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From co-regulation to self-regulation: Maternal soothing strategies and self-efficacy in relation to maternal reports of infant regulation at 3 and 7 months

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Abstract

This study, conducted in Germany, examines the role of maternal soothing strategies to explain the association of maternal self-efficacy with infant regulation (crying and sleeping behavior). Questionnaire data of 150 mothers, living in Germany, with mixed ethnic and educational backgrounds were collected when infants were 3 and 7 months old. Two types of maternal soothing strategies were distinguished: *close soothing*, involving close physical and emotional contact, and *distant soothing*, involving physical and emotional distancing from the infant. A cross-sectional *SEM* at 3 months indicated that maternal self-efficacy is associated with reported infant regulation through distant soothing strategies. Low maternal self-efficacy was associated with frequent maternal use of distant soothing, which in turn was related to reported infant regulation problems, that is, non-soothability and greater crying frequency. Frequent use of close soothing was associated with reported infant sleeping behavior, that is, frequent nighttime awakenings. A longitudinal *SEM* further indicated that the effects of close soothing persisted at least until the infants' age of 7 months. The study showed how low maternal self-efficacy, increased use of distant soothing, and reported early infant regulation problems are intertwined and that, due to their persisting positive effect on infant soothability, close soothing better supports infant development.

KEYWORDS

infant crying and sleeping behavior, infant regulation, maternal co-regulation, maternal self-efficacy, soothing strategies

1 | INTRODUCTION

Human infants can hardly survive without others taking care of their basic needs (Harrist & Waugh, 2002). To make sure that infants receive this kind of support, special neural and hormonal responses are elicited that make adults feel attracted to babies (e.g., Luo et al., 2015). In addition, intuitive parenting behavior is activated (Papoušek, 1989).

Natural response patterns can, however, be disturbed, for example, due to increased levels of stress (e.g., Crnic & Ross, 2017), a mental health problem of the caregiver (e.g., postpartum depression, Field, 2010), or other possible challenging circumstances (e.g. small social networks, Fair et al., 2020).

Parents' treatment of and reactions to their offspring at a young age are known to have important implications for children's later physical and mental health (e.g., Lobo & Lunkenheimer, 2020). It is also known to impact *self-regulation* development, here defined as children's ability to modulate their own reactivity (Rothbart et al., 2011) and to control behavior appropriately and self-sufficiently (Bandura, 1977; Carver & Scheier, 1981; Kopp, 1982). Numerous studies show that poor parental co-regulation is associated with impaired self-regulation skills in young children, whereas supportive parental co-regulation is associated with better self-regulation competencies (Blackman, 2017; Ispa et al., 2017; Mohr et al., 2019; Raghunath et al., 2020). Persistent regulation problems in infancy and early childhood often co-exist with diminished abilities linked to self-regulation, like executive functioning, effortful and cognitive control, executive attention, or working memory (e.g., Beauchaine & McNulty, 2013; Nigg, 2017). Low self-regulation is also associated with behavioral problems (e.g., Olsen et al., 2019; Schmid et al., 2010) and reduced academic performance during elementary school years (Kiel et al., 2018; Lunkenheimer et al., 2011; Robson et al., 2020), antisocial behavior in adolescence (Dishion & Patterson, 2016), as well as low academic competence, increased health issues, and low economic success in adulthood (Moffitt et al., 2011; Robson et al., 2020).

Thus, negative consequences of regulation problems in early childhood may persist over the years (Halligan et al., 2013; Schmid et al., 2010), rendering it highly important to explore the mechanisms that underlie the development of self-regulation starting in early infancy. Given that parental co-regulation is essential for self-regulation development during infancy and beyond (e.g., Pauen & EDOS group, 2016), understanding mechanisms underlying the effects of parental co-regulation is central to understanding the emergence of self-regulatory abilities in young children.

1.1 | Parent-infant co-regulation

Early parent-infant co-regulation, also called *pre-dyadic regulation* or *dyadic co-regulation* (Sansavini et al., 2015; Taipale, 2016), is generally an interaction process between infants and parents on emotional and behavioral levels (Aureli et al., 2017). Newborns cannot yet distinguish between their own feelings and the feelings of the other person and are emotionally dependent on external support to regulate their needs (Taipale, 2016). Co-perception of the child's signals, such as reflecting internal states through mimicking or verbalization by the parents, is explained as the beginning of parent-child co-regulation (Demetriou, 2000; Pauen & EDOS group, 2016). Consequently, co-regulation is one part of the process between parent and child both at the behavioral (e.g., supporting child self-control) and mental level (e.g., motivational, emotional, cognitive processes), which contributes to the formation of the child's self-regulation and self-reflection (Pauen & EDOS group, 2016). Parent-infant co-regulation is a mutual developmental process. The more infants take on an active role in these interactions, the more parents subside their supporting behaviors (Evans & Porter, 2009; Kochanska & Aksan, 2004). During development, infants will gradually learn to regulate their needs and emotions and, thereby, acquire self-regulation skills.

KEY FINDINGS

1. Cross-sectional and longitudinal analyses show significant relationships between maternal self-efficacy, soothing strategies and early infant self-regulation.
2. Mothers who show lower levels of maternal self-efficacy tend to use distant soothing strategies more often, which in turn affects infant non-soothability and crying at 3 months of age, yet not at 7 months of age.
3. Frequent use of close soothing strategies influences better infant soothability, but also frequent infant night-time awakenings at 3 and 7 months.

1.2 | Infant regulation in dealing with states of increased arousal

The earliest indicators of self-regulation in infancy refer to biological rhythmicity (e.g., Öztürk Dönmez & Bayik Temel, 2019; Williams et al., 2017), attentional control (e.g., Rothbart et al., 2011), the expression of positive and negative emotions (e.g., Diamond & Aspinwall, 2003), and self-soothing (Sadeh et al., 2010). These capacities can be inferred from infants' feeding and sleeping behavior (e.g., the time they take to fall asleep and sleep duration, frequency of night-time awakenings, ability to self-soothe when waking up at night, their ability to engage or disengage in terms of their attention, the amount, duration, and

intensity of their crying, and how well they can soothe themselves when getting upset or excited (Hemmi et al., 2011; Pauen, 2011; Vonderlin & Pauen, 2013) However, especially during the early months of life, infants rely heavily on their caregivers to interpret their needs and inner states (e.g., Pauen & EDOS group, 2016). This is where parental co-regulation comes into play, especially when considering situations involving feeding, sleeping, crying, and self-soothing. The first phase of adaption for parents and newborns typically lasts until the second month after birth followed by a time of relative stability regarding infants' limited self-regulation capacities (e.g., Trevarthen & Aitken, 2001). Not only do parents adapt to the new challenges of dealing with a newborn during this phase (Gloger-Tippelt, 1988), but infants also develop stability in their communicative behaviors, such as fussing or crying, beginning in the second month (St James-Roberts et al., 1998).

