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## REGULAR ARTICLE

# Validation study showed that ratings on the Welch Emotional Connection Screen at infant age six months are associated with child behavioural problems at age three years

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## Keywords

Child behavioural problems, Emotional connection, Mother–infant interaction, Relational health

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## ABSTRACT

**Aim:** The emotional connection between mothers and infants born preterm has been associated with positive behaviour. The aim of this study was to examine the longitudinal association between emotional connection at six months of age and behavioural problems at three years.

**Methods:** This study was carried out by the University of North Texas, USA and comprised 49 mothers and infants from a longitudinal investigation of family interaction and infant development conducted in 1994–1997. Face-to-face interaction and toy-based play were videotaped and coded at six months of age using the Welch Emotional Connection Screen (WECS), a brief screening tool for relational health. When the children were three years of age, the mothers reported on child behavioural problems.

**Results:** The children from dyads that were rated as emotionally connected at six months of age had fewer externalising and internalising behavioural problems at the age of three. No links were found between emotional connection during toy-based play at six months and later child behavioural problems.

**Conclusion:** We showed that when the WECS was used at six months of age it was a promising and valid relational screening tool for infants at risk of adverse behavioural outcomes at the age of three.

## INTRODUCTION

Extensive research has documented the negative impact of insensitive, unresponsive maternal care (1,2) on children's social and emotional development. This includes the development of child behavioural problems in the first three years of life (3). In contrast, warm, sensitive and responsive early interactions with parents have been shown to promote secure infant–parent relationships and healthy socio-emotional functioning (4–6). High-quality maternal caregiving in infancy has been associated with more optimal bio-behavioural development in infancy and early childhood (3,7), while low-quality maternal care has been directly linked with increased cortisol reactivity in children (8,9).

Although sensitive and responsive caregiving is important for healthy child development (10), the bi-directional,

dynamic nature of relationships suggests that both the parents and the children contribute to the patterns of early interaction and the quality of relationships (11). The need to assess early relationships through a dyadic or relational health lens has moved to the forefront of early childhood mental health investigations. An exclusive focus on individual behaviours, such as maternal sensitivity or child self-regulation, may miss the relationship-level, dyadic, co-

## Abbreviations

CBCL, Child Behavior Checklist; WECS, Welch Emotional Connection Screen.

## Key notes

- We used the Welch Emotional Connection Screen to see whether emotional connection between 49 full-term infants and their mothers at six months of age predicted behavioural problems at three years.
- Children in dyads that were emotionally connected at six months had fewer externalising and internalising behavioural problems at the age of three.
- However, no links were found between emotional connection during toy-based play at six months and later child behavioural problems.

regulatory behaviours that form the foundation for calming, synchronous interactions and later social-emotional development (12).

Recognition of both the importance of the dyad as the unit of analysis (13), and the need for relationship-based assessments, has been evident in efforts to describe dyadic-level constructs, such as synchrony, mutuality, emotional recognition and emotional availability (11,14,15). While each of the aforementioned dyadic-level constructs is defined differently, the common thread that links these constructs is a similar, underlying pattern of connection between a caregiver and a child. For example, Saunders et al. (15) described emotional availability as a shared dyadic emotional connection, encompassing proximity seeking and visual contact with a parent. While emotional availability is viewed as a dyadic-level construct, investigators have questioned how the mutual component is addressed. Emotional availability is usually measured using a combination of six subscales of behaviour in order to assess a dyad's emotional functioning. Of these, four are maternal subscales and the other two relate to the infant or child. Although both the caregiver and child dimensions are measured, they are rated separately.

This means that although dyadic-level interaction is essential to the quality of the parent-child relationship, it is hard to assess. While existing measures may capture essential features of emotional behaviour, they do not directly measure dyadic-level emotional connection. Existing methods for assessing the quality of relationships may also be time-consuming and labour intensive (16). This means that this type of assessment is beyond the capacity of practitioners who may desire, and require, a more rapid screening tool for gauging relational health in parent-infant dyads.

