THE BRIEF CHILD AND FAMILY INTAKE AND OUTCOMES SYSTEM FOR INFANTS: PSYCHOMETRIC CHARACTERISTICS

THE BRIEF CHILD AND FAMILY INTAKE AND OUTCOMES SYSTEM FOR INFANTS: PSYCHOMETRIC CHARACTERISTICS

By

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Abstract

Research has shown that early signs of behaviour problems can be identified in infancy and toddlerhood and, while some of these challenges may resolve over time, often they continue and place children at risk for later mental health problems. To identify infants with early signs of emotional-behavioural problems who may benefit from intervention, psychometrically strong infant mental health measures could be helpful. Unfortunately, measures for assessing infant mental health often cannot be used to assess children under 12 months old or do not comprehensively address clinically-relevant mental health domains in infants. The Brief Child and Family Outcome System for Infants (BCFOSI) is a questionnaire for parents of infants 8 to 17 months old with evidence on its reliability and factor structure and promising preliminary evidence on validity (Niccols et al., 2018). Stability and validity of the BCFIOSI were examined in a community sample of 50 infants at 8-, 14-, and 18-months. Total scale scores demonstrated moderate stability over 4, 6, and 10 months, *r*s = 0.48, 0.31, and 0.39, respectively, *p*s < 0.05. Criterion validity correlations with other measures of emotional-behavioural functioning (ASQ:SE, BITSEA, CBCL) were significant at 8, 14, and 18 months, *r*s = 0.36 to 0.61, *p*s < 0.05. There were two significant concurrent validity correlations with measures of infant and maternal physiological regulation: 8-month BCFIOSI Total scores and infant vagal withdrawal, *r* = -0.35, and 8-month BCFIOSI Sleeping and maternal baseline RSA, *r* = 0.32, *p*s < 0.05. With regard to maternal behaviour, 8-month BCFIOSI Eating was correlated with observational measures of maternal sensitivity, non-hostility, and structuring, *r*s = -0.35, -0.44, and -0.28, respectively, ps < 0.05. Measures of parental stress and parenting attitudes also were correlated with 8-month BCFIOSI Total scores, *r*s = .029 to 0.48, *p*s < 0.05. Predictive validity was supported by significant longitudinal associations with the CBCL 4 and 10 months later, *r*s = 0.33 and 0.31, respectively, *p*s < 0.05. Findings provide additional evidence to support the use of

the BCFIOSI with infants at potential risk for later mental health problems who may benefit from intervention.

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Introduction

Infant Mental Health

Both the concept and field of infant mental health are relatively new. Historically, the period of infancy was not seen as a particularly important developmental time (Kagan, Kearsley, & Zelazo, 1978). It was not until the early 20th century that the period of infancy became viewed as an important time in child development (Fitzgerald & Barton, 2000), and not until later in the 20th century that it was viewed as a time during which experiences shape life-long health and mental health (Simpson, et al., 2016). Infant mental health is now defined as "the young child's capacity to experience, regulate, and express emotions, form close and secure relationships, and explore the environment and learn" (Zero to Three, 2001).

Infancy is the time of the most rapid brain development, with early experiences influencing, for better or worse, how the brain matures and functions (Zeanah & Zeanah, 2018). Infant development is viewed as relational and embedded within various contexts, some intrinsic to the child such as genetics and biology, and some extrinsic to the child such as family and the infant-parent relationship (Clinton, Feller, & Williams, 2016). The influence of these contexts and relationships is bidirectional with each potentially influencing the development of the other (Larrieu, Middleton, Kelley, & Zeanah, 2018). The quality of these relationships and environments can have a profound impact on development. Early adverse experiences can alter developmental trajectories and lead to disruptions in social-emotional development (Zeanah & Zeanah, 2018). While it is widely recognized that these early experiences can put young children at risk for later psychopathology, many people are still reluctant to believe that infants can experience mental health disorders (Zeanah & Zeanah, 2018). However, up to 20% of parents report that their babies and toddlers experience significant emotional and behavioural difficulties, such as excessive crying or feeding and sleeping problems (Hemmi, Wolke, & Schedier, 2011), and 4 to 15% of infants experience two or more of these difficulties simultaneously (Wolke, Meyer, Ohrt, & Riegel, 1995, Schmid, Schrier, Meyer, & Wolke, 2010). Further, up to 16% of 2-to-5 year-olds have challenges significant enough to warrant an identification of psychiatric difficulties (Egger & Angold, 2006). Despite this fact, less than 8% of infants and families receive services to help mitigate the impact of these types of difficulties, despite more frequent visits to their pediatrician due to their behavioural concerns (Horwitz, Gary, Briggs-Gowan, & Carter, 2003, Zuckerman, Moore, & Glei, 1996).

Infant Mental Health and Later Emotional-Behavioural Problems

While crying, sleeping problems, and feeding problems are considered a normal part of infancy, for a small subset of children, such difficulties can indicate more significant issues. Research has shown that the first signs of severe behaviour problems can be identified as early as infancy and toddlerhood (Cote et al., 2009, Briggs-Gowan, Carter, Skuban, & Horwitz, 2001) and, while some of these behaviours might be resolved with time, often they continue and place these children at risk for long-term mental health problems (Briggs-Gowan, Carter, Bosson-Heenan, Guyer, & Horwitz, 2006; Campbell, Shaw, and Gilliom, 2000; Winsper & Wolke, 2014). Early problems with feeding, sleeping, or excessive or prolonged crying may indicate underlying difficulties in the infant's ability to regulate behavioural and emotional states (Schmid, Schrier, Meyer, & Wolke, 2011). Further, these early regulatory problems may, in many instances, be precursors to subsequent behavioural, social, and emotional difficulties (Cote et al., 2009, Hyde, O'Callaghan, Bor, Williams, & Najman, 2012, Wolke, Rizzo, & Woods, 2002). Stability across varying spans of time has been observed for both internalizing and externalizing problems at early ages (Briggs-Gowan et al., 2006).

Sleeping and crying problems are the most commonly reported difficulties in infancy (Wake et al., 2006), with between 23-36% of parents reporting sleeping difficulties (Armstrong, Quinn, & Dadds, 1994) and up to 28% of parents reporting difficulties of excessive crying or fussiness throughout the first year of life (Clifford, Campbell, Speechley, & Gorodzinsky, 2002). While most young infants experience some night waking and difficulties settling into sleep, the ability to regulate sleep cycles is usually better developed by midway through the first year (Hoppenbrouwers, Hodgman, Arakawa, Greidel, & Sterman, et al., 1988). Infants that do not develop the ability to regulate their sleep cycles appear to be at increased risk for later attentional and behavioural difficulties (Scher, Zukerman, & Epstein, 2005). Williams, Berthelson, Walker, and Nicholason (2017) found that sleep problems during infancy, including difficulties separating at bedtime and falling asleep, frequent night waking, and restless sleep, predicted emotional dysregulation 2 years later. Mindell, Leichman, DuMond, and Sadeh (2017) also reported that less total sleep over a 24-hour period and later bedtimes at 12 months predicted internalizing problems (but not externalizing problems) at 18 months and these sleep variables were as predictive of internalizing problems at 18 months as were 12 month ITSEA scores. Sadeh and colleagues (2015) reported that children with poorer quality sleep at 1 year had poorer executive control and increased behaviour problems at 3-4 years, and Huhdanpaa and colleagues (2019) found that sleep duration at 3, 8, and 24 months was inversely associated with attention problems later in childhood and maternal reported problems with sleep at 24 months was associated with attentional problems and hyperactivity at 5 years. Excessive crying during infancy also has been well documented as a risk factor for later behavioural problems. Three-month-old infants who exhibited excessive crying were more likely to score in the clinical range on the total, internalizing, and externalizing problems of the CBCL at 4 years (Santos, Matijasevich, Capilheira, Anselmi, & Barros, 2015). Smarius and colleagues (2017) further found that excessive crying at 3 months, defined as 3 or more hours of crying per day over the last week, was associated with a doubled risk for behaviour problems, conduct problems, hyperactivity, and mood problems at 5-6 years as measured by the Strengths and Needs Questionnaire. Wolke, Rizzo, and Woods (2002) examined school-related outcomes at 8-10 years and found that children who had exhibited excessive crying as infants had increased problems with hyperactivity as well as lower academic achievement.

The relation between early feeding problems and later behaviour problems is less clear. While there does not seem to be an association between isolated feeding difficulties in infancy, Motion and colleagues (2001) found that persistent feeding difficulties over the first 15 months of life were associated with increased problem behaviours at 18 months, specifically, a higher incidence of temper tantrums.

The presence of a single regulatory problem on its own may not be significant enough to increase the risk of later problems, but rather, the cumulation and persistence of multiple regulatory problems predicts poorer outcomes for children (Cook, Giallo, Hiscock, Mensah, Sanchez, & Reilly, 2018, Schmidt et al., 2010, Wolke et al., 2002). In a meta-analysis of early regulatory problems including excessive crying, sleeping problems, and feeding problems, Hemmi and colleagues (2011) found that children who had more regulatory problems in infancy had increased behaviour problems, internalizing problems, externalizing problems, and diagnoses of attention deficit hyperactivity disorder later in childhood. Laucht, Schmidt, and Esser (2004) similarly found that only children with multiple regulatory problems were at higher risk of later internalizing and externalizing disorders, while infants with a single regulatory problem had similar rates of these disorders as controls. Children from high-risk families and with multiple regulatory problems were at even greater risk than those with multiple regulatory problems alone (Laucht, et al., 2004).

