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DOI
10.1037/dev0001428

Publication date
2022

Document Version
Final published version

Published in
Developmental Psychology

AMERICAN PSYCHOLOGICAL ASSOCIATION

Developmental Psychology

ISSN: 0012-1649

2022, Vol. 58, No. 11, 2127–2139
https://doi.org/10.1037/dev0001428

Mothers' and Fathers' Mind-Mindedness in Infancy and Toddlerhood Predict Their Children's Self-Regulation at Preschool Age

Milica Nikolić[1], Moniek Zeegers[2], Cristina Colonnesi[1], Mirjana Majdandžić[1], Wieke de Vente[1], and Susan M. Bögels[1, 3]

[1] Research Institute of Child Development and Education, University of Amsterdam
[2] Mondium BV, Dutch Mental Health Care Center, Beesd, the Netherlands
[3] Psychology Research Institute, University of Amsterdam

The ability to regulate one's emotions and behaviors is essential for adaptive functioning in society. We investigated whether parental mind-mindedness—parents' tendency to treat their children as mental agents—in infancy and toddlerhood predicts school-age children's self-regulation. The sample consisted of 125 mostly Dutch and White families. We assessed mothers' and fathers' appropriate and nonattuned mind-related comments during free play with their 12- and 30-month-old child (70 girls and 55 boys). We measured children's physiological, temperamental, and behavioral self-regulation when children were 4 1/2 years old. Fathers' appropriate mind-related comments predicted children's higher temperamental and behavioral self-regulation and mothers' and fathers' nonattuned mind-related comments predicted children's lower physiological and temperamental self-regulation. Our findings emphasize the importance of both parents' mind-mindedness in children's socioemotional development.

Keywords: mind-mindedness, self-regulation, physiological regulation, effortful control

Supplemental materials: https://doi.org/10.1037/dev0001428.supp

Self-regulation, or the ability to regulate one's arousal and behaviors (Rothbart, 1981), is essential for adaptive functioning in society. Already starting in the first years of children's lives, the social environment requires children to manage their emotions and behaviors in response to the contextual demands, that is, to self-regulate. Virtually all caregivers value when children persist during challenges, tolerate frustration, comply with parental demands, and internalize social rules and moral standards, all of which are hallmarks of successful self-regulation (Eisenberg, 2000; Kochanska, 1993; Kochanska et al., 1995, 2001). Around the age of 4 years, most children enter a form of schooling that appeals to their abilities to stay on task, attend to learning goals, and participate actively in learning. From this age on, self-regulation becomes especially important for their academic motivation and success (e.g., Nota et al., 2004). Accumulating evidence, including meta-analytic results, indicate that self-regulation in childhood predicts not only academic success but also interpersonal behaviors, mental health, and healthy living in later life (de Ridder et al., 2012; Diamond, 2013; Robson et al., 2020). Hence, understanding how self-regulation develops and can be enhanced from birth onward seems essential to understanding general mental health and well-being in all people.

Different components of self-regulation, such as temperament-based effortful and inhibitory control, and physiological and emotion regulation emerge in childhood and are believed to be strongly influenced by social experiences, especially by early parenting practices and the parent–child relationship quality (Casey & Fuller, 1994; Eisenberg et al., 2005; Grolnick & Farkas, 2002; Kochanska et al., 2000; Regueiro et al., 2020). A meta-analytic review revealed relatively small but significant associations between a child's self-regulation and the way parents discipline their child (Karreman et al., 2006). Recent studies also demonstrated that specific parenting behaviors related to sensitivity and social communication are particularly important for the development of healthy self-regulation in children. For example, warm and responsive parenting as well as synchronous and positive early parent–child relationships have been shown to promote children's

This article was published Online First September 1, 2022.
Milica Nikolić https://orcid.org/0000-0002-7898-6012
Cristina Colonnesi https://orcid.org/0000-0002-5740-7827
Mirjana Majdandžić https://orcid.org/0000-0003-3579-2119
Wieke de Vente https://orcid.org/0000-0001-5279-9553
Moniek Zeegers is now at Levvel, Youth Care Center, Amsterdam, the Netherlands.
Milica Nikolić and Moniek Zeegers contributed equally to the study and, therefore, share first authorship.
The study's design and its analysis were not preregistered. There are no conflict of interest to report. The study data are available on OSF: https://osf.io/3x2mq/?view_only=07ca017989e34ac89331c31d355cea47
This study was supported by an Innovation Research Vici NWO Grant 453-09-001 to Susan M. Bögels. Milica Nikolić was funded by Amsterdam Brain and Cognition Talent Grant and by VENI NWO Grant (VI.Veni.201G.017) during the writing of this article.
Correspondence concerning this article should be addressed to Milica Nikolić, Research Institute of Child Development and Education, University of Amsterdam, Nieuwe Achtergracht 127, 1018 WS Amsterdam, the Netherlands. Email: m.nikolic@uva.nl

self-regulation (e.g., Kochanska et al., 2000; Thompson et al., 2008).

