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Effect of mindful with your baby training on infant temperament: What parental factors are at play?

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A R T I C L E   I N F O

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A B S T R A C T

Difficult infant temperament and problems in parental functioning can form a vicious circle and have negative long-term consequences for healthy child development. Mindful with your baby (MwyB) has been shown to have positive effects on different areas of parental functioning. This study aims to evaluate whether there is also a positive effect on infant temperament, and through which areas of parental functioning a possible improvement may occur. Mothers ($n = 53$) of 0–14 month-old infants completed questionnaires at pretest, posttest and follow-up and participated in a MwyB training between pretest and posttest. Mother-reported infant smiling and laughter, and soothability increased at posttest and follow-up whereas sadness and distress to limitation decreased at posttest only. There was no change in cuddliness. Improvements in parenting, maternal (mental) health factors, and coparenting (but not mindfulness factors) between pretest and posttest were predictive of a decrease in difficult infant temperament at follow-up. Improvement in difficult infant temperament between pretest and posttest did not predict improvement in maternal functioning, except for physical health complaints. MwyB may be suitable for mothers who experience problems in their functioning and who experience their infant's temperament as difficult.

1. Introduction

From the moment children are born, they exhibit various ways of responding to the world around them (Rothbart, 2007). A child's temperament explains individual differences in behavioral tendencies in response to external and internal stimuli and forms the core of personality. Temperament relates to one's emotionality, self-regulation, activity, and attention (Gartstein et al., 2016). Temperament is partly genetically and biologically determined and thus relatively stable over time (Gartstein et al., 2016). In early childhood however, temperament can be less stable due to changes in regulatory aspects of temperament and environmental influences (Gartstein et al., 2016).

An important environmental factor is parental functioning (Gartstein et al., 2016). Infant temperament can, to some extent, be influenced by parenting and mental health factors, such as parenting self-efficacy (Verhage et al., 2013), mother-to-infant bonding (Davies et al., 2021), depression (Hanington et al., 2010), and anxiety (Davies et al., 2021). On the other hand, difficult infant temperament has also been shown to increase the likelihood of parenting problems, such as low parenting self-efficacy (Fang et al., 2021) and poor mother-infant bonding (Takács et al., 2020). Also, there is evidence that difficult infant temperament is bidirectionally related to problems in the coparenting relationship as well as parental stress (Barreto et al., 2019; McQuillan & Bates, 2017).

Because of the bidirectional relationship between parental functioning and difficult infant temperament, there is the risk of a vicious circle, which may result in negative long-term consequences for child development (Ortiz & Barnes, 2019). This stresses the importance of providing effective interventions to parents who experience problems in their own functioning and difficult child temperament. Early intervention is crucial, on account of the relatively lower stability of temperament and the fundamental and fast development during infancy (Gartstein et al., 2016).

Mindful parenting interventions, in which parents learn to focus present-moment and non-judgmental awareness on their own experience as well as on their child, may be suitable for improving parental functioning by decreasing problems in parenting, parental mental

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Table 1
Sociodemographic characteristic of the participants.

	n	%
Infant sex boy	31	58.5
Infant first child	43	81.1
Maternal ethnicity		
Dutch	38	71.7
European or mixed Dutch/other European country	3	5.7
Moroccan or mixed Dutch/Moroccan	6	11.3
Non-European or mixed Dutch/non-European country	6	11.3
Maternal educational level		
High school	4	7.5
Intermediate vocational education	10	18.9
Bachelor or master degree	38	71.7
Unknown	1	1.9
Maternal job		
Stay-at-home mother	10	18.9
Part-time job	12	22.6
Full-time job	9	17.0
Sick leave	11	20.8
Maternity leave	8	15.1
Unknown	3	5.7
Family situation: Infant living…		
With both parents	48	90.6
(Primarily) with mother	4	7.5
Foster parents	1	1.9

health, and coparenting (Bögels & Restifo, 2013). Mindful parenting is a parenting specific form of mindfulness. Mindfulness is a form of meditation, based on Buddhist tradition, in which one creates awareness by focusing attention on the present moment, non-judgmentally and non-reactively (Kabat-Zinn, 2003).