Biologically-based regulatory problems may interact with environmental adversities such as poor parenting or low parental mood to move early regulatory problems to more stable long-term mental health problems. While differences in characteristics and behaviours may be identifiable at an early age, these individual differences alone may not predict later functioning, but rather qualities within the infant-parent relationship (Zeanah & Zeanah, 2018). Adversities may exert influence on infants through their impact on the parent-child relationship, and the nature of this relationship can either protect infants from or exacerbate the influence of such risks (Zeanah & Zeanah, 2018). In a study of premature and full-term infants, the risk of having elevated levels of internalizing behaviours at 12 months was increased only for those infants who had both higher amounts of withdrawal at 3 months and mothers with elevated levels of depression (Sidor, Fischer, Eickhorts & Cierpka, 2017). Early infant withdrawal alone did not predict later internalizing behaviours. Further evidence comes from a study examining early multiple regulatory disorders and family adversities. Becker, Holtman, Laucht, and Schmidt (2004) found that early multiple regulatory problems alone did not significantly account for problem behaviours at 11 years, but rather the presence of early family risk factors such as a single parent household, low parental education, or poor parental coping skills in addition to early multiple regulatory problems.

Despite the growing understanding that early emotional-behavioural problems can lead to lifelong difficulties, few infants with regulatory problems are identified and receive potentially beneficial early intervention (Horwitz, et al., 2003). This situation exists for a number of reasons. First, it is difficult to reliably identify and define emotional and behavioural difficulties in the early years because of the developmental appropriateness of many behaviours (Bagner, Rodriguez, Blake, Linares, & Carter, 2012, Szaniecki & Barnes, 2016). For example, all infants cry at times to express their needs and most toddlers have some temper tantrums. It is difficult to differentiate typical behaviours from severe and problematic behaviours. Second, identifying that there is a problem and seeking help is largely up to the parent. Parents' perception of problematic behaviours are based on their knowledge and understanding of what is typical development, which varies greatly among parents, cultures, and contexts (Cox, Huntington, Saada, Epee-Bounya, & Schonwald, 2010, Bagner et al., 2012, Peters, Skirton, Morgan, & Clark, 2019). If parents do not recognize early behavioural and emotional problems as signs of mental health problems, they do not report these concerns to their physicians (Pescosolido et al., 2008). Third, infant mental health measures with robust psychometric properties are lacking (de Wolff, Theunissen, Vogels, & Reijneveld, 2013), especially those that comprehensively address mental health domains in infants under 12 months old (Niccols, Cunningham, Pettingill, Bohaychuk, & Duku, 2018).

Infant Mental Health Measures

The Ages and Stages Questionnaire: Social Emotional (ASQ:SE; Squires, Bricker, Heo, & Twombly, 2002) is one of the few infant mental health measures that extends down to infancy, however there is limited evidence to suggest that it’s psychometric properties have been validated appropriately in this youngest age group and information on stability is largely lacking (Gridley et al., 2019). While the ASQ:SE has different versions for each 6-month age range, other measures, such as the Brief Infant and Toddler Social Emotional Assessment (BITSEA, Briggs-Gowan, Carter, Irwin, Wachtel, & Cicchetti, 2004) use the same version to cover the entire period of infancy and toddlerhood. There is some evidence to suggest that problems may present differently at 12 months compared to 35 months and, as such, applying toddler measures to infants might not result in adequate identification of difficulties (de Wolff et al., 2013, Gridley et al., 2019).

The Brief Child and Family Intake and Outcomes System

To assess infant mental health, the Brief Child and Family Intake and Outcomes System for Infants (BCFOSI) was developed as a parent-report measure for infants 8 to 17 months old

(Niccols et al., 2018). Originally a measure for children and adolescents 6 to 18 years old (Cunningham, Boyle, Hong, Pettingill, & Bohaychuk, 2009), the Brief Child and Family Intake and Outcomes System has been expanded for use with infants 8 to 17 months, toddlers 18 to 36 months, and preschool children 3 to 5 years old (Niccols, Cunningham, Pettingill, Bohaychuk, & Duku., 2019; submitted). The BCFIOS for school-aged children included six-item subscales that closely mapped onto DSM-IV criteria for common childhood diagnoses including attention deficit hyperactivity disorder, oppositional defiant disorder, conduct disorder, separation anxiety disorder, generalized anxiety disorder, and major depressive disorder. The measure for infants includes items and subscales that are specifically relevant to infant emotional and behavioural regulation (Niccols et al., 2018). Questions include the most common reasons infants are referred for mental health services, covering the areas of sleeping, eating, expressing emotion, responding to change, and cooperation. Each subscale includes six items rated 0 (never), 1 (sometimes), or 2 (often). The BCFIOSI has been shown to have high internal consistency and test-retest reliability over one week (Niccols et al., 2018), but longer-term stability was not assessed. Providing preliminary evidence of validity, the scales scores were significantly associated in expected ways with family distress, caregiver mood, parental marital status, parental education, and family income (Niccols et al., 2018), however criterion validity with existing measures, concurrent validity with objective measures, and predictive validity were not assessed.

The Present Study

In this study, I investigated the stability and validity of the BCFIOSI, which is important for a number of reasons. First, the BCFIOSI is relatively new and is one of the only comprehensive, brief, and easily administered mental health measures for infants under 12 months. It is necessary to determine to what extent BCFIOSI scores are stable over time, associated with existing measures of early mental health, and related to objective measures, such as physiological indices of infant emotion regulation, such as respiratory sinus arrhythmia (RSA) and laboratory observations of infant behaviour. RSA reflects the component of variability in heart rate that occurs with respiration and is thought to index vagal regulation of the heart (Porges, 2007). Higher levels of RSA are thought to reflect greater flexibility to deal with potential challenges in the environment (Porges, 2001). Baseline or resting RSA and RSA suppression during a challenging task are two commonly used indices of physiological regulation. Second, longitudinal studies of infant mental health are lacking. It is necessary to examine the relations between infant mental health and internalizing and externalizing problems in toddlerhood, as predictive validity is an essential component of the psychometric integrity of a measure designed for use in early identification.

METHOD

Participants

Participants were mothers and their 8-month old infants recruited from the Hamilton area using the Child Database in the Department of Psychology, Neuroscience, and Behaviour at McMaster University. This database includes information for mothers who were recruited from hospitals across the greater Hamilton area shortly after giving birth and consented to be contacted in the future about relevant research studies. All consenting mothers were 18 years of age or older and delivered healthy full-term infants within normal limits of birth weight. The experimental procedures were approved by the McMaster Research Ethics Board.

Fifty mother-infant dyads participated in the 8-month laboratory assessment and completed study questionnaires. The mothers' mean age was 33.62 (SD = 3.94) and the majority were born in Canada (96%) and used English as the primary language in the home (98%). Ninety four percent of mothers identified as coming from a dual-parent household, with the remainder either co-parenting but living separately (4%) or single (2%). Many mothers had either a college or university degree (80%) and reported having an annual household income of over $100 000 (63%). In addition, many of the children's other parents also had completed either college (34%) or university (36%). Demographic characteristics of the participants are presented in Table 1. Forty-five of the 50 mothers completed the 14-month follow-up questionnaire and 48 of the 50 mothers completed the 18-month follow-up questionnaire.

Procedure

Mothers and their infants were tested in the Child Emotion Laboratory at McMaster University when the infant was 8 months old (mean age = 8.5 months; SD = 0.28 months). The entire visit was digitally recorded for later behavioural coding. Upon arrival at the research laboratory, the infant and mother were greeted by two researchers. The primary researcher (AS) remained consistent across all participants, while the second researcher varied. Responsibilities of each researcher remained consistent across all participants. The study's objectives and procedures were described in detail to the mother while the infant had a chance to explore and acclimate to the room. After informed and signed consent were obtained, the mother was asked to complete a "day-of-testing" questionnaire regarding her and her infant's eating and sleeping patterns over the day, as well as the presence of any current mentally or physically stressful situations, in order to control for any effects on physiology. While the mother completed the questionnaire, the two researchers applied three electrodes to the infant's back in an inverted triangle pattern to collect ECG data as well as the MUSE headband around the forehead with an electrode on each mastoid to collect EEG data. When the mother completed the questionnaire, three electrodes were placed on her chest in an inverted triangle pattern as well as a MUSE headband around her forehead with an electrode on each earlobe. The EEG data were collected as part of a larger study and were not examined for this study.

To obtain baseline ECG and EEG, the dyad was seated at a table together, with the child in a highchair beside the mother. Mothers were instructed to sit as still and relaxed as possible for the duration of the baseline recording, but if her infant became distressed, she was free to respond. For mothers, 5 minutes of EEG and ECG were collected while sitting quietly with eyes alternating open and closed. For infants, 5 minutes of EEG and ECG were collected while the infant watched a quiet video.

Following the baseline assessment, the mother and infant engaged in a 15-minute free play task. The dyad was seated on the floor together and the mother was asked to interact with her infant as she usually would. A basket of age appropriate toys, including cars, blocks, stacking cups, balls, touch and feel books, and toy phones was provided.

Following the free play session, the infant was placed in a high chair across from the mother for the Still Face Paradigm (SFP; Tronick, Als, Adamson, Wise, & Brazelton, 1978). The SFP is a well-established task to measure infant emotionality (Mesman, van IJzendoorn, & Bakermans-Kranenberg, 2009). The SFP was explained to the mother by the researcher. Specifically, the mother was asked to play with her baby as usual without toys for the first 2 minutes, at which time she would be signaled to stop interacting but continue looking at her baby while maintaining a neutral expression for the next two minutes and then resume interacting with her baby as usual for the last two minutes. The mother was signaled the episode change by the flashing of a small light on the wall in front of her. If the infants engaged in more than 30 s of continuous crying at the beginning, the procedure was stopped, and the mother was able to remove the baby from the highchair to provide comfort. The SFP was attempted again if the baby was soothed. If the baby engaged in more than 30 s of continuous crying during the still face episode, the episode was ended early and the mother moved on to the reunion episode. If the baby continued to cry, the procedure was ended early. After the SFP was complete the mother was free to remove the child from the highchair and provide any comfort the child needed. The mother and baby were given as much time as needed before moving on to the next task. Observational data was later coded from video for both the free play and SFP episodes.