In the past 2 decades the influential mentalization theory has highlighted the role of parents' mentalizing capacity, that is, parents' tendency to interpret the child's behavior in terms of mental state, as an explanation for how parental understanding and external regulation of their children's internal states gradually become internalized to shape self-regulation in children (Fonagy et al., 2002). However, empirical support for an association between parental mentalizing and self-regulation is yet limited to studies in infancy (e.g., Bernier et al., 2010; Cheng et al., 2018; Gagné et al., 2018; Zeegers et al., 2018). In the present study, we tested whether a measure of mothers' and fathers' mentalizing—mind-mindedness (i.e., parents' tendency to treat their infant as a mental agent; Meins, 1997) during infancy and toddlerhood, predicts better self-regulation in preschoolers.

Physiological and Behavioral Measures of Self-Regulation in Early Childhood

Self-regulation has been defined as the modulation of thought, physiological affect, and behavior, involving conscious or reflective as well as unconscious or automatic mechanisms (Karoly, 1993; Rothbart et al., 2006). Here, we focused on a behavioral and physiological-emotional component of self-regulation, both of which have been used extensively in prior research: effortful control and parasympathetic regulation of the heart measured through heart rate variability (HRV; Holzman & Bridgett, 2017; Porges, 2001).

Effortful control is defined as "the efficiency of executive attention—including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors" (Rothbart & Bates, 2006, p. 129). Effortful control includes the ability to voluntarily focus attention and to inhibit or activate behavior as needed to adjust to a situation, especially when someone does not really want to do so (Eisenberg, 2005). For example, the ability to focus attention when the teacher is explaining math when there are interesting things to see outside of a window, to not interrupt others and sit still in class, and to make oneself do a school assignment while one has the option to play a fun videogame, are aspects of effortful control.

Spontaneous behavioral self-regulation of arousal begins as early as the first year of life, but the set of behaviors to deal with arousal is initially very limited, such as turning away from stimuli that cause overarousal, sleeping, self-distraction (e.g., playing with a toy), and self-soothing behaviors (e.g., sucking; Rothbart et al.,1992). Furthermore, these efforts are not intentional, which may be one reason they are of limited effectiveness (Buss & Goldsmith, 1998; Cole et al., 2009). At the end of the first year, children undergo a rapid development of the frontal cortex, which is thought to be important for coordinating and controlling attention (Kochanska et al., 2000; Nigg, 2013). In the second year of life, children become conscious of social requirements and are able to follow the instructions of caregivers (Kochanska et al., 2001). By the age of 2 years, children have developed the ability to suppress responses, and by the age of 3 years children become able to self-regulate or show behavior that is completely adjusted by the child and that meets social requirements (Gusdorf et al., 2011). Interestingly, although children, on average, improve their effortful control across childhood and adolescence (Davies et al., 2004), from the age of 3 years, the rank ordering of children's levels of effortful control is assumed to be highly stable (Kochanska & Knaack, 2003). Hence, although the development of effortful control is a gradual process that continues into early adulthood, individual differences in effortful control across children become relatively stable already around the age of 3.

Heart rate variability (HRV) indices are also commonly used to assess physiological and emotional regulation—how one's body is dealing with physiological arousal (Task Force of the European Society of Cardiology & the North American Society of Pacing and Electrophysiology, 1996). HRV is typically assessed during a resting (baseline) period to represent an individual's general capacity and flexibility to regulate arousal (Appelhans & Luecken, 2006). That is, a high baseline HRV level indicates a higher parasympathetic nervous system (PNS) activity, which is adaptive when there is no external threat (Propper & Moore, 2006). Also, it is thought that high resting HRV allows the autonomic nervous system to flexibly adapt to environmental changes, as it can more quickly withdraw the activity of the PNS, resulting in more arousal. Hence, more variation in PNS activity is associated with an increased capacity for rapid shifts between high and low arousal states, enabling better self-regulation (Appelhans & Luecken, 2006).

From birth and early childhood to adulthood, HRV demonstrates increasing interindividual stability similar to the expansion of behavioral regulation strategies in the first years due to improved motor, communication and, cognitive abilities (Alkon et al., 2006; Bornstein & Suess, 2000). However, mixed findings have been presented concerning an association between baseline HRV and several measures of self-regulation in children around the age of 3 to 4 years. On the one hand, high baseline HRV has been found to relate to greater effortful control, better executive functioning and better emotion regulation (e.g., Marcovitch et al., 2010; Skowron et al., 2014). On the other hand, a similar number of studies showed no association between baseline HRV and aspects or correlates of self-regulation, such as inattention, effortful control, and emotion regulation (e.g., Blankson et al., 2012). In adults, the correlation between resting HRV and self-regulatory capacity is more robust (see the review of Holzman & Bridgett, 2017). It has been argued that childhood marks a period in which increased interconnectivity between prefrontal cortical structures and cardiac activity unfolds and reaches maturity only after 18 years of age (Holzman & Bridgett, 2017). Hence, there is evidence that supports the idea that high baseline HRV is a physiological marker of self-regulation in children, although the physiological system underlying self-regulation seems to be relatively flexible and maturing in childhood.