1.3 | Parental soothing strategies

Quantifying parental co-regulation in interactions with young infants is difficult. Some researchers study interactions between a parent and their infant, taking into account the behavior of both interaction partners (e.g., in the still-face paradigm; Feldman et al., 2010). Other authors focus on self-reported parental strategies for regulating their infants' inner states and needs (e.g., Groß et al., 2013).

Soothing practices as types of co-regulatory responses play a key role in infant crying and sleeping behavior (e.g., Groß et al., 2013). Young infants have limited options to express their inner states (Gross & Cassidy, 2019) and often cry when they experience some kind of discomfort (Illingworth, 1955). In situations when crying cannot be attributed to an obvious and easy to remedied reason, a trial-and-error approach for developing a set of (successful) soothing techniques is needed to reduce the infant's negative arousal. For instance, persistent crying despite satisfied hunger (e.g., Howard et al., 2006) requires parents to explore other reasons and soothing techniques, such as offering a pacifier (Howard et al., 2003). There are culture-specific differences in the choice and frequency of maternal soothing behavior, but there are also strong similarities (e.g., touching, carrying, rocking, speaking) in the methods used (Richman et al., 1992; Toselli et al., 2011; Vinall et al., 2011).

Infant carrying describes another way of soothing and caring for infants (Gammie, 2013). This natural approach helps to establish bio-behavioral synchrony between a parent and his/her child based on heart sounds, visual-affective social cues (e.g., eye contact), and physical proximity (Feldman et al., 2011). It often involves skin-to-skin contact, which is known to be highly efficient in supporting the physiological regulation of young infants (Charpak et al., 2005; World Health Organisation [WHO], 2003). *Parental rocking of the baby* and *speaking to the baby* often accompany infant carrying; and also have calming effects (Dayton et al., 2015; Groß et al., 2013; Möller et al., 2019). Carrying the infant leads to the release of oxytocin, a bond-promoting hormone, in both mother and infant (Welch & Ludwig, 2017), and is associated with a reduction in crying and infant heart rate (Esposito et al., 2013).

Some parents use *tight swaddling* (i.e., wrapping the infant in a cloth, thereby restricting movements of the limbs). Although swaddling can be effective when dealing with premature babies or infants with brain damage (Lipton et al., 1965; van Sleuwen, Engelberts et al., 2007), evidence referring to the average population did not reveal any positive effects (van Sleuwen, L'Hoir et al., 2007). Tight swaddling limits infants' expressive capacity and prevents close physical contact with the caregiver; therefore, it remains controversial.

Furthermore, *musical toy*s are used for soothing purposes to provide distraction and entertainment (Dayton et al., 2015). Even though this is often recommended as an effective element for establishing a bedtime routine and may provide some comfort when the infant needs stimulation, it can be counterproductive in meeting the infant's natural need for social support and closeness (i.e., Allen et al., 2016).

Another controversial approach is to wait and let the infant cry until he/she gets tired and falls asleep. Although some experts recommend to refrain from *ignoring infant crying*, as it can lead to unhealthy degrees of arousal (Ludington-Hoe et al., 2002) and can disrupt the attachment process (Bell & Ainsworth, 1972), some recent findings suggest no adverse effects on attachment and behavioral development (Bilgin & Wolke, 2020)

Finally, parents who feel highly stressed, helpless, or overwhelmed may become aggressive towards a crying infant and then use harsh parenting practices such as *slapping* (Reijneveld et al., 2004), *shaking* the infant (Reijneveld et al., 2001), or *using medication* (Dayton et al., 2015). These harsh parenting practices are generally considered to disrupt the attachment process and may affect the infant's physical and mental health (Reijneveld et al., 2001).

According to Feldman et al. (2011), these different soothing techniques can be broadly divided into ***distant soothing (DS)*** and ***close soothing (CS) strategies***. Distant soothing strategies involve physical and emotional distancing of the caregiver from the child, whereas CS strategies involve emotional and physical contact between the caregiver and the infant. Based on this scheme, *offering*

breast- or bottle feeding, carrying the baby around, speaking or singing to the baby, and *rocking the baby* would count as CS strategies because they indicate physical and emotional proximity. The use of CS strategies during early infancy is associated with significantly shorter infant crying phases (Jahromi et al., 2004; Spinrad et al., 2004). By contrast, *ignoring infant crying* or *tight swaddling* in response to negative arousal, and to some extent, also *playing a musical toy* are considered DS strategies because these strategies involve physical and emotional separation from the infant. Harsh parenting strategies (i.e., *slapping, shaking, giving medication*) are extreme forms of distant soothing and constitute a separate category as they also count as child maltreatment (Reijneveld et al., 2004).

1.4 | Sensitivity and responsivity of parental co-regulation

In cases where caregivers regularly fail to provide co-regulation of infant needs, negative effects on children's stress responses and health during adolescence and early adulthood have been observed (Davidov & Grusec, 2006; Leerkes et al., 2009). When parents show too much co-regulation and thus display intrusive behavior, it can also have negative effects (Feldman et al., 2010). Hence, it seems important to apply situation-adequate soothing strategies. Sensitive and responsive parental behavior indicates the parent's ability to respond appropriately to the child's physical and emotional needs (Bornstein & Manian, 2013; Fonagy et al., 2018). High sensitivity, that is, the appropriateness and promptness of parental responses, is known to promote child development. Not only does it help infants to develop self-regulatory skills, but also helps foster the mother-infant relationship (Bigelow et al., 2010; Mastergeorge et al., 2014).

What determines how well caregivers manage to provide adequate and supportive co-regulation? One important predictor seems to be caregiver self-efficacy in their parenting abilities (Aranda, 2013; Wilson et al., 2014).

1.5 | Maternal confidence and self-efficacy

The concepts of maternal confidence or maternal self-efficacy are both grounded in the self-efficacy theory of Bandura (1977). The theory postulates that the general belief in one's own ability to show a given behavior increases the likelihood of its occurrence. Maternal self-efficacy typically refers to a mother's belief in her ability to provide sensitive and responsive care to her child (Hess et al., 2004; Vance & Brandon, 2017), as well as a sense of competence in relation to the maternal role (Badr, 2005; Troutman et al., 2012).

Caregiver self-efficacy is associated with more effective (Aranda, 2013; Wilson et al., 2014) and supportive parenting practices (Ardelt & Eccles, 2001; Glatz & Buchanan, 2015; Hess et al., 2004), including the use of CS strategies (e.g., Gärtner et al., 2018). High maternal self-efficacy has also been shown to correlate with the adaptive, social-emotional, and cognitive outcomes of the child (Coleman & Karraker, 2003). In contrast, low maternal self-efficacy has been found to correlate with more problems in infant sleeping, feeding, and crying during the first 4 months (Cook et al., 2019; Matthies et al., 2017). Infants of mothers with low maternal self-efficacy are described as more restless and difficult and as less predictable in their co-regulatory behavior (Zahr, 1991). Furthermore, they show more negative emotionality (Coleman & Karraker, 2003; Troutman et al., 2012).

