

Development of a scale for parent-to-baby emotions: Concepts, design, and factor structure

Ayako Hada MSN^{1,2,3}  | Masumi Imura PhD⁴ | Toshinori Kitamura FRCPsych^{1,2,5,6} 

¹Kitamura Institute of Mental Health Tokyo, Tokyo, Japan

²Kitamura KOKORO Clinic Mental Health, Tokyo, Japan

³Department of Community Mental Health and Law, National Institute of Mental Health, National Center of Neurology and Psychiatry, Tokyo, Japan

⁴Global Health Care and Midwifery Graduate School of Nursing, Japanese Red Cross College of Nursing, Tokyo, Japan

⁵T. and F. Kitamura Foundation for Mental Health Research and Skill Advancement, Tokyo, Japan

⁶Department of Psychiatry, Graduate School of Medicine, Nagoya University, Nagoya, Japan

Correspondence

Toshinori Kitamura, FRCPsych, Department of Psychiatry, Graduate School of Medicine, Nagoya University, Nagoya, Japan.
Email: kitamura@institute-of-mental-health.jp

Funding information

None

Abstract

Aim: Although infant crying is a prerequisite for a baby's survival, it often leads to negative consequences for the caregivers. We hypothesized that this would be mediated by a primary emotion that we feel directly in response to an internal or external event. Hence, this study aimed to develop a new scale to measure basic and self-conscious emotions as primary emotions towards an infant's cry.

Methods: We conducted a cross-sectional web survey including the scale for parent-to-baby emotions (SPBE)—with 73 items elicited from a literature review—targeted at mothers at 1 month after childbirth ($N = 879$). A series of explanatory and confirmatory factor analyses were conducted using item parcels. Internal consistency of the scale was calculated by omega indices. We also examined measurement invariance of the scale.

Results: The theory-driven six basic emotions bifactor model (comparative fit index [CFI] = 0.968, root mean square of error approximation [RMSEA] = 0.070) and four self-conscious emotions factor model (CFI = 0.973, RMSEA = 0.079) were judged as the best models. They were stable in terms of configural, measurement, and structural invariances across parity.

Conclusion: The SPBE we created is a psychometrically robust measure to assess the primary emotions under the rubric of parent-to-baby emotions. It is a promising tool for measuring parent-to-baby emotions in clinical and research settings.

KEYWORDS

basic emotions, differences between nulliparas and multiparas, infant crying, infant gender, measurement and structural invariance, self-conscious emotions

INTRODUCTION

The caregiver's immediate emotional reaction to the infant crying may be an extremely important candidate as a mediator of baby cry on the maternal psychological maladjustment. Parental emotional reaction to the own baby cry is often represented as basic emotions and self-conscious emotions. It is feasible to assess parent-to-baby emotions in terms of basic emotions and self-conscious emotions.¹

Seven characteristics of emotions have been described: (a) automatic appraisal, (b) commonalities in antecedent events, (c) presence in other primates, (d) quick onset, (e) brief duration, (f) unbidden occurrence, and (g) distinctive physiology.² These characteristics are appropriate to the caregiver's reaction to the infant crying. They include happiness (joy), anger, fear, sadness, disgust, and surprise. Whereas basic emotions are biological, self-conscious emotions are more reflective of internal self. Self-conscious emotions differ from basic emotions because they require self-awareness and self-representations.³ Psychologists (e.g., Freud) have

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2022 The Authors. *Psychiatry and Clinical Neurosciences Reports* published by John Wiley & Sons Australia, Ltd on behalf of Japanese Society of Psychiatry and Neurology.

speculated about the linkage between psychopathology and shame and guilt, in which the latter two have the role of super-ego functions.⁴ A growing theoretical and empirical literature has indicated importance of differentiation of shame and guilt in the phenomenology.⁵⁻¹² Pride contains two distinct dimensions (alpha pride and beta pride) characterized by distinctive ways of appraising the causes of accomplishments.^{3,6,13,14} These self-conscious emotions motivate action towards the goals in embodied self-representations.^{3,13} Own baby cry could stimulate the individuals to compare self-representations (e.g., "I want to be a smiling mother all the time") with external emotion-eliciting events (e.g., "My baby never stops crying"). The self-conscious emotions are evoked in parent's mind when their baby cries. Hence, we developed a new emotion scale towards infant crying constructed based on the basic emotion and self-conscious emotion theories to measure these emotional statuses. These different types of positive and negative emotions should be assessed in the same manner.

A statistically robust scale is necessary for assessing differences between groups derived from different backgrounds in the same manner. For example, we could not compare the mean values of the total score of the scale between first-time mothers and mothers with one child or more if the factor structure of the scale were not the same. Such a comparison would not make sense. For the purpose of comparison between groups of individuals with regard to their level on a trait, or to investigate whether trait-level scores should be differentiated correlates across groups, one must assume that the numerical values under consideration are on the same measurement scale.¹⁵⁻¹⁸ Hence, measurement tools are required to examine the invariance including configural, measurement, and construct invariance.

In the current study, our goal was to develop a robust scale that has measurement invariance for use with parents of infants, hoping that it would be useful in clinical and research situations. In the process of development of our new scale, we followed the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN) study design checklist.¹⁹ COSMIN was developed to evaluate the methodological quality of a study by measurement properties.^{20,21}

METHODS

Study procedures and participants

The target of this cross-sectional study was mothers at 1 month after childbirth. The data used in the present study came from two web surveys via SurveyMonkey and Rakuten Insight. For the first data set, we used the web survey system SurveyMonkey, where we created the questionnaire. We distributed flyers calling for participation which included the QR code and the weblink for the SurveyMonkey website. This was done at outpatient services when mothers came for a 1-month check-up after childbirth. We distributed the flyers to approximately 4500 mothers and 679 mothers participated in our

survey via SurveyMonkey. Our inclusion criteria were mothers who (a) lived with a 1-month old, (b) lived in Japan, and (c) stated that Japanese was their native language. Our exclusion criterion was cases of multiple births. For the second data set, with the cooperation of Rakuten Insight Inc., mothers at 1 month after childbirth were recruited from 47 prefectures in Japan. A total of 200 mothers participated in the Rakuten Insight survey. Rakuten Insight has a proprietary panel. We used the panel of parents with a child/children, named "the parent and child panel." All respondents provided personal information (e.g., date of birth, residence, gender, family, and occupation) when they created account as a respondent panel. Researchers were not able to know personal information except the member's age, residence area, and gender. All respondents were allocated an original ID number that researchers used for personal identification. Rakuten Insight set up the same questionnaire as that used in the first survey. Rakuten Insight sent a notification e-mail about the present survey with a URL to the parent and child panel members. Three screening questions identified the respondents who were eligible for the study. The two groups differed in none of the variables used in the present analyses except for a few points. Thus, as compared with the second group, the first group of women were significantly ($P < 0.001$ for multiple comparison) but slightly older while the mean age of the partner did not differ. The first group of women had a younger infant (39.2 [SD 1.2] days vs. 46.0 [9.3] days).

The questionnaire was preceded by an information page, with the aims of this research and affiliations of the study explained and information about ethical considerations. The questionnaire consisted of demographic variables and the measurement we created for this study (see below).

A total of 879 mothers participated in our study. Table 1 presents the demographic data of the sample. Their mean (SD) age was 33.4 (4.6) years old. Among them, 426 (51.3%) were nulliparae and 404 (48.9%) were multiparae. The parity of 49 women was not known. The gender ratio of infants was even: 406 (48.9%) boys and 421 (50.7%) girls. The gender of 52 babies was not known. The SurveyMonkey web page was open from November 5, 2018 to September 30, 2019, and the Rakuten Insight web page was available from June 28 to July 1, 2019.

