariance (MI) evaluates whether a construct holds similar meaning across groups (Kline, 2013). We consequently fitted four nested models: configural, metric, scalar, and residual invariance models and compared them with each others. The invariance model fit of our tool was assessed using the fit indices including χ^2 test, CFI and TLI (close to .95 or above), RMSEA (close to .06 or below) (Hu & Bentler, 1999). The comparison among different measurement invariance models was made using the χ^2 difference test ($\Delta\chi^2$) to assess whether our obtained latent structure attained the highest level of the MI. A non-significant $\Delta\chi^2$ test between two MI models fit indicates model fit does not significantly decrease for the superior model (**dimitrov2010testing?**) thus allowing the superior level of invariance model to be accepted.

Convergent validity was investigated by correlational analysis between Bangla Communication Scale and Beck Hopelessness Scale (Uddin et al., n.d.). Lastly, we analysed the item quality of Bangla Communication Scale in terms of item difficulty, item discrimination and item fit statistics. IRT judges an item's quality by providing item information (difficulty & discrimination) in the light of participants' trait level θ . The precision of the Bangla Scale was inspected using Test information Curve obtained from the fitted IRT model. In IRT based analysis our aim was only to assess the quality of the

items in our Bangla Communication Scale.

Results & Discussion.

Confirmatory Analysis and Reliability Estimation.

Table2 summarizes the model fit of Bangla Communication Scale. The fitted model exhibited a significant χ^2 statistic. However, χ^2 statistic is well known for its sensitivity towards sample size (Brown, 2015). As such more emphasize were given towards other fit indices. Other fit indices indicated acceptable fit of the fitted one factor model. The internal consistency reliability coefficients Ordinal α was .81 which was satisfactory. Figure 3 depicts the fitted model.

Measurement Invariance.

Our Model attained highest level of MI

Item Response Theory guided item analysis.

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 exceed 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.

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

Data and code availability

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

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Table 1

Items	Mean	SD	Skew	Kurtosis	Shapiro-Wilk Statistics	Item-Total Correlation	Alpha Dro
CS01	2.97	1.02	-0.65	-0.43	0.84*	0.20	0.79
RCS02	2.51	1.18	-0.26	-0.96	0.89*	0.26	0.79
CS03	2.94	1.09	-0.72	-0.44	0.84*	0.35	0.78
CS04	2.47	1.23	-0.42	-0.79	0.89*	0.33	0.79
RCS05	2.50	1.31	-0.48	-0.87	0.87*	0.08	0.80
CS06	2.82	0.97	-0.62	-0.01	0.87*	0.40	0.78
CS07	2.70	1.16	-0.63	-0.59	0.86*	0.41	0.78
CS08	2.92	1.07	-0.87	0.00	0.84*	0.36	0.78
CS09	3.60	0.76	-2.24	4.73	0.56*	0.18	0.79
CS10	3.08	0.97	-0.81	-0.18	0.82*	0.34	0.78
CS11	3.17	1.00	-1.07	0.40	0.78*	0.52	0.77
CS12	2.58	1.19	-0.40	-0.83	0.89*	0.43	0.78
CS13	3.22	1.12	-1.35	0.81	0.72*	0.29	0.79
CS14	2.82	1.10	-0.79	-0.06	0.86*	0.43	0.78
CS15	3.34	0.82	-1.19	1.19	0.76*	0.51	0.77
CS16	2.63	1.26	-0.45	-1.00	0.87*	0.28	0.79
CS17	2.20	1.33	-0.04	-1.22	0.89*	0.36	0.78
CS18	2.86	1.07	-0.76	-0.11	0.85*	0.38	0.78
CS19	2.03	1.23	-0.08	-0.93	0.91*	0.44	0.78
CS20	2.73	1.00	-0.44	-0.47	0.88*	0.52	0.78
CS21	2.79	1.08	-0.66	-0.25	0.87*	0.56	0.77
CS22	3.00	1.06	-0.94	0.26	0.82*	0.44	0.78
CS23	2.31	1.22	-0.12	-0.91	0.90*	0.05	0.80