1.6 | Relating maternal self-efficacy and soothing strategies to infant regulation

Existing evidence suggests that caregiver co-regulation (especially parental soothing behavior) is systematically linked to infant regulation. In general, CS strategies seem to be linked to better infant regulation than DS strategies, but in addition to the type of strategy, the frequency and appropriateness of its application should also be considered. Parent's self-efficacy affects their preferred soothing strategies as a caregiver (Dayton et al., 2015). Based on these arguments, it is assumed that maternal self-efficacy influences the type and frequency of soothing strategies, which in turn are related to the type and frequency of regulatory problems in the infant.

1.7 | Current study

In this study, we assessed maternal self-efficacy and soothing strategies at the infant's age of 3 months and infant regulation at both 3 and 7 months using maternal report, thus conducting cross-sectional as well as longitudinal analyses. We aim to investigate how maternal self-efficacy and soothing strategies are related to infant regulation in the first months of life and hypothesize the following:

- Mothers with low maternal self-efficacy use more DS strategies whereas mothers with high maternal self-efficacy use more CS strategies.
- Frequent use of DS strategies is associated with more infant regulation problems, whereas CS strategies

are assumed to be related to fewer regulation problems.

Infant regulatory behaviors remain largely stable between 3 and 7 months of age.

Choice and frequency of CS versus DS strategies link maternal self-efficacy to maternal reports of infant regulation.

2 | METHODS

2.1 | Participants

Overall, 150 mothers, living in Germany, aged 19 to 37 years (*Mdn* = 32 years, interquartile range = 8 years), with a median of upper secondary education (i.e., level 3: 11 to 13 years of education) according to the International Standard Classification of Education (ISCED11; UNESCO Institute for Statistics, 2012), and 49.4% employment rate, participated in the first wave of the Bremen Initiative to Foster Early Childhood Development (BRISE). The total sample of infants ($N = 143$; 79 males) were aged 2 to 4 months (*Mdn* = 3 months, IQR = 1 month) at measurement time point T1, and 6 to 10 months (*Mdn* = 7 months, IQR = 1 month) at measurement time point T2.

Overall, 71% of the mothers in this study had a migration background. Among these mothers, 40% were second-generation immigrants born in Germany but with at least one parent born abroad, and 31% were first-generation immigrants born outside Germany. The countries of migration in descending order of frequency ($n > 2$) were: Syria, Nigeria, Iraq, Kazakhstan, Russia, Turkey, Afghanistan, Egypt, Italy, and Ukraine. The longitudinal BRISE study targets children whose parents are socially or culturally challenged. The children and their families live in disadvantaged areas of Bremen identified by known social and demographic risk factors associated with disparities in child development (Spiess et al., 2008). For study inclusion, parents had to have at least one of the following risk factors: a low parental education level (as described by at least one parent with no more than a secondary school diploma or no vocational training), low family income due to at least one parent being unemployed or a low-wage earner, or a migration background of at least one parent or grandparent. Families were recruited by a network of gatekeepers (e.g., midwives, gynecologists, social workers) and through public advertisements (Schütte et al., 2020). Families interested in participating were individually screened via phone calls. Basic knowledge of German or English language were required in this screening process to ensure comprehension in the interviews. A national ethics committee approved the study and all participants gave their signed consent for participation.

2.2 | Procedure

As an ongoing longitudinal study, BRISE collects data at multiple measurement time points: in the last trimester of pregnancy or shortly after birth (T0), around 3 months (T1), and around 7 months (T2). Mothers were interviewed at home twice, using a structured questionnaire when their infants were about 3 and 7 months old. These age periods were chosen to cover the very beginnings of self-regulation development. The questionnaire included questions on maternal self-efficacy (3 months, T1) and soothing behavior (3 months, T1) as well as infant regulation (i.e., crying, sleeping, self-soothing, 3 and 7 months, T1 and T2).

Interviews were conducted in either German or English, depending on which language the caregiver understood best. In rare cases when families had limited English and German proficiency, families were assigned interviewers who spoke the language of the caregiver (Arabic, Russian or Turkish) in addition to German or English.

2.3 | Measures

Maternal self-efficacy was measured at an infant age of 3 months (T1) using the Maternal Confidence Questionnaire (MCQ; Badr, 2005; Parker & Zahr, 1985). The MCQ has been utilized in several countries and shows good reliability and validity measures (Badr, 2005). For the current study, the subscales *knowledge* (six items; e.g., "I know when my baby wants to play with me") and *feelings* (five items; e.g., "Taking care of the baby frustrates me") were assessed. The original English version of the MCQ was translated into German and then reviewed by a second bilingual psychologist. All items were answered on a five-point Likert scale and demonstrated similar reliability to the original samples, indicating a successful translation. The complete questionnaire shows sufficient internal consistency ($\omega = .97$, as calculated according to McDonalds omega which is equivalent to the alpha coefficient; McNeish, 2018).

Maternal soothing strategies were also measured at T1 by items describing different types of *soothing strategies* (Dayton et al., 2015) and items from the subscale *co-regulation* regulation of the German questionnaire on crying, feeding, and sleeping (Groß et al., 2013). A total of 10 items, each referring to one soothing strategy, were translated into German and then reviewed by a second bilingual psychologist. The items were assessed on a six-point Likert scale (never, less than 1-2 times per week, 1-2 times per week, 3-6 times per week, one-time daily, several times daily). The complete questionnaire of soothing types shows sufficient internal consistency ($\omega = .94$; McNeish,

2018). Following Feldman et al. (2011) the soothing strategies were categorized into DS and CS strategies. For the complete questionnaire, see Table A in the supplement.

Infant regulation was measured at T1 and T2 (infant age of 3 and 7 months) in terms of crying, self-soothing, and sleeping behavior based on maternal reports. Crying behavior was assessed by the frequency of crying and whining (at least 30 min continuously) on a five-point Likert scale (1 = never, 5 = four—six times a day) of a recent typical week (Groß et al., 2013). Infant ability to calm down after the use of soothing strategies was assessed on a four-point Likert scale (i.e., non-soothability: 1 = never, 4 = always; Groß et al., 2013). Sleeping behavior was assessed by minute, how long it took the infant to fall asleep (Pairfam, 2019), and the frequency of night-time awakenings (1 = not at all, 2 = once or twice a night, 3 = three to four times a night, and 4 = five times or more per night; Nationales Bildungspanel [NEPS], 2019).