Mindful with your Baby (MwyB) is an adaptation of a mindful parenting intervention (Bögels & Restifo, 2013), making it applicable for parents who experience parenting stress, mental health problems, regulation or relationship problems with their baby (Potharst et al., 2017). Several studies show MwyB's positive effects. A study that included 44 mother-baby dyads without a control group, found significant improvements in self-reported mindfulness, mindful parenting, well-being, self-confidence and responsivity, as well as a decrease in psychopathology and feelings of hostility towards the baby at posttest, 8-week and 1-year follow-up (Potharst et al., 2017). A quasi-experimental observational study in 50 mothers found significantly increased accepting parenting behavior, decreased non-attuned mind-related comments towards their infant, and improved infant responsiveness (Zeegers et al., 2019). Another quasi-experimental study on the effect of MwyB among seventeen mothers with parenting stress, showed mothers' improvements in self-reported depression and anxiety, self-compassion, mindfulness and parenting stress (Potharst, Veringa-Skiba, et al., 2022). A study of MwyB's working mechanisms among 61 mothers using self-report measurements found that improvements in maternal (mental) health outcomes were (partly) predicted by improvement in mindfulness (Potharst, Kuijl, et al., 2022). Also, bidirectional relationships were shown between mindful parenting and aspects of parenting, as well as between maternal (mental) health and aspects of parenting. A single case design study including five mothers of infants showed that all mothers improved on self-chosen goals, which indicated that MwyB could benefit mothers with various intervention goals (Schaeffer & Potharst, 2024). All in all, prior studies on MwyB have shown positive effects on parenting, mental health, and mindfulness outcomes, but little attention has been paid to infant temperament as an outcome.

Once before we investigated MwyB's effect on infant temperament. Of three broad temperament components, only positive affectivity improved significantly (Potharst et al., 2017). Additional research is needed to gain more insight in the possible effect of MwyB on specific aspects of temperament. Considering mindful parenting can have positive effects on parenting, maternal (mental) health, family, and mindfulness outcomes, difficult infant temperament might be decreased.

This study aimed to evaluate the effect of the MwyB training on specific aspects of infant temperament, making use of data of a prior study on the effects of MwyB on parental outcomes [blinded for review]. It was hypothesized that increases in smiling and laughter, cuddliness and soothability, and decreases in sadness and distress to limitation would be found at posttest and follow-up compared to pretest. Additionally, this study aimed to get insights into the working mechanisms of MwyB, considering improvements in parental factors in relation to infant temperament. It was hypothesized that improvements in parenting, maternal (mental) health, family (the coparenting relationship), and mindfulness factors between pretest and posttest, predicted decreased difficult infant temperament at 8-week follow-up. Lastly, we aimed to explore whether these associations were bidirectional.

2. Method

2.1. Design and procedure

For the current study data was used from a quasi-experimental study on the effectiveness of MwyB [blinded for review], which was approved by the Ethical Review Board of [blinded for review]. Data from this study on the parental outcomes was published before in [blinded for review], showing stability on all outcomes between waitlist and pretest, and improvement in parenting, maternal (mental) health, and mindfulness outcomes at posttest and follow-up. All participants gave informed consent before participation. Mothers who enrolled at least five weeks before the training, were asked to complete waitlist assessment. Pretest was completed one week prior to the training, post-test directly after, and follow-up eight weeks after finishing the training.

Power calculations using G*Power (Faul et al., 2007) were based on the first study aim, namely to study the effectiveness of MwyB on infant temperament. We assumed an alpha error probability of 0.05, a power of 0.95, and an average correlation between timepoints of.50. In order to find a small to moderate effect (which was found in the prior study on the effects of MwyB on infant temperament), a study sample of 43 was needed.

2.2. Participants

Eighty-two parents took part in the MwyB study. Four participants were fathers (4.9 %), who were excluded because of the small sample size. Five mother-infant-dyads (6.1 %) were excluded because of the age of their infant at pretest (15–18 months), that was not suitable for the temperament questionnaire used in the study (Infant Behavior Questionnaire, IBQ-R, Gartstein & Rothbart, 2003). The IBQ-R is developed for infants <12 months, and can be used for infants <18 months. Lastly, 20 mother-infant dyads were excluded because the mother did not complete the IBQ-R at both posttest and follow-up.

Therefore, the study sample consisted of 53 mothers (M_{age}=33.0 years; SD=4.1) with their infants (M_{age}=6.8 months; SD=3.9; range = 0–14). Thirty-three mothers (62.3 %) participated in the clinical setting in the study, and twenty mothers (37.7 %) in the preventive setting. They enrolled in or were referred to the intervention due to psychological distress, parenting stress or insecurity, baby's regulation and/or mother-infant relationship problems. Costs were covered by the insurance or the municipality in clinical settings. In preventive settings the mothers received a discount or refund, funded by [blinded for review]. Sociodemographic characteristics are shown in Table 1.