Parents' Mind-Mindedness and Children's Self-Regulation

In order to regulate one's arousal and behavior in an intentional or goal-oriented way, it is crucial to have a sense of self, recognizing oneself as an entity (i.e., self-awareness) and the agent of actions (a sense of agency; Jeannerod, 2003). Building a sense of self starts right from birth and becomes central in the toddlerhood marking a crucial period in which children find out about the nature of their own thoughts and feelings, as well as those of others (Fonagy et al., 2002; Jeannerod, 2003). This process is thought to be embedded in the social interactions with others of which

primary caregivers seem the most important (Carpendale & Lewis, 2004; Slade, 2005). That is, when a young infant is sad, they feel distressed and disorganized. The infant can learn about the meaning of this experience only through another individual who reflects upon their sadness (Cooley, 1902). Reflecting the infant's internal state enables the infant to see their experience outside of the self and provides a way to attribute meaning to all the sensations in relation to the sadness (Fonagy et al., 2002). When caregivers provide reactions that indicate that they are aware of how the infant feels, the infant can assimilate the caregiver's representation. Accumulating experiences of being reflected accurately help the infant to develop a more organized sense of internal experiences (i.e., understanding what one feels). This reflective capacity of primary caregivers is referred to as parental mentalizing (Sharp & Fonagy, 2008). Hence, it is the mentalizing of parents that marks the onset of a concept of self and emotional understanding in children, which is crucial to tolerating or modulating any form of arousal.

A concept that is at the interface of assessing parents' mentalizing stance but also their behavioral communication toward the child is mind-mindedness (Meins, 1997; Sharp & Fonagy, 2008; Zeegers et al., 2017). Mind-mindedness is defined as parents' tendency to treat their infant as a mental agent. A way to assess parents' mind-mindedness is by measuring their appropriate or nonattuned comments about their infant's putative internal mental states, typically during a free-play session (Meins, 1997; Meins et al., 2001). The appropriate and nonattuned indices demonstrate two dimensions of mind-mindedness that appear to be unassociated with each other (Meins et al., 2003, 2012). Appropriate mind-related comments indicate attunement to and validation of the infant's internal state. Nonattuned comments indicate the extent to which misinterpretations of the infant's state arise as a result of parents projecting their own state of mind or imposing their own agenda on the infant (Meins, 2013). Greater mind-mindedness is indexed by high levels of appropriate mind-related comments or low levels of nonattuned mind-related comments.

Next to being an indicator of parents' mentalizing tendency, mind-mindedness also reflects parents' behavioral tendency to put a verbal and appropriate mind-related label on their child's behavior on a regular basis. This means that mind-minded parents connect their child's behavior and associated physiological arousal by verbally categorizing the child's behavior in terms of putative mental states. The child, in turn, is provided with frequent opportunities to adopt these verbal categories and to start using them to organize their own internal experience, thereby supporting the development of cognitive strategies that enable children to communicate about and deal with internal arousal (Vallotton & Ayoub, 2011). Indeed, maternal mental state talk at 15 and 24 months has been previously shown to predict children's use of mental state talk at 24 and 33 months (Taumoepeau & Ruffman, 2006, 2008), suggesting that parents' tendency to use mind-related language is adopted by their young children. Furthermore, previous experimental studies indicated that verbal labels help infants categorize already before the age of 10 months. For example, 10-month-old infants use words (and not tones, sounds or facial expressions) as cues for appreciating which objects in the world are similar and distinct (Dewar & Xu, 2009; Xu, 2002). Although this has not yet been investigated directly, it has been proposed that labeling of mental states may be a meaningful cue for helping infants and young children understand mental state categories and apply those categories to their own internal experiences and observations (Lindquist et al., 2015).

So far, a few studies considered the role of mind-mindedness in the development of infants' and toddlers' self-regulation. In a study across infants' first year of life, mothers' appropriate mind-related comments at 4 and 12 months predicted the increase in infants' physiological self-regulation indexed as baseline HRV from 4 to 12 months (Zeegers et al., 2018). Mothers' nonattuned comments predicted lower baseline HRV and more HRV reactivity at 12 months. Similar but concurrent relations were found for fathers' appropriate and nonattuned mind-related comments and infants' HRV at 12 months. In another study, maternal sensitivity and mind-mindedness at 12 to 15 months predicted executive functioning in toddlers (Bernier et al., 2010). Specifically, children whose mothers were more mind-minded when they were 12 months old performed better on a working memory task at 18 months, after accounting for children's score on the Mental Development Index of the Bayley Scales of Infant Development. Similarly, maternal mind-mindedness at 9 months was found to predict children's inhibitory control at 2 and 3 years (Cheng et al., 2018). In a study on paternal mind-mindedness, fathers' appropriate mind-related comments were positively related to 3-year-old's inhibitory control, after accounting for the contribution of children's social fearfulness (Gagné et al., 2018). Lastly, more mind-related descriptions of mothers about their 2-year-olds during a describe-your-child interview was related to better performance on a delay-of-gratification task 6 months later (Senehi et al., 2018). There was no association between maternal mind-mindedness and maternal report of their toddlers' effortful control. Altogether, these results suggest that the mind-mindedness of different attachment figures (mothers and fathers) is associated with emerging self-regulation abilities during infancy and toddlerhood. However, we do not know yet whether mind-mindedness during infancy and toddlerhood predicts behavioral and physiological self-regulation in preschoolers, when individual differences in self-regulation become relatively stable and when self-regulation becomes especially important as some form of schooling starts.

