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RESEARCH ARTICLE

Emotional expressivity in the Bangladeshis: Psychometric properties of the Bangla Berkeley expressivity questionnaire

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ABSTRACT

Emotional expressivity is related to physical and mental well-being. However, there is no instrument for evaluating emotional expressivity in Bangladesh's cultural context. The Berkeley Expressivity Questionnaire (BEQ) is a commonly used instrument for measuring emotional expressivity, which consists of three correlated facets: positive expressivity, negative expressivity, and impulse strength. Therefore, this investigation aimed to adapt and validate BEQ in the Bangla language and Bangladeshi culture through two independent studies using classical test theory (CTT) and item response theory (IRT)- based approach. In Study 1, 377 participants (M_{age} = 25.52, *SD* = 1.18) were finally selected, where 244 (59%) were men and 133 (41%) were women. The confirmatory factor analysis indicated that the revised 15-item 3-factor model is the best model of the Bangla BEQ version. Additionally, the measurement invariance test results proved that this instrument is consistent across men and women. Furthermore, internal consistency analyses revealed that the total scale and its three facets sub-scales have acceptable reliability. In Study 2, 553 participants (M_{age} = 21.31, *SD* = 1.48) participated. Among them, 285 (52%) were women. IRT-based analyses indicated that the facets of the Bangla BEQ provide a significant amount of information across a broad continuum. The Bangla BEQ was assessed for concurrent validity by comparing it to external instruments that measure personality traits and well-being. The results of the correlation analyses confirmed the concurrent validity. Finally, the 15-item Bangla BEQ has been found to be a valid and reliable instrument for assessing emotional expressivity in Bangladeshis.

Keywords: emotional expressivity; confirmatory factor analysis; item response theory; validation; adaptation

1. Introduction

Expressing emotions is closely related to physical and mental health. Generally, our expression of emotions is not driven by impulses or reflexes; instead, it is regulated by our emotion system. Emotional expressivity is the core aspect of our personality that determines our social adaptation and well-being[1]. Emotional expressivity refers to the behavioral (e.g., facial, vocal, postural) changes with emotions (e.g., anger, pleasure, and sadness), such as smiling, frowning, crying, or storming[2]. Individuals who frequently express their emotions are more likely to get advantages of health benefits[3]. Research findings revealed that Alzheimer patients who showed more emotional expressiveness demonstrated significant advantages in decreasing blood pressure and other health-related benefits[4]. Additionally, women with breast cancer who

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utilized an emotion-expressive coping strategy experienced improved physical health[5,6]. Lower emotional expressivity is found to be associated with adverse health-related issues and distress. For example, impaired memory and cardiovascular risks are related to less or negative emotional expressions[7,8]. Intrusive thoughts and psychological distress are more common in individuals who are less outwardly expressive persons[9]. Psychological disorders such as depression are prevalent in less emotionally expressive persons[10]. Individuals with a lower degree of emotional expressiveness have a higher chance of developing borderline personality disorder[11].

Emotional expressivity is significantly connected to improved psychological health[6]. Individuals with a higher degree of emotional expressiveness are subject to experience greater levels of subjective well-being and life satisfaction[12]. Emotional expressiveness facilitates the release of negative emotions, such as emotional disturbance and unpleasant feelings that improves subjective well-being. On the contrary, suppression of emotions results in negative consequences to mental health. For example, emotion suppression hinders individuals from effectively expressing their true feelings, resulting in a sense of incompatibility. Suppressing unpleasant emotions can result in the development of psychological disorders such as depression[10,13], anxiety[14], somatization[15], dissociation[16], social phobia[17], substance abuse[18], and borderline personality disorder[11]. Furthermore, psychotic disorders, such as schizophrenia, are associated with emotional expressivity[19].

Emotional expressivity significantly affects interpersonal relationships and social functioning[12]. Individuals who exhibit greater expressiveness are more well-liked than those who show less expressiveness[20]. Moreover, facial expressions serve as a means of communication in social situations, and not displaying genuine expressions can affect relationships with others. In addition, couples who exhibit higher levels of emotional expression demonstrate a greater understanding of each other's feelings and experience higher levels of relational satisfaction[21]. In contrast, suppressing emotions decreases communication and intimacy, eventually impacting the process of forming social relationships[22]. Furthermore, emotional suppression leads to reduced social interaction, ultimately resulting in feelings of loneliness and hopelessness[23].

Gender plays a significant role in the expression of emotions[24]. The variations in the expression of emotions between males and females might be related to neurobiological differences or gender-specific emotion norms in cultures[25]. Girls are commonly taught to be more expressive from an early age, but boys are discouraged from displaying vulnerability and encouraged to stay conservative[26]. This assumption facilitates an environment where women are more at ease in openly expressing their feelings, whereas men tend to learn to repress their emotions[27]. Therefore, women express their emotions more often compared to men[28]. In addition, women are more sensitive to emotional cues than men[29]. Therefore, they are more expressive emotionally than men.

More recent research has been demonstrating increased attention regarding the conceptualization of emotional expressivity constructs and understanding its role in social functionality, and physical and psychological health benefits[2,12,19,30]. Emotional expression is the outward display of emotions through observable behavior. Gross and John[2] provided a heuristic model demonstrating the emotional expressivity mechanism. According to Gross and John's[2] framework, when confronted with internal or external stimuli, it triggers our emotions, such as happiness or sadness, and prepares us for a response. However, this response may or may not be manifest in overt behavior, depending on the person, i.e., emotional expressive behavior is the function of person. Following this model, Gross and John[2] developed a short self-report questionnaire,

the Berkeley Emotion Expressivity Questionnaire (BEQ), which measures not only the expression intensity but also the extent to which a person expresses this emotion as a visible behavior.

Another scale for measuring emotional expressivity is also available, namely the Emotional Expressivity Scale (EES)[30]. However, only the BEQ scale enables us to measure the strength of the impulse in addition to positive and negative emotional expressivity. BEQ includes three subscales: positive expressivity, negative expressivity, and impulsive strength. Positive expressivity measures to what extent a person expresses pleasant emotions such as happiness, joy, and amusement. On the other hand, negative expressivity measures the opposite emotional expressions, such as sadness and fear. The other facet, impulse strength, tends to measure the degree to which an individual can control their emotional impulses.

Given the significance of assessing emotional expression, the BEQ has already been adapted and validated in multiple countries, including Germany[31], Japan[32], Turkey[33], and the Netherlands[34]. Unfortunately, no instrument is currently available for evaluating emotional expressivity in the Bangladeshi population. In addition, findings regarding the factor structure of this scale across different versions and cultures are inconclusive. For example, Dobbs et al.[35] did not find an adequate model fit for the originally proposed factor structure of this scale. Kupper et al.[34] found the presence of cross-loaded items in all three factors for the Dutch samples. Akan and Barişkin[33] found a different factor structure than other versions. Moreover, the measurement invariance assessment of the BEQ is yet due. Therefore, this study opts not only to adapt it for the use in Bangladesh but also to validate the BEQ for the Bangladeshi population through independent studies. Study 1 opts to examine the factor structure of the BEQ by utilizing the traditional classical test theory (CTT)-based approach. CTT is a useful method centered on total test score computation, commonly used in instrument development and adaptation processes, as it aids in establishing construct validity[36]. The CTT approach focuses on scale-level information. Study 2 attempted to obtain more precise information about this instrument both in item and scale level by utilizing the item response theory (IRT)-based approach. IRT offers distinct psychometric characteristics compared to the more conventional CTT. Item Response Theory (IRT) offers enhanced item-level insights by illustrating the link between responses and traits[37].

2. Study-1: Cultural adaptation, CTT-based validation, and reliability assessment of the BEQ

2.1. Purposes

The purposes of the Study 1 were fourfold. We aimed- 1) to adapt the BEQ in Bangla language and Bangladeshi culture considering linguistic, psychological, and cultural context; 2) to assess construct validity of the Bangla adapted BEQ utilizing CTT-based confirmatory factor analysis (CFA); 3) to check the measurement invariance of this scale across gender using incremental constraint (configural, metric and scalar) models, and 4) to assess the internal consistency reliability (McDonald's Omega (ω), coefficient H, and Cronbach's alpha) of the Bangla BEQ at the total and sub-scale levels.