Table 2
Model-Fit of Bangla Communication Scale

	Chi-square	df	p	GFI	NFI	CFI	TIL	RMSEA	RMSEA-Upper	RMSEA-Lower
Model	237.51	119.00	0.00	0.97	0.88	0.94	0.93	0.06	0.05	0.04

Table 3

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*	NA
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	0.637
Scalar	290.78	270.00	0.98	0.98	0.02	0.00	0.04	0.08	13.002b	0.673
Residual	303.44	287.00	0.98	0.98	0.02	0.00	0.04	0.09	14.008c	0.667

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

Table 4

Items discrimination and response category difficulty thresholds of 17 items in Bangla Communication

Items	a	b1	b2	b3	b4	Standardized Outfit	Standardized Infit	S-Chi-square
CS03	0.67	-5.51	-3.25	-1.18	0.69	-0.73	-0.59	80.74
CS04	0.92	-2.92	-1.46	-0.15	1.61	-1.34	-1.09	86.36
CS06	0.72	-5.36	-3.25	-1.09	1.50	-0.50	-0.61	101.14
CS07	0.90	-3.83	-2.04	-0.76	1.16	-1.18	-0.95	77.50
CS08	0.88	-4.44	-2.63	-1.19	0.75	-1.10	-0.82	71.65
CS10	0.64	-6.98	-3.98	-1.57	0.84	-0.62	-0.50	89.19
CS11	1.22	-4.06	-2.83	-1.40	-0.10	-1.18	-0.87	60.34
CS12	0.82	-3.82	-1.97	-0.34	1.23	-0.80	-0.91	76.70
CS13	0.75	-4.81	-3.17	-1.89	-0.29	-0.75	-0.53	76.21
CS14	0.75	-4.88	-2.93	-0.99	1.34	-0.96	-0.80	64.03
CS15	1.16	-4.00	-3.30	-1.70	-0.09	-1.10	-0.77	64.76
CS17	0.89	-2.74	-0.94	0.43	1.78	-1.14	-1.26	75.92
CS18	0.71	-5.54	-2.98	-1.37	1.02	-0.61	-0.61	92.33
CS19	1.01	-2.11	-0.92	0.60	2.31	-0.87	-1.13	96.62
CS20	1.15	-4.16	-2.10	-0.60	1.22	-1.56	-1.49	69.01
CS21	1.20	-3.46	-2.08	-0.73	0.91	-1.67	-1.39	56.50
CS22	0.66	-5.71	-3.67	-1.66	0.68	-0.79	-0.53	70.85

Note. a = item discrimination parameter; b(1-4) = response category difficulty parameter

Table 5

Correlation matrix of the main variables

	1	2	3	4	5
1 Communication					
2 F1	.83**				
3 F2	.83**	.45**			
4 Hopelessness	-.16*	-.11	-.15+		
5 Life Satisfaction	-.02	-.02	.00	.02	
6 SE	.04	.02	.01	-.58**	-.07