The Present Study

In the present study, we tested whether mothers' and fathers' mind-mindedness during infancy and toddlerhood uniquely predict self-regulation of preschoolers. We had two main hypotheses. First, we hypothesized that children whose parents produced more appropriate mind-related comments about their child's internal states when the child was 12 and 30 months old would have better self-regulation at the age of 4 1/2 years—higher temperamental effortful control, higher behavioral self-regulation, and higher physiological self-regulation indexed as higher baseline HRV. Second, we hypothesized that children of parents who made more nonattuned comments about their child's internal states when the child was 12 and 30 months old would have lower self-regulation at the age of 4 1/2 years—lower temperamental effortful control, lower behavioral self-regulation, and lower physiological self-regulation indexed as lower baseline HRV.

We assessed mind-mindedness at two time-points: when children were 12 and 30 months old. Although typical observations of mind-mindedness are conducted around the age of 8 to 12 months when

infants are not able to produce words and sentences themselves (Meins & Fernyhough, 2015), we assessed parental mind-mindedness in toddlerhood as well. As mentioned above, mind-mindedness reflects parents' mentalizing tendency but also their tendency to put a mind-related verbal label on their child's behavior on a regular basis. This means that mind-mindedness may impact children's understanding and use of mind-related speech during toddlerhood (Bartsch & Wellman, 1995; Grazzani et al., 2016), which is important for developing self-regulation. A previous study showed that caregivers' mind-related comments at 12 months, but also at 30 months predicted important child's outcomes, such as preschoolers' externalizing behavior and social competence (Colonnesi et al., 2019), suggesting that mind-mindedness beyond infancy may continue to affect the developing child.

Since most children grow up with multiple primary caregivers, children likely assimilate the internal state representations of more than one caregiver. In this study, we considered whether the mind-mindedness of a mother and father showed unique effects on their children's self-regulation development. We hypothesized that fathers' and mothers' mind-mindedness would independently predict children's self-regulation. Fathers' communication style with their children seems to be generally more active, adventurous, unpredictable, emotionally arousing than mothers' communication style (Bögels & Perotti, 2011; Bögels & Phares, 2008; Möller et al., 2013). Especially because paternal play may evoke relatively more arousal than maternal play, fathers' understanding of, and reactions to, their child's emotional expressions may also be important in understanding how children embody ways to deal with arousal-evoking situations (Lamb, 2000; Martins et al., 2016). Two previous studies already demonstrated that paternal and maternal mind-mindedness can be related to infant physiological regulation indexed as HRV at 12 months (Gagné et al., 2018; Zeegers et al., 2018). In the present study we examined, for the first time, whether the effects of parents' mind-mindedness during infancy and toddlerhood extend to children's self-regulation indexed through behavioral and physiological indices at preschool age.

Method

Participants

The sample consisted of 125 families with the firstborn child (70 girls and 55 boys) participating in a larger longitudinal study. Couples expecting their first child were recruited through advertisements in magazines and flyers distributed by midwives in and around Amsterdam, The Netherlands. Families were excluded if the infant's birth weight was under 2,500 g, if the infant had neurological disorders or an APGAR score below 8. Families received a gift voucher after every measurement. The longitudinal study titled "Social Development from Babies to Young Children" received approval from the Ethics Review Board of the University of Amsterdam (protocol 2014-CDE-3748). We analyzed three measurement waves in the current study: when the children were 12 months (Time 1), 30 months (Time 2), and 4 1/2 years old (Time 3). Families for whom we had data for at least one of these waves were included in the current study. At Time 1, 114 couples with either the mother (n = 2) or the father (n = 4) or both (n = 108) and their firstborns (n = 114, M_{age} child = 11.90 months, SD = .83, 63 girls, 51 boys) participated. At Time 2, 113 couples with either the mother (n = 5) or father (n = 3) or both (105) participated with their toddlers (n = 113, M_{age} child = 29.87 months, SD = 1.31, 62 girls and 51 boys). At Time 3 when we assessed children's self-regulation, 117 couples participated with their children (n = 117, M_{age} child = 4.49 years, SD = .11, 64 girls and 53 boys). Of the 114 couples at time 1, 108 couples were included at Time 2. In addition, five couples were included at Time 2 who were not present at Time 1. At Time 3, 111 couples present either at Time 1 or 2 were included and, in addition, six couples who were not present at either Time 1 or 2 were included. Attrition was mainly due to couples indicating that they did not have enough time to participate in the study.

The mean age of mothers at Time 1 was 31.45 years (SD = 4.18) and the mean age of fathers was 34.24 years (SD = 5.53). The majority of the parents were Dutch and White. At Time 1, the mean educational level of parents was fairly high, M = 7.07, SD = 1.13 for mothers, and M = 6.61, SD = 1.58 for fathers (on a scale from 1 = *primary education* to 8 = *university degree*). Most parents obtained a college or university degree (67% of mothers and 52% of fathers). Most mothers (76%) and fathers (82%) were employed, and worked full or part time. On weekdays at the infants' age of 12 months (Monday to Friday), 34% of the infants were cared for by their mother, 11% were cared for by their father, and 55% were in nonparental care. On weekend days at 12 months, 11% of the infants were cared for by their mother, 5% by their father, and 82% of the couples reported that they both took care of the infant at the weekend.