2.2. Method

2.2.1. Participants

Approval from the ethical review board of the authors' affiliated department was obtained prior to conducting the research. A convenient sampling method (i.e., participants who were available at the time of data collection and were willing to participate were included) was utilized for collecting data from university students. Four hundred twenty-two university students were given printed copies of the questionnaire through in-person class visits. A total of 45 individuals were excluded from the study (as of these, 18

participants failed the attention check items, and 27 participants didn't provide their final consent). The final sample comprised 377 participants, with 244 (59%) men and 133 (41%) women. Participants' ages (M_{age} = 25.52, *SD* = 1.18) ranged from 19 to 25. Among the participants, 16.7% were from 1st year, 45.6% were from 2nd year, 27.6% were from 3rd year, and 10.1% were from 4th year in undergraduate (honors) studies.

2.2.2. Measures

The following questionnaire were administered along with a personal information form (PIF) that elicited demographic information such as age, gender, study year, and so on.

Berkeley Expressivity Questionnaire (BEQ). Gross and John[2] first developed this self-reported measure of emotional expressivity. BEQ is a 16-item scale designed to measure three facets of emotional expressivity: positive expressivity (4-items; e.g., I laugh out loud when someone tells me a joke that I think is funny), negative expressivity (6-items; e.g., what I am feeling is written all over my face), and impulse strength (6-items; e.g., I experience my emotions very strongly). It consists of a 7-point Likert-type response ranging from 1 = strongly disagree to 7 = strongly agree. Two items (3,8) of the negative expressivity facet and one item (9) of impulse strength were reverse-coded.

Attention check items. To check inattentive respondents, we employed two items to identify whether participants attentively completed the survey. Those items direct the participants to choose a particular response option, such as "To show that you are reading this sentence carefully, please select the choice somewhat agree", "If you are reading the sentence attentively, please select the option disagree". Those two items were placed randomly, one in the first half and the other in the last half of the survey.

2.2.3. Procedure

Before initiating the adaptation process, written permission and BEQ scoring procedure were obtained from the original author. A committee of experts was formed to direct and scrutinize the adaptation process. It comprises a professor and four bilingual individuals with also expertise in psychology. Firstly, two separate forward translators independently translated the original scale from English to Bangla. Later, the committee of experts evaluated and synthesized these two translations into one to create the best possible Bangla version. This version was provided to two other bilingual experts for backward translation. These two backward translations were compared with the original version to identify incongruence. Item numbers 1, 5, 8, 10, and 13 were revised to resolve the dissimilarities. Upon resolving these issues, the scale was ready for pre-testing.

During pre-testing-1, the new version of the Bagla BEQ was presented to 33 participants. Additionally, interviews were conducted with 10 participants to verify their accurate and clear understanding of all the items. The item analysis was conducted by calculating the corrected-item-total correlation based on the participants' responses. According to the findings of the corrected-item-total correlation (see **Supplementary Table 1**) and participant interviews, it was determined that item 3 was perceived as somewhat ambiguous by the respondents. Therefore, item 3 underwent a revision for a better version. Another pre-test phase (pre-testing 2) was conducted involving 44 individuals after revising item 3, and cognitive interviews were conducted with 15 participants. The Corrected-item-total correlation of all items was in the positive direction in pre-testing-2 (see **Supplementary Table 2**), and the second cognitive interviews of 15 participants recommended that they comprehended all items adequately. Informed consent was obtained before pre-testing and cognitive interviewing. Thus, the Bangla version of BEQ was ready for field administration.

At the final data collection stage, participants were informed about the study objectives and the ethical details. They were also assured about the anonymity of their data and their right of withdrawal of

participation. Their written consent was obtained before participation in the final survey. Participants who were available during data collection in the university classrooms were approached for the survey. On average, they spend about 15 minutes completing the questionnaire. They were inquired again at the end of the survey whether they finally agreed to provide their data for the study. After completing the survey, they were thanked for their support.

2.2.4. Data analyses

Microsoft Excel, SPSS, and RStudio version 2023.06.0+421[38] were utilized for data processing and analyses. CFA was employed using the *lavaan* package[39] in RStudio. Several criteria were followed for evaluating the CFA model fit: the proportion of chi-square and *df*, CFI, SRMR, and RMSEA. The proportion of chi-square and *df* value below 3 were considered acceptable[40]. CFI ≥ .90, SRMR ≤ .08, and RMSEA ≤ .10 were set as the benchmark for evaluating model fit[41]. Measurement invariance was checked across gender by assessing the deviation of fit indices on multiple models of CFA, including configural, metric, and scaler models. ΔCFI and ΔRMSEA were estimated to calculate differences in model fit. ΔCFI ≥ -.01 and ΔRMSEA ≤ .03 were used as the cutoff value[42]. If one of these benchmark criteria was achieved but the other was not, ΔRMSEA was emphasized because it provides more accuracy. Moreover, ΔSRMR ≤ .015 was also checked for further validation[42]. Internal consistency was calculated using McDonald's Omega (ω), Coefficient H, and Cronbach's Alpha (α), and values above .6 were considered acceptable[43].

2.3. Results

2.3.1. Descriptive statistics

Descriptive statistics (mean, SD, skewness, and kurtosis) for all items of BEQ are given in **Supplementary Table 3**. The mean value of the items in the BEQ ranged from 2.19 to 5.82. The standard deviation ranged from 1.21 to 2, the skewness from -1.53 to 1.54, and the kurtosis from 1.25 to 2.63. The shape of the distribution was not the primary concern, item responses are in the ordinal scale, and we used the Diagonal Weighted Least Squares (DWLS) estimator, which is recommended for its capacity to deal with non-normal distributions and ordinal response patterns like the Likert-scale[44].

2.3.2. CTT-based confirmatory factor analysis

We executed a series of CFA to determine the best-fitted model for the Bangla version of the BEQ (See **Table 1**), beginning with the original author's recommended higher-order model of three factors[45].

Table 1. The fit indices for models of the Bangla version of the BEQ.

Models	χ^2	*df*	χ^2 / *df*	CFI	RMSEA [90% CI]	SRMR	Model Comparison	$\Delta\chi^2$
M1. Higher order 3-factor with 16-item	282.807***	102	2.77	.936	.069[.059-.078]	.081	_	_
M2. 3-factor with 16-item	234.600***	101	2.32	.953	.059[.049-.069]	.074	2 vs. 1	48.208***
M3. Higher order 3-factor with 15-item	241.737***	88	2.75	.945	.068[.058-.078]	.079	_	_
M4. 3-factor with 15-item	192.276***	87	2.21	.962	.057[.046-.068]	.070	4 vs. 3	49.461***

Note: *n = 377. χ2 chi-square; ***p < .001; CFI = comparative fit index; RMSEA = root-mean square error of approximation; SRMR = standardized root-mean residual.*

Though the theoretically proposed higher-order 3-factor model with 16 (M1) showed adequate fit, item number 8, which was in the negative expressivity subscale, demonstrated poor factor loading (.124). Following that, we analyzed a correlated 3-factor model with 16-item (M2), which was better in terms of fit indices, however, the problem with item number 8 persisted with a low factor loading (.119). Then, we

decided to remove this item due to its problematic loading factor, which will not provide sufficient information for the construct of emotional expressivity. Next, we attempted to incorporate a higher-order model comprising 15 items (M3) by eliminating item number 8. This time, we were not only able to find a better model in terms of fit indices but also found acceptable factor loadings in all 15 items. To determine the best model, we planned to evaluate a 3-factor correlated model consisting of 15 items (M4). The Model 4 (M4) exhibited superior fit indices than the higher order 3-factor model with 15-item (M3), and the $\chi 2$ difference test demonstrated significant improvement over the other model. Thus, we concluded that the 3-factor model with 15 items (M4) is the most reliant model of the Bangla BEQ, whose factor loadings are depicted in **Figure 1**.