The mother was then asked to complete a questionnaire using an iPad. The infant remained in the same room with just the mother while she completed the questionnaire and no toys were provided. The time the mother spent completing the questionnaires was used as a divided attention task. This allowed for the coding of infant and maternal behaviour in a situation that reflects typical daily activities where the mothers' attention needs to be split between the infant and other daily responsibilities. Divided attention has been used extensively as a task to assess maternal behaviour (e.g., Atkinson, Paglia, Coolbear et al., 2000, Niccols, 2008). The researcher left the mother and child alone for approximately 15 minutes and then returned to the room to entertain the child while the mother finished the questionnaire. At this time, EEG and ECG equipment was removed from the mother and baby. When the mother completed the questionnaire, she was given a $20 gift card to compensate her for her time.

To evaluate the predictive validity of the BCFIOSI, 6 and 10 months after their laboratory visit, mothers were sent an email with a link to an online follow-up survey. When mothers completed each of the follow-up questionnaires, they received an additional $10 gift card to compensate them for their time.

Psychophysiology Measures

ECG data collection, reduction, and measures.

ECG data were collected using the MindWare Mobile Impedance Cardiograph, Model 50-2303-00, with a sampling range of 500 Hz and 24-bit ADC digitization. The cardiac signals were reduced and analyzed using a commercial software package (MindWare Heart Rate Variability (HRV) Analysis Software, v3.1.1, MindWare Technologies, Ltd.) and data were visually edited for artifact (missing or spurious R-waves). Baseline resting HP (ms) and RSA (ln ms^2) was estimated by averaging the mean HP and RSA from five 1-minute long ECG baseline condition segments. HP and RSA during the SFP was computed in the same way, except the number of segments was reduced to two 1-minute long segments from each episode. A high frequency range of 0.15 to 0.4 was used for adults and 0.24 to 1.04 was used for infants (Porges et al., 2007). RSA suppression was computed by subtracting the SFP still face episode RSA from the beginning play episode RSA and RSA recovery was computed by subtracting the reunion episode RSA from the still face episode RSA so that a positive sign indicated a decrease in RSA and greater suppression while a negative sign indicated an increase in RSA and greater augmentation.

Behavioural Measures

Infant behaviour: Data collection, coding, and measures.

The videotaped SFP episodes were coded for infant affect and infant regulatory strategies using a scoring system created for the current study, informed by coding strategies used in the SFP literature (Braungardt-Rieker, Garwood, Powers, & Wang, 2001; Calkins & Fox, 2002; Weinburg & Tronick, 1994). Using BORIS (Behavioral Observation Research Interactive Software), infant facial expressions and vocalizations were coded for each 2-minute SFP episode and regulatory strategies were coded for each 2-minute SFP episode and each 2-minute reunion episode. Three coders were trained to rate infants on: facial expressions, vocalizations, gaze (parent- or object- oriented), comfort (self-comfort or object manipulation), avoidance, tension reduction, and gesturing to parent. In addition, maternal violations of the SFP (e.g., smiling at baby during still face) were coded. Infant facial expression event codes comprised the following: positive (any indication of a smile) or negative (small frown to larger frown or grimace). Infant vocalization event codes comprised the following: positive (laughter), mildly positive (coo, quiet chuckle), mildly negative (mild fuss, complaining), negative (crying, screaming). Infant regulatory strategy event codes comprised the following: object orientation (infant's gaze focused on an object or own body), parent orientation (infant's gaze focused on mother's face), self-comforting (self-stimulation such as sucking on fingers, rubbing face or hair), object manipulation (playing with or manipulating an object such as own clothing or high chair straps), gesturing to mother (attempting to engage mother by reaching to her, trying to touch her), avoidance (turning head away, straining forward, pushing back against high chair), and tension reduction (repetitive movements such as banging of hands or feet).

To assess interrater reliability, 15% of the videos were coded by both the author and the coder. Reliabilities were calculated based on the duration of time coded for each behaviour and Cohen's kappas ranged from 0.78 to 0.99.

Maternal behaviour: Data collection, coding, and measures.

Maternal behaviour was coded for sensitivity, structuring, non-intrusiveness, and non-hostility using the Emotional Availability Scales (Biringen, 2008). Two trained and certified coders used the 4th Edition, Infancy/Early Childhood Version of the EAS to score the free play, play, and reunion episodes of the SFP, and the distraction task. To assess interrater reliability, 20% of the sample were randomly selected and double-coded (k = 0.75 to 1.00).

Maternal-Report Measures

Emotional-behavioural problems.

The Brief Child and Family Intake and Outcomes System for Infants. The BCFIOSI was administered at 8 and 14 months and the Toddler version was administered at 18 months. The BCFIOSI is a 30-item caregiver report questionnaire (Niccols et al., 2018, in press). The infant version is appropriate for ages 8 to 17 months while the toddler version is for children 18 to 36 months. The infant version includes five subscales: Cooperating, Expressing Emotion, Responding to Change, Eating, and Sleeping. The toddler version has these same subscales and an additional subscale (Regulating Attention, Activity, and Impulsivity). Higher scores on the BCFIOSI subscales are indicative of more problems. Data on psychometric properties show that both versions (infant and toddler) have high internal consistency, adequate to high test-retest reliability, and preliminary evidence of validity (Niccols et al., 2018, in press).

Ages and Stages Questionnaire: Social Emotional. The Ages and Stages Questionnaire: Social Emotional (ASQ:SE; Squires, Bricker, Heo, & Twombly, 2002) has good psychometric properties and has been used extensively to assess social and emotional behaviour of children ages 3 to 65 months (Squires et al., 2002). The ASQ:SE includes questions that cover seven behavioural areas (self-regulation, compliance, communication, adaptive functioning, autonomy, affect, and interaction with people) but yields one overall score. Higher scores on the ASQ:SE are indicative of problems, with a clinical cut-off of 45 for 8-month-olds and 48 for 14-month-olds. We administered the ASQ:SE at 8 and 14 months to assess the criterion validity of the BCFIOSI.

Brief Infant and Toddler Social Emotional Assessment. The Brief Infant and Toddler Social Emotional Assessment (BITSEA; Briggs-Gowan, Carter, Irwin, Wachtel, & Cicchetti, 2004) has strong psychometric properties and can be used to assess social-emotional problems and social competencies in children ages of 12 to 48 months. The BITSEA problem scale includes questions that cover the areas of externalizing, internalizing, and dysregulation problems, while the competence scale covers the areas of empathy, prosocial behaviours, and compliance. Higher scores on the problem scale are indicative of problems, while lower scores on the competence scale are indicative of less developed social competence. We administered the BITSEA at 14 months to assess the criterion validity of the BCFIOSI.

Child Behavior Checklist. The Child Behavior Checklist (CBCL; Achenbach, 2001) for 1.5- to 5-year-olds is well-validated (Achenbach, 2001) and the most frequently used instrument for assessing behavioural and emotional problems in young children. It includes 99 items on 7 syndrome scales (Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawn, Attention Problems, Aggressive Behaviour, and Sleep Problems), 7 DSM-oriented scales (Affective Problems, Anxiety Problems, Pervasive Developmental Problems, Attention Deficit/Hyperactivity Problems, Stress Problems, Autism Spectrum Problems, and Oppositional Defiant Problems), as well as four summary scales (Internalizing Problems, Externalizing Problems, Other Problems, and Total Problems). Higher scores on the CBCL are indicative of more problems. We administered the CBCL at 18 months to assess the predictive validity of the BCFIOSI.

Parental stress and parenting.

Parental stress. The Parenting Stress Index – Short Form (PSI-SF; Abidin, 2012) was used to evaluate parental stress. The PSI-SF includes 36 items and is comprised of 3 subscales (Parental Distress, Parent-Child Dysfunctional Interaction, and Difficult Child) as well as a Total Stress scale. Higher scores indicate more problems. The PSI-SF is highly correlated with the full-length PSI and has good psychometric properties (Abidin, 2012).

Parenting attitudes. The Adult Adolescent Parenting Inventory (AAPI; Bavolek & Keene, 2001) was used to assess parenting attitudes. The AAPI includes 40 items and is comprised of 5 subscales: Inappropriate Expectations, Lack of Empathy, Value of Corporal Punishment, Role Reversal, and Oppressing Children's Power and Independence. Higher scores indicate more problems. The authors report that the instrument has good reliability and strong predictive validity (Bavolek & Keene, 2001).

Potentially confounding variables.

Infant temperament. The Infant Behaviour Questionnaire-Very Short Form (IBQ-VSF; Putnam, Helbig, Gartstein, Rothbart, & Leerkes, 2014) was used to assess infant temperament. The IBQ-VSF is a 36-item caregiver report questionnaire and includes three scales (Surgency, Negative Affect, and Effortful Control). The authors report that it is significantly positively correlated with the original scale and similar internal consistency, stability, and convergence (Putnam et al., 2014).

Parenting support. The Co-Parenting Relationship Scale was used to evaluate the quality of co-parenting in the family (Feinburg, Brown, & Kan, 2012). It includes 35 items and seven subscales (Co-parenting Agreement, Co-parenting Closeness, Exposure to Conflict, Co-parenting

Support, Co-parenting Undermining, Endorsing Partner's Parenting, and Division of Labor). The Co-Parenting Relationship Scale was not included in questionnaires for mothers who reported not having a partner.

Social support. The Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Powell, Farly, Werkman, & Berkoff, 1990) was used to assess perceptions of support from family, friends, and a significant other. It includes 12 items with 4 items for each subscale (Family, Friends, Significant Other).

Data on infant temperament, parenting support and social support were collected as part of a larger study and were not examined for this study.

Missing Data

There was some missing data for the laboratory assessment measures at 8 months. Forty-nine mothers and 47 infants provided sufficient baseline ECG data. Baseline data were excluded for the following reasons: lack of useable heart rate data due to excessive artifact (n = 2); and ECG data recording failure (n = 1). Four dyads did not participate in the Still Face Paradigm due to high levels of infant distress during the first episode. Of the 46 dyads that began the Still Face Paradigm, 39 provided sufficient still face ECG data for physiological analyses. Still face data were excluded for the following reasons: lack of useable heart rate data due to excessive artifact (n = 6); and ECG data recording failure (n = 1). The demographic characteristics of the those with useable heart rate data did not differ from excluded participants on any of the demographic variables. In addition, data on key study variables were missing for less than 1% of participants, and as such, case mean substitution was used (Schafer & Graham, 2002).