2.3. Intervention

MwyB consists of eight weekly two-hour sessions and one booster session after eight weeks, during which skills are taught based on the Mindful parenting training (Bögels & Restifo, 2013). What is distinctive about the MwyB training, is that the babies are present in most of the sessions in order to enhance the practice in contact with their baby.

Table 2
Means and standard deviations of Infant Behavior Questionnaire (sub)scale mean scores measuring aspects of infant temperament behavior, and response rates at every timepoint.

Infant temperament behavior	Waitlist		Pretest		Posttest		Follow-up	
	n (%)	*M (SD)*	*n (%)*	*M (SD)*	*n (%)*	*M (SD)*	*n (%)*	*M (SD)*
Difficult temperament	8 (15 %)	3.1 (0.4)	52 (98 %)	2.8 (0.8)	49 (92 %)	2.5 (0.8)	34 (64 %)	2.6 (0.7)
Smiling and laughter	8 (15 %)	4.4 (0.9)	50 (94 %)	4.4 (1.1)	49 (92 %)	4.8 (1.1)	34 (64 %)	5.1 (1.0)
Sadness	8 (15 %)	4.2 (0.9)	52 (98 %)	4.1 (1.2)	49 (92 %)	3.6 (1.2)	34 (64 %)	3.7 (1.0)
Distress to limitation	8 (15 %)	3.9 (0.8)	52 (98 %)	4.2 (1.1)	49 (92 %)	3.7 (1.2)	34 (64 %)	4.0 (1.0)
Cuddliness	8 (15 %)	4.9 (0.7)	52 (98 %)	5.5 (1.0)	49 (92 %)	5.4 (0.9)	34 (64 %)	5.2 (0.9)
Soothability	6 (11 %)	4.6 (0.9)	52 (98 %)	5.1 (1.1)	49 (92 %)	5.5 (0.9)	34 (64 %)	5.6 (0.9)

The Difficult temperament score consisted of the subscales Smile and laughter [reverse coded], Sadness, Distress to limitation, Cuddliness [reverse coded], and Soothability [reverse coded]). Response rates are calculated by dividing the number of participants that completed a certain (sub)scale by the total number of participants ($N = 53$).

Mothers learn to non-judgmentally become aware of their internal experiences, act with intention, practice mindfulness in stressful situations and be more attentive towards their baby's signals (Potharst, 2018). Groups consist of a maximum of six mother-baby dyads. Groups are led by a trainer and co-trainer, who ensures babies physical and emotional safety during meditations. Although sessions follow a structured program, flexibility is embedded in case stress or difficult moments arise in the mother-baby dyad and a parent-child breathing space meditation is practiced. In between sessions, mothers are invited to practice, such as meditations and mindful parenting exercises.

2.4. Measures

2.4.1. Temperament behavior

Infant temperament was assessed using five subscales of the short form of the Dutch version of the revised Infant Behavior Questionnaire (IBQ-R, Gartstein & Rothbart, 2003), a parent-report questionnaire. Items were scored on a 7-point Likert scale. Because parents could also indicate 'does not apply' in response to items, mean scores were used instead of sum scores. The short form comprises 91 items, and consists of three factors, each containing several subscales. Five subscales were chosen for the current study on which change was expected after the MwyB training, namely Smiling and laughter, Sadness, Distress to limitation, Cuddliness and Soothability. Crohnbach's alphas were 0.78, 0.88, 0.78, 0.84, and 0.88 for these subscales in the current study, respectively. For the analyses in which the hypotheses on the parental factors predicting infant temperament were tested, we constructed a difficult temperament scale consisting of all five IBQ-subscales (Smile and laughter [reverse coded], Sadness, Distress to limitation, Cuddliness [reverse coded], and Soothability [reverse coded]).

2.4.2. Parenting factors: parenting self-efficacy, bonding, and parental stress

Parenting self-efficacy was measured using the Dutch version of the Self-Efficacy in the Nurturing Role scale (SENR; Oosterman & Schuengel, 2008), which is a self-report questionnaire, with 16 7-point Likert-scale items. The total score reflects the mothers' perceptions of their competence in basic skills required to care for an infant, where higher scores indicate greater feeling of efficacy. Cronbach's alpha in the current study was 0.85.

Mother-to-infant bonding was measured using the Pre- and Postnatal Bonding Scale (PPBS; Cuijlits et al., 2016), a self-report questionnaire that comprises five 4-point Likert scale items of positive feelings that a mother might feel towards her child. Cronbach's alpha was 0.89. Higher scores indicate more positive feelings of bonding.