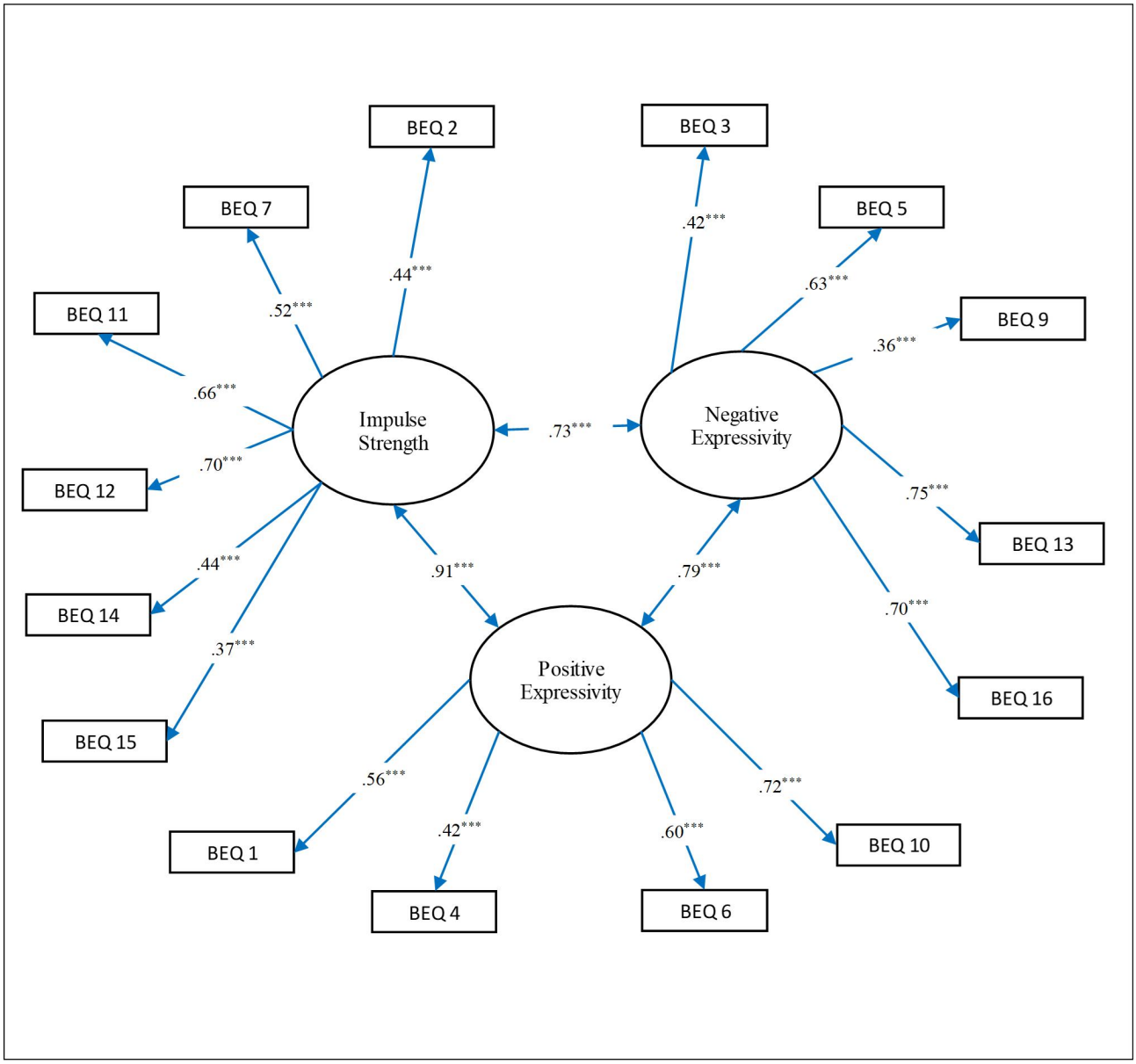


Figure 1. The factor loadings of the best-fitted 3-factor model with 15-item (Model 4) of the Bangla Berkeley Expressivity Questionnaire. ***p<.001. The values shown are the standardized coefficients.

2.3.3. Measurement invariance

To determine whether the construct is understood similarly across men and women, we implemented an ordered set of CFAs. Initially, we implemented a CFA by factoring the gender into our previously

formulated best-fitting 3-factor model (configural invariance). Then, we conducted an additional CFA by constraining factor loadings across gender (metric invariance); however, this did not deteriorate the model fit. Additionally, we conducted an additional CFA that restricted both factor loadings and intercepts across gender (scalar invariance). The difference was negligible when considering the value of ΔRMSEA (see **Table 2**). As a result, we assumed that Bangla BEQ was invariant across gender.

Table 2. Measurement invariance across gender of the Bangla BEQ.

Steps	χ^2	*df*	χ^2 /*df*	CFI	RMSEA [90% CI]	SRMR	Δ χ^2	ΔCFI	ΔRMSEA	ΔSRMR
1. Configural Invariance	247.420***	174	1.42	.974	.047 [.033-.060]	.075				
2. Metric Invariance	284.758***	186	1.34	.965	.053 [.040-.065]	.080	37.338***	-.009	.006	.005
3. Scalar Invariance	330.385***	198	1.67	.953	.060 [.048-.071]	.085	45.627***	-.012	.007	.005

Note: *n = 377. χ2 =chi-square; ***p < .001; CFI = comparative fit index; RMSEA = root-mean square error of approximation; SRMR = standardized root-mean residual.*

2.3.4. Reliability analyses

We utilized McDonald's Omega (ω), Coefficient H, and Cronbach's Alpha (α) to assess the internal consistency. McDonald's Omega (ω) coefficients reveal that all subscales and the total scale had excellent internal consistencies (See **Table 3**). The subscales of the Bangla BEQ and the total scale had adequate internal consistencies in terms of the Coefficient H and Cronbach's Alpha (α) coefficients (See **Table 3**).

Table 3. Results of the reliability analyses of the Bangla BEQ.

Construct	McDonald's Omega (ω) [95% CI]	Cronbach's Alpha (α) [95% CI]	Coefficient H
BEQ	.85 [.83-.87]	.84 [.82-.87]	.87
Positive Expressivity	.66 [.61-.72]	.66 [.60-.71]	.74
Negative Expressivity	.73 [.69-.77]	.73 [.68-.77]	.75
Impulse Strength	.71 [.66-.75]	.70 [.66- .75]	.73

3. Study-2: IRT-based validation and concurrent validity assessment

3.1. Purposes

The purposes of Study 2 were to- 1) scrutinize the construct validity of the Bangla BEQ incrementally using modern test theory-based IRT analyses, 2) determine convergent and concurrent validity through correlating BEQ and its three facets and with external validated measures, 3) examine sex differences in the three facets of BEQ.

3.2. Method

3.2.1. Participants and procedure

Data were collected in the same fashion as Study 1 by approaching university students during class intervals. A total of 621 university students who were interested were given a questionnaire and asked to complete it after understanding the purpose of the research. Sixty-eight data were removed from the analysis as 22 people failed in the attention check items, and 46 did not provide the final consent. The final sample consisted of 553 participants; among them, 285 (52%) were female, and 268 (48%) were male. Their ages ranged from 18 to 26 (M_{age} = 21.31, *SD* = 1.48). Among the participants, 40% were from 1st year, 27.7%

were from 2nd year, 21.2% were from 3rd year, 4.7% were from 4th year of undergraduate level, and the rest, 6.5%, were masters' students. ERB approval was also obtained prior to the data collection.

3.2.2. Measures

In addition to the Bangla-adapted BEQ and PIF as in Study 1, the following measures were administered additionally to the participants.

Ten-Item Personality Inventory Bangla version (TIPI-B). TIPI-B is a self-report measure designed to assess five personality traits: openness, extroversion, conscientiousness, agreeableness, and neuroticism. It was first developed by Gosling et al.[46] and later adapted in Bangla by Islam[47]. TIPI-B is a 5-point Likert scale on which respondents respond to what extent each statement applies to them, where 1 represents '*not applicable at all,'* and 5 represents '*completely applicable'*. The TIPI-B had adequate reliability and validity[47].

WHO (Five) Well-being Index Bangla version (WHO-5-B). To measure well-being, the Bangla version of the WHO-5 was used[48]. It is a 5-item short self-report measure containing a 6-point Likert-type (0 = *none of the time* to 5 = *all the time*) response where respondents were asked to rate their feelings for the last two weeks. This scale is also commonly utilized for evaluating depression. WHO-5-B was found to have a reliability score of .754[48].

3.2.3. Data analyses

Item response theory was utilized by using the mirt package[49] of RStudio. We independently assessed the graded response model for the three subscales (impulse strength, positive expressivity, and negative expressivity). Before calibrating them into the GRM model, we evaluate the unidimensionality and local independence of the three subscales. Unidimensionality was assessed by fitting the subscales individually, examining their fit indices in CFA, and calculating Loevinger's coefficients H where values >.3 indicate unidimensionality[50]. The local independence was evaluated by examining the residual correlation values, expecting each residual correlation to fall within the range of |.20|[51]. IRT reliability was assessed, and the benchmark coefficient of .60 was considered acceptable reliability. SPSS was used to conduct Pearson correlations to explore the connections between BEQ and two other measures, namely TIPI-B and WHO-5-B.