The initial development of the Welch Emotional Connection Screen (WECS) focused on identifying and assisting mother-infant dyads who displayed a lack of emotional connection, as a result of emotional and physical separation due to premature birth and an extended stay in a neonatal intensive care unit (12). Results from a randomised controlled trial of the Family Nurture Intervention, which sought to optimise emotional connection between the dyad, indicated significant improvements in mother-infant engagement at four months of age (17). It also found significant improvements in the neurodevelopmental and socio-emotional functioning of infants at 18 months of age when the dyads received the Intervention, rather than the standard care offered to the controls (18). Participation in the Family Nurture Intervention was also linked to increased maternal caregiving behaviour, decreased maternal anxiety and depressive symptomology and more positive infant socio-emotional outcomes (18-21).

These results led to the development of the WECS, which is a rapid observational assessment that can be used in a clinical setting as a screening tool to identify at-risk mother-child dyads. The WECS assesses emotional connection using a dichotomous rating derived from observations of mother-infant behaviour. Dyads rated as emotionally

connected exhibit responsive, synchronous interactions that are marked by both the mothers' and infants' abilities to receive and respond to one another's emotional signals (20,22).

The construct validity of the WECS has already been demonstrated with mothers and their preterm infants (23). Infants in dyads rated as emotionally connected showed the healthy response of vagal suppression and increased heart rate when confronted with the maternal still face. In contrast, infants in dyads rated as not emotionally connected showed increased heart rate and augmented vagal tone. This type of reaction indicates a non-reciprocal mode of autonomic response to stress in not connected dyads. While these results are correlational in nature, the findings point to a clear association between emotional connection and the physiological response of infants to relationship stress of the still-face paradigm (23). Being emotionally connected, as measured by the WECS, has been associated with healthier responses to relationship disruption, which is a finding consistent with the calming cycle theory (12).

Evidence has been published that greater parent-child dyadic mutuality has been associated with higher levels of social competence across childhood (24) and fewer child behaviour problems (25). With this in mind, we hypothesised that assessing a child's emotional connection in infancy would predict their emerging socio-emotional competence. The measurements of dyadic mutuality have been diverse, but they have ranged from a focus on shared positive affect and mutual compliance (24) to individual parent and child responsiveness, shared cooperation and reciprocity (25). The WECS, in contrast, focuses on the observable mutual relational characteristics of the parent and child.

While the WECS has been validated for use with mothers and preterm infants (23), no study to date has used the WECS for mothers and full-term infants or has examined the predictive validity of the WECS. We believed that demonstrating links between emotional connection, as assessed by the WECS, and later child behaviour problems would provide the empirical evidence that the WECS was a valid health screening tool that measured relationships. This could be used to identify at-risk dyads in an effort to prevent later child behavioural problems.

Early socio-emotional problems have an effect on families and children, including an impact on the children's long-term social, emotional, behavioural and cognitive development (26,27). That is why we decided to focus on assessing internalising and externalising behaviour problems in early childhood at the age of three years. We also felt that the co-occurrence of any internalising and externalising behaviour problems, in particular, may warrant early intervention (28). The aim of this longitudinal design was to validate the WECS using a sample of full-term six-month-old infants and their mothers. We tested whether the emotional connection between the dyads at this age, measured in two interaction contexts, predicted fewer behavioural problems at three years of age. We hypothesised that when dyads were rated as emotionally connected

during face-to-face interactions that the children would exhibit fewer internalising and externalising behaviour problems at the age of three, relative to children in dyads rated as not emotionally connected. Our second hypothesis was that assessing the dyad's emotional connection while they played with toys would not predict internalising and externalising behaviour problems at the age of three, as the primary focus of that interaction would be on the toys and not each other.