Parental stress was measured with the Parenting Stress Questionnaire (PSQ; Vermulst et al., 2015), a self-report questionnaire containing 34 4-point scale items. The items are divided in five subscales: depressive mood, physical health complaints, parent–child relationship problems, parenting problems, and parental role restriction. In the current study, only the three parenting-related subscales were combined into one parenting stress scale; Cronbach's alpha of this scale was 0.92. Higher scores on this scale indicate more parental stress.

2.4.3. Maternal (mental) health factors: psychological distress, depressive mood, and physical health complaints

Psychological distress was measured with the Dutch version of the Outcome Questionnaire (OQ; De Jong et al., 2007). This is a self-report questionnaire and comprises 45 5-point scale items, divided into four subscales. In the current study, only the total scale was used. Cronbach's alpha in the current study was 0.93. Higher scores reflect more symptoms of psychological distress.

Depressive mood and physical health complaints were measured with two subscales of the PSQ, which was described in paragraph 2.4.2. The subscales depressive mood (7 items) and physical health complaints (8 items), and the Cronbach's alphas were 0.84 and 0.79, respectively. Higher scores indicate more problems in the subscale area.

2.4.4. Family factors: coparenting relationship

The coparenting relationship was measured by the subscale Partner relationship of the Family Functioning Questionnaire for Parents (FFQP, Veerman et al., 2016), which consists of 5 4-point Likert scale items. A higher score indicates a better coparenting relationship. The Cronbach's alpha of the FFQP was 0.91 in the current study.

2.4.5. Mindfulness factors: mindfulness and mindful parenting

Mindfulness was measured with the short form of the Dutch translation of the Five Facets Mindfulness Questionnaire (FFMQ-SF; de Bruin et al., 2012). This is a self-report questionnaire consisting of 24 5-point scale items of the original 39 items, and it shows a five-factor structure, similar to the original form. In the current study, only the total score is used. Higher scores reflect a higher level of mindfulness. The Cronbach's alpha in the current study was 0.89.

Mindful parenting is measured with the Dutch translation of the Interpersonal Mindfulness in Parenting Scale (IM-P; De Bruin et al., 2014), which contains 29 5-point scale items. Higher scores reflect a higher level of mindfulness in parenting. Some small adaptions were made to make the items applicable for mothers with a baby ('child' was changed to 'baby', 'misbehaving' to 'crying and fussing', and 'worried' to 'uncomfortable', and 'listening with one ear' to 'distracted'). The Dutch IM-P consists of six subscales and a total scale, but only the total scale was used. The Cronbach's alpha was 0.86.

2.5. Statistical analyses

All analyses were completed using SPSS 27 software. Cronbach's alphas were calculated for all subscales and total scores at pretest. Of all variables at pretest, posttest and follow-up, normality was checked (by a Shapiro-Wilk test, and by checking if skewness and kurtosis $<|3|$, and by checking outliers >2 standard deviations from the mean). A total of three outliers were detected and adjusted to the next extreme score (the lowest/highest score of another participant that was no outlier).

Table 3
Parameter estimates (standard error between brackets) followed by *t* values and 95 % confidence intervals of multilevel models of treatment outcome predicted by timepoint (deviations from pretest).

		Intercept			Posttest			Follow-up			Infant age		
	n	*β (SE)*	*t*	95 % CI	*β (SE)*	*t*	95 % CI	*β (SE)*	*t*	95 % CI	*β (SE)*	*t*	95 % CI
Difficult temperament	53	0.23 (0.13)	1.69	−0.04, 0.51	−0.39 (0.13)	−3.03**	−0.65, −0.13	−0.27 (0.14)	−1.93	−0.55, 0.01	0.08 (0.12)	0.65	−0.17, 0.33
Smiling and laughter	52	−0.30 (0.13)	−2.31*	−0.57, −0.04	0.38 (0.14)	2.75**	0.10, 0.66	0.63 (0.14)	4.46***	0.35, 0.92	0.14 (0.11)	1.21	−0.09, 0.37
Sadness	53	0.20 (0.14)	1.38	−0.09, 0.48	−0.31 (0.13)	−2.29*	−0.58, −0.04	−0.23 (0.16)	−1.47	−0.55, 0.09	−0.03 (0.12)	−0.26	−0.27, 0.21
Distress to limitation	53	0.20 (0.13)	1.55	−0.06, 0.48	−0.44 (0.13)	−3.30**	−0.71, −0.17	−0.13 (0.17)	−0.78	−0.47, 0.21	0.09 (0.12)	0.76	−0.14, 0.32
Cuddliness	53	0.13 (0.13)	1.01	−0.13, 0.39	−0.13 (0.14)	−0.89	−0.41, 0.16	−0.30 (0.18)	−1.68	−0.66, 0.06	−0.42 (0.10)	−4.19***	−0.63, −0.22
Soothability	53	−0.22 (0.15)	−1.46	−0.52, 0.08	0.33 (0.15)	2.14*	0.02, 0.64	0.33 (0.13)	2.54*	0.07, 0.59	−0.04 (0.11)	−0.37	−0.27, 0.18