3.3. Results

3.3.1. Descriptive statistics

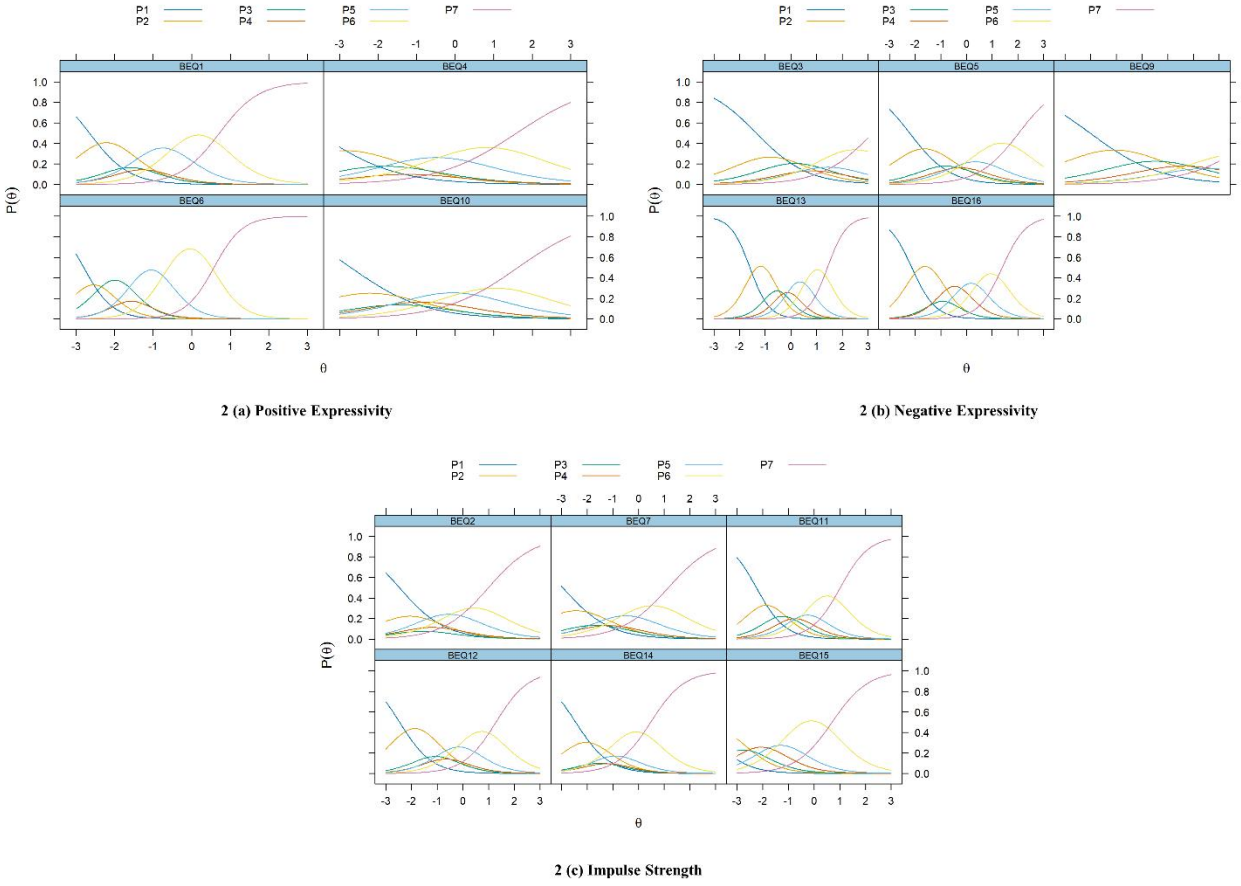
All the items of the subscale of used measures were summed after appropriately reversing the reverse items to achieve the total score of those measures. Mean, SD, Skewness, and Kurtosis of all measures are presented in **Table 4**. Additionally, mean scores of males and females for every BEQ subscale and total scale were calculated to compare between them. As suggested by the original author, females were more expressive in all subscales and also in the total expressivity score. The results of t-test analyses indicated that females were significantly more expressive than males in all three facets (Positive expressivity, Negative expressivity, and Impulse strength) of BEQ (See **Supplementary Figure 1**). Furthermore, scores of positive expressivity (M = 5.21, SD = 1.15) were greater than negative expressivity scores (M = 3.81, SD = 1.25). The results suggested that positive emotions were significantly more frequently expressed than negative emotions, t (552) = 27.85, $p < .001$.

3.3.2. Item response theory

As BEQ has a polytomous response category, we conducted IRT-based graded response model analyses to evaluate its construct validity. The Bangla BEQ consists of three factors, so we calibrated item response

theory-based analyses for these three factors separately. Before fitting into the graded response model, subscales were tested for unidimensionality and local independence. Positive expressivity, negative expressivity, and impulse were all unidimensional, as marked by their acceptable fit indices and values of Loevinger's H coefficient (see **Supplementary Table 4**). We concluded from the residual correlations of all three dimensions that all three subscales were free from local interdependence (see **Supplementary Table 4**). Response percentages in the seven options and item level fit for graded response are provided in **Supplementary Table 5**. RMSEA value associated with S-χ^2provided additional support that each item falls in its corresponding subscales.

Item slope for positive expressivity ranged from .983 to 2.689, and it has good IRT reliability marked by the score .757 (see **Supplementary Table 6**). Item Characteristics Curves (ICC) were calibrated and provided in **Figure 2(a)**. From the Item Information Curves (IIC) of positive expressivity, it was evident that item no. 1,4,6 provided the most information, while item 10 provided the tiniest information about the construct (see **Supplementary Figure 2**). Moreover, the Test Information Curve (TIC) of positive expressivity [**Figure 3(a)**] revealed that this construct provided a good amount of information for -3θ to 1.5θ.



2 (a) Positive Expressivity

2 (b) Negative Expressivity

2 (c) Impulse Strength

Figure 2. Item characteristics curve of the Bangla Berkeley Expressivity Questionnaire. Figures 2(a), 2(b), and 2(c) are the three subscales of the questionnaire. The horizontal axes denote the levels of the latent traits. The vertical axes measure the probability of choosing a given response category at a specified latent trait level. P1 to P7 are the response categories (1-7) in Figure 2(a)-2(c).

The negative expressivity subscale revealed good IRT reliability, marked by a score of .812, and the item slope ranged from .732 to 2.666 (see **Supplementary Table 6**). ICCs for all items of negative expressivity are demonstrated in **Figure 2(b)**. From the IICs curves of negative expressivity, it is evident that

items 3,5, 13, and 16 provided more information, and item 9 provided the lowest amount of information for this subscale (see **Supplementary Figure 3**). Furthermore, the TIC showed that this construct provided extensive information from -2θ to 2θ level [See **Figure 3(b)**].

The impulse strength subscale's item slope parameter ranged from 1.092 to 1.784, and IRT reliability was .779. **Figure 2(c)** presents ICCs for all impulse strength items. The IICs revealed that all items of this facet provided enough information (see **Supplementary Figure 4**). The TIC suggested that it allows for a greater amount of information from -3θ to 2θ ability level [See **Figure 3(c)**].