## METHOD

### Participants

This study was approved by the Institutional Review Board at the University of North Texas and involved secondary analysis of data collected from families who participated in a longitudinal study of family interaction and infant development 1994–1997 (29). Analysing the existing videotaped interactions was deemed a cost-effective and efficient first step in exploring the use of the WECS with a cohort of full-term infants. Families participating in the original study lived primarily in a Mid-western university town and were categorised as middle-income when they were compared to Census data. The majority (51.1%) were male, 54% were first born children and 92% of the mothers said they were Caucasian. The infants were six months old at the time of observation. Of the 57 families who participated in the longitudinal investigation, 49 mother–infant dyads completed the six-month videotaped sessions and three-year maternal report data and were included in this study.

### Procedure

When the infants were six months of age, the families were visited in their homes and each mother–infant dyad interacted in two brief, videotaped play sessions. The first was a toy-based play session lasting five minutes that featured a standard set of toys, namely soft blocks and rattles. The second, two-minute session was a face-to-face interaction between the mother and infant, with the infants sitting in an infant seat provided by the researchers. When the children were three years old, the mothers' reported on their child's behavioural problems using the Achenbach Child Behavior Checklist (30,31), which is a commonly used, reliable and valid measure of young children's behavioural problems.

### Measures

The videotaped mother–infant interactions were rated using the WECS (23). The observers first rated the dyads using four-dimensional scales – mutual attraction, vocal communication, facial expressiveness and sensitivity and reciprocity – using a continuous scale from 1 to 3 with 0.25 increments, where three indicated a more positive score. Higher scores were given when the dyad was using a specific modality to establish and maintain a connection with each other.

Mutual attraction is marked by shared physical proximity, a genuine motivation to initiate and sustain physical or visual contact and a large shared interest in each other. The

mother displays attraction by seeking to make eye contact with her child and leaning in and touching them. The child initiates and maintains visual contact with the parent and appears comfortable in close proximity with the parent.

Vocal communication reflects warm and positive vocal exchanges within the dyad and is marked by the mothers' and infants' clear vocal communication and participation in turn taking. This could include cooing, vocalising or responding to the parents' vocal bids with increased motor activity or interest. These communications represent the infants' pre-verbal capacity to be a communicative partner.

Facial expressiveness considers the extent to which the dyad engages in shared expressiveness. The mother's facial expressions appear genuine and suggest deep caring and enjoyment of her child. The child's expressions reflect comfort with, and evidence of, reciprocity or mimicking the parent. Because infant distress is an important communicative component of the infants' behavioural repertoire, the presence of distress does not preclude a high score in the WECS. This is because it can prompt a mother's empathic expressions of concern and desire to comfort reflect the dyad's ability to meet each other in a shared emotional space.

Sensitivity and reciprocity reflect the dyad's overall attunement and the level of appropriate responses to each other's behaviour, including timing of response and across all modalities measured by the WECS. The mother accurately interprets and responds to the child's physical and emotional state and this includes helping their infant remain calm or become calm again after episodes of distress in a timely manner. The mother is available to the infant when needed, without being overwhelming or interfering with the infant's autonomy. In return, the infant is aware of changes in the mother's behaviour and interprets and responds to her emotional state and social bids with pacing that is well-timed, seeming 'in-sync'. The infant accepts the mother's efforts through reciprocation.

After rating the dyad on the four subscales, the overall emotional connection is determined using a dichotomous classification: emotionally connected or not emotionally connected. Rather than providing evidence using a particular cut-off score, ratings of emotionally connected or not emotionally connected reflect the observers' overall assessment of emotional connection for the dyad. This means that the construct of emotional connection is neither continuous nor one of nuance, as dyads are either connected or not (12,23). A rating of emotionally connected is given if the mother–infant dyad appears to have a genuine, positive, sustainable connection. A rating of not emotionally connected is given if the relationship is disconnected, uncomfortable and/or appears to be non-mutually rewarding or engaging. An assessment of not emotionally connected means that the dyad's emotional connection needs to be established or strengthened.