The Difficult temperament score consisted of the subscales Smile and laughter [reverse coded], Sadness, Distress to limitation, Cuddliness [reverse coded], and Soothability [reverse coded]).

* $p < .05$.
** $p < .01$.
*** $p < .001$.

Effects of the training on infant temperament were tested with multilevel regression models. The structure of the multilevel models consisted of the repeated measurements of these outcomes across the three timepoints nested within the participants. Infant age was statistically controlled for by adding it as an independent variable to the analyses. Timepoints were dummy coded, so that each time point was represented by a dichotomous variable. Pretest scores were used as reference, so that both posttest and follow-up were compared to pretest scores.

Difference scores (pretest minus posttest) were calculated for all parental variables and difficult infant temperament, as a measure for change between pretest and posttest. To test hypotheses on the predictive value of improvement on the parental factors between pretest and posttest on changes to infant temperament, these difference scores were added as an independent variable to the multilevel model testing change in infant temperament. Also, interaction terms (difference score*posttest and difference score*follow-up) were added to the model. Only if the second interaction term (difference score*follow-up) was significant, it was regarded as significant predictive value of change in the parental factor on changes to infant temperament. To check for bidirectional effects, we repeated all analyses in the opposite direction.

A statistically significant effect was identified when $p < 0.05$. All scores on the outcomes and difference scores were standardized across assessments. Therefore, estimates of regression coefficients for dichotomous explanatory variables (post-test or follow-up) can be interpreted similarly to Cohen's *d* effect sizes (0.2 small, 0.5 medium, 0.8 large), and estimates of regression coefficients for continuous explanatory variables (interaction terms of difference scores * follow-up) can be interpreted similarly to Pearson's *r* effect sizes (0.1 small, 0.3 medium, 0.5 large; Cohen, 1988).

3. Results

Means, standard deviations and response rates of infant temperament scores at waitlist, pretest, posttest and follow-up are displayed in Table 2. Because the waitlist sample size was very low ($n < 9$), it was decided not to include this measurement in the analyses. Results of multilevel models of treatment outcomes predicted by timepoint are displayed in Table 3. At posttest, improvements were shown for the difficult temperament scale, and the subscales Smiling and laughter, Sadness, Distress to limitation, and Soothability (small effect sizes). At follow-up, the improvement in Smiling and laughter and Soothability was still significant (moderate and small effect size, respectively).

Means, standard deviations, and response rates of parental factors at pretest, posttest and follow-up are displayed in Table 4. Correlations between the parental factors and infant temperament at pretest are displayed in Table 5. Significant associations between difficult temperament and parental stress, psychological distress, physical health complaints, coparenting relationship, mindfulness and mindful parenting were found (moderate and large effect sizes). Parenting self-efficacy and depressive mood were only significantly associated with a specific aspect of infant temperament, namely Cuddliness, while mother-to-infant bonding was unrelated to infant temperament.

Test results of the multilevel analyses are displayed in Table 6, showing whether improvement in parental functioning between pretest and posttest was predictive of a decrease in difficult infant temperament at follow-up. Improvements in parenting self-efficacy, parental stress, depressive mood, physical health complaints, and coparenting problems were predictive of a decrease in difficult temperament (moderate effects). Results of the analyses in the opposite direction are displayed in Table 7. A decrease in difficult temperament was only predictive of a decrease in maternal physical health complaints.

4. Discussion

The current study aimed to study the effects of MwyB on infant

Table 4
Means and standard deviations of sum scores of all independent variables (parental factors) and response rates at every timepoint.