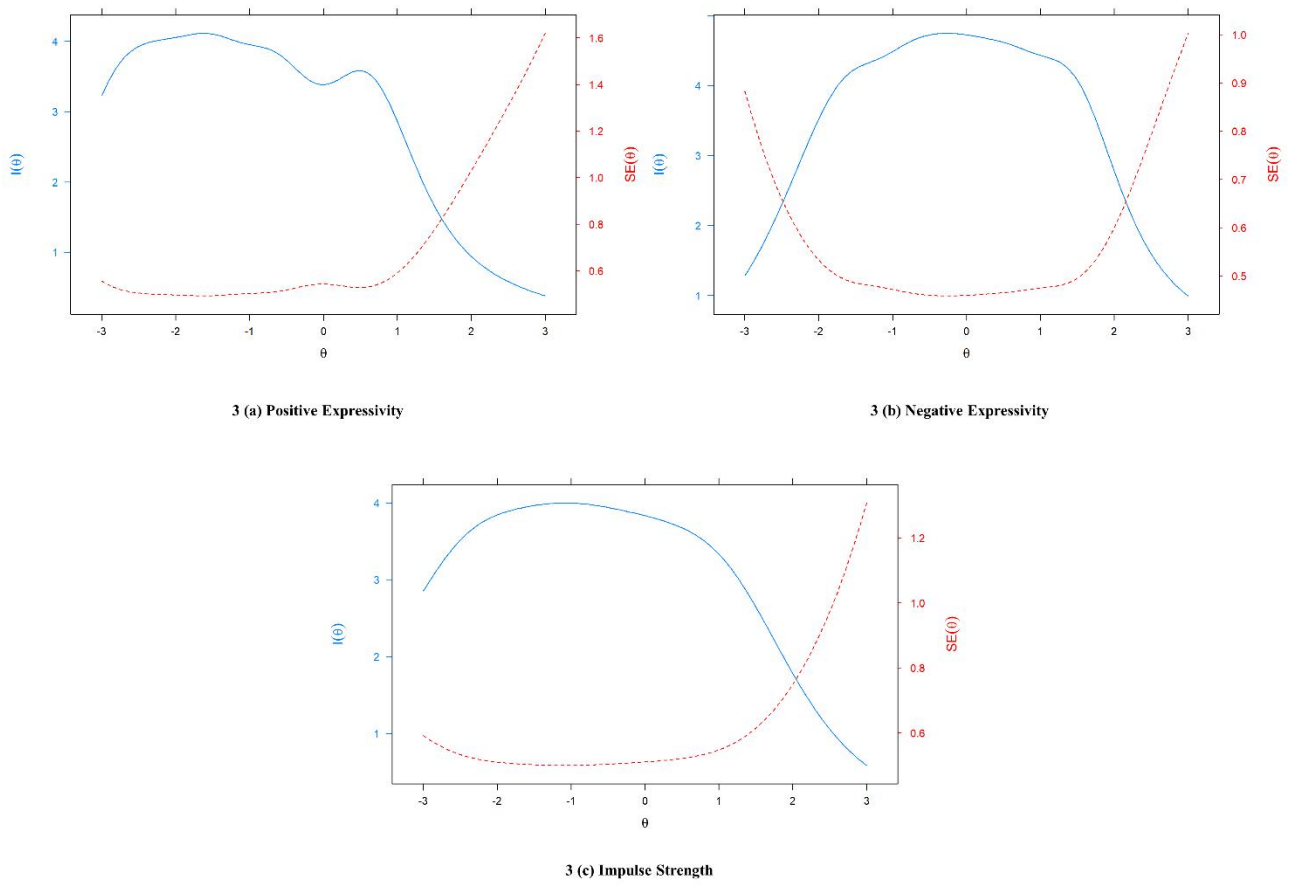


Figure 3. Test information curves of the Berkeley Expressivity Questionnaire. Figures 3(a), 3(b), 3(c) are the three sub-scales of the questionnaire. The horizontal axes represent the levels of latent traits (i.e., positive expressivity, negative expressivity, and impulse strength). The vertical axes represent the amount of information provided by the traits for a given score.

3.3.3. Convergent and concurrent validity

The total and subscale scores were used to conduct the correlation analyses. The subscales of the Bangla BEQ were internally significantly positively correlated to each other, providing evidence for convergent validity (See **Table 4**). Positive expressivity was significantly positively connected to well-being and personality traits such as extroversion, conscientiousness, and neuroticism. Negative expressivity was negatively associated with openness to experience, conscientiousness, and agreeableness. Furthermore, negative expressivity was positively connected with neuroticism. Impulse strength was significantly positively correlated with extroversion, agreeableness, and neuroticism. Therefore, the Bangla BEQ has concurrent validity with TIPI-B and WHO-5-B.

Table 4. Correlations among key variables.

	1	2	3	4	5	6	7	8	9	10
1. Positive Expressivity										
2. Negative Expressivity	.518**									
3. Impulse Strength	.571**	.516**								
4. BEQ	.798**	.826**	.862**							
5. WHO_5	.108*	-.073	-.094*	-.04						
6. Openness	.027	-.208**	-.052	-.104*	.179**					
7. Extroversion	.305**	.077	.088*	.169**	.232**	.15**				
8. Conscientiousness	.128**	-.098*	.035	.015	.278**	.187**	.167**			
9. Agreeableness	.007	-.152**	.091*	-.02	.066	.111**	.029	.283**		
10. Neuroticism	.165**	.301**	.22**	.281**	-.257**	-.212**	.182**	-.338**	-.282**	
M	20.82	19.03	30.90	70.76	12.54	7.29	6.52	7.35	8.35	4.05
SD	4.61	6.24	6.82	14.71	5.46	1.72	2.26	1.61	1.25	1.70
Range	7-28	5-35	9-42	24-105	0-25	2-10	2-10	2-10	4-10	1-9
Skewness	-0.58	0.13	-0.48	-0.24	-0.07	-0.62	-0.22	-0.28	-0.70	0.26
Kurtosis	-0.08	-0.52	-0.15	-0.35	-0.67	0.19	-0.90	-0.39	0.23	-0.14

Note: *N= 553, *p < .05; **p <.01.*

4. Discussion

It is considered that while bottled-up emotion harms an individual's well-being, emotional expression is advantageous and has a significant part in preserving psychological and physical well-being[52]. It is a widely held opinion among researchers and therapists who work in the discipline of psychotherapy that how people express their emotions has an impact on their mental health[3]. Psychodynamic and humanistic oriented psychotherapists, in particular, strongly emphasize the importance of emotional expressivity for sustaining physical and psychological well-being. As a result, they work to improve their patients' emotional insight and expression of their emotions[53] by using techniques that encourage emotional experience and expression as well as the development of secure and encouraging therapeutic relationships. So, understanding an individual's emotional expressivity and incorporating it into standard clinical practice can contribute to mental health by facilitating the regulation of emotional expression. The BEQ is one of the most frequently used multi-faceted tools for measuring emotional expressivity. Recognizing the importance of measuring emotional expressivity, this investigation aimed to adapt and validate the BEQ. We split our investigation into two independent studies to get a robust Bangla version of the BEQ. In the first study, we adapted the BEQ to Bangla, and with this newly adapted version, we evaluated CFA, measurement invariance, and internal consistency. Afterward, in the second study, we evaluated its item-level properties through IRT analysis and investigated its concurrent validity.

The linguistic transformation, while preserving cultural context, turned these instruments suitable for assessing the emotional expressivity of Bangladeshi individuals. Although we have found acceptable fit indices for two models (3-factor model and higher-order 3-factor model) items with 16, item 8 had poor factor loadings in both models. Consequently, we decided to delete this, which was also found problematic in the past study of Dobbs et al.[35]. After removing this item, we ran a higher-order 3-factor model and, subsequently, a 3-factor model with 15 items. Both models were found to have acceptable fit indices, but a 3-factor model with 15 items was significantly better model fit and factor loading. Therefore, we concluded

that the 3-factor model with 15 items is the best-fitting model for the BEQ Bangla version. The findings this study also supports theoretically three-facets model of Gross and John[2]. This approach demonstrated the comprehensiveness of this version in evaluating both verbal and nonverbal expressions of positive and negative emotions, as well as emotional intensity. Upon establishing the most appropriate Bangla version, we assessed whether the construct works similarly across men and women. The findings indicated that this measure can efficiently evaluate emotional expressivity for both genders. The internal consistency of this measure was assessed. The results of multiple reliability indices (McDonald's Omega, Coefficient H, and Cronbach's Alpha) indicated that the total measure and its three facets have acceptable reliability.

After identifying the best possible version of Bangla BEQ, to collect more precise information about the measures, we utilized using IRT analyses in Study 2. To our knowledge, it is the first study to explore this scale through IRT. We learned through the calibration of ICCs that every response category for each subscale was necessary to find information from different ability levels. Furthermore, IICs gave us more precise data regarding the specific quantity of information each item offers. The TIFs clearly demonstrated that each subscale was robust in offering information to a broad range of ability levels. In addition, the supplementary IRT reliability assessment strengthened the robustness of the BEQ Bangla version.

In Study 2, we also tried to determine whether women exhibit more expressiveness compared to men. The results of our study further validated the notion that women are more expressive by supporting the study of Kupper et al.[34]. This study supports the notion that Asian women exhibit greater emotional expressiveness than their male counterparts, as emotional expression is dependent upon cultural environment[26]. Additionally, positive emotions were more expressed than negative ones, suggesting that society accepted positive emotions more than negative ones[2]. This finding further validates the idea that society encourages positive emotions more than negative emotions, resulting in a higher expression of positive emotions. To test the concurrent validity, we calculated the cumulative score of each subscale. We investigated the correlation between the Bangla version of BEQ and other external measures such as TIPI-B and WHO-5-B. Total BEQ scores were positively correlated with extraversion and neuroticism, supporting the stand of Gross and John[2]. It was reasonably anticipated that extroverts, being more active, might effectively communicate emotions[54]. In addition, extroverted individuals typically exhibit behaviors that draw social attention; consequently, these two characteristics are conceptually connected. The anticipated correlation with neuroticism is also justified since individuals with neurotic traits exhibit emotional instability, resulting in challenges in emotional regulation. In turn, those emotions may be expressed through nonverbal behavior. While some studies present conflicting results[55], our research substantiated the prevalent findings that indicated a positive correlation[2,32,34]. Positive expressivity was significantly connected with extraversion and consciousness, which supported the study of Kupper et al.[34].