2.4 | Data analysis

First, we analyzed each variable at the descriptive level. Second, we selected items from the soothing questionnaire that best represented close and distant soothing for subsequent model-testing. The main research questions were then analyzed utilizing *structural equation modeling* (*SEM*) via path and latent factor analysis (e.g., Geiser, 2011; Hayduk & Glaser, 2000; Reinecke, 2014).

A cross-sectional *SEM* was performed for measurement point T1 (i.e., infant mean age: 3 months). Maternal self-efficacy was included as a manifest predictor of DS and CS strategies as well as infant regulation. Ordinal-scaled variables for infant regulation (i.e., infant soothability and crying behavior, as well as the frequency of night-time awakenings) at T1 were included in the *SEM* as categorical variables.

In an additional *SEM*, maternal self-efficacy and soothing strategies at T1 were combined with measures for infant regulation at T2 (i.e., 7 months of age) to test for longitudinal effects. Infant regulation at T1 was included as a covariate. Consequently, *SEMs* with continuous, latent, and categorical variables were used, whereby a logistic regression and integration analysis was calculated in the case of continuous dependent variables (Muthén & Muthén, 2012).

The plausibility of both models was verified by descriptive statistics, partial construction of the model (Geiser, 2011), and model fit indices of logistic regression (i.e., Wald test of parameter constraints; Hosmer et al., 2013). Instead of using the common model fit parameters such as χ^2 statistics or RMSEA, that are suitable for interval-scaled variables, the Wald Test for analyses with ordinal-scaled variables (Kwan & Chan, 2011) was applied. The comparison of infant regulation from T1 to T2 was performed using nonparametric statistics (chi-square test, Cramer's V; Acock & Stavig, 1979). Statistics were performed with IBM SPSS 25 and Mplus Version 8.4 (2020). Only cases containing more than 70% of the responses were included. Cases with missing values above 70% were excluded pairwise. For the remaining variables, missing values were estimated by FIML within the framework of the *SEM* via Mplus (Enders, 2010).

3 | RESULTS

3.1 | Descriptive statistics

The mean score of maternal self-efficacy questionnaire at T1 was $M = 44.12$ (maximum: 55) with a standard deviation of $SD = 4.63$ and a range of 31 to 55. Overall, mothers in the present sample revealed rather high levels of self-efficacy.

Migration background was not significantly associated with maternal self-efficacy, soothing strategies, or with infant regulation at 3 or 7 months (all correlations $p > .05$; Bonferroni-corrected). Due to the non-significant correlations and to keep the *SEM* parsimonious, migration background was not included in further analyses.

Correlation analyses of the questionnaire data revealed that higher maternal self-efficacy was associated with lower scores on non-soothability ($r_s = -.34$, $p < .001$) and less infant crying ($r_s = -.30$, $p < .001$) at 3 months of age (T1). However, it was not associated with any of the infant regulation variables at 7 months (T2; all correlations $p > .05$; Bonferroni-corrected).

Table 1 reports the descriptive statistics for the soothing items sorted into the two categories distant and close soothing (DS, CS) based on their content (see also introduction).

Even though data sets for each variable were mostly complete with only a few dropouts, most items referring to DS strategies were chosen very rarely in the present sample. In contrast, CS strategies were reported to be used very often, suggesting that the majority of mothers chose positive parenting strategies. Few mothers reported using distant/harsh soothing techniques such as slapping (DS4: $n = 6$), shaking (DS5: $n = 4$), or medication (DS6: $n = 5$). It should be noted, though, that some participants made comments revealing that they interpreted DS4 as tapping the baby gently on the back ($n = 2$), and DS6 as providing medical care when the infant is sick ($n = 2$). Hence, data for DS4 to DS6 is determined as non-interpretable and excluded from further analyses. The soothing strategy DS3 (playing music to the infant) was the only item with a very high value on the DS dimension. Correlational

TABLE 1 Descriptive statistics for soothing strategies.

Type of soothing	Items		*N*	*Mean (SD)***
Distant soothing	DS1*	I let my baby cry until he/she calms herself	137	1.36 (.88)
	DS2*	I wrap my baby very tightly in a cloth	137	1.72 (1.25)
	DS3	I play music to my baby (e.g., with a clock, a musical cuddly toy or a mobile)	138	4.15 (1.82)
	DS4	I slap my baby	137	1.16 (.77)
	DS5	I shake my baby	136	1.11 (.70)
	DS6	I give my baby medication (e.g., Paracetamol, Novalgin, Parkemed)	137	1.05 (.28)
Close soothing	CS1*	I carry my baby around	138	5.33 (1.27)
	CS2*	I rock my baby in my arms	135	5.08 (1.50)
	CS3*	I talk or sing to my baby in a soothing tone	137	5.48 (1.00)
	CS4	I breastfeed my baby or give him/her the bottle	138	4.49 (1.98)

Note: *Items included in further analyses. **Range: 1 (never) to 6 (several times daily).

TABLE 2 Descriptive statistics for different infant regulation problems at T1 and T2.

		T1[a]	T2[b]	Interrelation
Infant regulation	***N***	***M (SD)***	***M (SD)***	**T1 to T2**
Non-soothability	142	1.38 (.58)	1.26 (.55)	.22[c,*]
Crying	143	1.68 (.94)	1.30 (.61)	.30[c,***]
Falling asleep duration	132	22.62 (21.88)	20.18 (20.44)	.34[d,**]
Night-time awakenings	143	2.23 (.73)	2.42 (.95)	.39[c,***]

[a]Measurement point T1 infants aged Mdn = 3 months.
[b]Measurement point T2 infants aged Mdn = 7 months.
[c]Interrelation for ordinal scaled items via Cramer's V.
[d]standardized regression coefficients ß.
*$p \leq .05$. **$p \leq .01$. ***$p \leq .001$.

analysis revealed that this item correlates significantly with other CS items (i.e., CS4, CS4, CS5), thus being unspecific in terms of the distinction between DS and CS. Given the widespread use of DS3 and CS4 and the fact that they do not seem to distinguish well between mothers who tend to use CS strategies versus DS strategies, we decided to exclude these two items from further analyses. In sum, we thus selected DS1 and DS2 to represent DS strategies and CS1, CS2, and CS3 to represent CS strategies in the subsequent SEM.

3.2 | Stability of infant regulation during infancy

As displayed in Table 2, mothers reported low levels of infant crying and non-soothability at both T1 and T2. On average, infants were reported to require 20 min to fall asleep and to wake up twice at night at both time points. Overall, mothers' responses regarding the regulation of their 3-month-old infants are similar to the responses regarding the regulation of their 7-month-old infants (see Table 2: falling asleep duration and all-remaining variables).