Power Analyses

Although we ran structural equation models, we opted for fully saturated models (df = 0) with a perfect model fit and, thus, we were not interested in power to detect a misspecified model but rather, we were interested in power to detect target effects, that is, regression coefficients from predictors to outcomes (Wang & Rhemtulla, 2021). As we also did not model any latent but only observed variables, we used power calculations for general linear models to calculate the needed sample size to detect target effects of interest using the package pwr (Champely, 2018) in R: A language and environment for statistical computing (R Core Team, 2013). We had four predictors predicting three outcomes resulting in 12 parameter estimates of interest. To detect medium effects with power of .80, we needed a sample size of 122. Our sample size of 125 was, thus, adequate to detect medium effects.

Measures

Mind-Mindedness

At 12 and 30 months, parental mind-mindedness was assessed during a 10-minute free-play sessions at the university research lab. Parents were asked to play with their child as they would usually do. The parent and child were seated on a play mat with pillows and received a box with age-appropriate toys. After 5 minutes the toys were removed and the parent and child continued their play without toys for another 5 minutes.

The free-play sessions were recorded. Two trained observers transcribed and coded each comment made by the parent (i.e.,

each spoken word or sentence) using a translated version of the mind-mindedness coding manual (Meins & Fernyhough, 2015; Zeegers & Colonnesi, 2016). First, each parent comment was classified as either directed at the child's mental state or not (i.e., mind-related or not mind-related). The mind-related comments were categorized according to the specific state the parent referred to. Categories were cognitions (e.g., "you remembered this from the zoo"), likes and dislikes (e.g., "you do not like this rattle"), and emotions (e.g., "you're all excited to play with these toys"). Also, comments about infants' epistemic states (i.e., "are you teasing me?") and comments that were clearly meant to be dialogue said/thought by the infant (e.g., "Daddy, I want you to pick me up") were also classified as mind-related.

Second, each comment in one of the above categories was coded as an appropriate mind-related comment if one or more of the following conditions were met: (a) the trained coder agreed with the parent's reading of the infant's internal state, (b) the internal state comment linked the infant's current activity with similar events in the past or future (e.g., "do you remember which sound a cow makes from when we went to the petting zoo?"), or (c) the parent voiced (using the first person) what the child could have said if he or she could speak. Comments were classified as nonattuned when the independent coder believed (a) the parent misread the internal state of the child, or (b) the comment referred to a past or future event that had no obvious relation to the infant's current activity (e.g., "I'm sure you would like to feed the ducks later"). After categorizing each comment, proportions of mind-related were calculated ([number of appropriate or nonattuned mind-related comments/total number of comments]*100; Meins & Fernyhough, 2015).

Before all transcripts were coded, interrater agreement was assessed on 73 out of 480 transcripts (15%). First, we assessed the interrater agreement on the number of mind-related comments using intraclass correlations (ICC; two-way random effects model with an absolute agreement definition). Interrater agreement was high: at 12 months ICC_{father} = .84, ICC_{mother} = .84, and at 30 months ICC_{father} = .86, ICC_{mother} = .86. Next, we assessed the interrater agreement on the appropriateness of mind-related comments by calculating Cohen's Kappa. Interrater agreement was high: at 12 months κ_{father} = .92; κ_{mother} = .88, and at 30 months: κ_{mother} = .79; κ_{father} = .82. Disagreements within the 73 double-coded transcripts were resolved by discussion to further improve the coding of the remaining transcripts. We did not calculate interrater agreement on parsing parents' speech into separate comments in the transcript.

Because we assumed that mind-mindedness is a relatively stable trait of parents, we created a composite score of mind-mindedness at 12 and 30 months by converting the raw scores into *z*-scores and then computing an mean of the scores at 12 and 30 months for mothers and fathers separately. Appropriate mind-related comments of mothers and nonattuned mind-related comments of fathers were found to be relatively stable across time: $r(101) = .29$ $p = .003$ and $r(100) = .21$, $p = .039$, respectively. However, nonattuned mind-related comments of mothers and appropriate mind-related comments of fathers were not stable, $r(101) = .05$ $p = .587$ and $r(100) = .09$, $p = .382$, respectively. Because we wanted to test the effect of parental mind-mindedness in the first few years of child development without specific hypotheses about the exact time points in which mind-mindedness is most relevant (based, among others, on the study of Colonnesi et al., 2019 showing that parental mind-mindedness both in infancy and toddlerhood matters for children's socioemotional development) and in order to maximize power for detecting medium-size effects in our analyses, we decided to keep the mean composite scores of mothers' and fathers' mind-mindedness. However, because some aspects of mind-mindedness were not stable across child development, in the sensitivity analyses, we repeated our analyses with separate scores for 12 and 30 months.

Heart Rate Variability

When children visited the lab at 4 1/2 years, they were asked to read a child magazine for 2 minutes during which heart rate was recorded as a baseline measurement. Heart rate variability was calculated and analyzed with Vsrrp98 software (Molenkamp, 2011). Data acquisition in the program was performed by a National Instruments NI6224 data acquisition card sampling at a rate of 200S/s per channel. A standard Lead-II configuration was used to record ECG. In Vsrrp98, R-waves were identified and adjusted for artefacts. HRV was calculated as the square root of the mean squared differences (RMSSD) of successive normal-to-normal (NN) intervals (Task Force of the European Society of Cardiology & the North American Society of Pacing and Electrophysiology, 1996). The mean value of HRV during the 2-minute baseline was used as an index of physiological self-regulation (e.g., Holzman & Bridgett, 2017; Segerstrom & Nes, 2007). The same measurement was taken when children were 12 months and this measure was used as a covariate, in addition to HRV at 4 1/2 years, in the analyses presented in the online supplemental material.

