

1. **Title:** Multimodal Assessments of Preterm Temperament across the First Year of Life:  
Continuity, Stability, and Moderation by Country of Origin and Infant Age

2. **Short Title:** Preterm Temperament: Continuity, Stability

3. **Authors:** Maria Spinelli, PhD<sup>a</sup>, Marc H. Bornstein, PhD<sup>bc</sup>, Diane L. Putnick, PhD<sup>b</sup>,  
Prachi E. Shah, MD, MS<sup>d</sup>

**4. Institutional Affiliations:**

- a. Department of Neurosciences, Imaging and clinical Sciences, University G. D'Annunzio  
Chieti-Pescara, Chieti, Italy
- b. *Eunice Kennedy Shriver* National Institute of Child Health and Human Development
- c. Institute for Fiscal Studies
- d. Department of Pediatrics, Division of Developmental-Behavioral Pediatrics, University  
of Michigan, Ann Arbor, Michigan

**Address correspondence to:**

Prachi E. Shah, MD, MS  
University of Michigan-Ann Arbor  
Department of Pediatrics  
300 N Ingalls Street, Room 1056 Ann Arbor, MI 48109  
Tel: 734-764-2641 Fax: 734-936-9288

■ Email: [prachis@umich.edu](mailto:prachis@umich.edu)

■ ORCID ID: <https://orcid.org/0000-0003-3467-8816>

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<input checked="" type="checkbox"/> Data available on request due to privacy/ethical restrictions	The data that support the findings of this study are available on request from the second author. The data are not publicly available due to privacy or ethical restrictions.
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## Abstract

There is limited research regarding the continuity, stability, and role of country of origin in preterm infant temperament across the first year of life. This prospective longitudinal study examined patterns of mean-level continuity and individual-differences stability of select scales of temperament at 6 and 12 months in preterm infants from three countries, Chile ( $n=47$ ), United Kingdom ( $n=44$ ), and United States ( $n=50$ ). Temperament was assessed with the Infant Behavior Questionnaire and observed using the Bayley Behavior Rating Scale. Continuity and stability across infant age, country effects, and interactions of country and age on preterm infant temperament were examined. Chilean mothers rated infants higher in soothability, duration of orienting, and orientation/engagement compared with mothers from the United Kingdom and/or United States. Continuity of temperament from 6-12 months varied by country: Chilean mothers reported increasing smiling and laughter and activity level from 6-12 months, and mothers from the United Kingdom reported decreasing smiling and laughter and increasing fear from 6-12 months. Infant temperament was stable in all three countries. Correlations evidenced low concordance between maternal reports and examiner observations of infant temperament at 12 months. However, among Chilean infants, higher maternal reported activity level was associated with higher examiner observed orientation/engagement score.

**Keywords:** Prematurity; Temperament; Stability; Continuity; Country; Infancy

**Abbreviations:** IBQ: Infant Behavior Questionnaire

BRS: Behavior Rating Scale

GLM: General Linear Model

HOME: Home Observation Measurement of the Environment

## Relevance and Key Findings:

## Key Points:

- Mothers differ in their ratings of temperament by infant age, and continuity of infant temperament across the first year of life varies by country.
- Temperament by maternal report is stable from 6-12 months of age in preterm infants in three countries.
- Maternal expectations of infant temperament may vary by country and play a role in maternal attributions of infants born preterm.
- There is low concordance between maternal reports and examiner observations of infant temperament at 12 months.

## Relevance:

In this developmental study of preterm infant temperament in three countries with maternal reports from two ages (6 and 12 months), we found that mothers in three countries differed in their ratings of domains of temperament, and that continuity of infant temperament varied by country. Maternal reports of temperament were stable across ages and across countries. Furthermore, we found low concordance between maternal reports and examiner reports. Additional cross-cultural research is needed to explore the roles of culture, country, and maternal attributions of temperament in infancy to better inform culturally sensitive, temperament-based interventions.

## Introduction

Temperamental characteristics, manifest as individual differences in infants' emotionality, activity, and attention (Rothbart, 1981), are believed to emerge over time and are influenced by both biological processes and conditions in the caregiving environment (Bornstein et al., 2019; Bornstein et al., 2015; Shiner, 2005; Spinelli et al., 2018). Factors in the caregiving environment that influence typically developing infant temperament are related to family and psychosocial characteristics, including perturbations in early mother-infant interactions, socioeconomic disadvantage, and stressful life events (Bates et al., 2012; Bornstein et al., 2019). Another aspect of the caregiving environment, culture (here country of origin), is also associated with differences in temperament in typically developing infants (Bornstein, 2012; Gartstein & Skinner, 2018; Gartstein et al., 2003; Super et al., 2008).

One biological factor associated with differences in temperament is preterm birth, defined as delivery before 37 completed weeks of gestation (Bornstein et al., 2015; Cassiano et al., 2020). Characteristics associated with prematurity that influence the development of temperament are a history of physiological immaturity, prolonged hospitalization, and prenatal adversity (Cassiano et al., 2020; Jansen et al., 2009; Koullali et al., 2016; Lu & Chen, 2004; Masho et al., 2017). Preterm infants manifest differences in several dimensions of temperament compared to their full term counterparts (Cassiano et al., 2020), including lower attentional control (Bhutta et al., 2002; Clark et al., 2008), diminished alertness and responsivity (Goldberg & DiVitto, 1995; Washington et al., 1986), greater passivity, less initiation (Sajaniemi et al., 1998), fewer expressions of positive affect (Garcia Coll et al., 1992), and increased irritability, fussiness, and inconsolability (Hughes et al., 2002; Larroque et al., 2005).