Measurements

The first part of this study was the construction of a new scale of mother's emotions towards the infant's cry based on the theories of basic and self-conscious emotions. First, scale items were elicited from qualitative studies on the mother's responses towards infants crying. We browsed the Japanese literature on this topic via Igaku Chuo Zasshi (Ichushi). Ichushi is bibliographic database that was established in 1903 and is being updated by the Japan Medical Abstracts Society (JAMAS), a nonprofit and nongovernmental organization. We identified six references²²⁻²⁷ that described emotion words related to a mother's response towards infant crying. Next, items which were

TABLE 1 The demographic data of the sample

| | Mean (SD) |
|-----------------------------|----------------------|
| Mother's age | 33.4 (4.6) years old |
| Partner's age | 35.4 (4.7) years old |
| Infant's age | 40.1 (10.3) days |
| Infant's gestational age | 39.0 (1.3) weeks |
| Infants' mean weight | 3066 (408) g |
| | Frequency (%) |
| Parity | |
| Nulliparae | 426 (48.5) |
| Multiparae | 404 (46.0) |
| Not known | 49 (5.5) |
| Gender of infants | |
| Boys | 406 (46.1) |
| Girls | 421 (47.9) |
| Not known | 52 (6.0) |
| Mode of delivery | |
| Vaginally | 614 (69.9) |
| Obstetrical anaesthesia | 90 (10.2) |
| Caesarean section | 157 (17.9) |
| Planned Caesarean section | 94 (10.7) |
| Emergency Caesarean section | 63 (7.2) |
| Not known | 18 (2.0) |

expected to reflect emotion words on the basis of theories of basic and self-conscious emotions were elicited from the following existing scales to measure emotions in general: PANNAS,²⁸ the Multiple Mood Scale,²⁹ the Japanese version of State-Trait Anger Expression Scale,³⁰ and the Japanese version³¹ of Test of Self-Conscious Affect, Version 3.³² These were then classified into emotion categories based on the concepts of basic (i.e., happiness, anger, fear, sadness, disgust, and surprise) and self-conscious (i.e., shame, guilt, and alpha and beta pride) emotions. These emotion words and items were adjusted into items which were described with brief sentences. We intended to have five or more items for each emotion category, taking into consideration that some of them might be deleted during analysis. Where the number of items was insufficient, we added ad hoc items which are consistent with concepts of the emotion category. This process was conducted through discussion with master course colleagues as well as the authors (M.I., Professor of Global Health Care and Midwifery Graduate School of Nursing, and T.K., FRCPsych). Finally, all 73 items were listed and presented randomly in the scale. Our new instrument, the Scale for Parent-to-Baby Emotions (SPBE), consists of 73 items with a five-point scale from 1 (did not feel at all) to 5 (felt extremely strongly). These items were presented with the direction "How strongly did you feel these emotions when your baby cried the most recently?"

Data analysis

We used a sample which had no missing cases for the SPBE ($N = 831$). To start, we examined the skewness and kurtosis of each item to confirm a normal distribution of the item. We then conducted item parcelling as a stratagem because of a fairly large number of questionnaire items. Item parcelling is a method of aggregating individual items into one or more item parcels, which has several merits. First, item parcelling can make clearer and more comprehensible representations of even multidimensional constructs³³ and greatly help to eliminate theoretically unimportant noises.³⁴ Second, parcelled indicators could be more normally distributed than using individual items,³⁵ therefore model fit would be improved by using parcelled indicators rather than individual items. Each item must be unidimensional to be allocated to an item parcel.³³⁻³⁶ Hence, before item parcelling, we calculated the Cronbach's α ³⁷ coefficient and inter-item correlations for each emotion subscale separately. Although different parcel-forming algorithms exist, there is no standard algorithm to allocate items. Among methods of producing item parcels,³⁴ we applied the factorial algorithm. In this algorithm, first a factor analysis with a single-factor model must be performed on the scale and item parcels built in accordance with a guide which are computed factor loadings. The highest factor-loading item and the lowest factor-loading item are combined and allocated to each item parcel sequentially. Because three item parcels are recommended as the number of item parcels allocated for one subscale,^{34,35} we created 18 and 12 parcels for the basic and self-conscious emotions subscales, respectively.

On the premise that human emotion has two dimensions (i.e., basic and self-conscious), we conducted exploratory factor analyses (EFAs) and confirmatory factor analyses (CFAs) on the two dimensions of human emotion separately. We divided the whole sample ($N = 831$) randomly into two groups: one ($n = 417$) for EFAs and another ($n = 414$) for CFAs. Within the group for EFAs, we examined the Kaiser-Meyer-Olkin (KMO) index and Bartlett's sphericity test to confirm the factorability of the data. The skewness, kurtosis, and communalities of all item parcels were also examined. We next performed a series of EFAs with PROMAX rotation by the maximum-likelihood method from a single-factor structure and subsequently models with an increasingly greater number of factors (i.e., two- and three-factor structures, and so on).

Next, we compared the goodness-of-fit of these models in a series of CFAs with maximum likelihood mean (MLM) adjusted using the second sample. This was the cross-validation of the models derived from EFAs. We also added theory-driven models (i.e., six basic emotion subscales and four self-conscious emotion subscales). If necessary, bifactor models were also built and examined. A bifactor model has a structure where the general factors and several specific (group) factors are nested³⁸⁻⁴⁰ The fit of models with the data was examined in terms of χ^2 the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). According to conventional criteria, a good fit would be indicated by $\chi^2/\text{degree of freedom (df)} < 2$, CFI > 0.97 , and RMSEA < 0.05 , and an acceptable fit by $\chi^2/\text{df} < 3$, CFI > 0.95 , and RMSEA < 0.08 .^{41,42} We also used the Akaike information criterion (AIC),⁴³ where a lower AIC was judged as

being better. Starting from the single-factor model, the subsequent model was judged better only if its χ^2 value (for the df difference) was significantly lower than that for the former model.

As discussed later, the present study showed that, among basic emotions, a bifactor model fitted the data best. We then examined whether group factors were so negligible that the model was sufficiently unidimensional. To this end, we used a group of ω coefficients. First, ω indicates the proportion of variance of the whole measurement explained by the general factor and all group factors. Second, ω_s indicates the proportion of the variance among items of each specific group factor explained by both the general and group factors. The percentage of the variance of the whole measurement explained by the general factor and all the group factors explained only by the general factor is termed omega hierarchical: ω_H . Similarly, the omega hierarchical subscale (ω_{HS}) indicates the percentage of the variance among items of each specific group factor explained by the group factor. Hence, the higher the ω_H , the more suggestive of unidimensionality.^{18,44} Unidimensionality was also indicated by explained common variance (ECV) >0.8 .^{44,45}

After identifying the best fit model, we examined its measurement invariance across groups with different demographic features: nulliparae versus multiparae (parity) and mothers of boys versus girls (gender of the baby). We selected these two demographic features as point of measurement invariance for a few reasons. It is widely recognized that nulliparous and multiparous women differ in many psychological elements. Difference of the mothers' perception of the baby's gender may exist. For example, Japanese mothers prefer girls to boys,⁴⁶ thus gender preference may elicit different emotional reactions. The measurement invariance test was conducted in accordance with the recommendation by Vandenberg and Lance.⁴⁷ In this recommendation, we confirmed that the groups did not differ in terms of (a) configural invariance (each group had the same pattern of indicators and factors), (b) metric invariance, also known as weak factorial invariance (factor loadings for similar indicators were invariant across groups), (c) scalar invariance, also known as strong factorial invariance (intercepts of similar items were invariant across groups), (d) residual invariance, also known as strict factorial invariance (residuals of similar items were invariant across groups), (e) factor variance invariance (variances of similar factors were invariant across groups), (f) factor covariance invariance (covariances between factors were invariant across groups), and (g) factor mean invariance (means of factors were invariant across groups). We proceeded with tests for invariance step by step as we confirmed (a) a nonsignificant increase of χ^2 for df of difference, (b) a decrease of CFI less than 0.01, or (c) an increase of RMSEA <0.01 .^{48,49}

RESULTS

Item parceling

The skewness and kurtosis of all the scale items are shown in Supporting information Tables 1 and 2. A few items (43SH, 19FE, 46SH, and 33DI) showed extremely high kurtosis. Among the whole

sample, items of each subscale were characterized by excellent internal consistency with a Cronbach's α coefficient of more than 0.8 (Supporting Information Tables 1 and 2) as well as good interitem correlations (Supporting Information Tables 3–12). Items of each subscale were subjected to single-factor EFAs to show good communality and factor loading with 0.32 or higher⁵⁰ (Supporting Information Tables 13 and 14). These findings suggested that items for each subscale were unidimensional. Hence, these findings support our procedure of item parceling.

All of the 18 parcels for basic emotions and 12 parcels for self-conscious emotions showed excellent skewness and kurtosis (Table 2). Only two parcels (AN1 and FE1) showed skewness >2.0 and kurtosis >4 .⁵¹

EFA

We performed EFAs for basic and self-conscious emotion parcels separately. We started from a single-factor model and gradually increased the number of factors. For the basic emotion parcels, the three-factor model showed that parcels of anger, sadness, and disgust loaded on the first factor whereas those of fear and surprise loaded on the second factor, and those of happiness loaded on the final factor (Table 3). In the four-factor model, however, no parcels loaded on the fourth factor with 0.3 or more.

For the self-conscious emotion parcels, the two-factor model matched the theoretical expectation with the shame and guilt parcels loaded on the first factor while the alpha and beta pride parcels loaded on the second factor (Table 4). Shame and guilt were not differentiated, nor were alpha and beta pride. In the three-factor model of self-conscious emotion parcels, only one parcel (BETA2) loaded highly on the third factor.