Note. **p < .001

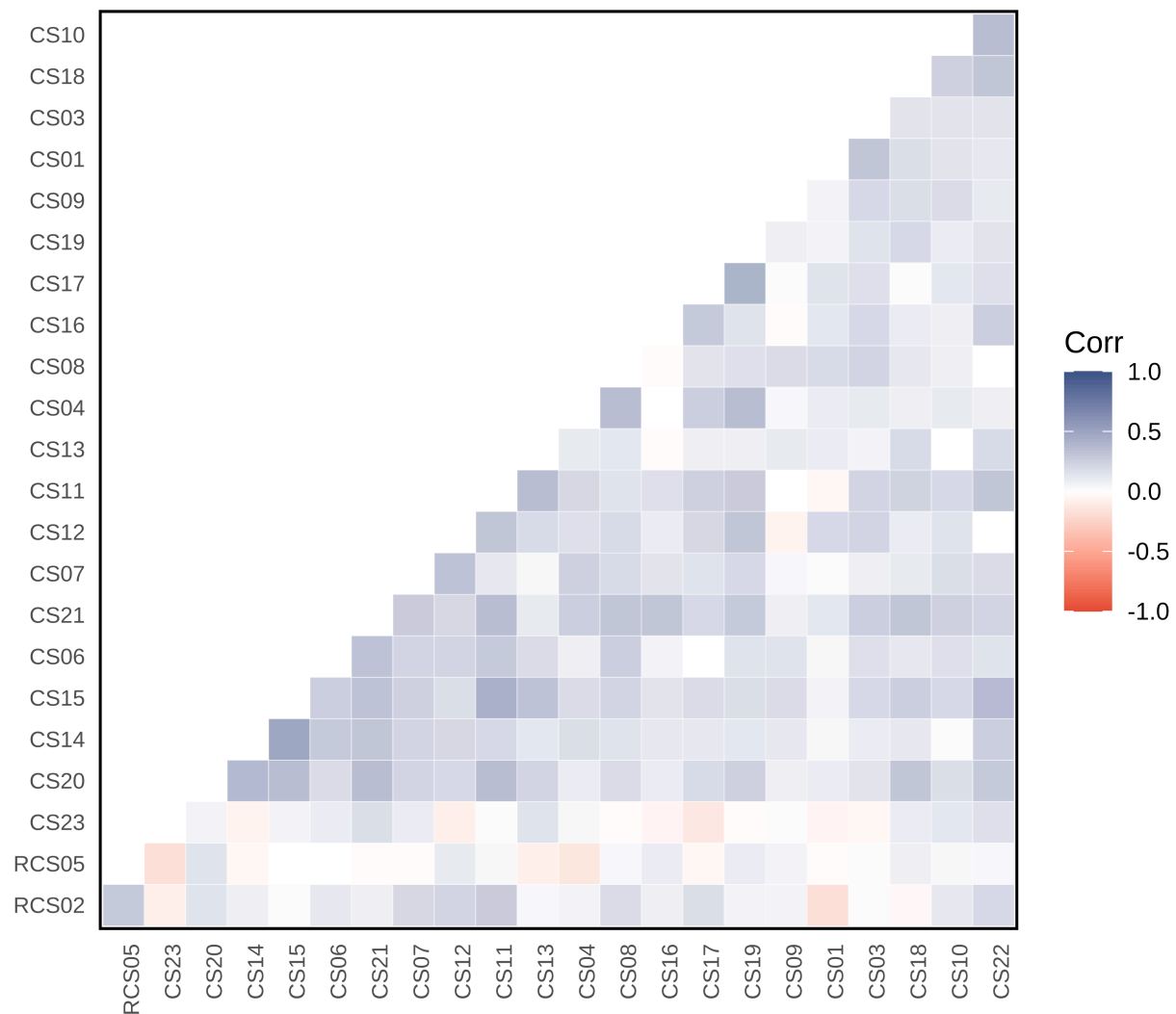


Figure 1. Inter item polychoric correlation coefficients for the 23 items. 9.8 % inter-item correlation coefficients were higher than $|\text{.30}|$