Effortful Control

The Children's Behavior Questionnaire (CBQ; Rothbart et al., 2001), filled out by fathers and mothers at 4 1/2 years, was used to assess parents' perceptions of the child's effortful control. The complete CBQ measures parents' perceptions of child temperament and consists of 15 scales. We created an Effortful Control Index by summing children's scores on two subscales, Inhibitory Control and Attentional Focusing. The subscale Inhibitory Control contains questions about the child's capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations. The Attentional Focusing subscale contains questions about the child's tendency to maintain attentional focus upon task-related aspects. These two subscales are considered the two most theoretically and empirically salient components of effortful control (Eisenberg et al., 2003; Posner & Rothbart, 2000). Reliability was sufficient for Inhibitory Control, Cronbach's alpha $\alpha = .71$ for mothers, $\alpha = .63$ for fathers, and for Attentional focusing $\alpha = .79$ for mothers and $\alpha = .78$ for fathers. Maternal and paternal reported Effortful Control scores correlated significantly ($r = .46$, $p < .001$) and were averaged to generate a composite measure at 4 1/2 years. For six cases only one parent reported on effortful control. In these cases, we used the reports from one parent only.

At the age of 12 months, temperamental regulation was measured with mothers' and fathers' reports on the Orienting/Regulation scale of the Infant Behavior Questionnaire–Revised (IBQ-R; Gartstein & Rothbart, 2003). The complete IBQ-R measures parents' perceptions of their infants' temperament and consists of 14 scales. We created an early Regulation score by averaging children's scores on the scales Cuddliness, Duration of Orienting,

Low Intensity Pleasure, and Soothability (following Gartstein & Rothbart, 2003). Reliability was good for Cuddliness (Cronbach's α = .87 for mothers and α = .82 for fathers), Duration of Orienting (α = .81 for mothers and α = .83 for fathers), Low Intensity Pleasure (α = .78 for mothers and α = .86 for fathers), and Soothability (α = .86 for mothers and .82 for fathers). Maternal and paternal reported Regulation scores correlated significantly (r = .34, $p <$ .001) and were averaged to generate a composite measure at 12 months. This measure was used as a covariate in the models presented in the online supplemental material.

Behavioral Self-Regulation

At 4 1/2 years of age Kochanska's Dinky toys task was administered at the lab visit to observe children's behavioral ability to inhibit a dominant response and activate a subdominant response (Kochanska et al., 1996). The child was asked to place their hands on a mat on the table while choosing on prize from (a) a box filled with small toys, and (b) a box filled with candies. The child was then asked to tell the experimenter which toy or candy he or she wanted without touching or pointing to the toy or candy and to keep his or her hand on the mat. Scoring was based on the child's latency to choose the toy/candy and the behavioral strategy. For each trial (toy and candy) a latency score was created by averaging the following latencies: (a) latency to remove hand from mat, (b) latency to touching the toy/candy, and (c) latency to choosing the toy/candy. The child's behavioral strategy was scored from 0 to 5, with 0 = *grabs toy/candy out of container;* 1 = *touches toy/candy but does not take out*; 2 = *points to toy/candy*; 3 = *removes hands from mat*; 4 = *moves hands but on the designated mat*; 5 = *keeps hands on the mat and remains calm*. For each of the two trials, the standardized latency score and behavioral strategy score were averaged. The scores in the two trials were highly correlated, r = .69, $p <$ .001, and were averaged into a single score of behavioral self-regulation at 4 1/2 years.

Statistical Analyses

The study variables were checked for distribution and outliers. The associations between the study variables were tested using Pearson's correlation coefficients. For the main analyses, path models were assessed using structural equation modeling (AMOS, 23.0, IBM SPSS, Version 22). Because all possible paths were examined in this model, the model was fully saturated, and fit indices are not informative (Kline, 2015). Missing data were handled using the full information maximum likelihood (FIML; Arbuckle et al., 1996) method. The FIML method obtains maximum use of the data, without substituting an actual value for missing data points or deleting cases with missing data points (Kline, 2015). Instead, parameter values are estimated that are most likely to have resulted in the observed sample data. Thus, the data of the whole sample were used for the models in the main analyses.

Transparency and Openness

We reported how we determined our sample size, all data exclusions, and all measures in the study. All data and analysis code are available on OSF (Nikolić et al., 2022): https://osf.io/3x2mq/?view_only=07ca017989e34ac89331c31d355cea47. Data were analyzed using AMOS 23.0, in IBM SPSS, Version 22. This study's design and its analyses were not preregistered.