Still relatively understudied with respect to preterm infant temperament are how contextual and cultural variations are associated with temperament and the development of

temperament over time (Chen et al., 2012; Gartstein et al., 2015). The present study extends prior research by examining and coordinating three areas regarding patterns of temperament in preterm infants: (1) group mean-level developmental continuity, (2) individual-differences developmental stability, and (3) country variation. In addition, this study examines the concordance between maternal report and examiner observations of temperament across countries. The findings from this study therefore aim to enhance understanding of the role of culture on maternal perceptions of preterm temperament over the first year of life. This information might also aid in the interpretation of findings from cross-cultural developmental studies, which in turn can inform the development of culturally oriented approaches to evaluate infant temperament specifically, and child behavior more generally, as well as interventions to support dyads at risk. Temperament-focused interventions are centered on increasing maternal awareness of infant temperament with the goals of promoting sensitive responsiveness to infants' needs and fostering multiple developmental outcomes (Iverson & Gartstein, 2018). This kind of information is particularly important for mothers of preterm infants, who may have more difficulty reading and responding to their infants' ambiguous behavioral cues (Poehlmann-Tynan et al., 2015; Spinelli et al., 2016). Understanding the role of culture in mothers' perceptions of preterm infants' temperament can also help inform the development of culturally sensitive interventions.

### **Developmental Continuity and Stability of Temperament**

The construct of developmental continuity considers whether the mean level of a measure (e.g., temperament) in a group manifests similar values across time (continuity), or whether the mean level changes across time (discontinuity) (Bornstein et al., 2017).

Regarding the construct of continuity, among full term infants, in certain countries, there is some evidence of discontinuity in some facets of temperament with increasing age. Among infants in the United States and Italy, for example, mean levels of the expression of positive

affect have been observed to increase over the first year of life (Montirosso et al., 2011). To our knowledge, patterns of temperamental continuity across the first year of life have not been previously examined in preterm infants.

The construct of stability considers individual-difference rank order across time, that is whether individuals in a group maintain their position in the group across time (stability) or whether they change in the position in the group across time (instability) (Bornstein et al., 2017). Regarding the stability of facets of infant temperament, one of the first studies to examine this issue found that positive dimensions of temperament showed stability over a 9-month period, whereas negative dimensions of temperament showed stability across a 3-month period (Rothbart, 1986). In a Finnish sample, select temperamental traits measured in infancy (i.e., activity, smiling and laughter, distress to limitations, and fear, but not soothability and duration of orienting), were observed to be associated with similar traits in preschool years (Komsu et al., 2006). Subsequent studies in full term infants have confirmed and extended the findings that the majority of the temperamental characteristics maintain a degree of stability into childhood (Bornstein et al., 2019; Bornstein et al., 2015; Carranza Carnicero et al., 2000; Gartstein et al., 2015; Rothbart et al., 2000; Van Den Akker et al., 2010). In contrast, among preterm infants, the pattern of stability of temperament appears to be more heterogeneous. Some studies have reported that most of the positive and negative dimensions of preterm temperament exhibit stability (Bornstein et al., 2015; Garcia Coll et al., 1992), but there is evidence of instability of some dimensions of preterm temperament which was associated with recovery from perinatal injury (Garcia Coll et al., 1992). Taken together, additional research is needed to better understand patterns of continuity and stability of preterm temperamental characteristics across the first year of life.

### **Temperament of Preterm Infants in the First Year of Life in Different Countries**

An additional limitation of the extant infant temperament literature is that most developmental studies of infant temperament have focused on full term infants from predominantly Western populations. Because parenting cognitions and practices vary by country with country-specific cultural norms, mothers' reports of their infants' temperament may differ across countries (Bornstein, 2012; Chen et al., 2012; Rubin et al., 2006). For example, mothers' reports of infant temperament from Spain, Japan, United States, Russia, Poland, and the People's Republic of China have been studied (Gartstein et al., 2005; Gartstein et al., 2003; Gartstein et al., 2010; Rothbart et al., 2001). Mothers from Western countries (e.g., United States) rated their infants higher on positive dimensions of temperament, whereas mothers from Eastern countries (e.g., People's Republic of China) rated their infants higher on more negative dimensions of temperament (e.g., distress to limitations). One study, comparing collectivist countries (Chile and South Korea) with individualist countries (United States, Poland), reported higher ratings of full-term infant negative affect in collectivist countries (Krassner et al., 2017).

Early studies of cultural variations of temperament also indicated that patterns of cross-cultural differences differed by the age of the infant, with cultural differences in some dimensions of temperament being more pronounced in early infancy, but other dimensions of temperament were more pronounced later in infancy. For example, in the domain of orienting/regulating, compared to infants from the United States, Dutch infants were noted to have higher scores at 6 months (versus 12 months). In contrast, in the domain of fear, compared to Dutch infants, infants from the United States had higher scores at 12 months (versus 6 months) (Sung et al., 2015). In full term infants, there is also evidence that, over time, cultural differences decrease for some temperamental dimensions (e.g., surgency and positive affect), but not for others (e.g., negative affectivity) (Slobodskaya et al., 2013). To our knowledge, variations in infant temperament across countries have not been examined in



preterm infants, which constitutes another gap in the literature, which the present study seeks to address.