Correlations between items of infant regulation showed non-significant relations except for infant non-soothability and crying at T1 ($r_s = .25$, $p = .002$; Bonferroni-corrected). All items revealed significant but small to moderate interrelations between T1 and T2, revealing systematic stability in infant regulation measures between 3 and 7 months of age (see Table 2).

A chi-square test revealed a significant interrelation of non-soothability, crying, and night-time awakening (the number of wake-ups per night) with a medium effect size (see Table 2). The regression analysis referring to the duration of falling asleep (in minutes) is also significant across both T1 and T2 (see Table 2). This indicates that the dimensions of infant regulation behavior were stable across both assessments.

3.3 | Cross-sectional SEM analysis of maternal self-efficacy, soothing and infant regulation at 3 months of age

Figure 1 shows the structure equation model testing the associations between DS versus CS strategies, maternal self-efficacy, and reported infant regulation

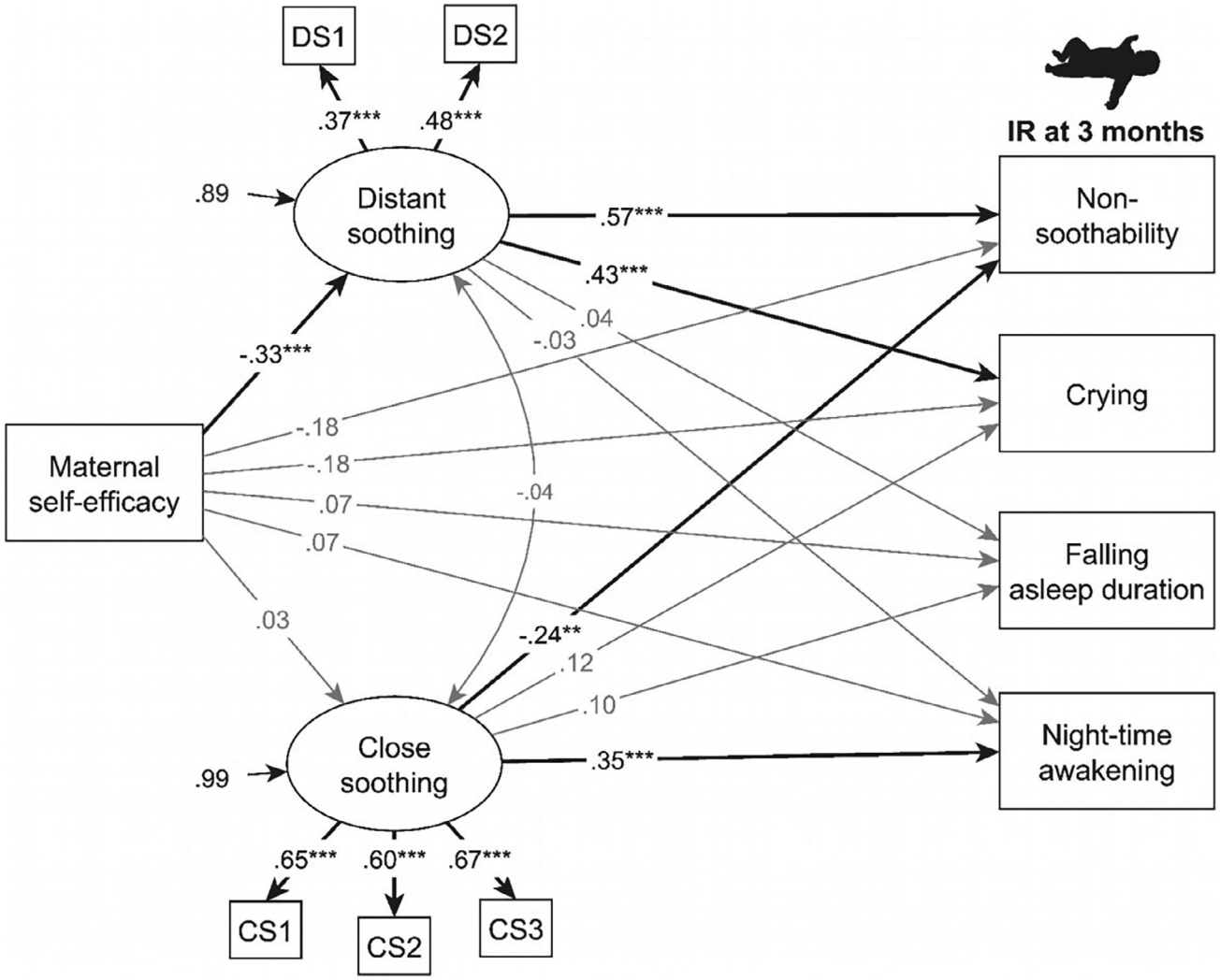

FIGURE 1 Structural equation model of maternal self-efficacy, soothing strategies, and infant regulation at 3 months. *Notes*. The model shows the association of maternal self-efficacy levels and the frequency of distant and close soothing use on infant crying and sleeping behavior. $N = 143$. Estimated values of standardized regression coefficients of multiple logistic regression analyses. DS1 = I let my baby cry until he/she calms herself; DS2 = I wrap my baby very tightly in a cloth (swaddling); CS1 = I carry my baby around; CS2 = I rock my baby in my arms; CS3 = I talk or sing to my baby in a soothing tone; IR = Infant regulation. R-Square: DS = 10.9% $p = .286$, CS = .1% $p = .913$, non-soothability = 49.0% $p = .003$, crying = 28.1% $p = .025$, falling asleep duration = 1.5% $p = .586$, night-time awakenings = 13.2% $p = .114$. Model fit information: Wald test of parameter constraints = 82.870, $df(3)$, $p < .001$, indicates that the overall effect of rank of logistic regression is statistically significant (Hosmer et al., 2013). $^*p \leq .05$; $^{**}p \leq .01$; $^{***}p \leq .001$.

cross-sectionally for T1. Although maternal self-efficacy was correlated with various dimensions of infant regulation, when soothing strategies were taken into account, direct and indirect associations between maternal self-efficacy and infant regulation variables were no longer significant (for specific indirect effects see appendix Table B). When soothing behavior was included, maternal self-efficacy affected soothing behavior, which in turn affected infant regulation. More specifically, low maternal self-efficacy levels significantly increased the frequency of use of DS strategies, explaining 10.9% of its variance. Frequent use of DS strategies was associated with maternal ratings of infant regulation, showing a significant association with higher non-soothability and higher crying frequency. Infant sleep behavior was not directly associated with DS strategies. It should be noted that the items DS1 and DS2 showed only moderate loadings on the latent variable of DS, thus indicating that each item covers a different aspect of distant soothing. Maternal self-efficacy was not associated with the use of CS strategies, explaining only .1% of its variance. As expected, frequent use of CS strategies was associated with maternal ratings of less non-soothability of the infant. Interestingly, it was also associated with the frequency of night-time awakenings. Falling asleep duration, as one dimension of infant regulation, was neither associated with CS nor with DS maternal strategies.