Following extensive training with the WECS creators, we established inter-rater reliability of least 0.80 for the separate teams. The two coders then independently scored the face-to-face and toy-based play interactions. In order to

calculate the inter-rater reliability, each team overlapped on approximately 30% of the episodes. To maintain fidelity in coding, the teams met weekly to review and resolve all discrepancies via conferencing. The inter-rater reliability ranged from 0.78 to 0.96 with a mean of 0.93 for the toy-based play paradigm and from 0.83 to 0.97, with a mean of 0.91 for the face-to-face interaction paradigm. Cohen's Kappa for the dichotomous rating of emotionally connected versus not connected was 0.86 for the toy-based play paradigm and 1.00 for the face-to-face paradigm.

The Child Behavior Checklist (CBCL) is a 99-item questionnaire that measures a child's behaviour and emotional stability (30,31). The mothers in our study rated the presence of each problem on a three-point scale, where zero was not true, one was somewhat true and two was very true. The externalising behaviour problem index score was calculated based on the CBCL subscales of aggressive and destructive behaviour. The internalising problem behaviour index score was calculated based on the subscales of anxious and withdrawn behaviour. To account for the broader range of score variations in this non-clinic, research sample, raw scores were used instead of T scores (32,33).

## RESULTS

Longitudinal analyses predicted three-year child behavioural problems from the six-month ratings of emotional connection, namely emotionally connected versus not connected. The final sample consisted of 49 mother–infant dyads (51.1% male) and the mothers had a mean age of  $34 \pm 4.77$  years. Two outliers were identified and winsorised to the largest acceptable value and four participants had missing scores on one or both of the dependent variables of the CBCL scores. In addition, four videos could not be coded because they were blurred or the mother's face was obscured. Our analysis of included and excluded cases did not reveal any differences in family demographics. All the continuous variables were normally distributed. Child gender was checked as a potential moderator, but did not explain any additional variance and was subsequently removed from the model. Descriptive discriminant analysis was conducted with 18 emotionally connected mother–child dyads and 31 not emotionally connected mother–child dyads based on the mother's reports of internalising and externalising problem behaviour. The analysis contained two discriminant variables, namely internalising and externalising problem behaviour, which gave the study adequate power (34). Descriptive discriminant analysis was selected for the analyses, as it decreased the probability of making a type I experiment-wise error, better suited the complexity of humans and better suited our analyses due to correlated outcomes (35). The descriptive statistics of the groups can be seen in Table 1.

When we looked at face-to-face emotional connection, the log determinants were relatively close, at 5.85 for not emotionally connected and 3.78 for emotionally connected. This confirmed that the variance–covariance matrices of the dependent variables were homogeneous across both

**Table 1** Means and standard deviations of dependent variables by emotional connection in face-to-face and toy-based play contexts

Group	Emotionally connected Mean (standard deviation)	Not emotionally connected Mean (standard deviation)
Face-to-face		
Externalising	7.78 (3.19)	11.64 (6.02)
Internalising	5.11 (2.86)	6.88 (3.84)
Toy-based play		
Externalising	9.39 (5.96)	9.62 (6.24)
Internalising	5.88 (3.33)	5.76 (3.76)
	<b>Externalising</b>	<b>Internalising</b>
Externalising	–	–
Internalising	0.653	–