CFA

As cross-validation of the EFA-derived factor models, as well as theory-driven models of the basic and self-conscious emotion parcels, we used the second sample to perform CFAs in which different models were compared (Table 5). For the basic emotion parcels, the goodness-of-fit of the model was significantly better for the two-factor than the single-factor models. Improvement was also noted from the two-factor to the three-factor models, but the absolute value of goodness-of-fit was far below acceptable: CFI <0.95 and RMSEA >0.8 . The theory-driven six-factor structure model, corresponding to the six basic emotions, showed a statistically significantly better fit than the three EFA-derived models. We further constructed a bifactor model that showed a better fit. Because happiness represents a positive emotion whereas the remaining five basic emotions (anger, fear, sadness, disgust, and surprise) represent negative emotions, we set a general factor influencing the five negative emotion item parcels (Figure 1). This showed an even better fit than any of the other models: CFI = 0.968, RMSEA = 0.070. The model fit using all samples ($N = 831$) was even better than when using second halved

TABLE 2 Parcels and items included each parcel, mean, SD, skewness, and kurtosis (sample for EFA, $n = 417$)

| Subscale | Name | Item label (item no.) | Mean | SD | Skewness | Kurtosis |
|-------------------------------------|--------|--|------|------|----------|----------|
| Parcels for basic emotions | | | | | | |
| Happiness | HA1 | 04HA (E72), 02HA (E62), 05HA (E67) | 7.38 | 2.99 | 0.43 | -0.53 |
| | HA2 | 06HA (E71), 08HA (E28), 07HA (E59) | 9.56 | 2.74 | 0.11 | -0.51 |
| | HA3 | 03HA (E39), 01HA (E2) | 5.26 | 1.99 | 0.40 | -0.46 |
| Anger | AN1 | 12AN (E36), 15AN (E49), 13AN (E58) | 3.92 | 1.66 | 2.17 | 5.11 |
| | AN2 | 10AN (E5), 14AN (E4) | 2.94 | 1.29 | 1.21 | 0.35 |
| | AN3 | 11AN (E40), 09AN (E15) | 3.36 | 1.46 | 0.94 | 0.24 |
| Fear | FE1 | 18FE (E31), 19FE (E55), 16FE (E6) | 3.97 | 1.72 | 2.37 | 6.65 |
| | FE2 | 22FE (E68), 21FE (E64), 20FE (E30) | 5.38 | 2.54 | 0.97 | 0.23 |
| | FE3 | 17FE (E60), 23FE (E43) | 3.07 | 1.48 | 1.29 | 1.00 |
| Sadness | SA1 | 25SA (E35), 28SA (E54) | 2.77 | 1.27 | 1.86 | 3.65 |
| | SA1 | 26SA (E34), 29SA (E10) | 3.50 | 1.53 | 0.86 | 0.07 |
| | SA3 | 24SA (E14), 27SA (E9) | 3.13 | 1.51 | 1.28 | 0.90 |
| Disgust | DI1 | 30DI (E53), 33DI (E25) 37DI (E73) | 4.60 | 1.92 | 1.15 | 0.77 |
| | DI2 | 34DI (E11), 36DI (E32), 31DI (E56) | 5.04 | 2.29 | 1.04 | 0.34 |
| | DI3 | 32DI (E12), 35DI (E50) | 3.39 | 1.53 | 0.85 | -0.16 |
| Surprise | SU1 | 40SU (E51), 39SU (E13) | 2.89 | 1.36 | 1.65 | 2.79 |
| | SU2 | 38SU (E46), 42SU (E65) | 3.24 | 1.57 | 1.03 | 0.02 |
| | SU3 | 41SU (E44) | 1.74 | 0.97 | 1.07 | 0.24 |
| Parcels for self-conscious emotions | | | | | | |
| Shame | SH1 | 52SH (E52), 43SH (E27), 49SH (E8), 44SH (E1) | 6.12 | 2.41 | 1.24 | 1.28 |
| | SH2 | 50SH (E24), 45SH (E21), 47SH (E33) | 5.04 | 2.09 | 0.91 | 0.20 |
| | SH3 | 51SH (E63), 46SH (E26), 48SH (E47) | 4.29 | 1.78 | 1.53 | 2.18 |
| Guilt | GU1 | 54GU (E23), 57GU (E69), 53GU (E7) | 5.13 | 2.06 | 0.69 | -0.20 |
| | GU2 | 58GU (E48), 56GU (E61), 61GU (E19) | 5.27 | 2.11 | 0.65 | -0.40 |
| | GU3 | 60GU (E16), 55GU (E22), 59GU (E38) | 4.63 | 1.92 | 1.22 | 0.97 |
| Alpha-pride | ALPHA1 | 63ALPHA (E70), 64ALPHA (E18) | 4.63 | 1.99 | 0.51 | -0.45 |
| | ALPHA2 | 62ALPHA (E66), 66ALPHA (E20) | 3.83 | 1.77 | 0.85 | 0.38 |
| | ALPHA3 | 67ALPHA (E45), 65ALPHA (E29) | 4.05 | 1.81 | 0.85 | 0.52 |
| Beta-pride | BETA1 | 68BETA (E41), 69BETA (E17) | 4.35 | 1.85 | 0.67 | 0.09 |
| | BETA2 | 70BETA (E57), 73BETA (E3) | 5.26 | 1.92 | 0.35 | -0.37 |
| | BETA3 | 71BETA (E37), 72BETA (E42) | 4.43 | 1.90 | 0.54 | -0.31 |

Note: The names of parcels and items were attributed to each emotion domain.

Abbreviations: ALPHA, alpha pride; AN, anger; BETA, beta pride; DI, disgust; EFA, exploratory factor analysis; FE, fear; GU, guilt; HA, happiness; SA, sadness; SH, shame; SU, surprise.

sample: CFI = 0.972, RMSEA = 0.066. We thought that the best fit was the modified bifactor model with the six specific factors and one general factor.

The single-factor model of self-conscious emotion parcels showed a poor fit with the data and the two-factor model was much better in terms of fit indices (Table 6). CFI and RMSEA were

slightly improved by the theory-driven four-factor model, reaching an acceptable level (RMSEA = 0.079) (Table 6). A significant reduction of χ^2 was shown in the theory-driven four-factor model. In addition, the AIC of this model showed an even better fit than any other models. A bifactor model demonstrated an improper solution. Taking these findings into account, the

TABLE 3 EFA for basic emotions dimension ($n = 417$)

| | Communality | One factor | Two-factor | | Three-factor | | | Four-factor | | | |
|-----|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------|
| | | I | I | II | I | II | III | I | II | III | IV |
| HA1 | 0.77 | -0.15 | 0.13 | 0.93 | 0.08 | 0.08 | 0.94 | 0.06 | 0.05 | 0.95 | 0.06 |
| HA2 | 0.79 | -0.29 | -0.01 | 0.93 | -0.02 | 0.02 | 0.93 | -0.03 | -0.01 | 0.94 | 0.04 |
| HA3 | 0.67 | -0.24 | 0.01 | 0.85 | 0.03 | -0.01 | 0.86 | 0.03 | -0.01 | 0.85 | -0.03 |
| AN1 | 0.68 | 0.75 | 0.74 | 0.02 | 0.89 | -0.08 | 0.15 | 0.97 | -0.02 | 0.10 | -0.25 |
| AN2 | 0.64 | 0.70 | 0.67 | -0.06 | 0.85 | -0.12 | 0.06 | 1.04 | 0.04 | -0.07 | -0.59 |
| AN3 | 0.70 | 0.75 | 0.72 | -0.03 | 0.91 | -0.12 | 0.10 | 1.02 | -0.04 | 0.04 | -0.33 |
| FE1 | 0.63 | 0.69 | 0.74 | 0.09 | 0.18 | 0.66 | 0.01 | 0.22 | 0.70 | -0.03 | -0.13 |
| FE2 | 0.75 | 0.67 | 0.74 | 0.13 | -0.03 | 0.91 | -0.01 | -0.04 | 0.85 | 0.01 | 0.11 |
| FE3 | 0.74 | 0.73 | 0.77 | 0.03 | 0.11 | 0.78 | -0.07 | 0.10 | 0.72 | -0.04 | 0.15 |
| SA1 | 0.67 | 0.78 | 0.77 | -0.05 | 0.46 | 0.38 | -0.06 | 0.44 | 0.29 | 0.01 | 0.20 |
| SA2 | 0.67 | 0.81 | 0.78 | -0.10 | 0.57 | 0.28 | -0.08 | 0.59 | 0.26 | -0.06 | 0.01 |
| SA3 | 0.63 | 0.75 | 0.76 | -0.01 | 0.41 | 0.42 | -0.03 | 0.42 | 0.39 | -0.02 | 0.03 |
| DI1 | 0.81 | 0.88 | 0.82 | -0.13 | 0.86 | 0.05 | -0.04 | 0.87 | -0.02 | 0.02 | 0.10 |
| DI2 | 0.81 | 0.89 | 0.82 | -0.16 | 0.87 | 0.04 | -0.07 | 0.88 | -0.04 | -0.01 | 0.11 |
| DI3 | 0.75 | 0.82 | 0.75 | -0.20 | 0.87 | -0.05 | -0.09 | 0.87 | -0.12 | -0.02 | 0.12 |
| SU1 | 0.65 | 0.57 | 0.65 | 0.17 | -0.06 | 0.82 | 0.04 | -0.02 | 0.88 | -0.02 | -0.15 |
| SU2 | 0.75 | 0.62 | 0.70 | 0.14 | -0.13 | 0.96 | -0.01 | -0.12 | 0.94 | -0.02 | 0.03 |
| SU3 | 0.58 | 0.48 | 0.59 | 0.27 | -0.14 | 0.84 | 0.14 | -0.12 | 0.85 | 0.11 | -0.04 |

Note: The names of parcels and items were attributed to each emotion domain. Factor loadings > 0.3 are in bold.