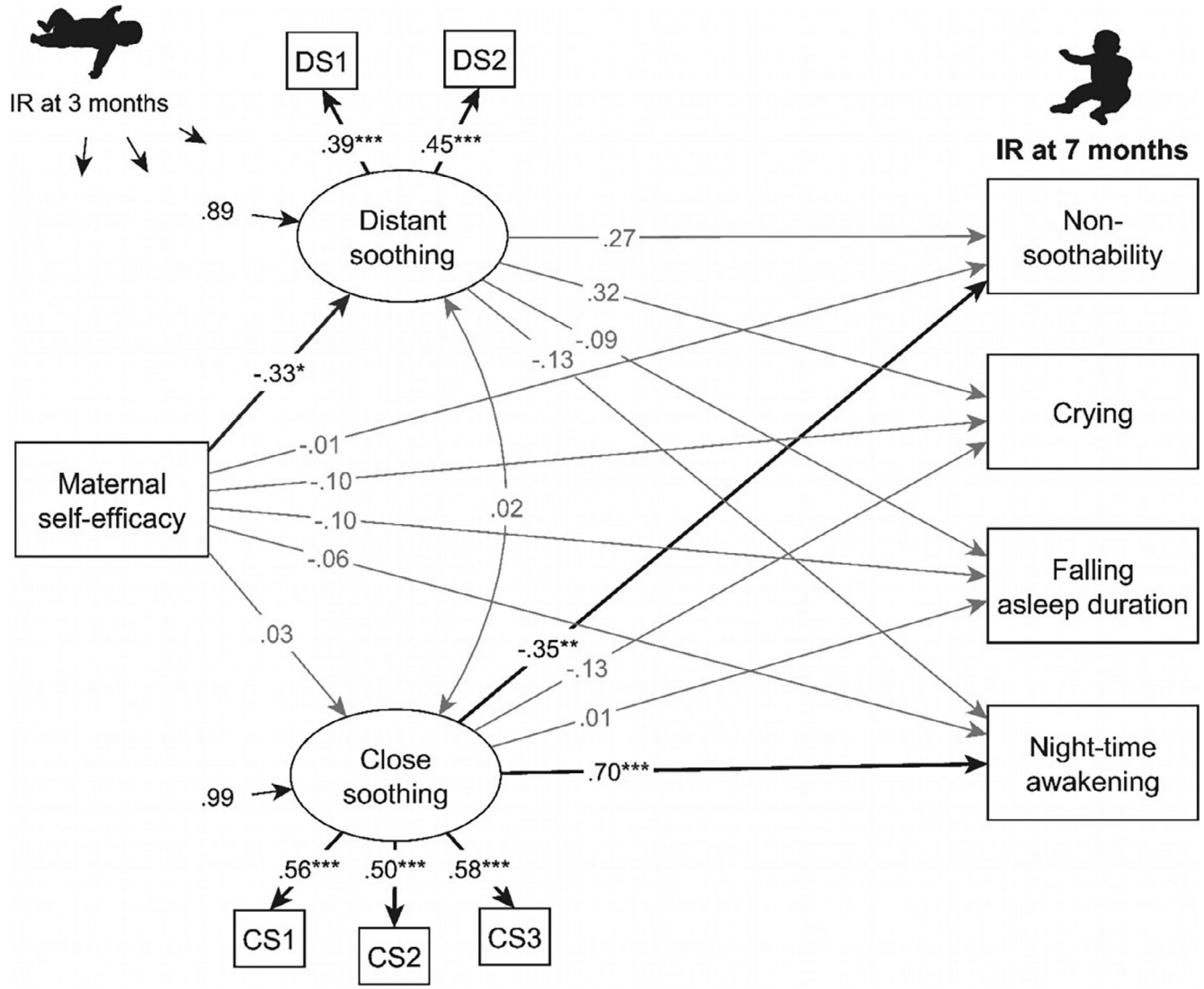

FIGURE 2 Structural equation model of maternal self-efficacy and soothing strategies at 3 months, and infant regulation at 7 months (controlling for infant regulation at 3 months). *Notes*. The longitudinal model shows the association of maternal self-efficacy levels and the frequency of use of distant and close soothing strategies at T1 (3 months, left-hand side) to infant regulation (infant crying and sleeping behavior, right-hand side) at T2 (7 months) after controlling for infant regulation at T1. $N = 143$. Estimated values of standardized regression coefficients of multiple logistic regression analyses. DS1 = I let my baby cry until he/she calms herself; DS2 = I wrap my baby very tightly in a cloth (swaddling); CS1 = I carry my baby around; CS2 = I rock my baby in my arms; CS3 = I talk or sing to my baby in a soothing tone; IR = Infant regulation. R-Square: DS = 10.7% $p = .300$, CS = .1% $p = .916$, non-soothability = 19.4% $p = .074$, crying = 15.3% $p = .323$, falling asleep duration = 1.2% $p = .775$, night-time awakenings = 49.9% $p = .017$. Model fit information: Wald test of parameter constraints = 74.675, $df(3)$, $p < .001$, indicates that the overall effect of rank of logistic regression is statistically significant (Hosmer et al., 2013). *$p \leq .05$; **$p \leq .01$; ***$p \leq .001$.

3.4 | Longitudinal SEM analysis of maternal self-efficacy, soothing at 3 months and infant regulation at 7 months of age

In order to address how early maternal self-efficacy and soothing strategies effect maternal reports on infant regulation longitudinally, a second *SEM* was conducted relating maternal self-efficacy and soothing strategies at T1 to infant regulation at T2, while controlling for infant regulation at T1. Figure 2 displays the results of the longitudinal analysis. Similar to the first *SEM*, the indirect associations between maternal self-efficacy and infant regulation variables were not significant (for specific indirect effects see appendix Table C). In contrast to the first *SEM*, frequent use of DS strategies did not show a significant association with non-soothability and crying frequency at T2 when being controlled for infant regulation at T1. Neither CS nor DS strategies at T1 were related to the duration of falling asleep at T2, mirroring findings of the cross-sectional analysis. Frequent use of CS strategies at T1 was associated with

better soothability and more frequent night-time awakenings of infants at T2, indicating that the influence of early soothing strategies on maternal ratings of infant regulation persists with higher estimated *ß*-values compared to the cross-sectional *SEM* at 3 months.

Taking the results of both *SEMs* together, lower levels of maternal self-efficacy at T1 were found to be associated with the use of DS strategies at T1. Increased use of DS strategies at T1 was further related to increased non-soothability and crying in maternal reports at T1. However, neither early maternal self-efficacy nor DS strategy use at T1 were significantly associated with infant regulation at T2 when initially reported levels of infant regulation were controlled. While no direct link between maternal self-efficacy and CS strategies was found, high use of CS strategies supported infant soothability and led to more night-time awakenings in maternal reports within the first 7 months of life.