We theorize that mothers' perceptions of preterm infant temperament will differ across countries, similar to what has been found regarding mothers' perceptions of full-term infant temperament. Of course, culture and country of origin are not interchangeable, there may be many cultures within a country, and cultural differences relate to multiple complex factors (Putnam & Gartstein, 2017). In the present study, we consider two Western individualist countries, the United Kingdom and the United States, in which parenting cognitions and practices tend to emphasize psychological independence and individual autonomy (Tamis-Lemonda & McFadden, 2010), in contrast with a Western collectivist country, Chile, where conformity to group norms and interdependence are promoted (Mesman et al., 2016). Note that all three are Western countries, but contrast individualism and collectivism. As reported in the Hofstede Insights Countries Comparison Tool, Chile, in line with most other Latin American countries, has a low score on individualism, whereas United Kingdom and United States are similar and have among the highest individualism scores (Hofstede-Insights, n.d.).

In addition, we consider the possibility that maternal reports of temperament (in contrast to observer reports of temperament) could reflect characteristics of the mother, such as cultural beliefs. We examined preterm infant temperament in the three countries using both mother report and examiner observations. A well-described limitation of the contemporary infant temperament literature is that most studies have relied on parent report (i.e., questionnaires) to assess infant temperament, and therefore reporter bias is a potential concern (Bornstein et al., 1991). Including multimodal assessments of infant temperament (i.e., maternal reports and examiner observations) allowed us to examine infant temperamental characteristics during a structured assessment and to test the concordance between reported and observed measures of infant temperament.

## The Present Study

This study addresses four gaps in the developmental literature regarding temperament in preterm infants across the first year of life, namely (1) group mean-level continuity/discontinuity; (2) individual-differences stability/instability; (3) continuity/discontinuity and stability/instability by country of origin; and (4) the concordance between reported and observed measures of infant temperament. We examined these issues in otherwise comparable samples of preterm infants from Chile, the United Kingdom, and United States. We hypothesized individualist versus collectivist differences in maternal reports of infant temperament. Specifically, we hypothesized that in the individualist countries (United Kingdom and United States), mothers may be more attentive to (and identify) temperamental traits that are associated with exploration (e.g., report lower levels of negative temperamental characteristics, such as fear), aligning with a cultural perspective which values exploration and approach to novelty as indicators of developing independence. Conversely, we hypothesized that in the collectivist country (Chile), where conformity is valued, mothers would rate their infants higher on expressions of positive infant temperamental characteristics (e.g., soothability), which they may interpret as compliance to country-specific parenting expectations (Bornstein, 2012; Bornstein & Cote, 2009; Cheah & Rubin, 2003; Liu et al., 2005; Vergara et al., 2019). We hypothesized that group-mean level continuity over the first year of life might differ among countries, with differences more pronounced at 12 months than at 6 months. Concerning individual-differences stability, we hypothesized that infants in each country would be stable over time. In light of the possibility that maternal reports (more than examiner observations), could reflect characteristics of the mother (such as cultural beliefs), we hypothesized low concordance between mother and examiner reports of temperament with no differences among countries.

## Methods

## Participants

From a larger study of longitudinal development of preterm infants across the first year of life (c.f., O'Connor, 2001 and O'Connor, 2003), we utilized data from 141 healthy preterm infants (< 33 weeks' gestational age:  $M = 30.27$  weeks,  $SD = 1.65$ ) with birth weights less than 1800 g ( $M = 1363.52$  g,  $SD = 261.59$ ), who were recruited from neonatal intensive care units (NICUs) in major urban centers in Chile ( $n = 47$ ), the United Kingdom ( $n = 44$ ), and the United States ( $n = 50$ ). Infant and family demographic information were obtained at enrollment. Neonatal, perinatal, and family characteristics of enrolled infants were obtained from medical records or parental report. Preterm infants spent  $M = 6$  weeks in hospital. Exclusion criteria were as follows: infants with serious medical conditions or congenital abnormalities, APGAR scores < 7, history of significant cardiac, respiratory, ophthalmologic, gastrointestinal, or hematologic disease, periventricular leukomalacia, intraventricular haemorrhage greater than Grade II, maternal incapacity, asphyxia resulting in neurological damage, or uncontrolled systemic infection. Temperament assessments took place at 6 and 12 months (corrected for prematurity). A window of  $\pm 5$  days was permitted for the 6-month assessment, and a window of  $\pm 7$  days for the 12-month assessment.

Sample sociodemographic characteristics by country are shown in Table 1. Mother and infant characteristics did not vary by country with the exception of maternal verbal IQ and the HOME (described below). Because this report involved analysis of a subsample of previously collected data with de-identified participants, it was exempted by the Institutional Review Board.

Insert Table 1 about here

## Measures

### Maternal Reports of Preterm Infant Temperament

At 6 and 12 months term-corrected age, maternal ratings of infant temperament were assessed using the Infant Behavior Questionnaire (IBQ; (Rothbart, 1981). English-language versions were used in the United Kingdom and the United States; the validated Spanish version was administered in Chile (González Salinas et al., 2000). The IBQ consists of 94 items that measure the frequency of specific infant behaviors during the previous week, with responses ordered on a 7-point scale from 1 = *never* to 7 = *always*. Behavior ratings were used to derive 6 scales: Smiling and laughter, duration of orienting, soothability, activity level, fear, and distress to limitations. Early studies with the IBQ (Rothbart, 1986) grouped these temperament scales in two domains, Positive affectivity and Negative Affectivity; however, subsequent analyses with the revised IBQ (Gartstein & Rothbart, 2003) moved away from this dichotomization of temperament scales. We therefore examined the constructs of continuity, stability, and cultural differences with the six individual scales. Temperament scores were computed as means of all scale items.