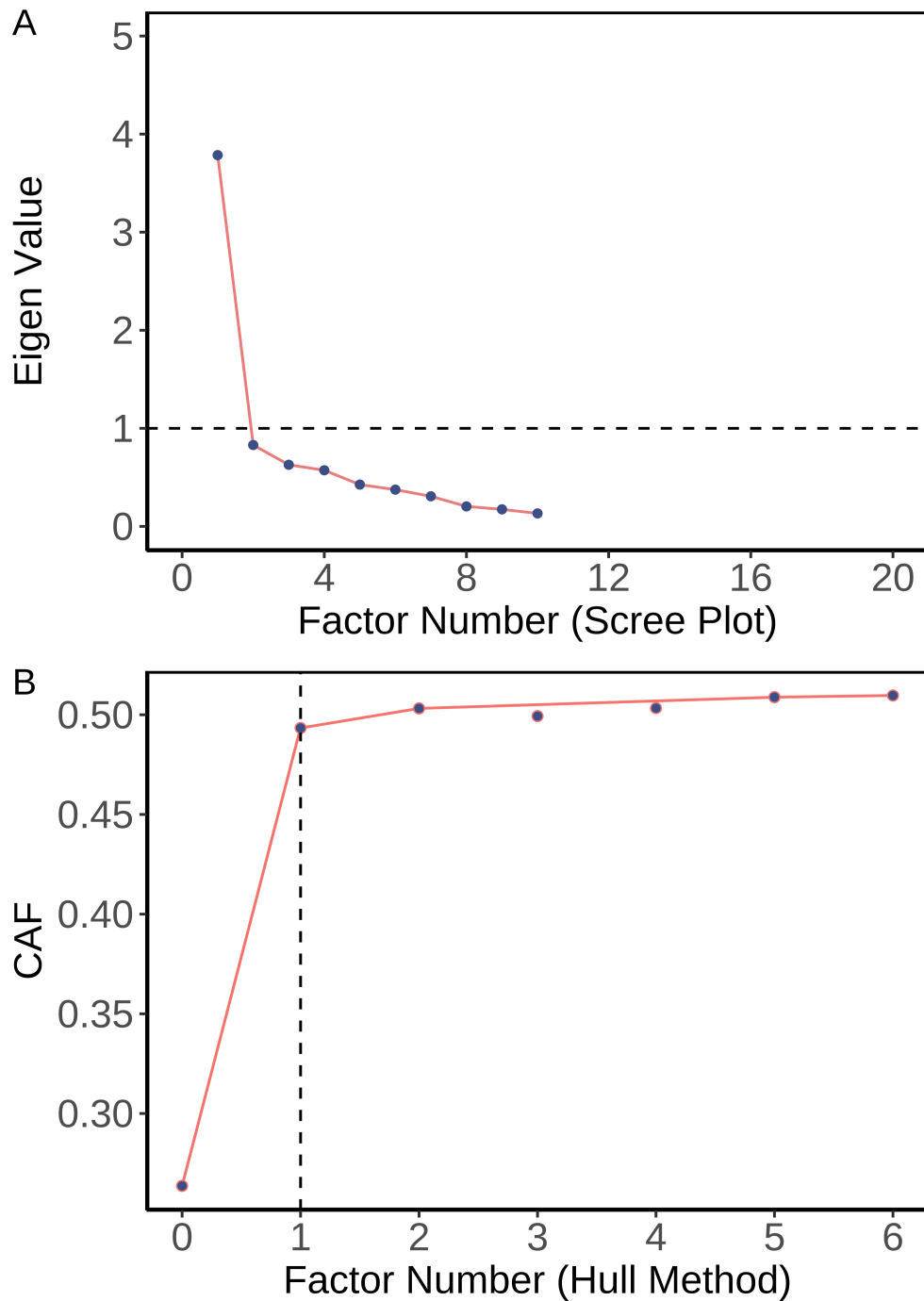


Figure 2. Factor Identification Methods (A) Scree plot suggested one factor. (B) Hull method indicated one factor were required to balance the model fit and number of parameters.