RESULTS

Descriptive Information

Fifty mothers completed the 8-month BCFIOSI questionnaires, of which 45 (90%) completed them again when their infants were 14 months and 48 (96%) completed the toddler (18-month) version of the questionnaire. The 5 mothers who did not complete the follow-up questionnaires when their infants were 14 months old were significantly more likely to have completed only high school ($x^2(1) = 7.73$, $p < 0.05$) and to have a low income (under $40,000) ($x^2(1) = 7.73$, $p < 0.05$) than the 45 mothers who completed the 14-month questionnaire. The two mothers who did not complete the follow-up questionnaires at 18 months did not differ on any demographic characteristics from those who completed them.

A univariate ANOVA indicated that there were significant mean total score differences among the three time points, $F(2,45) = 30.85$, $p < 0.001$. Specifically, although there were no significant differences between BCFIOSI mean total scores at 8 and 14 months, BCFIOSI mean total scores at 18 months were significantly higher than scores at both 8 and 14 months, $p < 0.05$.

BCFIOSI Score Distribution and Intercorrelations

Table 2 presents the descriptive statistics for the BCFIOSI at 8, 14, and 18 months. Total scores at 8 months ranged from 1 to 27 (possible range 0 to 60), and the mean was 14.44 (SD = 4.86). Total scores at 14 months ranged from 5 to 26 (possible range 0 to 60), and the mean was 13.45 (SD = 5.02). Total scores at 18 months ranged from 10 to 39 (possible range 0 to 66), and the mean was 24.17 (SD = 6.6). Kurtosis and skewness of the distribution were within the acceptable range for the total scores and most subscales. Expressing Emotion scale scores at 8- and 18-months Expressing Emotion were skewed toward low scores (Skewness = 2.167 and 3.054, SE of Skewness = 0.337 and 0.343, respectively). Information on the inter-correlations for each of the subscales is presented in Table 3.

Stability

The 6-month stability of the BCFIOSI Total score was examined for the 45 infants for whom there were both the 8-month and 14-month questionnaires completed, and found to be statistically significant, $r = 0.31$, $p < 0.01$ (Figure 1).Ten-month stability of the BCFIOSI Total score was examined for the 48 children for whom there were both the 8-month and 18-month questionnaires completed, and found to be statistically significant, $r = 0.37$, $p < 0.01$ (Figure 2). The 4-month stability of the BCFIOSI total score was examined for the 45 children for whom there were both 14-month and 18-month questionnaires completed, and found to be statistically significant, $r = 0.48$, $p < 0.001$ (Figure 3). Six-, ten-, and four-month stability information on each subscale is provided in Table 4.

Criterion Validity of the BCFIOSI

To assess criterion validity, correlations were examined between scores on the BCFIOSI and other measures of early emotional-behavioural problems (i.e., ASQSE, BITSEA, CBCL). Eight-month BCFIOSI total scores and ASQSE total scores at 8 months were significantly correlated, $r = 0.36$, $p < 0.01$ (Figure 4). At 14 months, BCFIOSI total scores were significantly correlated with ASQSE total scores, $r = 0.43$, $p < 0.01$ (Figure 5) and BITSEA problems scale scores, $r = 0.60$, $p < .001$ (Figure 6). At 18 months, significant correlations were found between the BCFIOSI total scale and the CBCL total scale, $r = 0.61$, $p < 0.001$ (Figure 7).

Concurrent Validity of the BCFIOSI

To determine concurrent validity, correlations between the 8-month BCFIOSI Total and subscales scores and measures of infant and maternal behavioural and physiological regulation were examined. BCFIOSI Total and subscale scores were not significantly correlated with infant baseline RSA or heart rate, however, RSA suppression was associated with the 8 month BCFIOSI Total score, $r = -0.35$, $p < 0.05$, such that infants who showed higher amounts of vagal withdrawal during the Still Face episode had lower BCFIOSI total scores (Figure 8). BCFIOSI scores were not associated with negative or positive affect during the Still Face task nor were they associated with regulation strategies employed by the infant during each episode of the Still Face task.

BCFIOSI total scores were not significantly correlated with maternal baseline RSA or heart rate; however, maternal baseline RSA was associated with 8-month infant Sleeping subscale scores, $r = 0.32$, $p < 0.05$, such that mothers with higher baseline RSA had infants with higher scores on the BCFIOSI Sleep subscale. While there were no significant associations between BCFIOSI total scores and maternal behaviours (sensitivity, non-hostility, and structuring), there were significant associations between BCFIOSI Eating subscale scores and maternal sensitivity, $r = -0.35$, $p < 0.01$, maternal non-hostility, $r = -0.44$, $p < 0.001$, and maternal structuring, $r = -0.28$, $p > 0.05$. Mothers who displayed more sensitivity, non-hostility, and structuring had infants with fewer eating problems.

Correlations between 8-month BCFIOSI scores and scores on self-report measures of parenting were examined (see Tables 5 and 6). BCFIOSI Total scores were significantly correlated with AAPI Power and Independence, PSI Parental Distress, PSI Parent-child Dysfunctional Interaction, and PSI Difficult Child, and PSI Total scores: Mothers who reported higher risk parenting attitudes towards oppressing children's power and independence and more parenting stress had 8-month-olds with higher BCFIOSI Total scores.

Relations between the BCFIOSI and demographic characteristics were examined. There were no significant differences on 8-month BCFIOSI subscales for infant sex, family income (low versus high), family composition (single parent household versus dual parent household), or maternal education (high school versus college/university completed). However, infants without siblings were reported to have significantly more problems with Cooperation ($t = 2.69$, $p = 0.01$)

than infants with siblings and infants of fathers who completed only high school were reported to have significantly more problems with Cooperation (t = -2.0, p = 0.05) than infants whose fathers completed post-secondary education.

Predictive Validity of the BCFIOSI

Predictive validity was examined by conducting correlations between BCFIOSI total scores and scores on other measures of emotional-behavioural problems (ASQ, BITSEA, CBCL) administered 4 and 10 months later (See Table 7). Eight-month BCFIOSI Total scores were not correlated with 14-month ASQ or 14-month BITSEA scores but were significantly correlated with 18-month CBCL Total scores (Figure 9). Fourteen-month BCFIOSI Total scores also were significantly correlated with 18-month CBCL Total scores (Figure 10).

Post-Hoc/Secondary Analyses for Infants with Stable Elevated Total Behaviour Problem Scores

The triangular shape of the scatterplot in Figure 9 (8-month BCFIOSI – 18-month CBCL) suggested a necessary but not sufficient condition for elevated 18-month CBCL scores. To further explore this finding, we compared participants with elevated BCFIOSI Total scores at 8 months (BCFIOSI Total scores above the mean) and 18 months CBCL Total scores (CBCL Total scores above the mean) ("stable elevated") or elevated BCFIOSI scores at 8 months and low CBCL Total scores (CBCL Total scores less than the mean at 18 months ("decreasing"). Compared to infants with decreasing scores, infants with stable elevated scores had significantly greater heart rate acceleration during the Still Face episode $t(10.58) = 2.612$, p = 0.025 and higher 8-month BCFIOSI Total scores, $t(15) = -2.91$, p = 0.011, 14-month BCFIOSI Total scores, $t(20) = -2.7$, p = 0.014, and 14-month BITSEA total scores, $t(20) = -2.17$, p = 0.043.

Discussion

Early regulatory problems are often stable and can predict later emotional and behavioural problems (Briggs-Gowan & Carter, 2008). While indicators of later problems can be seen in the first year of life, there are no comprehensive and feasible measures to identify these challenges in infants. The aim of this study was to examine a new and promising measure for identifying emotional-behavioural problems in infants. Findings from this study provide evidence of the stability and validity of the *Brief Child and Family Intake and Outcomes System for Infants* (BCFIOSI) and add to the existing evidence of its psychometric properties (Niccols et al., 2018).

Stability of the Brief Child and Family Intake and Outcomes System for Infants

The infant scale had moderate stability over time, and was significantly associated with the toddler scale. These findings indicate that the trajectory of early emotional-behavioural functioning is stable over time, with infants who had higher scores in the first year of life likely to continue to have elevated scores 6 and 10 months later. The correlation between 14- and 18-month scores was medium-large, likely at least partially due to the short time span (4 months) between assessments. The findings regarding stability are consistent with previous findings in this area which have indicated significant associations between early and later emotional-behavioural functioning (de Wolff et al., 2013).

Among the subscales, Eating and Sleeping (regulatory scales) were both significantly associated with the corresponding subscale at each time point (8-14, 8-18, and 14-18 months), with most correlations of large effect sizes. Cooperation (the externalizing scale) was significantly associated from 8 to 18 months and from 14 to 18 months. Responding to Change (an internalizing scale) was significantly associated only from 14 to 18 months. Expressing Emotion (an internalizing scale) was not significantly associated between any two time points.

These findings suggest that the basic regulatory functions of eating and sleeping and externalizing behaviour remain stable over time, while internalizing problems may vary somewhat over time. The subscale Expressing Emotion includes questions related to internalizing behaviours (e.g., shows little interest in or gets little pleasure from usual activities, has a flat expression or shows little emotion), with the majority of mothers reporting the absence of such behaviours at all time points, suggesting a restricted range of scores may have limited the possible associations across time. Also, previous research has suggested that parents are less accurate in identifying internalizing symptoms in their children than externalizing symptoms (Gardner, Lucas, Kolko, & Campo, 2007). These findings could help explain the absence of significant correlations between several time points for the Expression Emotions and Responding to Change subscales.

Criterion validity of the Brief Child and Family Intake and Outcomes System for Infants

Significant correlations with other measures of emotional-behavioural development provided evidence for concurrent validity of the BCFIOSI. BCFIOSI Total scores correlated significantly with the Ages and Stages Social Emotional Questionnaire at both 8 and 14 months, the Brief Infant and Toddler Social Emotional Assessment at 14 months and the Child Behaviour Checklist Total Score at 18 months, suggesting that the BCFIOISI assesses constructs similar to those assessed by these established measures.