### **Examiner Reports of Preterm Infant Temperament**

At 12 months, infants were administered the Behavior Rating Scale (BRS; (Bayley, 1993). The BRS assesses qualitative aspects of the infant's behavior during administration of the Bayley Scales of Infant Development by using a rating scale completed by the examiner. This study used two subscales of the BRS: orientation/engagement, which includes observations of the infant's state, affect, energy, interest, exploration, and responsiveness to the examiner, and emotional regulation, which describes the infant's range of affect and emotional responses to experiences of mastery and difficulty during the Bayley administration. These two scales were chosen because their items theoretically align with domains of temperament (Thompson et al., 1996). The orientation/engagement scale includes aspects related to the infant's ability to engage with the environment, which are analogous to those accounted by the IBQ scales duration of orienting, soothability, and activity level. The

emotional regulation scale captures behaviors related to the regulation of positive and negative emotions, which are analogous to the IBQ scales of distress to limitations, smiling and laughter, and fear. Individual items in each domain were scored on a 5-point scale ranging from 1 = *less observable* to 5 = *more observable*; raw scores for each domain ( $M$ ,  $SD$ ) are reported; and a total raw score was also calculated.

### **HOME Inventory**

During a 9-month visit, to measure the quality and quantity of stimulation and support available to the infant in the home environment, the Home Observation Measurement of the Environment (HOME) Inventory (Bradley, 1994), was administered via an in-office questionnaire to the mother. The HOME Inventory contains 45 items scored as Yes = 1 and No = 0, which are summed, with higher cumulative scores indicating a more enriched home environment. Scores on the HOME Inventory ranged from 21 – 44 ( $M = 35.23$ ,  $SD = 5.70$ ).

### **Maternal Verbal Intelligence**

Because educational systems varied across countries and were not readily comparable, and because maternal verbal intelligence has been shown to correlate with years of education (Matarazzo & Herman, 1984), we included maternal verbal intelligence as a covariate. The verbal scale of the Wechsler Adult Intelligence Scale-Revised (WAIS-R) was individually administered to the biological mother at the 9-month visit. The WAIS requires respondents to provide the definitions of 35 words (scored 0 to 2). Maternal raw scores ranged from 11 – 67 ( $M = 40.79$ ,  $SD = 13.62$ ).

### **Neonatal Health Index**

To account for neonatal medical risk, we used the Neonatal Health Index (Scott et al., 1989), which calculated a standardized score for the days of hospitalization, adjusting for infant birth weight. Neonatal Health Index scores ranged from 42 to 129 ( $M = 99.04$ ,  $SD = 15.45$ ). **Statistical Analysis**

Maternal and infant characteristics were examined with descriptive statistics.

Repeated-measures General Linear Models (GLMs) were used to examine the continuity of maternal reports of infant temperament at 6 and 12 months of age, and the differences among countries by testing the main effects of country and infant age, and the interactive effects of Age x Country on maternal reports of temperament (IBQ) scale scores. Analyses controlled for HOME score, maternal verbal intelligence, neonatal health index, infant gestational age, and infant gender. GLM was also used to examine differences in examiners' reports of temperament at 12 months by country, controlling for HOME score, maternal verbal intelligence, neonatal health index, infant gestational age, and infant gender. We examined the stability of maternal reports of infant temperament from 6 to 12 months in each country using univariate GLMs. After controlling for HOME score, maternal verbal intelligence, neonatal health index, infant gestational age, and infant gender, we examined the associations of 6-month ratings of infant temperament, country of origin, and the interaction between country and temperament with 12-month ratings of infant temperament for each temperament subscale. Estimation of  $\beta$  parameters are reported. All analyses were performed with SPSS version 23. Finally, we examined Pearson correlations among mother reports of infant temperament on the IBQ at 12 months and examiner reports of infant behavior assessed by the BRS at 12 months to assess concordance between mothers' and examiners' reports of temperament.

## Results

### **Continuity of Mothers' Reports of Preterm Infant Temperament by Country and Age**

Mean scores of maternal reports of scales of preterm infant temperament are presented in Table 2.

Insert Table 2 about here

Insert Figure 1 about here

Controlling for HOME score, maternal verbal intelligence, neonatal health index, infant gestational age, and infant gender, main effects of country for soothability and duration of orientating emerged (Table 3). In general, collectivist Chilean mothers rated their preterm infants differently from individualist U.K. and U.S. mothers. Infants from Chile were rated higher in soothability compared with infants from the United Kingdom ( $p < .01$ ) and United States ( $p = .05$ ) (Figure 1b); and higher in duration of orienting compared with infants from the United States ( $p = .02$ ).

An interaction effect of Country x Age indicated that, for some dimensions of temperament in preterm infants, the effect of Country was moderated by Age, as evidenced by different trajectories of mean temperament scores from 6 to 12 months in the three countries (see Figure 1). The interaction effect was significant for smiling and laughter ( $p = .03$ ), with trend-level increasing in smiling and laughter from 6 to 12 months for infants from Chile,  $F(1,132) = 3.22, p = .07, \eta^2_p = .02$ , and decreasing from 6 to 12 months for infants from United Kingdom,  $F(1,132) = 3.84, p = .05, \eta^2_p = .03$  (Figure 1a).