	Pretest		Posttest		Follow-up	
	n (%)	*M (SD)*	*n (%)*	*M (SD)*	*n (%)*	*M (SD)*
Parenting factors						
Parenting self-efficacy	41 (77 %)	88.4 (14.4)	28 (53 %)	94.9 (13.6)	27 (51 %)	93.5 (15.3)
Mother-to-infant bonding	52 (98 %)	11.3 (3.1)	52 (98 %)	12.6 (2.69)	36 (68 %)	13.2 (2.7)
Parental stress	52 (98 %)	44.6 (9.4)	52 (98 %)	40.1 (8.3)	36 (68 %)	39.0 (7.0)
Mental (mental) health factors						
Psychological distress	46 (87 %)	73.7 (22.5)	42 (79 %)	66.5 (20.9)	28 (53 %)	64.6 (20.4)
Depressive mood	52 (98 %)	15.9 (3.7)	52 (98 %)	13.9 (4.2)	36 (68 %)	13.5 (4.0)
Physical health complaints	52 (98 %)	16.8 (3.8)	52 (98 %)	15.0 (3.5)	36 (68 %)	14.6 (3.4)
Family factors						
Coparenting relationship	49 (92 %)	15.1 (3.5)	50 (94 %)	15.4 (3.4)	36 (68 %)	15.7 (3.4)
Mindfulness factors						
Mindfulness	52 (98 %)	67.3 (12.2)	52 (98 %)	77.4 (12.4)	36 (68 %)	77.3 (13.1)
Mindful parenting	50 (94 %)	89.7 (14.6)	47 (89 %)	99.7 (15.2)	35 (66 %)	97.0 (11.2)

Response rates are calculated by dividing the number of participants that completed a certain (sub)scale by the total number of participants (N = 53).

Table 5
Correlations between the independent variables (parental factors) and dependent variables (infant temperament behavior) at pretest.

	Difficult temperament	Smile and laughter	Sadness	Distress to limitation	Cuddliness	Soothability
Parenting factors						
Parenting self-efficacy	−0.20	−0.25	−0.24	−0.22	0.48**	0.00
Mother-to-infant bonding	−0.20	0.16	−0.18	−0.08	0.21	0.07
Parental stress	0.54***	−0.21	0.52***	0.40**	−0.36**	−0.39**
Mental (mental) health factors						
Psychological distress	0.46**	−0.22	0.36*	0.30*	−0.48***	−0.30*
Depressive mood	0.25	0.09	0.25	0.23	−0.32*	−0.16
Physical health complaints	0.39**	0.01	0.41**	0.34*	−0.35*	−0.29*
Family factors						
Coparenting relationship	−0.51***	0.39**	−0.40**	−0.43**	0.33*	0.26
Mindfulness factors						
Mindfulness	−0.36*	−0.12	−0.39**	−0.34*	0.35*	0.30*
Mindful parenting	−0.42**	0.17	−0.44**	−0.37**	0.30*	0.20

The Difficult temperament score consisted of the subscales Smile and laughter [reverse coded], Sadness, Distress to limitation, Cuddliness [reverse coded], and Soothability [reverse coded]).
* $p < .05$.
** $p < .01$.
*** $p < .001$.

temperament, and studied whether changes in infant temperament were predicted by improvements in parental factors or the other way around. The main results can be summarized as follows: first, difficult infant temperament and four of the five aspects of infant temperament smiling and laughter, sadness, distress to limitation, and soothability) improved immediately after MwyB, second, the improvement in smiling and laughter and soothability was still significant at 8-week follow-up, and third, improvement in parenting, maternal (mental) health and family factors between pretest and posttest were predictive of a decrease in difficult infant temperament. Decrease in difficult infant temperament between pretest and posttest did not predict an improvement in parental functioning, except for maternal physical health complaints.

Smiling and laughter significantly improved at posttest (small effect size) and follow-up (moderate effect). In an earlier study on the effectiveness of MwyB, which showed a significant increase in infant positive affectivity at posttest and follow-up (moderate effects), another significant effect emerged, namely of age (moderate effect size, Potharst et al., 2017). In the current study such an age effect was not found. The average infant age was 10.3 months and 6.8 in these studies, respectively, implying that there may be a correlation between smiling and laughter and age only in a later stadium of infancy. This is not confirmed by longitudinal cohort-studies on the development of infant temperament (Bornstein et al., 2015; Carranza Carnicero et al., 2000), which also found contradictory results in the development of smiling and laughter. Bornstein et al. (2015) reported a steady increase between 2 and 12 months, while Carranza Carnicero et al. (2000) reported relative stability between 3 and 12 months.