Abbreviations: AN, anger; DI, disgust; EFA, exploratory factor analysis; FE, fear; HA, happiness; SA, sadness; SU, surprise.

TABLE 4 EFA for self-conscious emotions dimension ($n = 417$)

| | Communality | One-factor | Two-factor | | Three-factor | | |
|--------|-------------|-------------|-------------|-------------|--------------|--------------|-------------|
| | | I | I | II | I | II | III |
| SH1 | 0.66 | -0.15 | -0.02 | 0.82 | -0.00 | 0.80 | -0.19 |
| SH2 | 0.74 | -0.16 | -0.02 | 0.89 | -0.02 | 0.88 | -0.10 |
| SH3 | 0.64 | -0.18 | -0.06 | 0.78 | -0.023 | 0.760 | -0.29 |
| GU1 | 0.67 | -0.10 | 0.03 | 0.83 | 0.01 | 0.84 | 0.08 |
| GU2 | 0.64 | -0.13 | -0.00 | 0.81 | -0.02 | 0.82 | 0.04 |
| GU3 | 0.74 | -0.08 | 0.06 | 0.90 | 0.04 | 0.90 | 0.06 |
| ALPHA1 | 0.77 | 0.90 | 0.90 | 0.02 | 0.90 | 0.01 | 0.02 |
| ALPHA2 | 0.76 | 0.88 | 0.87 | -0.03 | 0.91 | -0.05 | -0.14 |
| ALPHA3 | 0.73 | 0.86 | 0.86 | 0.02 | 0.88 | 0.01 | -0.09 |
| BETA1 | 0.70 | 0.84 | 0.84 | -0.02 | 0.81 | -0.01 | 0.18 |
| BETA2 | 0.70 | 0.83 | 0.83 | -0.04 | 0.79 | -0.01 | 0.32 |
| BETA3 | 0.80 | 0.91 | 0.92 | 0.04 | 0.90 | 0.05 | 0.10 |

Note: The names of parcels and items were attributed to each emotion domain. Factor loadings > 0.3 are in bold.

Abbreviations: ALPHA, alpha pride; BETA, beta pride; EFA, exploratory factor analysis; GU, guilt; SH, shame.

TABLE 5 Model comparison for basic emotions dimension (factorial algorithm parceling)

| Model (n = 414) | χ^2/df | $\Delta\chi^2 (df)$ | CFI | ΔCFI | RMSEA | $\Delta RMSEA$ | AIC |
|--|----------------------------|---------------------|--------------|--------------|--------------|----------------|----------------|
| Models derived from EFA | | | | | | | |
| One-factor | 2931.148/135 = 21.712 | Ref | 0.599 | Ref | 0.217 | Ref | 3039.148 |
| Two-factor | 2025.517/134 = 15.116 | 905.631 (1)*** | 0.729 | 0.13 | 0.179 | 0.038 | 2135.517 |
| Three-factor | 1038.687/132 = 7.869 | 986.83 (2)*** | 0.870 | 0.141 | 0.125 | 0.054 | 1152.687 |
| Theory-driven basic emotions model | | | | | | | |
| Theory-driven six-factor | 443.899/120 = 3.699 | 594.788 (12)*** | 0.954 | 0.084 | 0.078 | 0.047 | 581.899 |
| Theory-driven six-factor bifactor | 336.710/102 = 3.301 | 107.189 (18)*** | 0.966 | 0.012 | 0.072 | 0.006 | 510.710 |
| Theory-driven six-factor modified bifactor | 329.708/105 = 3.140 | 114.191 (5)*** | 0.968 | 0.014 | 0.070 | 0.008 | 497.708 |
| Model (N = 831) | | | | | | | |
| Theory-driven six-factor modified bifactor | 483.135/105 = 4.601 | 153.427 (0) | 0.972 | 0.004 | 0.066 | 0.004 | 651.135 |

Note: The theory-driven basic emotions six-factor modified bifactor model was compared with the theory-driven basic emotions six-factor model. The best indices are in bold.

Abbreviations: AIC, Akaike information criteria; CFI, comparative fit index; EFA, exploratory factor analysis; RMSEA, root mean square error of approximation;

*P < 0.05; **P < 0.01; ***P < 0.001.

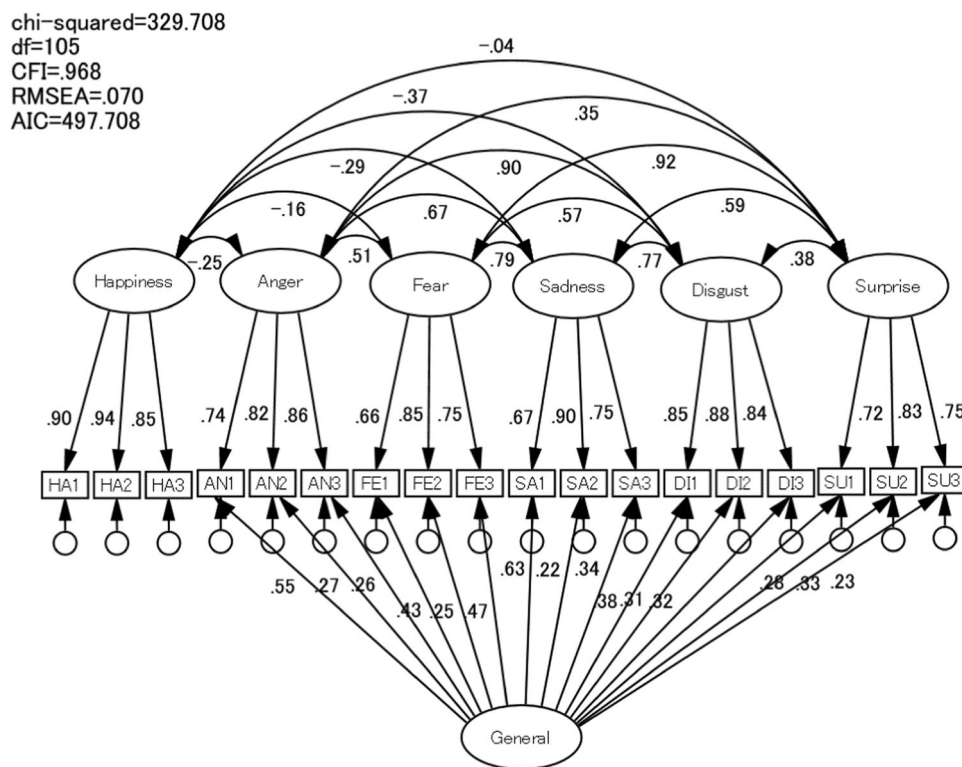


FIGURE 1 Confirmative factor analysis of theory-driven basic emotions modified bifactor model (n = 414). AIC, Akaike information criteria; CFI, comparative fit index; RMSEA, root mean square error of approximation. Paths are standardized. Significant paths are in bold. The names of error variables are deleted

four-factor theory-driven model was the best fit to the data. The model fit using all samples (N = 831) was even better than when using second halved sample: CFI = 0.980, RMSEA = 0.069. We therefore selected the four-factor theory-driven model for the self-conscious emotions dimension (Figure 2).