In addition, a significant interaction of Country and Age in activity level emerged ( $p < .01$ ) with Chilean mothers reporting increasing preterm infant activity levels from 6 to 12 months of age,  $F(1,132) = 28.63, p < .01, \eta^2_p = .18$ , in contrast to reports of infant activity level from mothers from the United Kingdom and United States, which did not vary over time. Activity level resulted higher for infants from Chile than for infants from United Kingdom and United States at 12 months,  $F(1,132) = 9.55, p < .01, \eta^2_p = .13$  (Figure 1d).

We also found evidence of interactive effects of Country and Age on the temperamental domain of fear, with United Kingdom mothers reporting increasing preterm infant fear from 6 to 12 months,  $F(1,132) = 7.95, p < .01, \eta^2_p = .06$ , in contrast to mothers from Chile and United States, whose reports of preterm infant fear did not vary over time. Moreover, mothers from Chile reported higher fear than mothers from United Kingdom at 6

months,  $F(1,132) = 3.76, p = .26, \eta_p^2 = .05$  (Figure 1e). No significant effects emerged for the distress to limitations domain.

Insert Table 3 about here

### **Stability of Preterm Infant Mothers' Reports of Temperament by Country and Age**

In all three countries, maternal reports of infant temperament between 6 and 12 months of age were largely stable. For all temperament scales, we did not find evidence of significant main effects of country, or interactive effects of temperament at 6 months x country. All temperament scales demonstrated stability from 6 to 12 months, with no differences among countries for smiling and laughter ( $\beta = .58$ ), soothability ( $\beta = .63$ ), duration of orienting ( $\beta = .63$ ), activity level ( $\beta = .43$ ), fear ( $\beta = .32$ ), and distress to limitations ( $\beta = .51$ ).

### **Examiner Reports of Observed Preterm Infant Temperament by Country**

Infant temperamental characteristics were observed at 12 months corrected age, with the descriptive statistics by country shown in Table 4. After controlling for covariates, a main effect for country emerged in orientation/engagement. Post-hoc analyses revealed that Chilean preterm infants demonstrated higher observed orientation/engagement than preterm infants from the United Kingdom ( $p = .02$ ), but demonstrated no difference from United States preterm infants ( $p = .41$ ). No main effects of country emerged in the domains of emotional regulation or for overall BRS scores.

Insert Table 4 about here

### **Concordance of Maternal and Examiner Reports of Preterm Infant Temperament by Country**

Correlations among the dimensions of temperament assessed with maternal report (IBQ) and examiner reports of infant behavior (BRS) at 12 months were computed (Table 5). Overall, there was low concordance between maternal reports and examiner reports of



preterm infant temperament. However, among Chilean mothers, higher activity level on the IBQ was positively correlated with higher orientation/engagement scores on the BRS.

Insert Table 5 about here

## **Discussion**

The present study examined the continuity and stability of several domains of temperament in preterm infants across the second half of the first year of life, and differences in maternal reports of temperament by preterm infants' country of origin. In addition, this study used multimodal assessments of temperament, including both maternal report and examiner observations, which allowed us to examine the concordance between maternal and examiner reports of preterm infant temperament.

Across countries, mothers differed in their ratings of select domains of temperament by age, and continuity of infant temperament across the first year of life varied by country of origin. We interpret our findings in light of country-specific differences in maternal perceptions of preterm infant temperament that may be partially attributed to cultural differences in parenting practices and perceptions of infant behavior (Bornstein, 2012; Mesman et al., 2018).

We considered three countries (United Kingdom, United States, and Chile) with unique cultural aspects. The United Kingdom and United States are two Western countries with similarly high individualism scores (Hofstede-Insights, n.d.) indicating cultural characteristics in which infant autonomy and independence are normally encouraged in the context of a nuclear family (Bornstein, 2012; Bornstein & Cote, 2009; Super et al., 2008; Trommsdorff & Cole, 2011). We did not find differences in maternal reports of temperament between infants from United Kingdom and United States, suggesting that shared cultural perspectives of mothers from these two individualist countries are manifested in similar perceptions of infant behavior across the first year of life. Infants from United Kingdom and

United States are rated lower than infants from Chile in soothability, duration of orienting, and activity level suggesting that their mothers are less prone to see these aspects in their infants than mothers in collectivist cultures, perhaps because individualist cultures harbor expectations that children are highly extroverted, active, socially adaptive, and able to think for themselves.

In contrast, Chile is a Latin American country in which in-group belonging is emphasized and compliance to cultural norms is encouraged (Weis et al., 2016). Our results demonstrated that maternal reports of infant temperamental characteristics of infants from Chile differed from maternal reports of infant temperament from the United Kingdom and United States. Specifically, Chilean mothers rated their infants higher in soothability (i.e., the ability to reduce fussing, crying, or distress) and duration of orienting (i.e., a measure of the ability to focus on objects and activities). This finding may be partially attributed to family and cultural characteristics specific to Chile (Krassner et al., 2017). Because Chilean families emphasize an approach to parenting which values interpersonal harmony, respecting and sharing others' feelings, and the avoidance of negative behaviors and expressions of anger (Weis et al., 2016), it is not surprising that, in this cultural parenting framework, Chilean mothers of preterm infants may focus on promoting the ability of their infants to regulate expressions of negative affect and engage with aspects of their environment (Vergara et al., 2019).