At 14 months, the BCFIOSI was strongly associated with the BITSEA Problems scale while the ASQ:SE was moderately associated with both the BCFIOSI and BITSEA. In studies comparing the psychometric properties of various social emotional development measures, the BITSEA was found to have the most robust psychometric properties and the highest sensitivity for detecting later social emotional problems (de Wolff et al., 2013). These findings suggest that, at 14 months, the BCFIOSI may have some advantage over the ASQ:SE in assessing social emotional functioning. Further, at 18 months, the BCFIOSI was strongly correlated with the CBCL total score, providing further evidence of criterion validity.

Concurrent Validity of the Brief Child and Family Intake and Outcomes System for Infants

In examining concurrent validity, we sought to determine if BCFIOSI scores were related to assessments of functioning other than parent-report (i.e., observational and physiological infant measures) and to maternal variables (behavioural observations, physiological measures, parenting, and stress). We compared BCFIOSI scores to observational measures of infant negative affect, specifically the amount of crying or distressed facial expressions exhibited during the Still Face task and hypothesized that infants engaging in higher amounts of negative affect would have higher BCFIOSI scores; however, we did not find associations between these measures. We also hypothesized that infants with higher BCFIOSI scores would engage in more tension reduction and avoidance behaviours, and less orienting to their mother during the Still Face Paradigm (SFP), however, we again did not find these expected associations. One possible explanation is that infants' behaviours in new environments may not reflect their functioning in more familiar environments. While many studies have focused on maternal behaviours in the context of the SFP, few studies have examined the relation to infant characteristics such as temperament or social-emotional functioning and those that have had mixed findings. While Braungart-Rieker, Garwood, Powers, and Notaro (1998) found that maternal report of infant negative temperament predicted less self-comforting behaviours and object orientation, Tarabulsy and colleagues (2003) found that maternal report of infant difficultness did not predict infant affect during the SFP. Additionally, other infant risk factors, including prenatal substance exposure and prematurity have not consistently been found to predict infants' responses to the SFP (Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2009). Rather, maternal sensitivity has fairly consistently been found to predict infants' regulatory behaviours and affect during the SFP (Mesman et al., 2009) and some studies suggest that it is likely an interaction of maternal behaviour and infant temperament that influences infant responses to the SFP (Tarabulsy et al., 2003). Another possible explanation comes from the developmental appropriateness of the SFP with 8-month old infants. While the SFP has been used with infants ranging in age from 2-12 months (Adamson & Frick, 2003), a review of the SFP literature suggests that infants are generally under the age of 7 months and that the still-face effect becomes less pronounced after 6 months (Mesman, et al., 2009). In addition, by 8 months, infants tend to be more mobile and we found that many of the infants responded negatively to being placed in a highchair. Many infants were quite distressed during the first episode, presumably from being restrained in the high chair, and often had to delay starting the task until the infant had settled. Because of this, levels of negative affect and regulation strategies used may not reflect their typical regulatory behaviours.

To further explore concurrent relations with objective measures of emotional functioning, we examined relations between the BCFIOSI and infant and maternal physiological indicators of regulation. While 8-month BCFIOSI scores were not correlated with either infant resting RSA or heart rate, they were moderately associated with RSA suppression during a stressor. Infants with higher total BCFIOSI scores exhibited less RSA suppression during the Still Face episode. RSA suppression during a challenging or stressful event is considered a biological marker of behavioural and emotional regulation (Cooper-Vince, et al., 2017) because withdrawal of vagal control allows the body to use this energy to mobilize other functions to help cope with the demands of the situation (Calkins & Keane, 2009). A lack of RSA withdrawal during challenging tasks or arousal may reflect underlying difficulties in regulating the autonomic nervous system to allow for adequate coping during such situations (DeGangi, DiPietro, Greenspan, & Porges, 1991) and has been associated with later sleep problems (Gueron-Sela et al., 2017) and behaviour problems (Dale, O'Hara, Keen, & Porges, 2011, Porges, Doussard-Roosevelt, Portales, & Greenspan et al., 1996). Higher levels of suppression have been associated with better social and emotional regulation (Hastings, et al., 2008), less negative emotionality, and better social skills (Calkins & Keane, 2004). Less RSA suppression in infancy also has been found to predict increased behaviour problems at 3 years (Porges, et al., 1996). Further, some studies have found a more robust association between RSA suppression and risk level than resting measures of RSA or heart period (Calkins, Graziano, & Keane, 2007). Our findings that infants whose mothers reported emotional-behavioural difficulties also demonstrated challenges in physiological regulation, but not overall lower resting RSA support these previous findings. This finding also provides evidence of concurrent validity of the BCFIOSI compared to an objective measure of regulation.

Providing further evidence of concurrent validity, some of the infant scales were related to measures of maternal physiology and behaviour. Total scores were not related to maternal resting RSA or RSA suppression, but the Sleep subscale was associated with maternal resting RSA, such that infants whose mothers reported more Sleeping difficulties had mothers with higher resting RSA levels. Although somewhat surprising and in the opposite direction as expected, this finding may reflect that individuals with higher RSA also exhibit more empathy and responsiveness to others' distress (Fabes, Eisenberg, Karbon, Troyer, & Switzer, 1994) and as a result mothers with higher RSA may be quicker to respond to their infants' cries or distress during sleep times and be overly involved in soothing their infants to sleep. This behaviour could inadvertently lead to or perpetuate the development of sleep problems (Sadeh, et al., 2016). While there was no significant relation between BCFIOSI Total scores and maternal behaviours, infants whose mothers reported more Eating difficulties had mothers who displayed less sensitivity and structuring and more hostility during the laboratory visit. These findings are consistent with previous research finding that lower levels of maternal sensitivity during infancy are associated with feeding difficulties (Bilgin & Wolke, 2017, Davies et al., 2006). Although surprising that maternal sensitivity and other parenting behaviours were not associated with social emotional functioning, previous research on concurrent relations between infant regulatory difficulties and sensitive parenting is inconsistent. While maternal sensitivity has a well-established link to later child functioning (Deans, 2018), it is unclear whether maternal sensitivity influences regulatory difficulties in infancy (Leerkes, Blankson, & O'Brien, 2010). For example, Bilgin and Wolke (2017) failed to find any association between maternal sensitivity and regulatory problems at 6 months. Further, there is some evidence that maternal sensitivity in response to distress, rather than sensitivity in general, is a more significant and unique influence on emotional-behavioural functioning in infancy (Leerkes, et al, 2010). In the current study, maternal sensitivity was assessed over the course of a free play session, the SFP, and the divided attention task. Perhaps if sensitivity was examined specifically during the reunion episode of the SFP or during the divided attention task, we would have found the predicted association between maternal behaviours and regulatory problems. In addition, some studies have found that maternal sensitivity interacts with child related factors such as sustained attention and surgency (Frick, et al., 2018), and infant temperamental negativity (Crockenberg & Leerkes, 2006) in predicting emotional-behavioural functioning. Interactive parent-child effects were not examined in this study and are an important next step.

The infant scales also were related to parenting attitudes and stress. Infants with higher total scores had mothers who reported a more restrictive attitude towards their children's power and independence as well as more stress related to being a parent, dysfunctional parent-child interaction, and their perception of their child as difficult. High levels of parenting stress and harsh parental attitudes consistently have been linked to childhood behaviour problems (Anthony et al., 2005, Haapsamo et al., 2013, Tsotsi et al., 2019).

Predictive Validity of the Brief Child and Family Intake and Outcomes System for Infants

Findings supported the predictive validity of the BCFIOSI: Both 8-month and 14-month BCFIOSI scores were significantly and moderately associated with 18-month CBCL scores. Infants who had elevated BCFIOSI scores at either 8 months or 14 months were likely to display more problematic behaviour at 18 months as measured by the CBCL, suggesting that the BCFIOSI is able to identify infants at-risk of later emotional-behavioural difficulties. This finding of a moderate correlation between regulatory problems at 8 months and 14 months and behaviour problems at 18 months are consistent with findings from previous studies of early predictors of psychopathology. For example, Sidor, Fischer, Eickhorst, and Cierpka et al, (2013) found low, but statistically significant associations between regulatory problems at 4 and 6 months and emotional-behavioural functioning at 12 months. Further, in a meta-analysis of the associations between early regulatory problems and childhood behavioural outcomes, Hemmi and colleagues (2011) found that early problems of crying, sleeping, and feeding moderately predicted internalising, externalizing, and attentional difficulties in later childhood.

While not directly related to the validity of the BCFIOSI, we found that infants with stable elevated emotional-behaviour problems from 8 to 18 months exhibited greater heart rate acceleration during the SFP and displayed more emotional-behavioural problem at 8 months and at 14 months than infants with decreasing emotional-behavioural problems from 8 to 18 months.. Deficits in physiological regulation and persistent regulatory difficulties may have placed these infants at greater risk of continued emotional-behavioural problems. The moderate correlation between emotional-behavioural functioning at 8 months and 18 months, together with these findings, may reflect that, in the absence of other risk factors such as physiological deficits in regulation, persistent regulatory problems, or maternal psychopathology, early regulatory problems alone may not entirely predict ongoing mental health difficulties. The trajectory from early regulatory problems to later psychopathology is not linear but rather has been conceptualized as a developmental cascade in which early regulatory problems may be the beginning of the cascade, both further shaping and being shaped by other biological and environmental factors (Winsper & Wolke, 2014), and no single risk factor alone can predict outcome (Kostyrka-Allchorne, Wass, & Sonuga-Barke et al, 2019). For example, parents of infants with sleeping difficulties may feel higher levels of parenting stress, which in turn leads to less sensitive interactions with their infant (Calkins, Hungerford, & Dedmon et al., 2004). Less sensitive parent-child interactions fail to encourage the development of self-regulation skills which subsequently can lead to increased problem behaviours and mental health difficulties (Sroufe, 2005, Tsotsi, et al., 2019).