4 | DISCUSSION

The present study investigates the associations between maternal self-efficacy, soothing strategies, and infant regulation in very young infants based on maternal report, thereby focusing on the role of soothing strategies in the well-documented relation between maternal self-efficacy and infant regulation problems (Cook et al., 2019; Matthies et al., 2017). In line with the literature, we found associations between maternal self-efficacy and soothing strategies, and between soothing strategies and maternal ratings of infant regulation, with fairly stable infant regulatory behaviors throughout early infancy. Maternal self-efficacy correlated with infant regulation at 3 months. Importantly, this relation disappeared when soothing strategies were also considered in structure equation modelling. In addition, the correlation between maternal self-efficacy (assessed at 3 months) and infant regulation at 7 months was no longer significant which points to the high dynamic in early caregiver-child interactions during the first year of life.

Looking more closely at different types of soothing strategies, we found that mothers with low maternal self-efficacy used more DS strategies but did not vary in terms of CS strategies when the use of CS strategies was generally very high. Nonetheless, the use of CS strategies was systematically related to infant non-soothability and night-time awakenings at both measurement points (i.e., at 3 and 7 months), whereas DS strategies were associated with regulation problems (non-soothability and crying) only at 3 months of age and did not predict maternal ratings of infant regulation at 7 months when baseline manifestations of regulation problems were controlled. To better understand these findings, results for each measurement point will be discussed in more detail.

4.1 | Maternal self-efficacy, soothing strategies, and infant regulation at 3 months

4.1.1 | Distant soothing strategies

Consistent with the existing literature, our data showed that low maternal self-efficacy is associated with less effective (Aranda, 2013; Wilson et al., 2014) and less supportive parenting practices (Ardelt & Eccles, 2001; Glatz & Buchanan, 2015; Hess et al., 2004). The data also supported the relation between DS strategies and infant regulation difficulties like non-soothability or a greater frequency of infant crying at 3 months of age (e.g., Gärtner et al., 2018; Jusienė & Breidokienė, 2019; Sanders & Woolley, 2005). According to Papoušek (2004), maternal self-efficacy, distant soothing strategies, and infant regulation are closely intertwined. Frequent and persistent crying of the infant reduces the intuitive competence and self-efficacy of caregivers, which promotes more frequent use of distant or negative soothing strategies, thus leading to even more infant crying. In line with this interpretation, a recently introduced model on the origins and evolution of maternal self-efficacy postulates feedback loops between child behavior, maternal emotional and cognitive processes, maternal behavior, and maternal self-efficacy (Cao et al., 2022). Furthermore, de Cock et al. (2015) demonstrate that adults who hear a child cry for 10 min feel increasingly incompetent and less confident as a parent in the future. Hence, it seems plausible to assume that frequent infant crying increases feelings of helplessness in caregivers, which may in turn increase the use of DS strategies (see Papoušek, 2004). What holds true for infant crying, however, may not apply equally to other regulative problems. The current study did not reveal any significant association between DS strategies and infant sleep regulation at 3 months of age. In an attempt to better understand this finding, it seems useful to first take a closer look at results regarding CS strategies.

4.1.2 | Close soothing strategies

In contrast to the findings regarding DS strategies, maternal self-efficacy was not associated with CS strategies. This may be attributed in part to a lack of variance regarding CS, as CS strategies were used very often by mothers in the present sample, as indicated by high group means and low standard deviations on this variable. Nonetheless,

we found that mothers who used more CS strategies were better able to soothe their infant than mothers who reported less frequent use of CS strategies, which is largely consistent with previous work (Hunziker & Barr, 1986; Klamann et al., 2019). If high sensitivity means appropriateness and promptness of parental response behavior (Bornstein & Manian, 2013; Fonagy et al., 2018), then carrying and rocking the infant as well as singing seem to be effective soothing methods.

Interestingly, we found a positive link between CS strategies and night-time awakenings of the infant. If the infant wakes up at night, CS strategies such as picking the child up, rocking, and singing may not always help the infant sleep through the night. During the first months, infants' nocturnal crying can be easily misinterpreted as hunger crying by the caregiver, resulting in more-than-necessary feeding of the infant during a sensitive period for the development of a stable sleeping rhythm (Burnham et al., 2002). Supporting these findings, the review by Sadeh et al. (2010) shows that increased parental activity (i.e., bedtime interactions and soothing routines) is associated with more fragmented infant sleep. Furthermore, mothers who prioritize CS strategies often also prefer co-sleeping or sleeping in the same room as their infant which increases the likelihood of waking up the baby at night (Teti et al., 2016; Volkovich et al., 2015; Voltaire & Teti, 2018). At the same time, infants during the first 3 months do not yet have a regular sleep rhythm (Paavonen et al., 2020). The associated frequent night-time awakenings are naturally responded to by the use of close soothing strategies. Recent studies highlight the effectiveness of nocturnal soothing through maternal carrying or reciprocal motion from a moving cot for awake infants, but not for non-crying ones (Ohmura et al., 2022). Thus, the observed association of CS strategies with night-time awakenings can be considered sensitive parenting behavior at 3 months, but could also slow down the development of self-regulatory skills.

4.2 | Maternal self-efficacy, soothing strategies and infant regulation at 7 months

4.2.1 | Distant soothing strategies

We further examined the persistent effects of early maternal self-efficacy and DS on maternal ratings of infant regulation problems, and these were diminished. Although infant regulatory skills at 3 and 7 months were intercorrelated, indicating that infants who are better at regulating themselves continue to do so, the longitudinal model did not link early maternal DS behavior at 3 months with infant regulation at 7 months when controlled for infant regulation at 3 months—a pattern confirmed by a recent comprehensive literature review by Samdan et al. (2020) that focuses on the relationship between infant regulation and parental behavior. According to this literature review, the strong empirical relations often found between infant regulation and parental behavior during the first postnatal months tend to decline in strength until the end of the first year of life. Hence, the longitudinal dynamics including changes of maternal self-efficacy and adaptation of maternal soothing strategies always need to be taken into account (see also Cao et al., 2022).