In addition, compared to mothers from the United Kingdom and United States, Chilean mothers rated their infants higher in activity level, a difference also observed with 2-year-old children (Krassner et al., 2017). This temperament scale is also associated with the dimension of surgency/extraversion, characterized by an infant's positive and active engagement with the environment. This finding is further supported by higher observed ratings of Chilean infants in the orientation/engagement dimension of the BRS and in the

concordance between maternal reports of activity level on the IBQ and examiner reports of orientation/engagement in the BRS. This pattern of results suggests that Chilean mothers' perceptions of their infants' gross motor abilities (as described by their activity level) are similarly observed by examiners, reflecting (Chilean) infants' ability to adaptively engage with and react to the environment. This behavior might be related to unique cultural factors in Chile, such as the common cultural practice of allowing infants to freely move and explore their environment (Krassner et al., 2017), or it might indicate that Chilean infants are actually more active than infants from the United Kingdom or United States.

Regarding the continuity of temperamental scales, the effect of country was moderated by age on the smiling and laughter, activity level, and fear scales, indicating that the maternal reports of temperament from 6 to 12 months varied across countries. Mothers of preterm Chilean infants reported an increase in the activity level and in smiling and laughter scales from 6 to 12 months, whereas maternal reports of preterm infants from the United Kingdom and United States did not vary over time for either scale. These two scales refer to the infant's active engagement in and interaction with the environment (which relates to the dimension of surgency/extraversion).

These differences in maternal report might be explained by cultural expectations that are unique to collectivist Chile compared with individualist countries. Between 6 and 12 months of age, infants manifest rapid motor development, transitioning from a mostly non-mobile baby to an increasingly locomotive, pre-ambulatory toddler. While these developmental milestones are encouraged in individualist cultures as a sign of emerging autonomy, in a culture that values conformity the emergence of locomotor skills may be regarded with reservation or even disapproval. Chilean mothers who value compliance over exploration may be more aware of infant behaviors that appear to violate cultural norms. As such, they may be more likely to over-identify expressions of higher infant activity level

which align with more exploratory behavior (Weis et al., 2016). At the same time, the higher levels of observed orienting/engagement reported at 12 months for Chilean infants suggest, as stated above, that a greater interest in the environment and social interaction is present despite maternal perceptions of infant behavior. It is not clear whether the infant's engagement with the environment is related to temperament activity level or reflects socialization processes unique to Chilean families. If the latter, we might theorize that, in a collectivist culture where parents promote sociality and interdependence, at 12 months infants show an enhanced ability to engage with the examiner during the evaluation. This possibility calls for further exploration.

Mothers from the United Kingdom reported increasing expressions of fear across the transition from 6–12 months, a pattern not significant in the other two countries. However, the means of United States infants followed a similar pattern, suggesting that this result needs to be further explored in larger samples.

No differences by country emerged regarding the expression of the most intense positive and negative dimensions of infant temperament: smiling and laughter and distress to limitations. It is possible that, across cultures and settings, the expression of intense positive and negative affect (i.e., smiling and laughter and distress to limitations) is easier to observe, and as such maternal ratings of these scales are more reliable and less susceptible to cultural expectations.

Regarding stability, we found evidence of stability of temperament in preterm infants from 6-12 months of age, across countries. This finding is consistent with the view of temperament as a stable trait, at least during the first year of life, and that this stability, consistent with previous research, is little affected by variation in maternal characteristics such as culture (Bornstein et al., 2019; Bornstein et al., 2015).

With the exception of the correlation between maternal reports of activity level and examiner observations of orientation/engagement in preterm infants from Chile, maternal reports of all other scales of temperament were not correlated with examiner reports in the three countries. Several possible theories might explain these findings. One possibility is that maternal reports of infant temperament are more affected by maternal beliefs and personal interpretations of infants' behavior. Alternatively, it is possible that these findings are attributable to limitations of the instrument used to observe temperament. The temperament scales of the BRS are broad and include multiple dimensions of temperament which are captured by single scales on the IBQ. For example, the emotional regulation scale of the BRS includes the regulation of both positive and negative emotions (Thompson et al., 1996), which are separated scales on the IBQ (i.e., the distress to limitations and the smiling and laughter scales). Third, the BRS was scored during the administration of the Bayley Scale, which may capture behavior during a challenging assessment and may not generalize to aggregated naturalistic situations drawn from months of observed interactions with the infant, as captured by the IBQ compiled by mothers. Further research examining the concordance of the BRS with other observational instruments would help clarify this pattern of findings.

We acknowledge several limitations of the present study. First, the sample size from each country was relatively small; larger samples would allow us to examine other within-group differences (such as infant gender and family factors). In addition, we recognize that culture and country of origin are not interchangeable, and that culture is a multidimensional construct, related not only to country of origin (e.g., where the mothers grew up) but also to other factors including religion, personality, and family cultural beliefs (Putnam & Gartstein, 2017). Inclusion of these constructs in future research will be important to further understanding associations between culture and maternal perceptions of infant temperament. Finally, our study focused on low-risk preterm infants, and reports were collected only from

mothers, leaving high-risk infants and fathers' (or others') reports of preterm temperament unexplored. Future studies should include at-risk preterm infants to evaluate whether associations of culture with maternal reports of infant temperament are similar in preterm infants with greater biological risk. In addition, future research should include fathers' reports of infant temperament to examine patterns of similarity and difference with maternal reports of infant temperament, and associations with country of origin.