Strengths and Limitations

A strength of the current study was its longitudinal design: Measures of social-emotional functioning were collected at multiple points in infancy and toddlerhood, which allowed for the examination of predictive validity. Another strength was the inclusion of observational and physiological measures of regulation in validating the BCFIOSI. An inherent problem with measures of early emotional-behavioural functioning is their over-reliance on information from parents alone. There can be variation between methods of assessment and their location (e.g., home, laboratory). Parental perception relies on assumed knowledge of what constitutes problematic behaviour (Godoy, Davis, Heberle, Briggs-Gowan, & Carter, 2018) and parent report is potentially biased (Weitzman, Edmonds, Davagnino, & Briggs-Gowan, 2011). Thus, it is difficult to ascertain whether the measure is assessing individual differences in functioning or differences in parental knowledge, expectations, or stress. Additionally, this study included data on different types of validity. In a systematic review of the psychometric properties of commonly used emotional-behavioural measures, Gridley et al. (2019) found that the majority of studies reported on internal consistency and structural validity. Properties of stability, criterion validity, concurrent validity, and predictive validity were largely missing, raising the question of whether these measures have been appropriately tested and validated for use with infants. By examining stability, criterion validity, concurrent validity, and predictive validity of the BCFIOSI, this study contributes evidence of the psychometric properties of this measure.

Despite these strengths, the current findings should be considered in light of several limitations. First, our sample was quite restricted in terms of demographic characteristics and levels of child functioning. The majority of the sample came from dual-parent, high income families and infants generally had low scores on measures of regulatory problems and problematic behaviours. None of the infants had scores in either the borderline range or clinical range of the CBCL at the 18-month follow-up. Because of the restricted range of scores, the clinical utility and sensitivity of the measure could not be addressed. Further work is needed with a more varied sample of infants in order to examine the sensitivity and specificity of the BCFIOSI. Second, the predictive validity of the BCFIOSI was measured in relation to the CBCL, which is also a parent-report measure and subject to potential parental biases. Stronger evidence of predictive validity would come from a diagnostic assessment. In addition, a longer follow-up period covering the period up to school entry would be beneficial in order to allow for multiple informants (i.e., teacher report). And third, information on children's prior health concerns or medical conditions was not collected, and the impact of such could not be accounted for in analyses.

Conclusion

Notwithstanding these limitations, we were able to demonstrate adequate stability and criterion, concurrent, and predictive validity of the Brief Child and Family Intake and Outcomes System for Infants at 8 and 14 months of age, as well as adequate criterion validity of the Brief Child and Family Intake and Outcomes System for Toddlers. The BCFIOSI may have added value beyond that of other measures of early emotional-behavioural functioning because it can be used with infants under the age of 12 months, it is brief yet covers areas of infant emotional-behavioural functioning comprehensively and in a developmentally appropriate manner, it has established Canadian norms for each version (infant, toddler, preschool), and it has strong psychometric properties (Niccols et al., 2018, 2019). Findings also provide additional evidence of the continuity of regulation problems starting in infancy and early trajectories of emotional-behavioural problems. Even in a typically developing sample at relatively low risk, increased early regulatory problems at 8 months were associated with increased behaviour problems at 18 months. The findings provide additional evidence to support of the use of the BCFIOSI in detecting potential early risk for later mental health problems and identifying infants who may benefit from intervention.

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Tables

Table 1: Demographic characteristics

Variable		N	%
Number of children			
	Single child	24	48
	1 sibling	18	36
	2 siblings	3	6
	3 siblings	4	8
	6 siblings	1	2
Child sex			
	Male	25	50
	Female	25	50
Household composition			
	Single parent	1	2
	Dual parent living separately	2	4
	Dual parent	47	94
Mother's highest level of education			
	Secondary/high school	3	6
	College/CEGEP	17	34
	University	23	46
	Graduate Degree	6	12
	Prefer not to answer	1	2
Other parent's highest level of education			
	Secondary/high school	7	14
	Apprenticeship/Trade	3	6
	College/CEGEP	17	34
	University	18	36
	Graduate Degree	4	8
	Prefer not to answer	1	2
Household income (in Canadian Dollars)			
	$0-20 000	2	4
	$20 000 - 29 999	2	4
	$60 000 - 79 999	6	12
	$80 000 - 99 999	8	16
	$100 000 - 149 999	23	46
	$150 000 +	9	17

Table 2: Descriptive Statistics for the BCFIOSI Questionnaire

	8 months			14 months			18 months		
	range	M	SD	range	M	SD	range	M	SD
Cooperation	0-8	4.64	1.75	1-10	5.11	1.81	3-11	6.19	1.69
Expressing Emotion	0-3	0.38	0.78	0-2	0.29	0.59	0-7	0.65	1.54
Responding to Change	0-10	3.56	2.09	0-7	2.47	1.74	0-8	3.02	2.19
Sleeping	0-11	3.72	2.76	0-10	2.98	2.56	0-10	3.00	2.6
Eating	0-10	2.14	2.29	0-11	2.84	2.49	0-11	3.52	2.52
Regulating Attention, Impulsivity, and Activity							1-12	7.85	2.58
Total	1-27	14.44	4.86	5-26	13.69	4.96	10-39	24.17	6.6

Subscale scores have a possible range of 0-12

Total scores at 8 and 14 months have a possible range 0-60

Total scores at 18 months have a possible range 0-66

Table 3: Inter-correlations of the BCFIOSI Subscales and Total Scores

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. 8 month Cooperation	-0.032	0.140	0.135	0.197	.584**	0.252	-0.147	-0.276	0.151	0.231	0.172	0.281	0.081	-0.003	0.257	.285*	0.227	.392**
2. 8 month Expressing Emotion		-0.096	-0.016	.279*	0.230	-.372*	0.277	-0.071	-0.160	0.009	-0.206	0.055	-0.057	-0.017	-0.134	-0.106	-0.189	-0.174
3. 8 month Responding to Change			0.021	-0.038	.459**	0.051	-.375*	0.113	0.071	-0.019	0.041	0.073	0.047	0.249	0.204	0.093	0.234	.323*
4. 8 month Sleeping				-0.126	.564**	-0.135	-0.066	-0.024	.644**	-0.063	0.235	-0.171	-0.129	0.028	.488**	0.049	-0.046	0.130
5. 8 month Eating					.498**	0.023	0.066	-0.141	0.035	.554**	0.262	-0.010	-0.015	-0.046	0.021	.350*	-0.041	0.106
6. 8 month Total						-0.021	-0.170	-0.141	.448**	.303*	.306*	0.037	-0.042	0.093	.441**	.313*	0.101	.367*
7. 14 month Cooperation							-0.009	0.135	-0.014	.347*	.578**	.367*	0.148	0.290	0.196	0.171	0.158	.425**
8. 14 month Expressing Emotion								0.176	-0.041	0.233	0.273	-0.037	0.008	0.102	-0.239	-0.113	-0.212	-0.194
9. 14 month Responding to Change									-0.094	0.180	.462**	-0.064	0.190	.414**	-0.014	0.035	-0.123	0.124
10. 14 month Sleeping										-0.018	.464**	-0.253	-0.249	-0.012	.589**	0.161	0.013	0.175
11. 14 month Eating											.709**	0.068	-0.083	0.286	0.168	.551**	0.134	.420**
12. 14 month Total												0.010	-0.048	.400**	.427**	.420**	0.063	.476**
13. 18 month Cooperation													0.084	0.161	0.054	0.189	.312*	.547**
14. 18 month Expressing Emotion														-0.124	0.101	-0.017	-.554**	0.029
15. 18 month Responding to Change															0.015	0.163	.304*	.537**
16. 18 month Sleeping																.322*	-0.101	.524**
17. 18 month Eating																	0.224	.701**
18. 18 month Regulating Attention, Impulsivity, and Activity																		.493**
19. 18 month Total																		

Table 4: Correlations Among the BCFIOSI Scores at 8, 14, and 18 months

	8 and 14 months	8 and 18 months	14 and 18 months
Cooperating	0.252	0.281*	0.367*
Expressing Emotion	0.277	-0.057	0.008
Responding to Change	0.113	0.249	0.414**
Sleeping	0.644**	0.488**	0.589**
Eating	0.554**	0.350*	0.551**
Total	0.306*	0.367*	0.476**

* *p* , 0.05
** *p* , 0.01

Table 5: Correlations Between BCFIOSI and AAPI

	AAPI Inappropriate Expectations	AAPI Lack of Empathy	AAPI Role Reversal	AAPI Power and Independence	AAPI Physical Punishment
BCFIOSI Total	0.082	0.057	0.046	0.290*	0.016

* $p < 0.05$
** $p < 0.01$

Table 6: Correlations Between BCFIOSI and PSI-SF

	PSI-SF Parental Distress	PSI-SF Parent Child Dysfunction	PSI-SF Difficult Child	PSI-SF Total
BCFIOSI Total	.410**	.289*	.397**	.480**

* $p < 0.05$
** $p < 0.01$

Table 7: Predictive Validity Correlations Between BCFIOSI Total Scores at 8 and 14 Months and Other Measures of Emotional-Behavioural Problems at 14 and 18 Months

	14-month ASQ:SE Total	14-month BITSEA Problems	18 month CBCL Total
8 month BCFIOSI Total	0.085	0.272	.310*
14 month BCFIOSI Total	.427**	.603**	.331*