Moreover, our findings point out that people who express their positive feelings possess more psychological well-being. Another facet of BEQ, negative expressivity, was significantly positively connected with neuroticism, supporting the work of Lin et al.[32]. Furthermore, negative expressivity was also negatively associated with agreeableness, conscientiousness, and openness, aligning with the work of Lin et al.[32]. The other facet of BEQ, impulse strength, was positively related to agreeableness, extroversion, and neuroticism, showing similar results to Gross and John's[2] work. These findings provided concurrent validity evidence for the Bangla version of BEQ.

Our study is not exempted from limitations. First, we could not assess its convergent validity by comparing it with similar tools due to the absence of comparable measures in this cultural context for measuring emotional expressivity. Also, we could not investigate the test-retest reliability due to the need to

collect identifiable information, which would compromise the anonymity of participants' responses and may discourage their participation. Therefore, future research should prioritize the measurement of its test-retest validity. In addition, future research should concentrate on validating this tool through a direct comparison with laboratory tests, where participants are exposed to emotionally evocative scenarios. Another limitation of this study is that young adults who are university students were only included as a sample; hence, future studies should concentrate on applying this version to a broader population.

This study introduces a new instrument for measuring emotional expressivity in the cultural context of Bangladesh. Beyond that, the use of CTT and IRT in validating this instrument provided proof of its robustness cross-culturally. This tool can be handy for practitioners as it will assist them in choosing intervention planning. Moreover, as mentioned earlier, this trait is connected with physical and psychological health, making it valuable in uncovering the root causes of many health and psychological issues.

Supplementary materials

Supplementary Table 1: The Pre-testing -1 Findings of the Corrected-Item-Total Correlation of Bangla Version of the Berkeley Expressivity Questionnaire (BEQ), **Supplementary Table 2:** The Pre-testing-2 Findings of the Corrected-Item-Total Correlation of The Bangla Version of the Berkeley Expressivity Questionnaire (BEQ), **Supplementary Table 3:** Descriptive Statistics of the Bangla Berkeley Expressivity Questionnaire (BEQ), **Supplementary Table 4:** Unidimensional Assumption Testing Loevinger's H Coefficient, and Residual Correlations of the Bangla Berkeley Expressivity Questionnaire, **Supplementary Table 5** Item Response Percentages and Item Level Fits of the Bangla Berkeley Expressivity Questionnaire, **Supplementary Table 6:** Item level Psychometric Properties and IRT Reliability of the Bangla Berkeley Expressivity Questionnaire, **Supplementary Figure 1:** Sex differences in expressivity scores, **Supplementary Figure 2:** Item information curves (IIC) of the Positive Expressivity Subscale of the Bangla Berkeley Expressivity Questionnaire, **Supplementary Figure 3** Item Information Curves (IIC) of Negative Expressivity Subscale of the Bangla Berkeley Expressivity Questionnaire, **Supplementary Figure 4** Item Information Curves (IIC) for Impulse Strength Subscale of the Bangla Berkeley Expressivity Questionnaire,

Author contributions

Conceptualization, R.A.; methodology, R.A.; software, M.I.U.; validation, M.I.U.; formal analysis, M.I.U.; investigation, M.I.U.; resources, M.I.U.; data curation, M.I.U; writing—original draft preparation, M.I.U; writing—review and editing, R.A..; visualization, M.I.U.; supervision, R.A.;. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest.

Data availability

The datasets generated during and/ or analyzed during the current study are not publicly available due to ethical restrictions but are available from the corresponding author upon reasonable request.

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Appendix

Revised BEQ with 15 Items

1. Whenever I feel positive emotions, people can easily see exactly what I am feeling.
2. I sometimes cry during sad movies.
3. People often do not know what I am feeling. (R)
4. I laugh out loud when someone tells me a joke that I think is funny.
5. It is difficult for me to hide my fear.
6. When I'm happy, my feelings show.
7. My body reacts very strongly to emotional situations.
8. No matter how nervous or upset I am I tend to keep a calm exterior (R)
9. I am an emotionally expressive person.
10. I have strong emotions.
11. I am sometimes unable to hide my feelings even though I would like to.
12. Whenever I feel negative emotions, people can easily see exactly what I am feeling.
13. There have been times when I have not been able to stop crying even though I tried to stop.
14. I experience my emotions very strongly.
15. What I'm feeling is written all over my face.

Supplementary Materials

Emotional expressivity in the Bangladeshis: Psychometric properties of the Bangla Berkeley Expressivity Questionnaire

Supplementary Table 1. The Pre-testing -1 Findings of the Corrected-Item-Total Correlation of Bangla Version of the Berkeley Expressivity Questionnaire (BEQ).

Subscales	Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Positive Expressivity	BEQ1	0.46	0.67
	BEQ4	0.56	0.61
	BEQ6	0.57	0.63
	BEQ10	0.44	0.69
Negative Expressivity	BEQ3	-0.06	0.64
	BEQ5	0.18	0.54
	BEQ8	0.29	0.49
	BEQ9	0.55	0.37
	BEQ13	0.44	0.40
	BEQ16	0.36	0.46
Impulse Strength	BEQ2	0.37	0.62
	BEQ7	0.43	0.60
	BEQ11	0.47	0.58
	BEQ12	0.53	0.55
	BEQ14	0.33	0.63
	BEQ15	0.20	0.66

N= 33

Supplementary Table 2. The Pre-testing-2 Findings of the Corrected-Item-Total Correlation of The Bangla Version of the Berkeley Expressivity Questionnaire (BEQ).

Subscales	Items	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Positive Expressivity	BEQ1	0.47	0.56
	BEQ4	0.41	0.60
	BEQ6	0.57	0.54
	BEQ10	0.39	0.63
Negative Expressivity	BEQ3	0.56	0.66
	BEQ5	0.19	0.78
	BEQ8	0.35	0.72
	BEQ9	0.49	0.69
	BEQ13	0.68	0.62
	BEQ16	0.59	0.65
Impulse Strength	BEQ2	0.38	0.72
	BEQ7	0.61	0.65
	BEQ11	0.39	0.70
	BEQ12	0.65	0.62
	BEQ14	0.42	0.70
	BEQ15	0.41	0.71

N=44

Supplementary Table 3. Descriptive Statistics of the Bangla Berkeley Expressivity Questionnaire (BEQ).

Items	Mean	SD	Skewness	Kurtosis
BEQ1	5.22	1.80	-0.93	-0.19
BEQ2	4.93	2.00	-0.77	-0.80
BEQ3	2.97	1.86	0.79	-0.62
BEQ4	5.12	1.69	-0.78	-0.35
BEQ5	4.14	1.87	-0.18	-1.25
BEQ6	5.82	1.21	-1.53	2.63
BEQ7	5.09	1.80	-0.83	-0.43
BEQ8	2.19	1.43	1.54	2.12
BEQ9	2.82	1.68	0.96	0.05
BEQ10	4.54	1.93	-0.43	-1.05
BEQ11	4.81	1.86	-0.61	-0.79
BEQ12	4.59	1.87	-0.47	-1.06
BEQ13	4.14	1.87	-0.12	-1.19
BEQ14	5.10	1.94	-0.86	-0.57
BEQ15	5.78	1.23	-1.40	2.12
BEQ16	4.63	1.75	-0.49	-0.76

N= 377

Supplementary Table 4. Unidimensional Assumption Testing Loevinger's H Coefficient, and Residual Correlations of the Bangla Berkeley Expressivity Questionnaire.