Despite these limitations, these findings have implications for, and contribute to, understanding the role of culture in infant development. These results suggest that maternal reports of an infant's temperament, which has been long-held as biologically based trait, are affected by cultural beliefs systems and are associated with culturally held ideas regarding the nature of infant behavior. These findings also have implications for the tools used to assess infant temperament, and how perceptions of infant temperament are explored with the mothers. Because perceptions of preterm infant temperament appear to vary with cultural beliefs and expectations, cultural beliefs and expectations should be taken into account when designing interventions to promote parental understanding and responding to infant temperament and needs.

### **Conclusions**

In this multimodal developmental study of preterm infant temperament in three countries, we found that mothers from similar individualist cultural backgrounds in the United Kingdom and United States rated their infants similarly on temperament, whereas mothers from collectivist Chile rated their infants differently. Individual differences among infants in all the countries were stable over the first year of life, but variations in temperamental descriptions among countries were discontinuous and were not explained by the quality of the home environment, maternal verbal intelligence, or neonatal risk.

Moreover, at 12 months, we found low concordance between maternal and examiner reports

of temperament. Our results suggest that maternal expectations of infant behavior may vary by country (and culture), and may play a role in attributions of infant temperament. The present study highlights the need for more cross-cultural and developmental studies to explore the roles of culture, country of origin, and maternal attributions on the continuity and stability of temperament in infancy (Bornstein, 2012; Mesman et al., 2018). Future research in this area can help refine our understanding of the theoretical underpinnings of temperament and help inform future interventions to mitigate the possible negative effects of difficult infant temperament on the mother-infant dyad.

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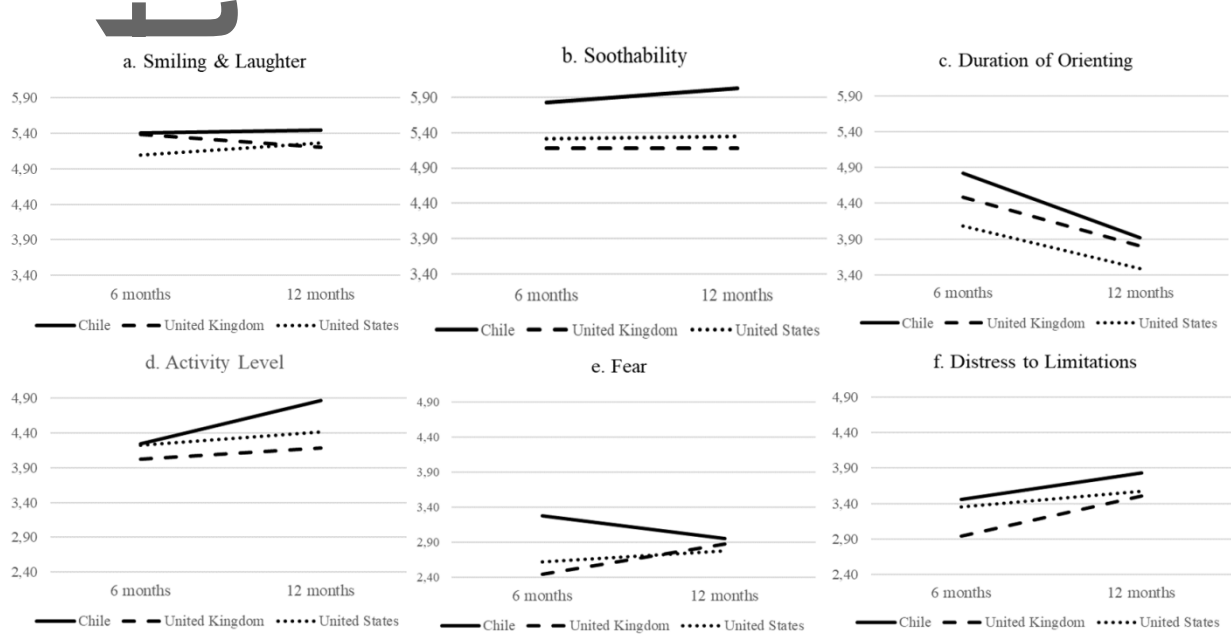
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**Figure 1a, b, c, d, e, and f**

*Estimated Mean Scores of Maternal Report of temperament at 6 and 12 Months by Country*



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**Table 1***Infant and Maternal Characteristics (M, SD)*

	Chile	United Kingdom	United States
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>
<b>Infant Characteristics</b>			
Birthweight (g)	1359.8 (230.2)	1334.7 (288.5)	1392.4 (266.7)
Gestational Age (weeks)	30.2 (1.4)	30.2 (1.8)	30.5 (1.8)
Days of Hospitalization	44.9 (17.4)	44.9 (19.7)	39.1 (20.0)
Neonatal Health Index	96.7 (12.6)	98.4 (18.3)	101.8 (15.0)
Gender ( <i>n</i> Male)	33 (70.2%)	24 (54.5%)	29 (58.0%)
<b>Maternal/Home Characteristics</b>			
HOME Score	30.8 (4.7) <sup>a</sup>	36.4 (5.2) <sup>b</sup>	38.3 (4.3) <sup>b</sup>
Maternal IQ (WAIS score)	34.7 (10.5) <sup>a</sup>	41.2 (14.8) <sup>b</sup>	46.2 (13.0) <sup>b</sup>
Maternal age (years)	27.2 (9.0)	29.7 (5.4)	28.5 (5.5)

*Note.* Means with different superscripts denote significant differences: HOME  $F(2,138) =$

33.08,  $p < .01$ ; Chile vs United Kingdom difference = 5.64,  $p < .01$ ; Chile vs United States

difference = 7.55,  $p < .01$ ; WAIS  $F(2,137) = 9.78$ ,  $p < .01$ , Chile vs United Kingdom

difference = 6.48,  $p < .05$ ; Chile vs United States difference = 11.52,  $p < .01$ .