Results

Preliminary Analyses

Of the participating families, data on mind-mindedness at 12 and 30 months was available for 119 couples (116 with both mothers and fathers, one only with mother, and two only with father). Missing scores on mind-mindedness were due to parents speaking a foreign language during the interaction that we did not master (e.g., Japanese), and technical problems. At 4 1/2 years, data on children's effortful control was available for 110 (questionnaire) and 109 (task) children. Valid data on baseline HRV were available for 88 children. Missing data on HRV was due to movement artifacts, technical problems, or the child rejecting to be assessed with the physiological equipment. In total, we had at least one self-regulation measure for 117 children. We conducted t-tests to examine whether infants with (n = 8) and without missing data (n = 117) had parents with different levels of mind-mindedness and different demographic characteristics. These t-tests and chi-square tests showed nonsignificant results (all p-values $>$ .075). We also performed Little's MCAR test to check the assumption that data were missing completely at random. The test was nonsignificant suggesting that the pattern of missing values did not significantly deviate from a missing-completely-at-random pattern, $\chi^2(50) = 67.00$, p = .054.

We examined the distribution of the outcome variables, which were normally distributed. The distribution of nonattuned mind-mindedness was skewed because approximately 41.6% of the fathers and 48.1% of the mothers did not make any nonattuned comments at 12 and 30 months. Logarithm and square-root transformations of the variables did not improve the distribution. We ran the analyses with the untransformed variables. There were two outlying scores ($>$ |3.29| *SD*s) on the effortful control (Dinky toy) task. Detected outliers in the outcome variable were Winsorized by modifying their values to the closest observed values in the range of $<$ 3.29 *SD*s (Keselman et al., 2008, as cited in Tabachnick & Fidell, 2014).

Descriptives statistics and zero-order correlations for all study variables are presented in Table 1 and Table 2. There were no significant differences between boys and girls on any of the study variables (all *p*s $>$ .122), thus, sex was not included in the following analyses.

Main Analyses

We tested whether mothers' and fathers' appropriate and nonattuned mind-related comments averaged across 12 and 30 months predicted children's self-regulation indexed through physiological self-regulation, effortful control, and behavioral self-regulation at 4 1/2 years. Figure 1 displays the standardized path coefficients of this model. Table 3 presents the unstandardized coefficients, standard errors, and p-values of the models. Fathers' appropriate mind-related comments predicted children's higher levels of temperamental effortful control, β = .19, p = .030 and higher levels of behavioral self-regulation during the Dinky toy task, β = .28, p = .004. Other paths from parental

Table 1
Descriptive Statistics

Measured variable	*N*	*M* (*SD*) %	Range
Parents			
Mothers' appropriate MRC (12 and 30 months)	117	4.37 (2.35)	0–13
Fathers' appropriate MRC (12 and 30 months)	118	4.65 (2.42)	0–12
Mothers' nonattuned MRC (12 and 30 months)	117	0.32 (0.45)	0–3
Fathers' nonattuned MRC (12 and 30 months)	118	0.60 (0.95)	0–6
Children			
Physiological self-regulation at 4 1/2 years	88	41.64 (20.83)	9.22–104.97
Behavioral self-regulation at 4 1/2 years	109	−.001 (0.67)	−1.26–2.19
Temperamental effortful control at 4 1/2 years	110	4.81 (0.72)	2.75–6.00

Note. MRC = mind-related comments.

appropriate mind-related comments, including fathers' appropriate mind-related comments to physiological self-regulation and all paths from mothers' appropriate mind-related comments to children's self-regulation were not significant. Regarding parental nonattuned mind-related comments averaged across 12 and 30 months predicting children's self-regulation at 4 1/2 years, we found that paternal nonattuned mind-related comments predicted lower baseline HRV at 4 1/2 years, $\beta = -.24$, $p = .022$. Maternal and paternal nonattuned mind-related comments predicted lower ratings of children's temperamental effortful control, for mothers $\beta = -.33$, $p < .001$, and for fathers $\beta = -.23$, $p = .010$. Maternal and paternal nonattuned mind-related comments did not significantly predict children's behavioral self-regulation during the Dinky toys task.

Exploratory Analyses

To explore the developmental timing of the effect of maternal and paternal mind-mindedness on children's self-regulation, we reran the main models with appropriate and nonattuned mind-related comments of mothers and fathers at 12 and 30 months separately (instead of with the mean composite of 12 and 30 months) as some of these constructs were not stable over time. Importantly, we ran separate models for appropriate and nonattuned mind-related comments so to maintain power to detect medium effect sizes. We chose to model mothers' and fathers' mind-related comments together because this allowed us to investigate the unique contribution of each parent's mind-mindedness to their children's self-regulation. That is, we could investigate the impact of one parent given the impact of the other parent. Also, mothers' and fathers' mind-related comments were significantly correlated with each other and modeling them in one model allowed us to account for this. The results of these models are presented in Table 4 and Table 5. In the model with mothers' and fathers' appropriate mind-related comments at 12 and 30 months, fathers' appropriate mind-related comments at 30 months predicted children's higher levels of behavioral self-regulation but not temperamental effortful control. In the model with mothers' and fathers' nonattuned mind-related comments, fathers' nonattuned mind-related comments at 12 months predicted children's lower physiological self-regulation. In addition, both mothers' and fathers' nonattuned mind-related comments at 30 months predicted lower ratings of children's temperamental effortful control. These analyses demonstrated that most of the significant associations found in the main model remained significant. The only association that was not replicated was the contribution of fathers' appropriate mind-related comments to children's temperamental effortful control. In addition, these analyses revealed at which point in child development parental mind-mindedness matters for children's self-regulation —seemingly more so at 30 than at 12 months for temperamental effortful control and behavioral self-regulation and more so at 12 than at 30 months for physiological self-regulation.