Sadness and distress to limitation showed a decrease between pretest and posttest (small effects). The decreases were no longer significant at follow-up. It could be that mothers may need the support of the training meetings to help their infants regulate negative emotionality, explaining that the effect diminishes after finishing the training. An alternative explanation might be the infant's age. Prior research shows an increase in distress with limitations during the last few months of the first year (sadness was not included in these studies; Bornstein et al., 2015; Carranza Carnicero et al., 2000). Although we did not find an increase, the increasing infant age may have diminished the positive effect.

Soothability showed significant improvement at posttest and follow-up (small effects). Prior research shows that soothability is a stable trait after six months (Bornstein et al., 2015, Carranza Carnicero et al., 2000), which suggests that the change might be due to the training. Cuddliness did not increase at posttest or follow-up, but it was negatively related to infant age, as has also been shown in a prior study (Erickson et al., 2017).

The study on the effectiveness of MwyB on parental factors used the same data as in the current study, found positive effects on parenting (parenting self-efficacy, mother-to-infant bonding, parental stress), maternal (mental) health (psychological distress, depressive mood), and mindfulness factors (mindfulness, mindful parenting) at posttest (small to moderate effects) and follow-up (moderate to large effects) [blinded for review]. Maternal physical health problems only decreased at follow-up (small effect size). The current study shows that these improvements

Table 6
Test results of the multilevel analyses testing whether improvement in parental functioning between pretest and posttest (independent variable) was predictive of a decrease in infant difficult temperament at follow up (dependent variable).

	Dependent variable: child difficult temperament at follow-up				
Independent variables: improvement between pretest and posttest	*n*	*β (SE)*	t	95 % CI	*p*
Parenting factors					
Parenting self-efficacy	28	−0.31 (0.15)	−2.11	−62, −0.00	0.049
Mother-to-infant bonding	51	−0.28 (0.15)	−1.84	−0.58, 0.03	0.073
Parental stress	51	0.37 (0.14)	3.24	0.09, 0.65	0.010
Mental (mental) health factors					
Psychological distress	41	0.27 (0.18)	1.55	−0.09, 0.63	0.131
Depressive mood	51	0.39 (0.14)	2.73	0.10, 0.68	0.010
Physical health complaints	51	0.33 (0.12)	2.73	0.08, 0.58	0.010
Family factors					
Coparenting relationship	48	−0.45 (0.14)	−3.22	−0.74, −0.17	0.003
Mindfulness factors					
Mindfulness	51	−0.08 (0.14)	−0.60	−0.37, 0.20	0.554
Mindful parenting	46	−0.34 (0.17)	−2.02	−0.69, −0.00	0.050

Nota bene: For clarity, only the test results of the interaction between difference score of parental functioning between pretest and posttest and timepoint follow-up (difference score x follow-up) is being displayed. The other variables which are not relevant for our hypotheses, namely the main effects of time and of the difference score, and the other interaction variable (difference score x posttest) are not displayed.

Table 7
Test results of the multilevel analyses testing whether decrease in infant difficult temperament between pretest and posttest (independent variable) was predictive of an improvement in parental functioning at follow up (dependent variable).

	Independent variable: decrease in difficult temperament between pretest and posttest				
Dependent variables: improvement at follow-up in	*n*	*β (SE)*	t	95 % CI	*p*
Parenting factors					
Parenting self-efficacy	37	−0.00 (0.15)	−0.05	−0.32, 30	0.958
Mother-to-infant bonding	48	−0.13 (0.16)	−0.83	−0.47, 0.19	0.411
Parental stress	48	0.12 (0.19)	0.61	−0.27, 0.51	0.546
Mental (mental) health factors					
Psychological distress	44	−0.04 (0.15)	−0.24	−0.35, 0.28	0.812
Depressive mood	48	0.20 (0.18)	1.14	−0.16, 0.57	0.264
Physical health complaints	48	0.43 (0.17)	2.57	0.09, 0.77	0.014
Family factors					
Coparenting relationship	45	0.03 (0.15)	0.20	−0.27, 0.32	0.845
Mindfulness factors					
Mindfulness	48	−0.24 (0.16)	−1.50	−0.57, 0.08	0.141
Mindful parenting	46	−0.25 (0.16)	−1.56	−0.58, 0.08	0.128

Nota bene: For clarity, only the test results of the interaction between difference score of parental functioning between pretest and posttest and timepoint follow-up (difference score x follow-up) is being displayed. The other variables which are not relevant for our hypotheses, namely the main effects of time and of the difference score, and the other interaction variable (difference score x posttest) are not displayed.