At first sight, finding a positive link between DS and infant crying only at the age of 3 months might argue against the long-term relevance of negative feedback-loops in mutual caregiver-child regulation. Bilgin & Wolke (2020) as well as Van Ijzendoorn & Hubbard (2010) showed that leaving infants to 'cry it out' only a few times shortly after birth is associated with less frequent crying at 3 months. In the light of such findings, one could speculate that the use of DS strategies (e.g., ignoring infant crying) at 3 months can reduce infant crying und non-soothability at 7 months, because "benign neglect" of whining may stimulate infants to acquire skills for dealing with mild stress on their own (Van IJzendoorn & Hubbard, 2010). Mothers of difficult-to-soothe infants use DS strategies more often (e.g., letting the infant cry) and this may reduce the infant's demand for maternal attention resulting in a decrease in crying and non-soothability at 7 months. Given that Bilgin and Wolke's (2020) study shows small effect sizes and other recent work shows opposite results (Blackman, 2017; Jahromi & Stifter, 2007; Öztürk Dönmez & Bayik Temel, 2019), the interpretation should be treated with caution. This is not to say that letting your infant cry is a good strategy to promote self-regulation development. Importantly, it is the frequency and the appropriateness of a given strategy in a given context that influences infant regulation development in either a positive or negative way (Bilgin & Wolke, 2017; Mastergeorge et al., 2014).

4.2.2 | Close soothing strategies

In our longitudinal analysis, we found that frequent use of CS strategies at 3 months remained significantly associated with maternal ratings of better soothability at 7 months, even after controlling for maternal reports on infant regulation at 3 months. Thus, CS strategies appear to represent sensitive parental behavior with lasting positive effects. At the same time, however, this study also shows its opposite effect on the night-time awakenings of infants as young as 7 months. In this context, it should be taken into account that carrying and rocking the infant or singing during night-time awakening can be effective, however,

sensitive observation whether gentle waking noises cease before intervention seem appropriate. From an evolutionary perspective, as well as in other (e.g., non-Western) cultures, infants are not expected to sleep through the night. It is reported, that infants develop a natural sleep rhythm around the age of 3-to-6-month (Henderson et al., 2011; Galland et al., 2012). Through careful consideration of the appropriate soothing type and time depending on the infant's signals parents may support the consolidation of the natural sleep rhythm.

Considering that recent longitudinal studies on cognitive development in the first year of life show positive associations between optimal sleep of 8-month-old infants in their home environment and their cognitive abilities and language development at the age of 14 months (Hernandez-Reif & Gungordu, 2022), parental responsivity must to be balanced with the childs actual needs. As early child regulation is influenced by both genetic-biological factors as well as parenting behavior (Samdan et al., 2020), more studies are needed that investigate the positive and negative effects of CS and DS strategies (especially at night) during the first year of life.

4.3 | Limitations and future research

The first limitation that should be addressed in future studies is the operationalization and assessment of DS and CS strategies. For our analysis, only those strategies were selected that (a) were used by a substantial number of participants, (b) were understood correctly, and (c) provided clear examples for DS and CS, respectively. Despite the fact that we assessed a fairly broad range of different strategies derived from the literature, several strategies were used only rarely by our participants. Among those participants who did report their use, some misinterpreted their meaning (i.e., "I slap my baby", "I shake my baby"). Other items turned out to be rather unspecific for DS or CS strategies, respectively (i.e., "I play music to my baby", "I breastfeed my baby or give him/her the bottle"). Despite the fact that only two items remained to assess DS, and only three items to assess CS, both our theory-based structural equation models using these constructs revealed a fairly good fit to the empirical data. However, future studies would profit from a broader range of items for each construct that can be applied interculturally.

Furthermore, the items of maternal soothing strategies did not take into account the infant's state (e.g., crying, fussing) at the time the strategy was used either. Thus, it only covers the more general concept of parental co-regulation. Mothers could have been asked about the soothing level of the infant (non-soothability) after the use of the soothing strategies. Ideally, future studies should explore parent-child interactions by assessing video-microanalysis to document the dynamics of self- and co-regulation in more detail.

In addition, both maternal and infant data in the current study were derived only from questionnaires filled out by mothers, as is often the case, especially in longitudinal studies. Some objective measures of infant behavior would have helped to reduce the concern that associations are attributed to shared perceptions of mothers across variables. Although we cannot rule out the possibility that these assessments may be biased, Glascoe (2003) argues that parents' ratings of their child's development are as reliable and valid as expert assessments in developmental screenings, regardless of place of residence, parents' health status, and socioeconomic status. Nevertheless, language barriers of non-native parents may lead to misunderstandings and invalid answers. To prevent this, questionnaires were filled out by an interviewer explaining items upon request in the present case. This procedure can, however, increase the likelihood that parents give socially desired responses.

With respect to future research, our work indicates the need for more studies relating caregiver characteristics, interactive behaviors, and infant regulation outcomes to each other. For instance, potential covariates such as co-sleeping, breastfeeding, education, and poverty may have a considerable effect on parents' perception of infant crying and sleep problems (e.g., Birmingham et al., 2017; Sidor et al., 2013). By testing comprehensive models (e.g., Cao et al., 2022) rather than reporting only single correlations, it is possible to learn more about the interplay between these factors.

4.4 | Implications for practice

Maternal involvement and comfort reduces infant crying and distress (Ganda et al., 2011), which leads to a more profound parent-child relationship (Blackman, 2017). Experts highlight the importance of having higher levels of self-efficacy in parenting but also using appropriate parenting practices during the day and at night for better parent-child relationship and child behavioral outcomes (Albanese et al., 2019; Higley & Dozier, 2009; Sadeh et al., 2010; Volkovich et al., 2015). Thus, courses and programs on feeding, infant-care or parenting which start during pregnancy can help expectant mothers to develop maternal self-efficacy, and to learn and use appropriate soothing strategies (Samdan et al., 2022).

Intervention programs for caregivers who have difficulties regarding co-regulation should focus on two aspects: (1) to improve caregivers' knowledge about and confidence in their own parenting skills, and (2) to teach caregivers

effective ways to calm down the infant and to support self-regulation development, considering the actual needs of the infant (e.g., when he/she is actually in need of body contact or stimulation). For example, offering stimulation or body contact, or providing objects to play with while infants avert their gaze can be regarded as intrusive behavior (Atzil et al., 2011; Feldman et al., 2011). Likewise, providing close soothing at night even when the infant does not really ask for it, can be intrusive, too. Thus, it is not only a question of using distant or close strategies. Rather, caregiver should use a soothing strategy that is appropriate for the given situation and for the infant at a given time.

5 | CONCLUSION

Using a prospective longitudinal study design and interviewing mothers from mixed ethnic and educational backgrounds, the present study revealed that mothers who have lower self-efficacy in parenting use more distant strategies to soothe their infants. They report higher levels of infant crying and non-soothability when their infants are 3 months old. Regarding longitudinal effects, mothers who use more close soothing strategies continue to report better infant soothability, but also more frequent night-time awakenings when their infants are 7 months old. Overall, the results indicate that future studies as well as intervention programs should take into consideration both maternal self-efficacy and soothing strategies and highlight the importance of using sensitive maternal behavior, but also allowing the infants to learn to regulate themselves.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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