As the basic emotions were best explained by the bifactor model, we then examined whether the model was sufficiently multidimensional or whether the subscale (group) factors were so negligible that the model was virtually unidimensional (Table 7). Most of the whole-scale variance was explained by this model. Hence the scale showed excellent internal

TABLE 6 Model comparison for self-conscious emotions dimension (factorial algorithm parceling)

| Model (n = 414) | χ^2/df | $\Delta\chi^2 (df)$ | CFI | ΔCFI | RMSEA | $\Delta RMSEA$ | AIC |
|-------------------------------------|---------------------------|---------------------|--------------|--------------|--------------|----------------|----------------|
| Models derived from EFA | | | | | | | |
| One-factor | 2457.186/54 = 45.503 | Ref | 0.509 | Ref | 0.318 | Ref | 2529.186 |
| Two-factor | 215.035/53 = 4.057 | 2212.151 (1)*** | 0.967 | 0.458 | 0.083 | 0.512 | 289.035 |
| Theory-driven self-conscious models | | | | | | | |
| Theory-driven four-factor | 178.166/48 = 3.712 | 36.869 (5)*** | 0.973 | 0.006 | 0.079 | 0.004 | 262.166 |
| Model (N = 831) | | | | | | | |
| Theory-driven four-factor | 238.223/48 = 4.963 | 59.563 (0) | 0.980 | 0.007 | 0.069 | 0.010 | 322.223 |

Note: CFI, comparative fit index. The best indices are in bold.

Abbreviations: AIC, Akaike information criteria; EFA, exploratory factor analysis; RMSEA, root mean square error of approximation.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

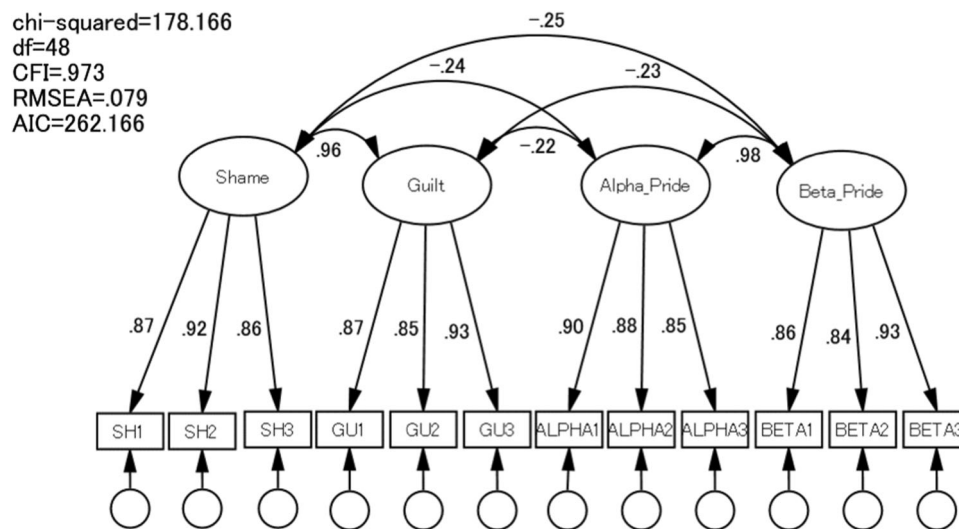


FIGURE 2 Confirmative factor analysis of the self-conscious emotions four-factor model (n = 414). AIC, Akaike information criteria; CFI, comparative fit index; RMSEA, root mean square error of approximation. Paths are standardized. The names of error variables are deleted

consistency. The general factor, however, explained less than half of the whole-scale variance, rejecting the possibility of unidimensionality. On the other hand, group factors, particularly happiness, explained more than 70% of the variance of each subscale. This suggests that although the general factor added some contribution to the whole-scale variance of the group for negative emotions, each subscale substantially influenced the variance of each group. ECV was 0.146, also suggesting multidimensionality.

Measurement invariance, construct invariance, and factor mean

The comparisons between nulliparae and multiparae, as well as mothers of boys and girls, showed that the theory-driven six-factor modified bifactor model and the theory-driven four-factor self-conscious model were invariant from configural, metric, scalar, factor variance, and factor covariance perspectives (Tables 8 and 9). It was therefore proven that the factor structure of the present instrument

TABLE 7 Omega coefficients for the theory-driven six-factor modified bifactor model

| Factors | ω/ω_S | ω_H/ω_{HS} |
|-----------|-------------------|------------------------|
| General | 0.942 | 0.464 |
| Happiness | 0.924 | 0.924 |
| Anger | 0.920 | 0.770 |
| Fear | 0.888 | 0.708 |
| Sadness | 0.917 | 0.726 |
| Disgust | 0.944 | 0.819 |
| Surprise | 0.859 | 0.760 |

Note: ω , omega; ω_S , omega subscale; ω_H , omega hierarchical; ω_{HS} , omega hierarchical subscale.

had the same factor structure regardless of the parity of mothers and gender of infants.

Factor means differed in terms of parity and gender of child. Compared to multiparae, nulliparae were rated higher in anger, fear,

TABLE 8 Measurement invariances for the theory-driven six-factor modified bifactor model

| | χ^2 | df | χ^2/df | $\Delta\chi^2(df)$ | CFI | Δ CFI | RMSEA | Δ RMSEA | AIC | Judgement |
|---|----------|-----|-------------|--------------------|-------|--------------|-------|----------------|----------|-----------|
| Nulliparae (n = 426) vs. multiparae (n = 404) | | | | | | | | | | |
| Configural | 603.014 | 210 | 2.871 | Ref | 0.970 | Ref | 0.047 | Ref | 939.014 | ACCEPT |
| Metric | 705.361 | 236 | 2.989 | 102.347 (26)*** | 0.964 | 0.006 | 0.048 | 0.001 | 989.361 | ACCEPT |
| Scalar | 864.586 | 254 | 3.404 | 159.225 (18)*** | 0.953 | 0.011 | 0.053 | 0.005 | 1112.586 | ACCEPT |
| Residual | 1171.628 | 272 | 4.307 | 307.042 (18)*** | 0.931 | 0.012 | 0.062 | 0.009 | 1393.495 | ACCEPT |
| Factor variance | 1294.001 | 279 | 4.638 | 122.373 (7)*** | 0.922 | 0.011 | 0.065 | 0.003 | 1492.001 | ACCEPT |
| Factor covariance | 1415.850 | 293 | 4.832 | 121.849 (14)*** | 0.914 | 0.008 | 0.067 | 0.002 | 1585.850 | ACCEPT |
| Boys (n = 406) vs. girls (n = 421) | | | | | | | | | | |
| Configural | 632.318 | 210 | 3.001 | Ref | 0.969 | Ref | 0.049 | Ref | 968.318 | ACCEPT |
| Metric | 685.389 | 236 | 2.904 | 53.071 (26)** | 0.967 | 0.002 | 0.048 | 0.001 | 989.389 | ACCEPT |
| Scalar | 709.056 | 254 | 2.792 | 23.667 (18) | 0.967 | 0.000 | 0.047 | 0.001 | 957.056 | ACCEPT |
| Residual | 748.064 | 272 | 2.750 | 39.008 (18)* | 0.965 | 0.002 | 0.046 | 0.001 | 960.064 | ACCEPT |
| Factor variance | 761.918 | 278 | 2.741 | 13.853 (6)* | 0.964 | 0.001 | 0.046 | 0.000 | 961.918 | ACCEPT |
| Factor covariance | 793.662 | 293 | 2.709 | 31.744 (15)** | 0.963 | 0.001 | 0.046 | 0.000 | 963.662 | ACCEPT |

Abbreviations: AIC, Akaike information criteria; CFI, comparative fit index; RMSEA, root mean square error of approximation.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

TABLE 9 Measurement invariances for the theory-driven 4four-factor model

| | χ^2 | df | χ^2/df | $\Delta\chi^2(df)$ | CFI | Δ CFI | RMSEA | Δ RMSEA | AIC | Judgement |
|---|----------|-----|-------------|--------------------|-------|--------------|-------|----------------|---------|-----------|
| Nulliparae (n = 426) vs. multiparae (n = 404) | | | | | | | | | | |
| Configural | 302.029 | 96 | 3.146 | Ref | 0.977 | Ref | 0.051 | Ref | 470.029 | ACCEPT |
| Metric | 310.944 | 104 | 2.990 | 8.915 (8) | 0.977 | 0.000 | 0.049 | +0.002 | 462.944 | ACCEPT |
| Scalar | 415.877 | 116 | 3.585 | 104.933 (12)*** | 0.967 | 0.010 | 0.056 | 0.007 | 543.877 | ACCEPT |
| Residual | 467.498 | 128 | 3.652 | 51.621 (12)*** | 0.962 | 0.005 | 0.057 | 0.001 | 571.498 | ACCEPT |
| Factor variance | 517.392 | 132 | 3.920 | 49.894 (4)*** | 0.957 | 0.005 | 0.059 | 0.002 | 613.392 | ACCEPT |
| Factor covariance | 525.360 | 138 | 3.807 | 7.968 (6) | 0.957 | 0.000 | 0.058 | +0.001 | 609.360 | ACCEPT |
| Boys (n = 406) vs. girls (n = 421) | | | | | | | | | | |
| Configural | 311.483 | 96 | 4.196 | Ref | 0.977 | Ref | 0.052 | Ref | 479.483 | ACCEPT |
| Metric | 326.687 | 104 | 3.991 | 15.205 (8)* | 0.976 | 0.001 | 0.051 | +0.001 | 478.687 | ACCEPT |
| Scalar | 345.972 | 116 | 3.777 | 19.284 (12)* | 0.975 | 0.001 | 0.049 | +0.002 | 473.972 | ACCEPT |
| Residual | 384.77 | 128 | 3.813 | 38.798 (12)*** | 0.973 | 0.002 | 0.049 | 0.000 | 488.770 | ACCEPT |
| Factor variance | 387.405 | 132 | 3.762 | 2.635 (4) | 0.973 | 0.000 | 0.048 | +0.001 | 483.405 | ACCEPT |
| Factor covariance | 405.961 | 138 | 3.741 | 18.557 (6)** | 0.972 | 0.001 | 0.049 | 0.001 | 489.961 | ACCEPT |

Abbreviations: AIC, Akaike information criteria; CFI, comparative fit index; RMSEA, root mean square error of approximation.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

sadness, disgust, and surprise, and lower in happiness (Table 10). Compared to mothers of girls, mothers of boys were rated higher in disgust and general factors than those of girls. As for self-conscious emotions, nulliparae were rated higher in shame and guilt but lower in alpha and beta pride. There were no differences in terms of means of self-conscious emotion factors between mothers with boys and those with girls (Table 11).