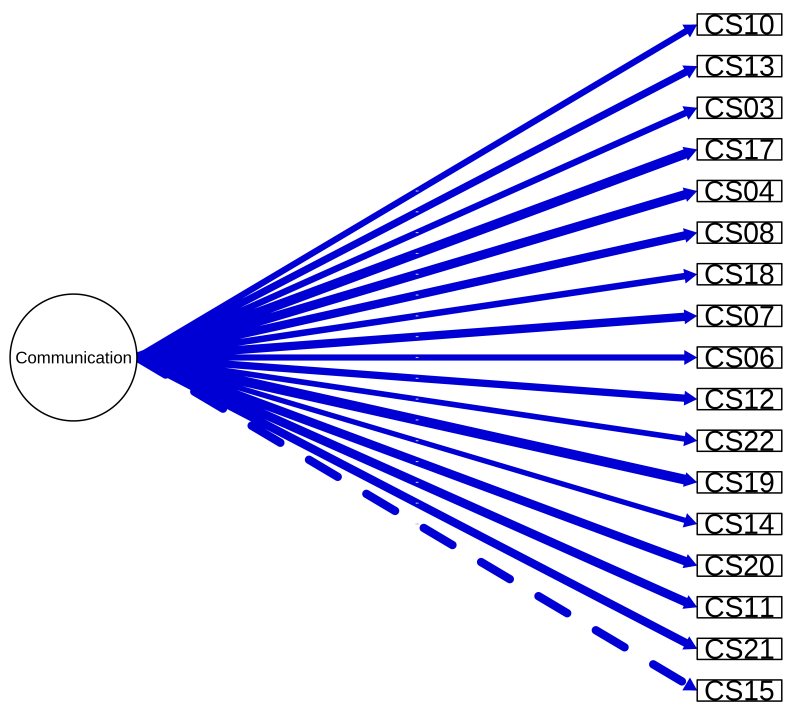


Figure 3. CFA Plot.

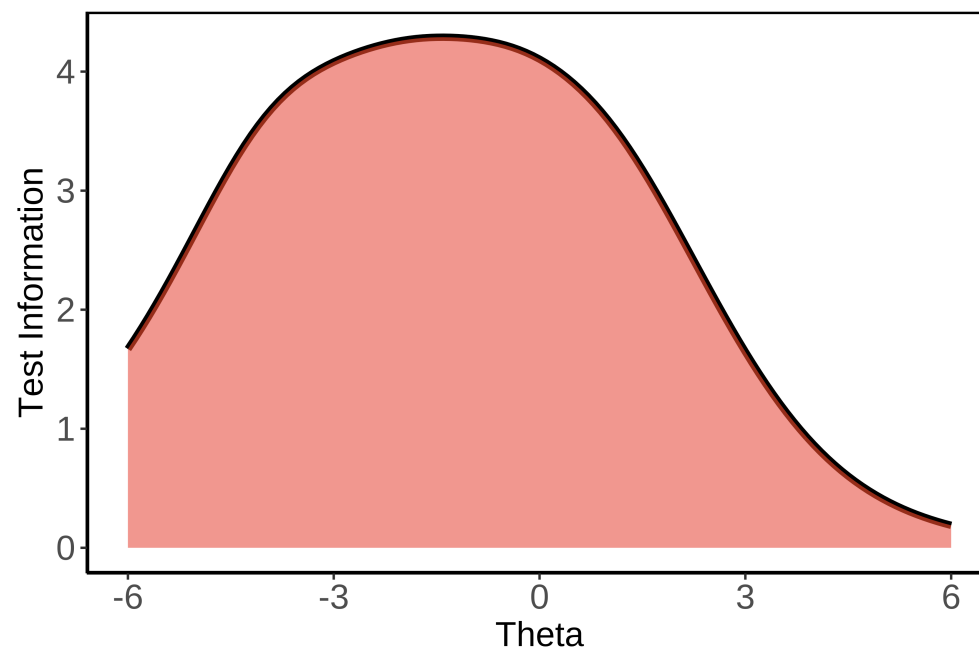


Figure 4. TIC.