in parental functioning were predictive of a positive effect on infant temperament. Improvement in parenting self-efficacy and parental stress between pretest and posttest was predictive of a decrease in difficult infant temperament at follow-up (moderate effect sizes). A relation in the opposite direction was not found. A prior study also found that parenting self-efficacy predicted maternal perception of infant temperament, but not the other way around (Verhage et al., 2013). In the literature on infant temperament and parental stress however, the contribution of difficult infant temperament to parental stress does emerge clearly (McQuillan & Bates, 2017). This was not found in the current study, which may be explained by the fact that the current study does not observe development as it unfolds, but development during an intervention that is focused on mothers and their ability to deal with parental stress. The change in parental stress may therefore be larger than in cohort studies, making the subsequent effect on infant temperament clearer and diminishing the effect the other way around.

Evidence was also found for maternal mental health factors to play a role in a decrease in difficult infant temperament: decrease in maternal depressive mood (but not general psychological distress) between pretest and posttest was predictive of a decrease in difficult infant temperament at follow-up (moderate effect). There was no evidence that difficult temperament predicted depressive mood. This is in line with a study on depression and temperament, in which parent-to-child effects were found, but no child-to-parent effects (Hanington et al., 2010). We did find a bidirectional effect for maternal physical health complaints and difficult infant temperament. This relationship has not been studied extensively. One study on physical and psychological birth experiences and infant temperament (Power et al., 2022) showed a bidirectional relationship between both physical and emotional states, and infant temperament. Possibly, a mother who experiences physical health complaints is restricted (e.g., because of pain or fatigue) in supporting the child to regulate (e.g., by carrying around a crying baby, or night-time soothing), impacting the development of regulating temperament. On the other hand, taking care of an infant with a difficult temperament may ask so much of the mother (also physically) that recovering from physical complaints (possibly related to pregnancy/childbirth) decelerates, and susceptibility to physical ailments or illness increases.

The parental coparenting relationship was also predictive of child temperament (moderate effect). A relationship in the opposite direction was not found. A systematic review on coparenting and temperament did report on studies showing bidirectional effects (Barreto et al., 2019). In this review, no intervention studies were included. It may be that without intervention the coparenting relationship and infant temperament influence each other, but if an intervention is sought, change starts with the parents, after which the infant benefits.

Although significant associations between mindfulness and mindful parenting and difficult temperament at pretest were found (moderate effect sizes), we did not find evidence for improved mindfulness outcomes being predictive of decreased difficult temperament. However, the *p*-value of mindful parenting was almost significant (0.050, moderate effect size), suggesting that possibly, power was too limited to show a significant effect. A study on the effectiveness of mindful parenting on parents of older children showed that improved mindful parenting (not mindfulness) predicted decreased child externalizing behavior (Meppelink et al., 2016).

Strengths of the current study were the broad measurement of parental functioning and the fact that it was an intervention study, which sheds another light on the relationship between parental functioning and child temperament than cohort studies. Regarding limitations, first of all, there was no control group. A randomized waitlist control group would have given more clarity on the role of infant age in studying the effects of MwyB on infant temperament. Also, the number of waitlist assessments was very limited, making it difficult to use this assessment to statistically control for change overtime without intervention. Power was sufficient for our first aim, but for the more complicated analyses used for the second aim, power was probably limited. Furthermore, only self-report measures were used, meaning that all outcomes are based on participants' perceptions, including their infants' temperament. It is thus unclear whether the actual infant temperament changed or merely the perception of infant temperament, which may also have a positive impact on the mother-infant relationship, and thus being beneficial for the infant.

5. Conclusion

The 8-week MwyB has positive effects on some aspects of infant temperament, and these positive effects may be (partly) explained through improvements in parental functioning. Increases in maternal parenting self-efficacy and the parental coparenting relationship, as well as decreases in parental stress, maternal depressive mood and physical health complaints after following MwYB contribute to a decrease in difficult infant temperament. In addition, a decrease in difficult infant temperament may support the recovery of maternal physical health complaints.

CRediT authorship contribution statement

Eva S. Potharst: Writing – original draft, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Robin Kraakman:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Formal analysis, Data curation. **Susan M. Bögels:** Writing – review & editing, Funding acquisition, Conceptualization. **Cristina Colonnesi:** Writing – review & editing, Supervision, Methodology, Investigation.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Susan Bögels has published books about Mindful parenting and Eva Potharst published a book in Dutch about Mindful with your baby (and Mindful with your toddler).

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Data availability

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical reasons (personal data).

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