DISCUSSION

In the current study, we measured mother's emotions towards infant crying using the SPBE. We found evidence for its content validity, structural validity, and internal consistency. The theory-driven models were evaluated in terms of the fitness to the data by CFA series for both basic and self-conscious emotions. Hence, the SPBE was reflecting the

TABLE 10 Factor mean for the theory-driven six-factor modified bifactor model

| | Factor mean (SE) | | | | | | |
|-------------------------------------|--------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------|--------------------------------|--------------------------------|
| | Happiness | Anger | Fear | Sadness | Disgust | Surprise | General |
| Nulliparae compared with multiparae | -0.355** (0.12) | 0.287** (0.11) | 0.954*** (0.09) | 0.696*** (0.010) | 0.469*** (0.11) | 0.566*** (0.06) | -0.018 ^{NS} (0.10) |
| Boys compared with girls | -0.106 ^{NS} (0.19) | 0.121 ^{NS} (0.09) | 0.173 ^{NS} (0.18) | 0.165 ^{NS} (0.11) | 0.339* (0.17) | -0.066 ^{NS} (0.11) | -0.203* (0.10) |

Abbreviations: NS, not significant; SE, standard error.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

TABLE 11 Factor mean for the theory-driven four-factor model

| | Factor mean (SE) | | | |
|-------------------------------------|-----------------------------|------------------------------|------------------------------|------------------------------|
| | Shame | Guilt | Alpha_Pride | Beta_Pride |
| Nulliparas compared with multiparas | 0.974*** (0.117) | 0.989** (0.135) | -0.265* (0.114) | -0.327* (0.129) |
| Boys compared with girls | 0.080 ^{NS} (0.121) | -0.048 ^{NS} (0.139) | -0.179 ^{NS} (0.115) | -0.131 ^{NS} (0.131) |

Abbreviations: NS, not significant; SE, standard error.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

theory of basic and self-conscious emotions. Weidman et al. insisted that researchers need to label their scale based on the terms or concepts comprising it to close the gap between theory and measurement.⁵² The theoretical model for “parent-to-baby emotions” needs to be explained by human emotions. The construction and names of subscales of the SPBE came from theories of basic emotions and self-conscious emotions.

In the basic emotion dimension, the best fit model was a bifactor model in which five negative emotion factors but not the happiness factor also loaded on the general factor. As expected, the five negative emotion factors were correlated with each other whereas the happiness factor was negatively correlated with the others. This suggested that although there appeared to be six basic emotion factors, these may also be grouped into positive and negative ones. To note Ekman, negative emotions could be differentiated by a change of heart rate and temperature.⁵³ We need to identify correlates of the autonomous nervous system or other biological markers.

In the self-conscious dimension, the four-factor theory-driven model was identified. Negative self-conscious emotions such as shame and guilt are not unusual among mothers facing an infant crying. The infant crying may be a stimulus to elicit awareness of “self” among mothers. Such negative emotions are evoked because infant crying is a self-relevant negative life event for mothers. Baby-cry-induced emotions are observed worldwide. Narrative expressions are found such as “Parents felt ashamed feeling that they were not good enough parents” or “They believed that others thought that they were bad parents.”⁵⁴ Tangney, Wagner, Hill-Barlow et al. indicated that shame and guilt were related to anger.⁵⁵ Identification of shame may be immensely helpful when intervening with a mother if she has negative emotions such as anger, hostility, and irritation, or behaves aggressively towards her baby. Alternatively, shame and guilt are followed by depression.^{59,56,57} In an investigation on life events after childbirth, the severity of infant crying was linked with depression.⁵⁸

Whereas shame and guilt represent the negative aspect of self-conscious emotions of mothers towards infant crying, the two types of pride represent the positive aspect. Pride evoked by the infant's cry may be preceded by an evaluation concerning the “global self as a mother” (alpha pride) and “specific self as a mother” (beta pride). A mother is proud of herself or her own behaviors if she successfully soothes her own baby. When a mother is aware of her baby's authentic needs for safety, protectiveness, and comfort, she is conscious of “self” as a mother whom her baby is seeking. Therefore, she feels pride as well as happiness about infant crying. It may be such positive self-conscious emotions that underlie self-esteem (alpha pride) and self-efficacy (beta pride) about parenting, and thus appropriate and efficient parenting practices. These aspects have received less attention so far. Future studies should focus more on the positive self-conscious emotions of mothers towards infant crying.

Mothers' emotion towards infant crying differs between different groups. For example, shame, guilt, and fear are significantly more prominent among first-time mothers. First-time mothers are in the process of obtaining a role as a mother.⁵⁹ These findings indicate that first-time mothers feel challenged towards caring for their infants. First-time mothers should be provided with mental healthcare more than before. Continuous feelings of shame, guilt, and fear may lead to mental health problems and we think that our results may be used when designing a preventive means for postnatal mental illnesses. Compared to mothers of girls, mothers of boys scored significantly higher in terms of disgust and general (negative emotions) factors. This might be linked to the gender difference of the mothers' perception of the baby's gender. Thus, unlike Indian mothers, Japanese mothers prefer girls to boys.⁴⁵ Such baby gender preference is likely to induce feeling of disgust among caregivers.

Negative basic emotions may be a consequence of the mother's feeling of frustration,^{60–62} depression,⁶³ or perception that her spiritual

ideal as a mother (e.g., the Virgin with Child) has been polluted.⁶⁴ These may be elicited from not only the current but also past experiences.⁶⁵⁻⁶⁷ Hence, the profiles of the mother's emotions towards infant crying manifest various patterns depending on her current as well as past conditions and situations. Perinatal health professionals can understand these emotion profiles towards infant crying using the SPBE.

The internal consistency of the SPBE was excellent. The basic emotions were best explained by the bifactor model having multi-dimensional constructs. The omega index of each factor was more than 0.7 and ECV was as low as 0.146. These results suggest that we should capture the parent-to-baby emotions as multidimensional constructs. The theory-driven six modified bifactor model for basic emotions has a general factor. In this model, the general factor had some contribution to the whole-scale variance of the group for negative emotions, but each subscale (specific factors) substantially influenced the variance of each group. Each group factor was not negligible, but the general factor also contributed to negative emotion factors.

It was proven that the factor structure of the SPBE had the same factor structure regardless of the parity of mothers and gender of infants by the examination of measurement invariance. The SPBE has a robust construct and structure. Although it goes beyond the scope of the present report, what should be performed is a multi-group CFA for assessing cross-cultural validity between different groups in terms of age, gender, and disease characteristics (COSMIN study design checklist).¹⁹

Our study has limitations. First, it has too many items to be useful for clinical scenarios or research, therefore we need to develop a shorter version. Another theoretical problem is that each item was rated with a five-point scale. One may claim that the items should be regarded as ordinal. Nevertheless, such coarsely categorized variables can be treated normally. This is because goodness-of-fit is little impacted by the number of categories if the items are not very skewed and factor loadings are not underestimated if the categories were not as few as two or three and if the items were not much skewed.⁶⁸

Second, for defining how a mother's emotions relates to perinatal mental health or mother-child interaction, convergent-validity and discriminant-validity need to be examined. To ensure that the newly constructed category of emotion can measure the intended emotion, we need to carry out a study examining the association between the new scale scores and the scores of other variables that are theoretically related to maternal emotion towards baby cry. They may include, for example, maternal parenting behaviors, child abuse, breastfeeding ratio, and infant's temperament, to name just a few. Third, the current study used a cross-sectional design and test-retest reliability was not examined. Because maternal emotions towards a baby may be influenced by many elements, such as the baby's physical and temperamental conditions, they may temporarily vary. For longitudinal use, examination of measurement invariance in terms of multiple time points over a long period of time is needed. It is reasonable to think that the measured emotion is not stable even in the same person because emotion may vary even in response to baby cry depending on various factors, including the mother's mood state, the existence of another person, and the event triggering the cry. We speculate that some types of emotions are stable across time and

others vary greatly. The former is more trait-like while the latter is more state-like. Longitudinal studies with multiple observation times may give us an insight into trait-state differences.