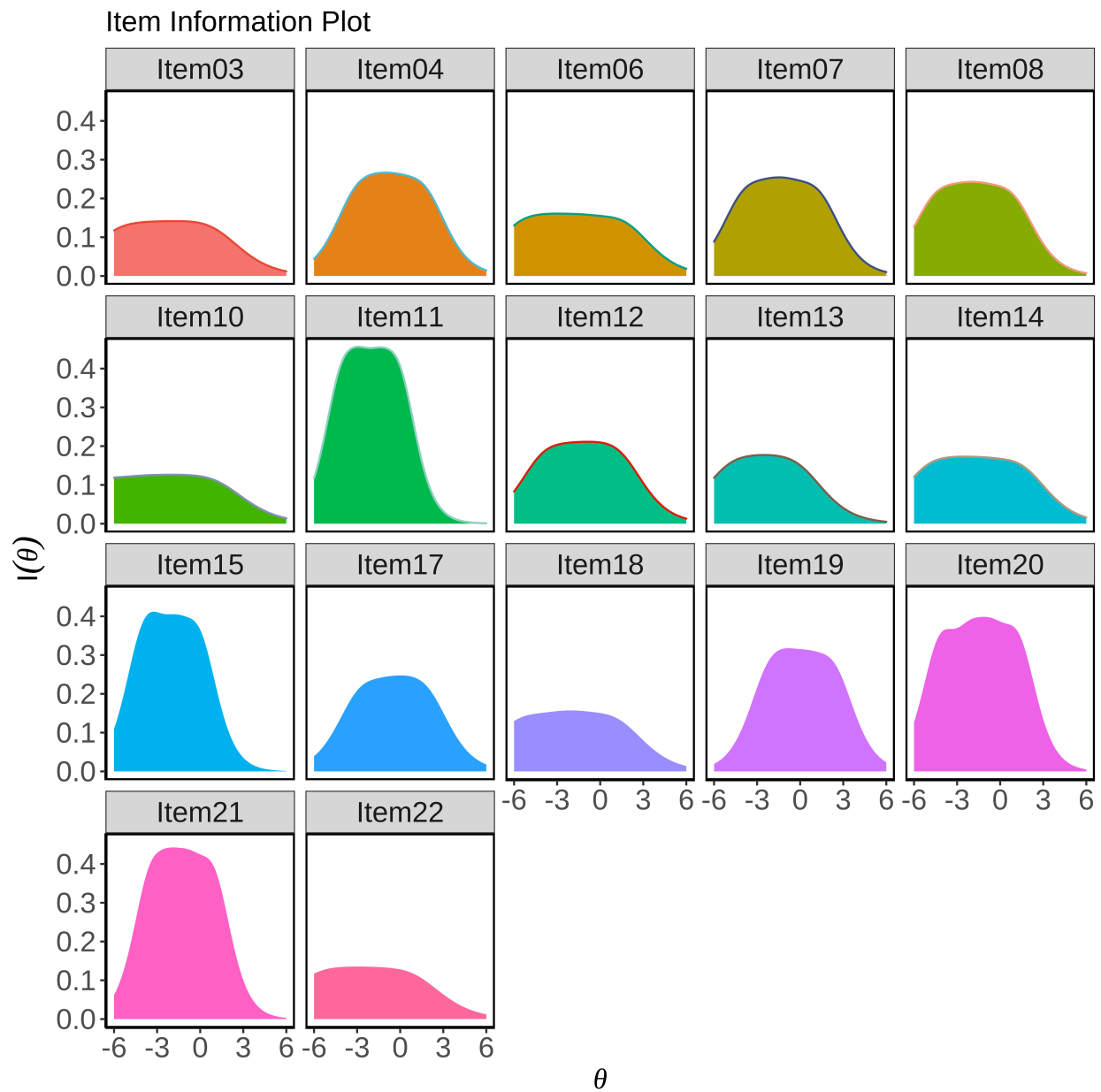


Figure 5. Item Information Curve.

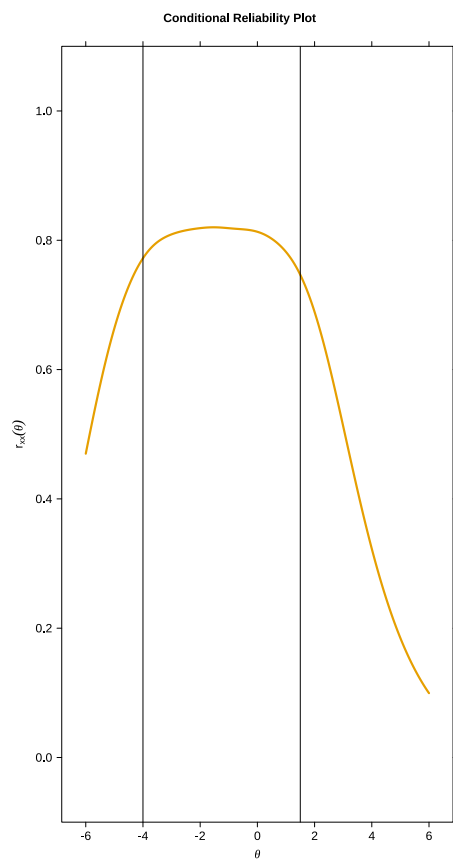


Figure 6. Conditional Reliability.