Items	Loevinger's H coefficients	Residual Correlations					
Positive Expressivity [$\chi2(2) = 7.366$, $p = .025$, CFI = .981, RMSEA = .070, SRMR = .042]							
		BEQ1	BEQ4	BEQ6	BEQ10		
BEQ1							
BEQ4	0.347	-0.05					
BEQ6		0.06	-0.02				
BEQ10		-0.02	0.09	-0.05			
Negative Expressivity [$\chi2(5) = 8.407$, $p = .135$, CFI = .994, RMSEA = .035, SRMR = .035]							
		BEQ3	BEQ5	BEQ9	BEQ13	BEQ16	
BEQ3							
BEQ5		-0.02					
BEQ9	0.348	0.09	0.04				
BEQ13		0	-0.03	-0.01			
BEQ16		-0.03	0.03	-0.07	0.03		
Impulse Strength [$\chi2(9) = 16.565$, $p = .056$, CFI = .987, RMSEA = .039, SRMR = .043]							
		BEQ2	BEQ7	BEQ11	BEQ12	BEQ14	BEQ15
BEQ2							
BEQ7		0.03					
BEQ11	0.307	-0.01	0.01				
BEQ12		-0.06	0.01	0.07			
BEQ14		0.08	-0.04	-0.09	0.02		
BEQ15		-0.02	-0.02	0.02	-0.05	0.09	

N= 553

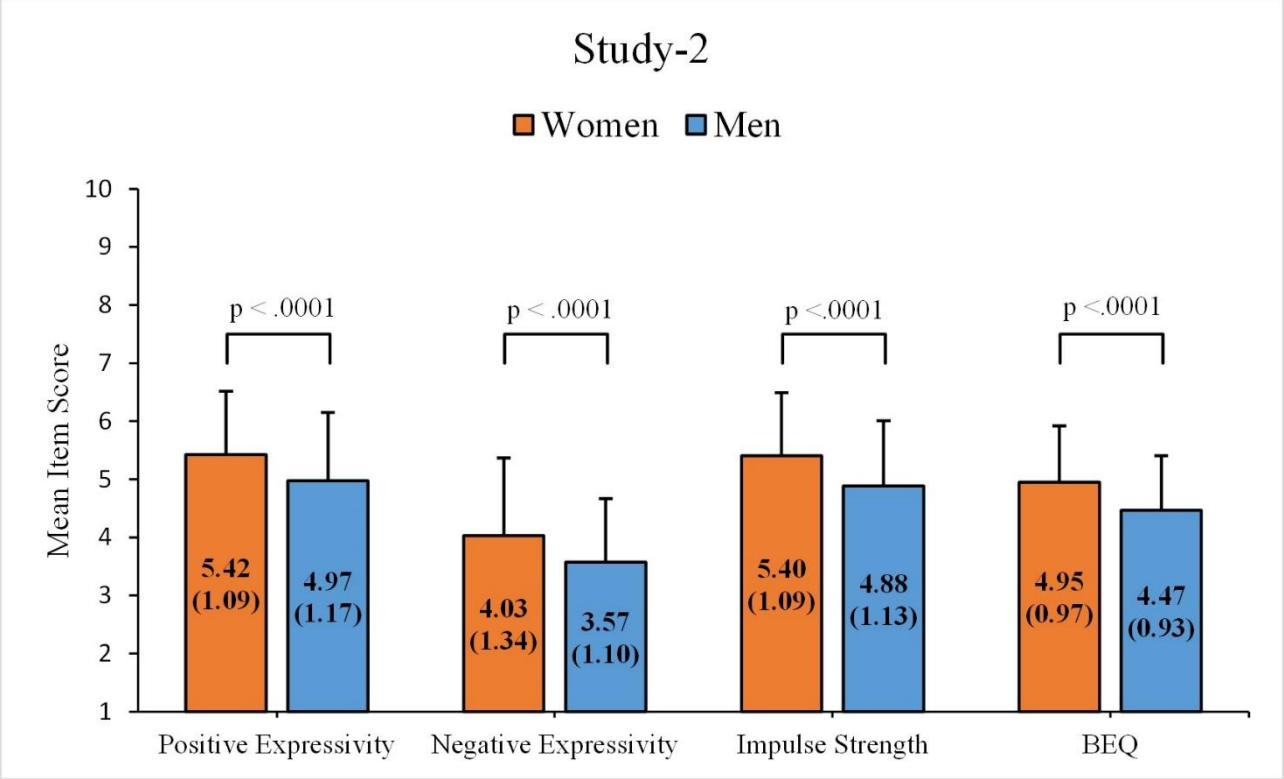
Supplementary Table 5. Item Response Percentages and Item Level Fits of the Bangla Berkeley Expressivity Questionnaire.

Items	**Response Percentages**							**S-χ^2**	***df***	**p-value**	**RMSEA**
	1	**2**	**3**	**4**	**5**	**6**	**7**				
Positive Expressivity											
BEQ1	2.5	7.2	5.1	5.6	19.7	30.9	28.9	51.455	47	0.405	0.013
BEQ4	4.3	9.9	9.8	6.7	21.5	27.1	20.6	52.246	53	0.503	0.000
BEQ6	0.9	1.8	4.9	3.6	17.7	40	31.1	45.371	39	0.405	0.017
BEQ10	8.3	10.3	8.3	12.1	21	20.6	19.3	69.126	54	0.322	0.023
Negative Expressivity											
BEQ3	24.8	20.8	17	9.8	9.9	11.9	5.8	77.902	85	0.695	0.000
BEQ5	9.4	15.7	11.9	12.5	17	22.2	11.2	80.317	81	0.626	0.000
BEQ9	21	27.8	19.7	12.3	7.4	7.8	4	120.181	86	0.022	0.027
BEQ13	9	17.7	12.8	13.4	18.1	17.2	11.8	112.051	66	0.002	0.036
BEQ16	5.1	14.3	7.4	17.9	21.2	20.3	13.9	83.687	64	0.083	0.024
Impulse Strength											
BEQ2	8.9	9	4.2	7.2	18.6	23.5	28.6	82.208	96	0.841	0.000
BEQ7	6	9	7.2	8.9	18.1	25	25.9	90.369	93	0.824	0.000
BEQ11	5.2	8.9	10.1	11.8	15.4	25.7	23	80.100	87	0.824	0.000
BEQ12	4.9	14.8	9.8	9.4	18.1	24.2	18.8	104.049	83	0.262	0.021
BEQ14	5.4	8.7	4.3	4.9	10.3	29.5	36.9	99.312	83	0.262	0.019
BEQ15	0.5	2.2	3.3	7.2	14.1	40.3	32.4	74.602	62	0.262	0.019

Notes. *Percentage represents the percentage of respondents who endorsed specified options 1-7 on 7-point Likert type scale for each item (1 = strongly disagree, 7 = strongly agree); p-values adjusted for false discovery rate (FDR), RMSEA: Root-mean-square-error of approximation.*

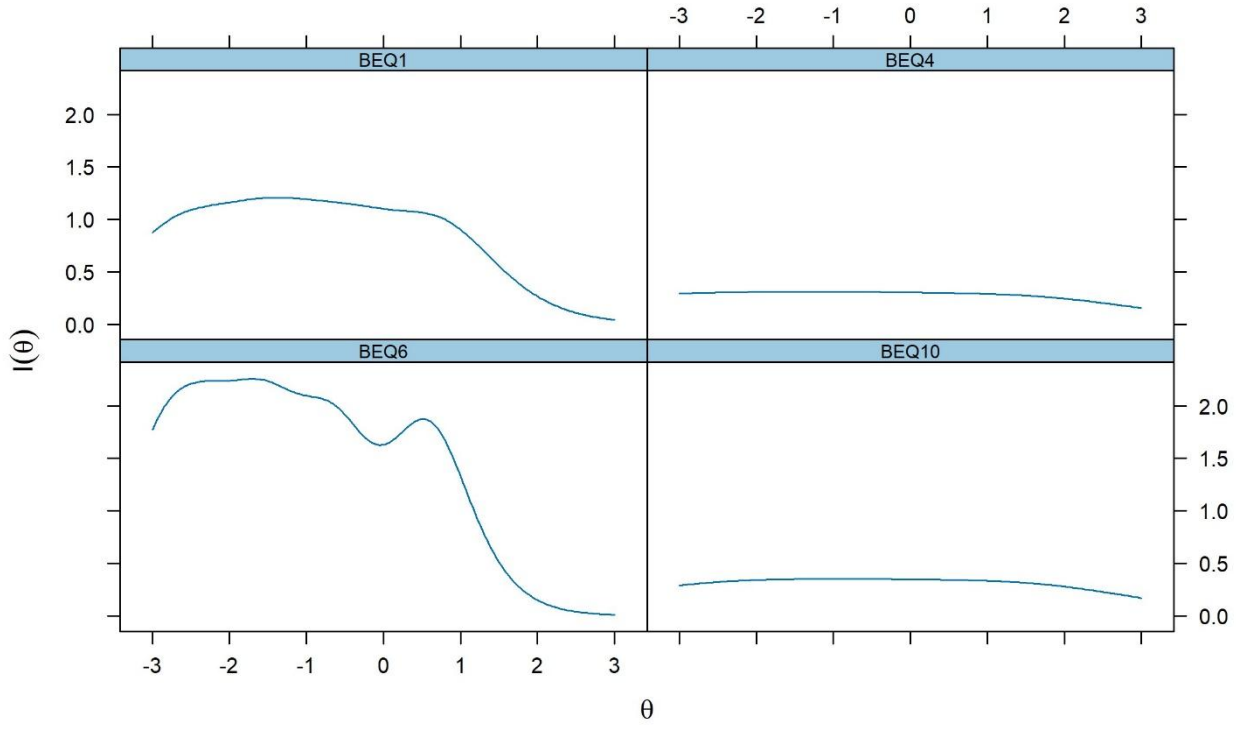
Supplementary Table 6. Item level Psychometric Properties and IRT Reliability of the Bangla Berkeley Expressivity Questionnaire.