It is necessary to have a longitudinal study covering a wide range of the child's age from childbirth through infancy/toddlerhood to school childhood because the child's age is a very important factor in determining maternal emotion. Special attention should be paid to the difference in maternal emotion in terms of the child's age in the first few weeks and months after childbirth.

What remains to be investigated is the association between the maternal emotions and adverse situations, such as traumatic birth, illness in the mother or baby, prematurity, and others that could affect the emotional state of the mother and therefore the interpretation of the baby's condition. Such studies may be available after creating a short version of this scale.

Furthermore, it is necessary to replicate the study among fathers as well as step- and fostering parents. Another important population is parents who are listed as abusive parents. Taking into account these drawbacks, the SPBE is a promising tool for measuring parent-to-baby emotions.

CONCLUSION

The SPBE illustrated the rubric of parental emotions towards infant crying based on the basic and self-conscious emotion theories. These emotions should be evoked as primary emotions when an infant cries, therefore they play an important role as mediators in response to internal or external events. We should pay more attention to these emotions. The SPBE may make it possible to assess these primary emotions under the rubric of parent-to-baby emotions to provide the tailor-made care with consideration for individual differences.

AUTHOR CONTRIBUTIONS

Ayako Hada and Masumi Imura performed the research design. Ayako Hada collected the data. Ayako Hada and Toshinori Kitamura performed statistical analyses. Ayako Hada wrote the manuscript. All the authors read and approved the final draft.

ACKNOWLEDGMENTS

We are grateful to all participants and thank the following clinics for their cooperation: Japanese Red Cross Medical Centre, Seibo Hospital, Fuchu-no-mori Tsuchiya Obstetrics and Gynaecology, Keiai Hospital, St Luke's International Hospital, Higashi-Fuchu Hospital, Ohkubo clinic, Gonohashi Hospital, Akutagawa Birth Clinic, Fukuma Obstetrics and Gynaecology Clinic, Hamura Himawari Clinic, Miyashita Midwifery Centre, Morita Midwifery Centre, Yajima Midwifery Centre, Inada Midwifery Centre. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

The data set analyzed and used in this study may be available upon reasonable request to the first author.

ETHICS APPROVAL STATEMENT

This study was conducted under the approval of the Ethical Committee of Japanese Red Cross College of Nursing, to which the responsible researcher (A.Y.) belongs (No. 2018-068).

PATIENT CONSENT STATEMENT

All participants were provided with an explanation about the aim as well as the procedure of this survey and the security of personal information. They were regarded as agreeing to participate by responding to the questionnaire via web survey.

ORCID

Ayako Hada  <http://orcid.org/0000-0002-2835-8456>

Toshinori Kitamura  <http://orcid.org/0000-0002-2326-3140>

REFERENCES

- Hada A, Imura M, Kitamura T. Parent to baby emotions: parental immediate emotional reactions towards infant crying. *Open Psychol J*. 2021;14(1):338–41. <https://doi.org/10.2174/1874350102114010338>
- Ekman P. All emotions are basic. In: Ekman P, Davidson R, editors. *The nature of emotion: fundamental questions*. New York: Oxford University Press; 1994. p. 15–9.
- Tracy JL, Robins RW. The self in self-conscious emotions a cognitive appraisal approach. In: Tracy JL, Robins RW, Tangney JP, editors. *The self-conscious emotions*. New York, London: Guilford Press; 2007. p. 3–20.
- Freud S. Further remarks on the defence neuro-psychosis. In: Strachey J J, editor, *Trans. The standard edition of the complete psychological works of Sigmund Freud Vol. 3*. 1896 Original Work published. London: Hogarth; 1953. p. 157–85.
- Harder DW, Cutler L, Rockart L. Assessment of shame and guilt and their relationships to psychopathology. *J Pers Assess*. 1992;Dec 1 59(3):584–604. https://doi.org/10.1207/s15327752jpa5903_12
- Tangney JP. Assessing individual differences in proneness to shame and guilt: development of the self-conscious affect and attribution inventory. *J Pers Soc Psychol*. 1990;59:102–11.
- Tangney JP. Conceptual and methodological issues in the assessment of shame and guilt. *Behav Res*. 1996;34(9):741–54.
- Tangney JP, Wagner P, Fletcher C, Gramzow R. Shamed into anger? The relation of shame and guilt to anger and self-reported aggression. *J Pers Soc Psychol*. 1992;62:669–75.
- Tangney JP, Wagner P, Gramzow R. Proneness to shame, proneness to guilt, and psychopathology. *J Abnorm Psychol*. 1992;101:469–78.
- Tangney JP, Miller RS, Flicker L, Barlow DH. Are shame, guilt, and embarrassment distinct emotions? *J Pers Soc Psychol*. 1996;70:1256–69.
- Tangney JP, Niedenthal PM, Vowell-Covert M, Hill-Barlow D. Are shame and guilt related to distinctive self-discrepancies? A test of Higgins's (1987) hypotheses. *J Pers Soc Psychol*. 1998;75(1):256–68.
- Tibbetts SG. Self-conscious emotions and criminal offending. *Psychol Rep*. 2003;93(1):101–26. <https://doi.org/10.2466/pr0.2003.93.1.101>
- Tracy JL, Robins RW. Putting the self into self-conscious emotions: a theoretical model. *Psychol Inq*. 2004;15(2):103–25. https://doi.org/10.1207/s15327965pli1502_01
- Tracy JL, Robins RW. The psychological structure of pride: a tale of two facets. *J Pers Soc Psychol*. 2007;92(92):506–25.
- Drasgow F. Scrutinizing psychological tests: measurement equivalence and equivalent relations with external variables are the central issues. *Psychol Bull*. 1984;95(1):134–5. <https://doi.org/10.1037/0033-2909.95.1.134>
- Drasgow F. Study of the measurement bias of two standardized psychological tests. *J Appl Psychol*. 1987;72(1):19–29.
- Drasgow F. Scrutinizing psychological tests: measurement equivalence and equivalent relations with external variables are the central issues. *Psychol Bull*. 1984;95(1):134–5. <https://doi.org/10.1037/0033-2909.95.1.134>
- Reise SP, Bonifay WE, Haviland MG. Scoring and modeling psychological measures in the presence of multidimensionality. *J Pers Assess*. 2013; 95(2):129–40. <https://doi.org/10.1080/00223891.2012.725437>
- Mokkink LB, Prinsen CA, Patrick DL, Alonso J, Bouter LM, De Vet HC, et al. COSMIN study design checklist for patient-reported outcome measurement instruments. 2019. [cited 2022 June 26]. Available from: https://www.cosmin.nl/wp-content/uploads/COSMIN-study-designing-checklist_final.pdf
- Mokkink LB, de Vet HCW, Prinsen CAC, Patrick DL, Alonso J, Bouter LM, et al. COSMIN Risk of bias checklist for systematic reviews of patient-reported outcome measures. *Qual Life Res*. 2018;27(5):1171–9. <https://doi.org/10.1007/s11136-017-1765-4>
- Prinsen CAC, Mokkink LB, Bouter LM, Alonso J, Patrick DL, de Vet HCW, et al. COSMIN guideline for systematic reviews of patient-reported outcome measures. *Qual Life Res*. 2018;27(5):1147–57. <https://doi.org/10.1007/s11136-018-1798-3>
- Horikoshi S, Tokiwa Y, Kunikiyo K, Takatsu M. (2016). Perception of mothers about the crying of one month old babies. *Kitakanto Med J*. 2016;66(1):23–30. (in Japanese).
- Nakayama H. Longitudinal studies of crying in infancy from the perspective of communication. (Publication No. 20150314-29) [Doctorial dissertation, the University of the Sacred Hart, Tokyo] NII Institutional Repositories Program. 2015. [cited 2022 June 26]. Available from: <https://id.nii.ac.jp/1045/00000123/>
- Okamoto M, Matsuoka M. Postpartum crisis of primiparous mothers facing persistent crying of 1, 2 months old babies. *Jpn Soc Psychosomat Obstet Gynecol*. 2003;8(1):85–92.
- Sugiura K. Development of a scale for mothers' emotional response to infants' crying. *Jpn J Matern Heal*. 2008;49(1):114–9.
- Tabuchi N. A study of a mothers' reaction to infant cries. *J JPN Acad Midwifery*. 1999;12(2):32–44. https://doi.org/10.3418/jjam.12.2_32
- Tabuchi N, Shimada K. Development of a scale of mothers' childcare difficulty feeling toward their infants' crying. *J Tsuruma Heal Sci Soc Kanazawa Univ*. 2006;30(2):179–92. <http://hdl.handle.net/2297/11524>
- Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J Pers Soc Psychol*. 1988;54(6):1063–70.
- Terasaki M, Kishimoto Y, Koga A. Construction of a multiple mood scale. *JPN J Psychol*. 1992;62(6):350–6.
- Suzuki T, Haruki Y. The relationship between anger and circulatory disease. *JPN J Health Psychol*. 1994;7:1–13.
- Hasui C, Kitamura T, Tamaki A, Takahashi M, Masuda S, Ozeki N. The test of self-conscious affect-3 in Japanese university students. *J Nerv Ment Dis*. 2009;197(6):458–60. <https://doi.org/10.1097/NMD.0b013e3181a61f52>
- Tangney JP, Dearing R, Wagner P, Gramzow R. *The test of self-conscious affect (TOSCA-3)*. Fairfax, VA: George Mason University; 2000.
- Little TD, Rhemtulla M, Gibson K, Schoemann AM. Why the items versus parcels controversy needn't be one. *Psycholog Methods*. 2013;18(3):285–300. <https://doi.org/10.1037/a0033266>
- Matsunaga M. Item parceling in structural equation modeling: a primer. *Commun Methods Meas*. 2008;2(4):260–93. <https://doi.org/10.1080/19312450802458935>