groups. The results showed a statistically significant difference between the emotionally connected and not connected dyads. These differences accounted for 14.6% of the multivariate variance in the composite problem behaviour variable, based on the mothers' reports of internalising and externalising problem behaviour:  $F_{2,46} = 3.76$ ,  $p = 0.05$ ,  $1 - \text{Wilks' } \lambda = 0.119$ . Only one function could be extracted ( $IV-1 = 1$ ) and is presented in Table 2. Function 1 largely comprised both externalising (standardised coefficient = 0.929,  $r_s = 0.996$ ) and internalising (standardised coefficient = 0.111,  $r_s = 0.673$ ) problem behaviour, as both have large structure coefficients. This means that internalising and externalising problem behaviour accounted for the same explained variance in the synthetic dependent variable, but externalising problem behaviour accounted for more unique explained variance. Group centroids, calculated through a one-way ANOVA using the discriminant function scores, determined how much the emotionally connected and not emotionally connected dyads differed on the dependent variable. Children in the emotionally connected dyads, with a mean of  $-0.47$  and 95% confidence interval (95% CI) of  $-0.79$  to  $-0.15$ , had significantly lower scores than the children in dyads identified as not emotionally connected (mean 0.27, 95% CI:  $-0.014$  to 0.69,  $p < 0.05$ ,  $d = 0.80$ ), suggesting that children in emotionally connected dyads had fewer behavioural problems.

**Table 2** Canonical correlations, standard discriminant function coefficients and structure coefficients for function one in face-to-face and toy-based play contexts

	$R_c^2$	Standard coefficient	$r_s$	$r_s^2$
Face-to-face				
Externalising	0.12	0.929	0.996	0.992
Internalising		0.111	0.673	0.452
Toy-based play				
Externalising	0.001	1.23	0.446	0.198
Internalising		$-1.19$	$-0.378$	0.142

$R_c^2$  = squared canonical correlation;  $r_s$  = structure coefficients;  $r_s^2$  = squared structure coefficients.

When it came to emotional connection during toy-based play, the Box's  $M$  was not statistically significant: Box's  $M = 1.615$ ,  $F_{3,1049109.725} = 0.509$ ,  $p = 0.67$ . This confirmed that the variance-covariance matrices of the dependent variables were homogeneous across the groups. However, there was no significant difference between the emotionally connected and not connected dyads in the play paradigm,  $F_{2,39} = 0.26$ ,  $p = 0.963$ ,  $1 - \text{Wilks' } \lambda = 0.001$ . Moreover, children in the emotionally connected dyads (mean  $-0.04$ , 95% CI:  $-0.51$  to  $0.43$ ) were not statistically significantly different from children in the not emotionally connected dyads when it came to problem behaviours (mean  $0.05$ , 95% CI:  $-0.37$  to  $0.46$ ],  $p = 0.78$ ,  $d = 0.09$ ). The remaining results are reported in Table 2 for cross-context comparisons.

## DISCUSSION

Research must translate into practice in order to improve the health of children and families (36). This study showed an association between the dyads being emotionally connected during face-to-face interaction at six months of age and fewer internalising and externalising behaviour problems at the age of three, as reported by the mother. In contrast, emotional connection assessed during toy-based play at six months, where the focus was on the toys rather than each other, did not predict mothers' reports of later child behaviour problems.

These findings show that the WECS has promising potential as a practical, valid screening tool and underscores the importance of using an interactional context when assessing relational health. Our results indicate that face-to-face interaction may be a better paradigm for assessing emotional connection as a relational health construct. Unlike toy-based play interactions, where the joint focus can be on objects, face-to-face interactions enable infants and mothers to experience synchrony as a co-regulatory process (16). Thus, our findings are consistent with Welch's (12) calming cycle theory, which states that emotional connection is evidenced by the ability of the dyad to connect with each other in a way that is mutually attuned, comfortable and intimate. This, in turn, co-regulates the autonomic health of the dyad (23).