* $p < 0.05$
** $p < 0.01$

Figures

Figure 1: 6-Month Stability of BCFIOSI Total

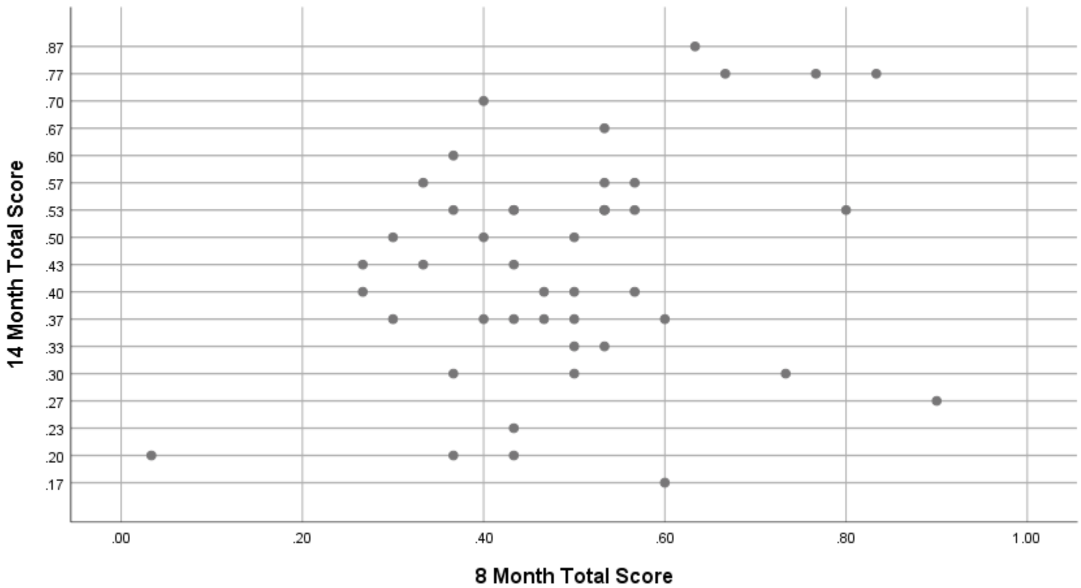

Figure 2: 10-Month Stability of BCFIOSI Total

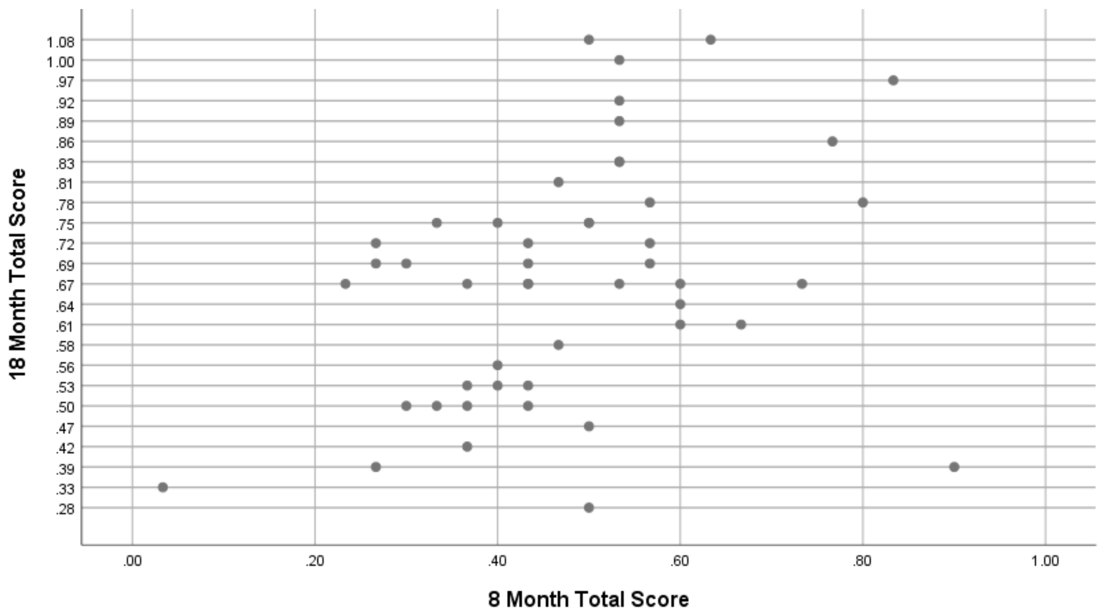

Figure 3: 4-Month Stability of the BCFIOSI

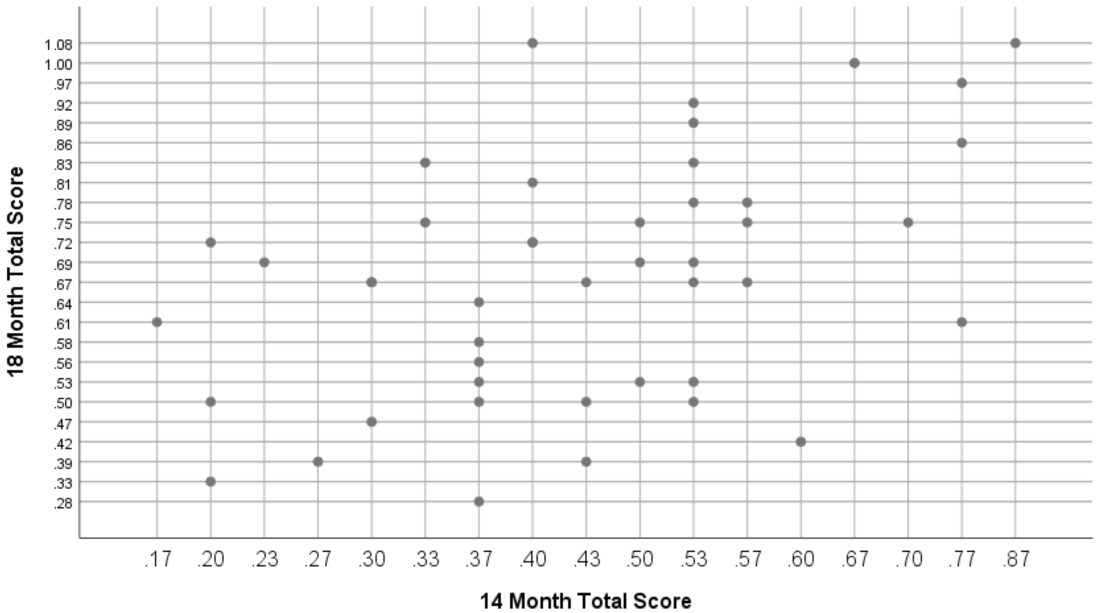

Figure 4: Correlation Between BCFIOSI Total Scores and ASQ:SE Total Scores at 8-Months

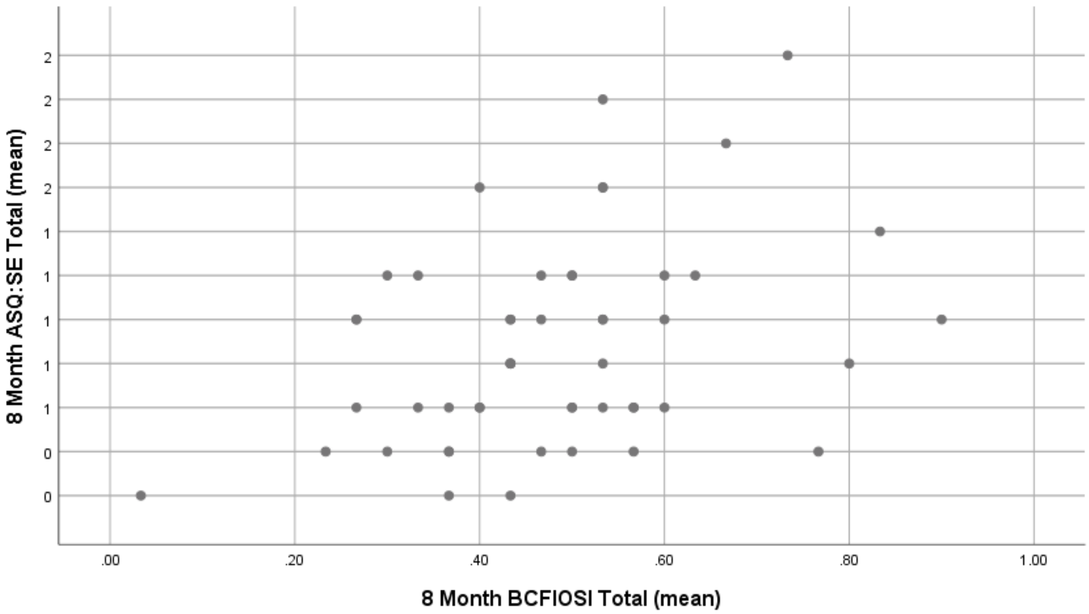

Figure 5: Correlation Between BCFIOSI Total Scores and ASQ:SE Total Scores at 14-Months

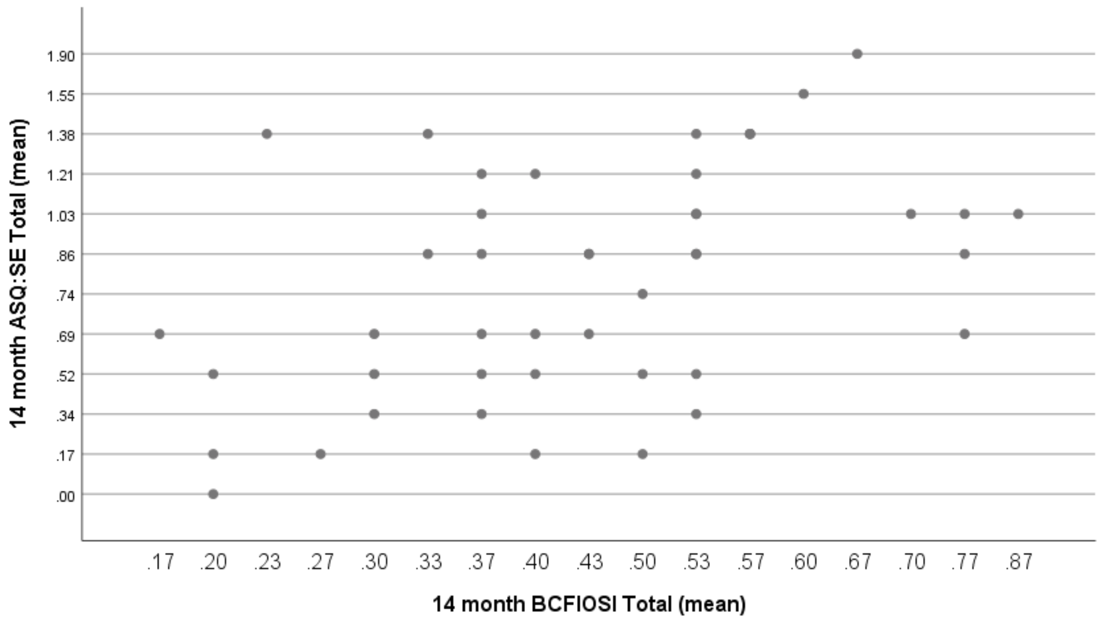

Figure 6: Correlation Between BCFIOSI Total Scores and BITSEA Problems Score at 14 Months