Items	**IRT**	**Slope**	**Thresholds**					
	Reliability	***a***	***b*$_1$**	***b*$_2$**	***b*$_3$**	***b*$_4$**	***b*$_5$**	***b*$_6$**
Positive Expressivity								
BEQ1		1.943	-2.656	-1.766	-1.424	-1.127	-0.363	0.718
BEQ4	.757	0.983	-3.567	-2.172	-1.442	-1.039	0.055	1.591
BEQ6		2.689	-2.803	-2.289	-1.697	-1.438	-0.666	0.576
BEQ10		1.041	-2.709	-1.727	-1.196	-0.562	0.437	1.627
Negative Expressivity								
BEQ3		1.003	-1.342	-0.252	0.577	1.111	1.787	3.193
BEQ5		1.282	-2.209	-1.076	-0.510	0.005	0.705	2.036
BEQ9	.812	0.732	-2.020	-0.115	1.140	2.131	2.990	4.680
BEQ13		2.666	-1.596	-0.745	-0.324	0.071	0.641	1.424
BEQ16		2.160	-2.129	-1.084	-0.763	-0.154	0.517	1.393
Impulse Strength								
BEQ2		1.127	-2.468	-1.663	-1.394	-0.988	-0.113	0.995
BEQ7		1.092	-2.947	-1.907	-1.406	-0.921	-0.076	1.160
BEQ11	.779	1.784	-2.249	-1.482	-0.974	-0.522	0.011	1.015
BEQ12		1.579	-2.466	-1.273	-0.847	-0.489	0.181	1.285
BEQ14		1.527	-2.449	-1.626	-1.361	-1.110	-0.658	0.473
BEQ15		1.427	-4.293	-3.075	-2.422	-1.685	-0.894	0.698

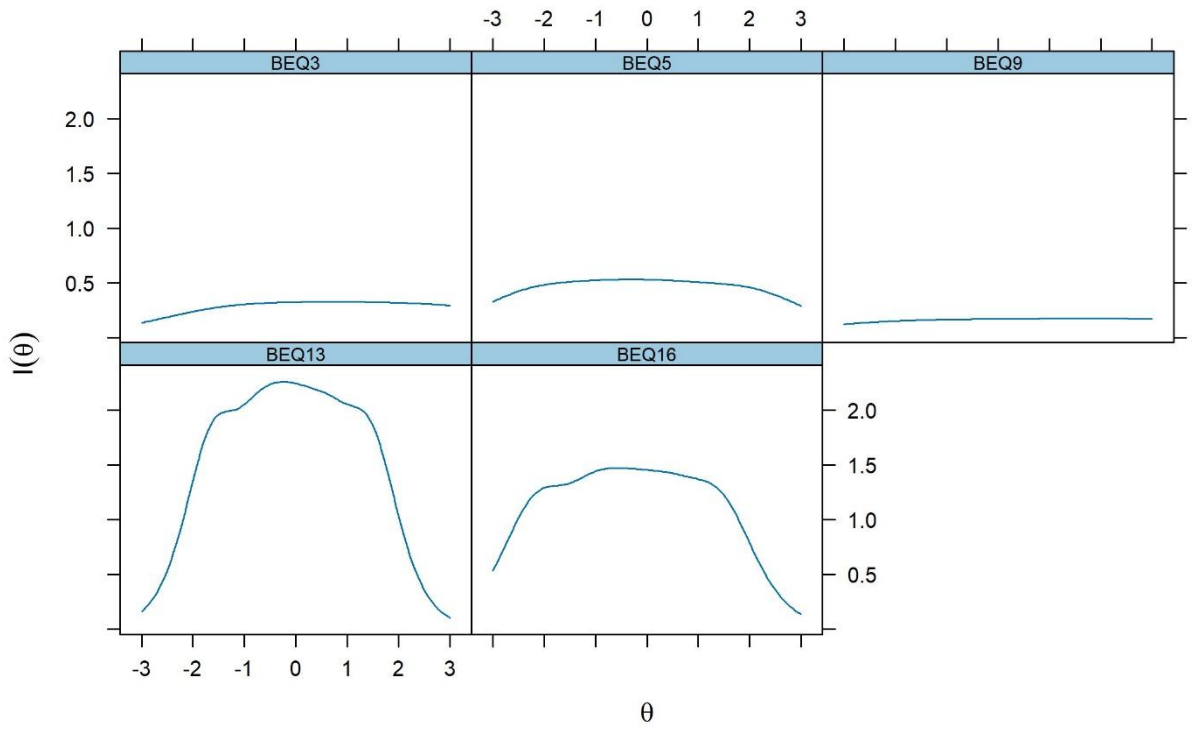


Supplementary Figure 1. Sex differences in expressivity scores.

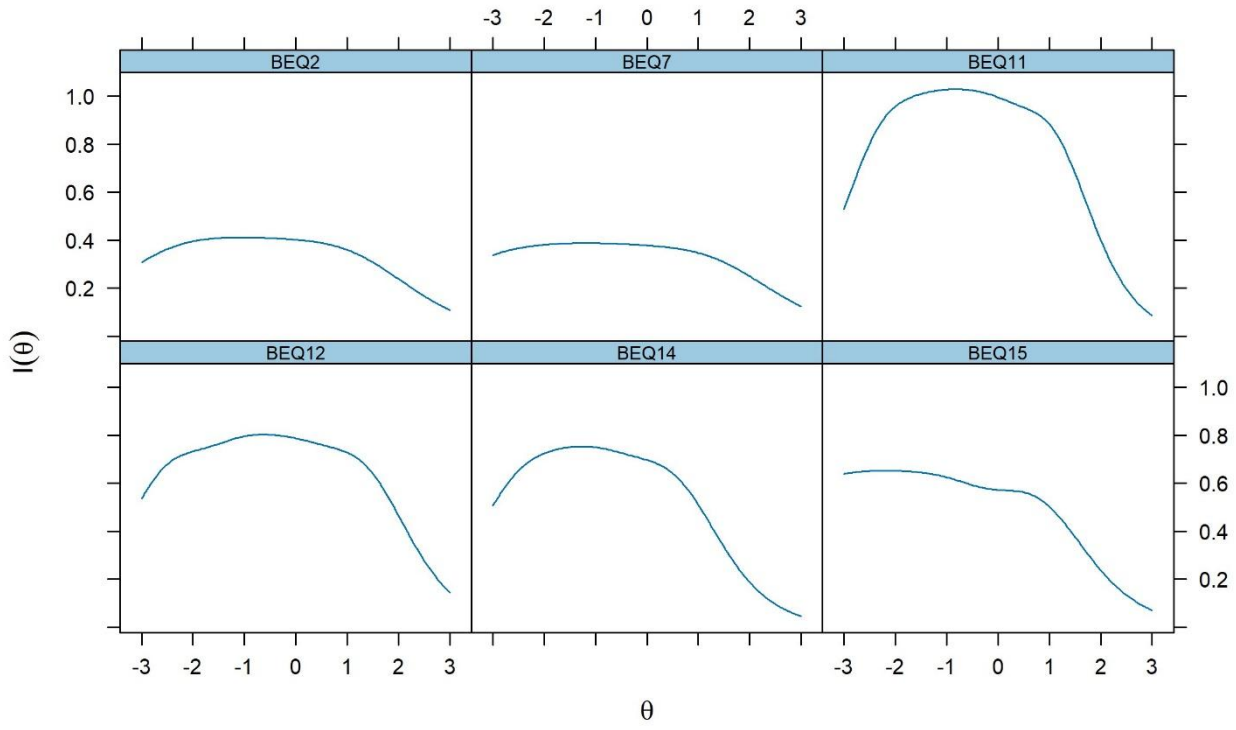
Notes. *Means ± (SD) for each subscale and each gender are presented inside the bars.*



Supplementary Figure 2. Item information curves (IIC) of the Positive Expressivity Subscale of the Bangla Berkeley Expressivity Questionnaire.



Supplementary Figure 3. Item Information Curves (IIC) of Negative Expressivity Subscale of the Bangla Berkeley Expressivity Questionnaire.



Supplementary Figure 4. Item Information Curves (IIC) for Impulse Strength Subscale of the Bangla Berkeley Expressivity Questionnaire.