The simplicity of the face-to-face paradigm means that it can be used by primary care practitioners or paediatricians, because parents can simply be asked to hold their infant and engage in a brief face-to-face interaction. Relatively brief assessments of parent-child interactions can inform intervention efforts (37) and ratings of behavioural problems are highly stable over time (38). This means that early identification of disturbances in relational health, even in otherwise low-risk samples, such as white, middle-class two-parent families, may be critical for promoting healthy connections across childhood and across developmental contexts. The number of dyads rated as not emotionally connected in this sample (31/49) suggests that, compared to measures that focus heavily on parental sensitivity and responsiveness as determinants of relationship quality, the

WECS captures mutual behaviours and reflects the presence or absence of dyadic emotional connection. In this way, a lack of connection may reflect a relationship disruption, rather than a maternal behaviour or child behaviour that should be addressed in isolation from the relationship context. Compared to the preterm sample reported by Hane et al. (23), which included infants who received the Family Nurture Intervention, the current sample exclusively comprised full-term infants who were not enrolled in a nurture-based intervention. Future research with larger samples of full-term infants is necessary to determine whether our findings regarding the percentage of emotionally connected and not emotionally connected dyads are replicated.

The calming cycle theory (22) contends that dyadic interactions between infants and mothers are regulated through bottom-up processes. These processes are mediated by co-conditioning mechanisms, such as eye contact, holding and touching, listening, smelling, crying, singing and talking. In emotionally connected dyads, an instance of emotional dysregulation exhibited by one member is modulated by these bottom-up processes via the emotional attunement of the other member, as they help to form healthy co-regulation of the dyad's autonomic nervous systems (23).

We did not have heart rate or vagal tone data or measures of salivary cortisol to expand upon possible co-regulatory states and processes. However, such data would be useful in full-term samples as they would help to identify how the experience of responding to a caregiver, and being responded to, may help to shape the body's physiological and psychological responses to stress (39). The achievement of synchronous states, although infrequent, reflects the dyad's ability to engage in the process of repair to experience matched or coordinated states (40). By exploring physiological correlates of emotional connection derived from the same observation as the WECS, we can examine whether ratings of observed relational health match the indices of the individual partner's physiological responses during observed interactions. Preliminary evidence with preterm infants suggested links between ratings of relational health based on the WECS and measures of heart rate and respiratory sinus arrhythmia in response to stress at four months of corrected age (23).

## Strengths and limitations

The strengths of the present study included the longitudinal design and the use of the WECS to rate emotional connection between mothers and infants in two interactive contexts. Although we demonstrated that ratings of emotional connection during face-to-face interaction were related to reports of children's behavioural problems 2.5 years later, we do not know whether the WECS would apply to father-infant dyads. Given that fathers can and do play an important and unique role in young children's development (41,42), future work will consider using the WECS with father-infant dyads. Moreover, because this investigation focused on exploring the use of the WECS as a

rapid and valid screening tool, we chose to use an existing data set based on a largely homogenous, full-term community sample in an effort to provide preliminary evidence for using the WECS in future research. On-going publication of research findings from projects reflects the field's sustained recognition of how early relationship experiences shape development and foster resilience across the lifespan (43). These include the National Institute of Child Health and Human Development Study of Early Child Care and Youth Development, the Fragile Families and Child Wellbeing Study and the Family Life Project, which all began collecting data in the United States more than a decade ago. The construct of emotional connection (12), which emphasises co-regulatory processes, offers a new way to assess these early relationships.

Future directions include exploring possible mediating and moderating variables that may affect the development of emotional connection and emerging social competence, including socio-contextual factors such as family stress and socioeconomic status. In addition, determining if, and how, emotional connection is related to individual-level characteristics may help in the development of prevention and intervention efforts that support relational health. These include maternal reflective functioning or self-efficacy, as well as infant temperamental characteristics, such as reactivity or inhibition.

## CONCLUSION

Unlike existing measures of relationship quality, the WECS seeks to directly assess a dyad's mutual achievement of emotional connection (23). It does this by incorporating behavioural components that are associated with visceral and autonomic co-regulation, in line with the calming cycle theory (12,23). The findings presented in this paper demonstrate that the WECS has the potential to be a valid screening tool for assessing relational health in full-term mother–infant dyads and suggest that this new assessment tool can predict later behavioural problems. In addition, refinements to the WECS training protocol have decreased the time needed to start using the WECS in research and clinic settings. This means that the WECS is an accessible tool for a variety of settings.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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