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**Table 2***Descriptive Statistics of Infant Temperament Scales at 6 and 12 Months by Country*

	6 months		12 months	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Smiling & Laughter				
Chile	5.41	0.76	5.45	0.77
United Kingdom	5.39	0.80	5.21	0.69
United States	5.10	0.90	5.27	0.79
Soothability				
Chile	5.82	0.88	6.02	1.08
United Kingdom	5.18	0.78	5.18	0.82
United States	5.31	0.91	5.34	1.04
Duration of orienting				
Chile	4.82	0.78	3.92	0.78
United Kingdom	4.49	1.03	3.81	1.01
United States	4.08	1.12	3.49	1.15
Activity Level				
Chile	4.25	0.88	4.87	1.00
United Kingdom	4.02	0.79	4.19	0.84
United States	4.23	0.90	4.42	0.83
Fear				
Chile	3.28	1.13	2.95	0.90
United Kingdom	2.44	0.82	2.87	0.72
United States	2.62	0.94	2.78	0.70
Distress to limitations				

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Chile	3.46	1.08	3.92	0.98
United Kingdom	2.94	0.67	3.51	0.81
United States	3.35	0.73	3.57	0.72

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**Table 3**

*GLM Results for Maternal Report of temperament scales on the IBQ at 6 and 12 months*

	Smiling & Laughter			Soothability			Duration of Orienting			Activity Level			Fear			Distress to Limitations		
	<i>F(1,132)</i>	<i>p</i>	$\eta^2$	<i>F(1,132)</i>	<i>p</i>	$\eta^2$	<i>F(1,132)</i>	<i>p</i>	$\eta^2$	<i>F(1,132)</i>	<i>p</i>	$\eta^2$	<i>F(1,132)</i>	<i>p</i>	$\eta^2$	<i>F(1,132)</i>	<i>p</i>	$\eta^2$
Intercept	26.34	<.01	.17	42.70	<.01	.24	17.31	<.01	.12	5.48	.02	.04	10.67	<.01	.07	7.23	<.01	.05
Country	0.65	.52	.01	5.19	<.01	.03	3.29	.04	.05	5.56	<.01	.04	1.50	.23	.02	2.36	.10	.04
Age	2.89	.09	.02	0.06	.81	.01	0.68	.41	.01	0.70	.40	.01	0.36	.55	.01	0.45	.51	.01
Country x Age	3.63	.03	.05	1.22	.30	.02	0.24	.79	.01	6.72	<.01	.09	4.13	.02	.06	2.58	.08	.04
HOME	0.01	.95	.01	0.35	.55	.01	0.20	.75	.01	0.33	.56	.01	0.86	.36	.01	0.93	.34	.01
Maternal Verbal IQ	0.32	.57	.01	5.12	.02	.04	2.17	.14	.02	0.33	.57	.01	8.57	<.01	.06	0.39	.53	.01
Neonatal Index	0.79	.37	.01	1.16	.28	.01	1.04	.31	.01	3.70	.06	.03	0.56	.46	.01	0.12	.73	.01
Infant gestational age	0.53	.47	.01	5.36	.02	.04	3.13	.08	.02	0.01	.90	.01	0.01	.95	.01	0.07	.79	.01
Gender	6.82	.01	.05	0.69	<.01	.01	0.03	.87	.01	0.09	.76	.01	0.04	.84	.02	0.01	.99	.01

**Table 4**

*Descriptive Characteristics of Observed Infant Temperament at 12 Months by Country (GLM main effects of country are reported).*

	Chile		United Kingdom		United States		$F(2,13)$	$p$	$\eta^2$
	$M(SD)$	$Rang$	$M(SD)$	$Rang$	$M(SD)$	$Rang$			
Overall BRS	104.7(7.5)	81-118	108.3(10.1)	87-125	108.3(9.2)	78-121	2.50	.09	.04
Orientation/Engagement	44.2(4.4)	32-50	42.2(4.9)	31-51	44.0(4.4)	30-53	3.41	.04	.05
Emotional Regulation	31.4(3.1)	25-36	33.5(5.1)	22-47	32.4(3.3)	19-39	2.50	.09	.04

**Table 5**

*Correlations Between Maternal Report and Examiner Report of Temperament at 12 Months by Country of Origin*

	BRS Domains	
	Orientation/Engagement	Emotion regulation
Smiling & Laughter		
Chile	-.070	-.272
United Kingdom	-.001	.143
United States	.040	.175
Soothability		
Chile	-.082	-.148
United Kingdom	-.065	-.030
United States	-.166	-.028
Duration of orienting		
Chile	.007	-.143
United Kingdom	.075	.083
United States	-.111	.053
Activity Level		
Chile	.341*	.012
United Kingdom	-.060	.102
United States	-.129	-.001
Fear		
Chile	.008	.074
United Kingdom	.099	-.091
United States	.003	-.259

Distress to limitations

Chile	.023	.086
United Kingdom	.032	-.056
United States	.124	-.219

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\* $p < .05$

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