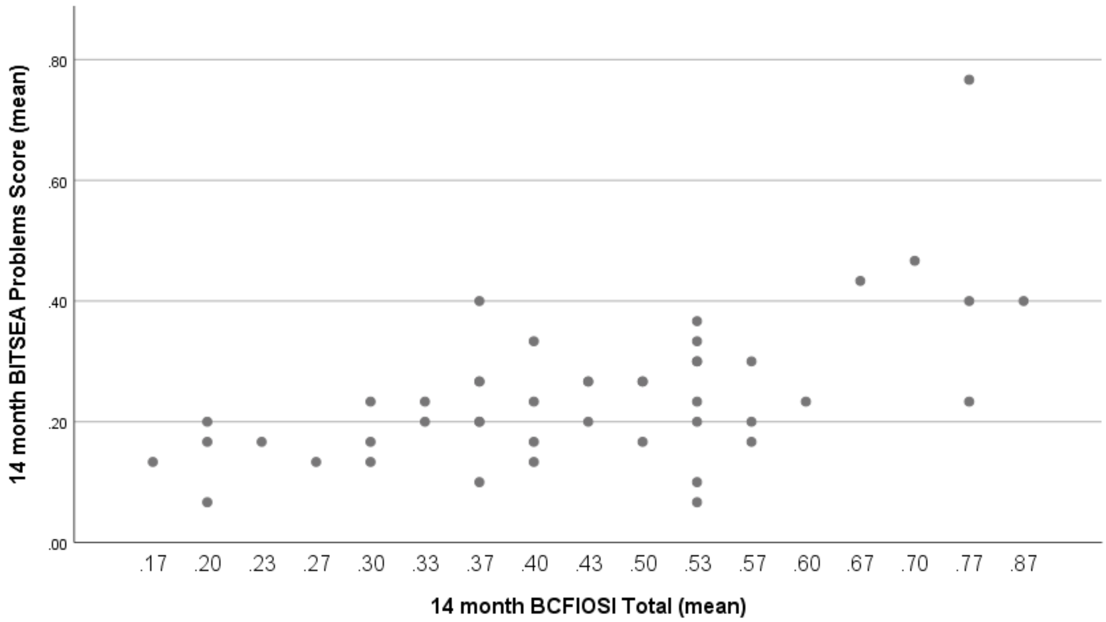

Figure 7: Correlation Between BCFIOSI Total Scores and CBCL Total Scores at 18 Months

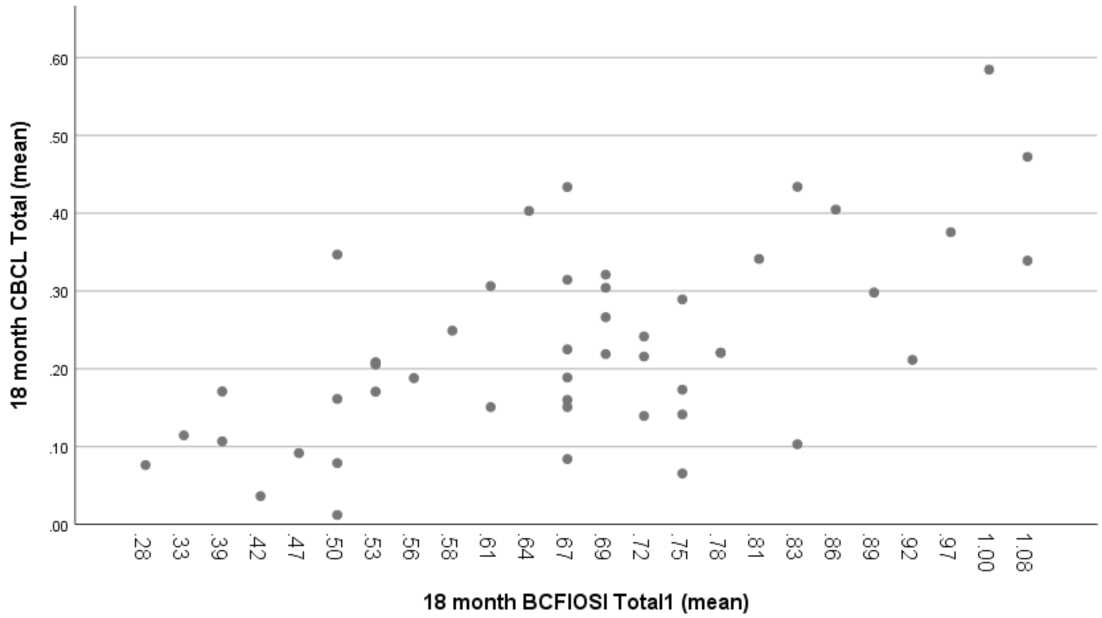

Figure 8: Correlation Between 8-Month BCFIOSI Total Scores and RSA Suppression During Stressor

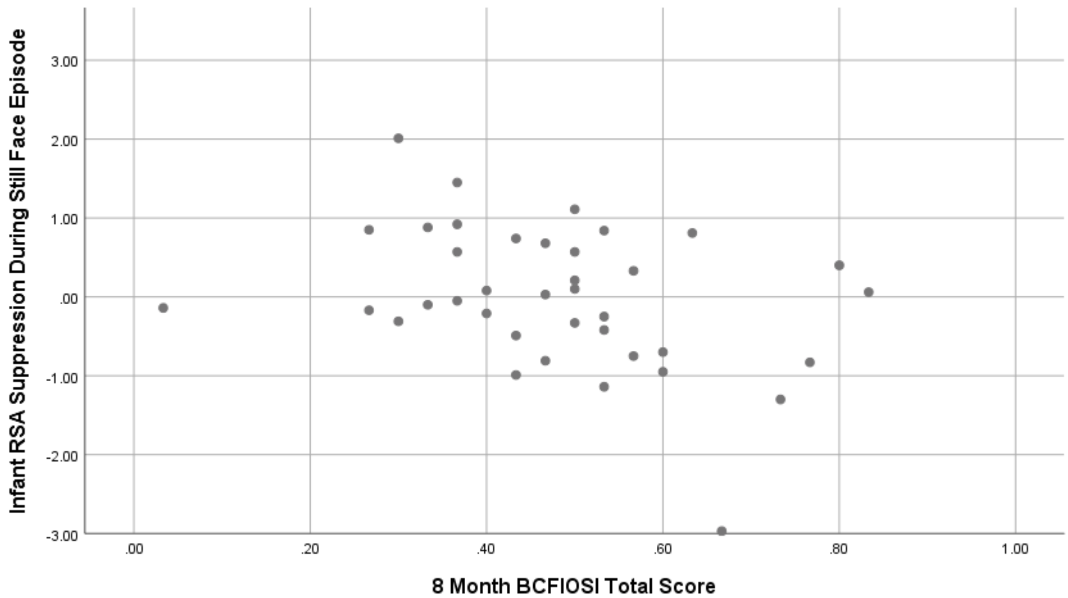

Figure 9: Correlation Between 8-Month BCFIOSI Total Scores and 18-Month CBCL Total Scores

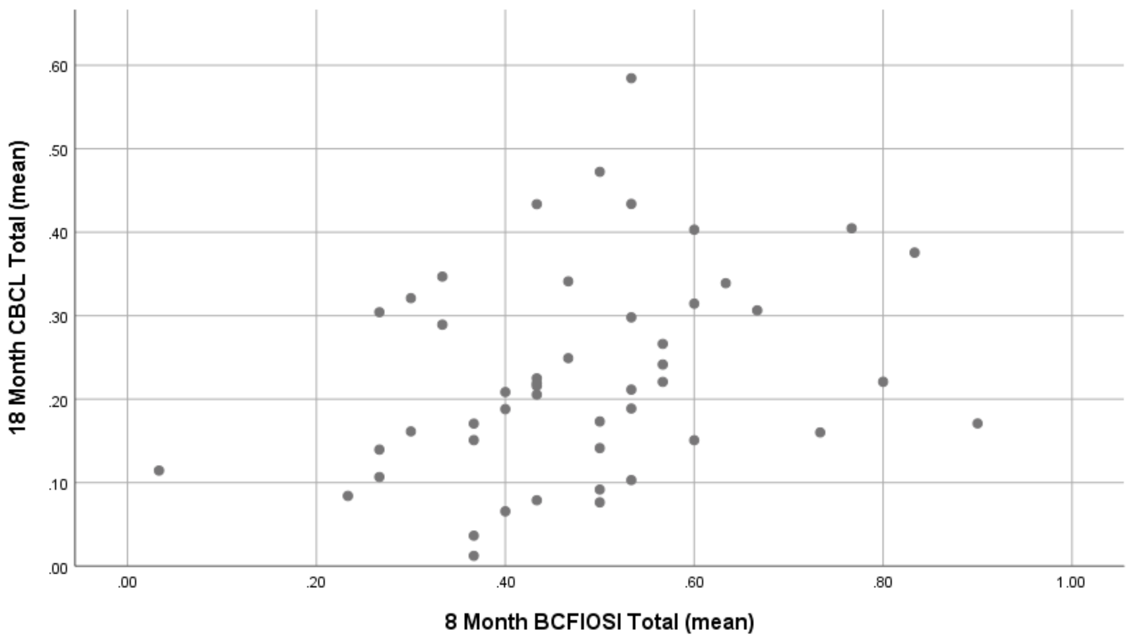

Figure 10: Correlation Between 14-Month BCFIOSI Total Scores and 18-Month CBCL Total Scores