35. Little TD, Cunningham WA, Shahar G, Widaman KF. To parcel or not to parcel: exploring the question, weighing the merits. *Struct Equ Model A Multidiscip J*. 2002;9(2):151–73. https://doi.org/10.1207/S15328007SEM0902_1
36. Kline RB. Principles and practice of structural equation modeling. 4th ed. New York, London: Guilford Press; 2016.
37. Cronbach LJ. Coefficient alpha and the internal structure of tests. *Psychometrika*. 1951;16(3):297–334. <https://doi.org/10.1007/BF02310555>
38. Chen FF, Hayes A, Carver CS, Laurenceau JP, Zhang Z. Modeling general and specific variance in multifaceted constructs: a comparison of the bifactor model to other approaches. *J Personal*. 2012;80(1):219–51.
39. Brunner M, Nagy G, Wilhelm O. A tutorial on hierarchically structured constructs. *J Pers*. 2012;80(4):796–846. <https://doi.org/10.1111/j.1467-6494.2011.00749.x>
40. Reise SP, Morizot J, Hays RD. The role of the bifactor model in resolving dimensionality issues in health outcomes measures. *Qual Life Res*. 2007;16(1):19–31.
41. Bentler PM. Comparative fit indexes in structural models. *Psychol Bulletin*. 1990;107(2):238–46. <https://doi.org/10.1037/0033-2909.107.2.238>
42. Schermelleh-Engel K, Moosbrugger H, Müller H. Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures. *Methods Psychol Research Online*. 2003;8(2):23–74.
43. Akaike H. Factor analysis and AIC. In: Parzen E, Tanabe K, Kitagawa G, editors *Selected Papers of Hirotugu Akaike. Springer Series in Statistics (Perspectives in Statistics)*. New York, NY: Springer; 1987. https://doi.org/10.1007/978-1-4612-1694-0_29
44. Rodriguez A, Reise SP, Haviland MG. Evaluating bifactor models: calculating and interpreting statistical indices. *Psychol Methods*. 2016;21(2):137–50.
45. Reise SP. The rediscovery of bifactor measurement models. *Multivariate Behav Res*. 2012;47(5):667–96.
46. Takegata M, Ohashi Y, Lazarus A, Kitamura T. Cross-national differences in psychosocial factors of perinatal depression: a systematic review of India and Japan. *Healthcare*. 2017;5:91.
47. Vandenberg RJ, Lance CE. A review and synthesis of the measurement invariance literature: suggestions, practices, and recommendations for organizational research. *Organ Res Methods*. 2000;3(1):4–69.
48. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Struct Equ Model A Multidiscip J*. 2007;14(3):464–504. <https://doi.org/10.1080/10705510701301834>
49. Cheung GW, Rensvold RB. Evaluating goodness-of-fit indexes for testing measurement invariance. *Struct Equ Model A Multidiscip J*. 2002;9(2):233–55. https://doi.org/10.1207/S15328007SEM0902_5
50. Costello AB, Osborne JW. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Pract Assessment, Res Eval*. 2005;10:1–9.
51. West SG, Finch JF, Curran PJ. Structural equation models with nonnormal variables: Problems and remedies. In: Hoyle RH editor. *Structural equation modeling: Concepts, issues, and applications*. Thousand Oaks: Sage Publications Inc.; 1995. p. 56–75.
52. Weidman AC, Steckler CM, Tracy JL. The jingle and jangle of emotion assessment: imprecise measurement, casual scale usage, and conceptual fuzziness in emotion research. *Emotion*. 2017;17(2):267–95. <https://doi.org/10.1037/emo0000226>
53. Ekman P, Levenson RW, Friesen WV. Autonomic nervous system activity distinguishes among emotions. *Science*. 1983;221(4616):1208–10.
54. Landgren K, Hallström I. Parents' experience of living with a baby with infantile colic: a phenomenological hermeneutic study. *Scand J Caring Sci*. 2011 Jun 1;25(2):317–24. <https://doi.org/10.1111/j.1471-6712.2010.00829.x>
55. Tangney JP, Wagner PE, Hill-Barlow D, Marschall DE, Gramzow R. Relation of shame and guilt to constructive versus destructive responses to anger across the lifespan. *J Per Soc Psychol*. 1996;70(4):797–809.
56. Orth U, Berking M, Burkhardt S. Self-conscious emotions and depression: rumination explains why shame but not guilt is maladaptive. *Personal Soc Psychol Bull*. 2006;32(12):1608–19. <https://doi.org/10.1177/0146167206292958>
57. Sekowski M, Gambin M, Cudo A, Wozniak-Prus M, Penner F, Fonagy P, et al. The relations between childhood maltreatment, shame, guilt, depression and suicidal ideation in inpatient adolescents. *J Affect Disord*. 2020;276:667–77. <https://doi.org/10.1016/j.jad.2020.07.056>
58. Ohashi Y, Takegata M, Haruna M, Kitamura T, Takauma F, Tada K. Association of specific negative life events with depression severity one month after childbirth in community-dwelling mothers. *Int J Nur Heal Sci*. 2015;2(2):13–20.
59. Rubin R. Maternal identity and the maternal experience. *Am J Nurs*. 1984;84(12):1480.
60. Ekman P, Friesen WV. *Unmasking the face: a guide to recognizing emotions from facial clues*. San Jose CA: Ishk; 2003.
61. Ekman P. Editor. *Darwin and facial expression: a century of research in review*. Cambridge MA, Los Altos CA: Ishk; 2006.
62. Lazarus RS. *Emotion and adaptation*. New York: Oxford University Press; 1991.
63. Kitamura T, Yoshida K, Okano T, Kinoshita K, Hayashi M, Toyoda N, et al. Multicentre prospective study of perinatal depression in Japan: incidence and correlates of antenatal and postnatal depression. *Arch Womens Ment Health*. 2006;9(3):121–30. <https://doi.org/10.1007/s00737-006-0122-3>
64. Haidt J, Graham J. When morality opposes justice: conservatives have moral intuitions that liberals may not recognize. *Soc Justice Res*. 2007;20(1):98–116. <https://doi.org/10.1007/s11211-007-0034-z>
65. Fraiberg S, Adelson E, Shapiro V. Ghosts in the nursery: a psychoanalytic approach to the problems of impaired infant-mother relationships. *J Am Acad Child Adolesc Psychiatry*. 1975;14(3):387–421.
66. Nemiah JC, Sifneos PE. Affect and fantasy in patients with psychosomatic disorders. In: Hill OW editor. *Modern trends in psychosomatic medicine*. 2. London, UK: Butterworth; 1970. p. 26–34.
67. Nemiah JC, Freyberger H, Sifneos PE. Alexithymia: A view of the psychosomatic process. In: Hill OW, editor. *Modern trends in psychosomatic medicine*. 3. London, UK: Butterworth; 1976. p. 430–439
68. West SG, Finch JF. Structural equation models with nonnormal variables: Problems and remedies. In: Hoyle RH. editor. *Structural equation modeling: concepts, issues and applications*. Newbury Park CA: Sage; 1995. p. 56–75

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Hada A, Imura M, Kitamura T. Development of a scale for parent-to-baby emotions: concepts, design, and factor structure. *Psychiatry Clin Neurosci Rep*. 2022;1:e30. <https://doi.org/10.1002/pcn5.30>