Sensitivity Analyses

To check the robustness of our main analyses, we reran our models taking into account different analytical approaches. The results of these analyses are presented in the online supplemental materials.

First, we reran our exploratory models with appropriate and nonattuned mind-related comments measured at 12 and 30 months for mothers and fathers separately. The results of these models are presented in Table S1 for mothers and Table S2 for fathers (in the online supplemental material). These analyses showed that all the significant effects remained significant. In addition, new significant

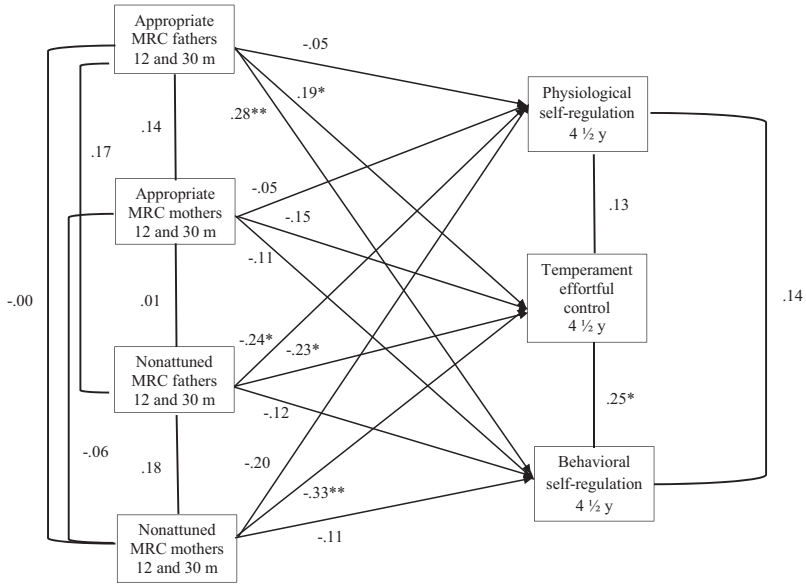
Table 2
Correlations Between Parental Mind-Mindedness and Children's Self-Regulation

Measured variable	1	2	3	4	5	6
1. Mothers' appropriate MRC (12 and 30 months)						
2. Fathers' appropriate MRC (12 and 30 months)	.14					
3. Mothers' nonattuned MRC (12 and 30 months)	−.07	.00				
4. Fathers' nonattuned MRC (12 and 30 months)	.01	.17	.17			
5. Physiological self-regulation at 4 1/2 years	−.06	−.13	−.24*	−.30*		
6. Behavioral self-regulation at 4 1/2 years	−.08	.21*	−.05	−.08	.17	
7. Effortful control (CBQ) at 4 1/2 years	−.08	.10	−.27**	−.24*	.25*	.31**

Note. MRC = mind-related comments; CBQ = Children's Behavior Questionnaire.
* $p < .050$. ** $p < .010$.

Figure 1

Path Model With Standardized Coefficients of Maternal and Paternal Appropriate Mind-Mindedness Averaged Across 12 and 30 Months Predicting Children's Self-Regulation at 4 1/2 Years



Note. Outcomes are modeled as endogenous variables and the correlation between their errors was modeled. MRC = mind-related comments.
* $p < .050$. ** $p < .010$.

effects occurred: maternal nonattuned mind-related comments at 30 months predicted children's lower physiological self-regulation. Also, next to the significant effect of maternal nonattuned mind-related comments at 30 months on children's lower temperamental effortful control, the effect of maternal appropriate mind-related comments at 12 months also became significant and predicted children's lower physiological self-regulation.

Second, because we know that parental mind-mindedness influences self-regulation already in infancy (Zeegers et al., 2018), we also reran the main analyses controlling for indices of self-regulation in infancy. In these models we added basal HRV and early indices of temperamental self-regulation (i.e., the Orienting/Regulation scale of the Infant Behavior Questionnaire–Revised, Gartstein & Rothbart, 2003) reported by their parents when children were 12 months old. Behavioral self-regulation with a Dinky toy task is typically not measured this early in child development, and thus, we did not measure it at this age in the current study. All the results remained after controlling for baseline HRV and early indices of temperamental self-regulation at 12 months (for details, see online supplemental material Table S3 and S4). In addition, a significant effect for maternal nonattuned mind-related comments predicting lower physiological self-regulation occurred.

Finally, to check the joint influence of mothers' and fathers' mind-related comments (i.e., whether the effects of one parent's mind-related comments on children's self-regulation depend on the percent of mind-related comments of the other parent), we reran the analyses adding an interaction term between mothers' and fathers' mind-related comments, separately for the models with appropriate and nonattuned mind-related comments. In both models, the interaction between mothers' and fathers' appropriate/nonattuned mind-related comments did not significantly predict

Table 3

Unstandardized Parameters for Mothers' and Fathers' Appropriate and Nonattuned Mind-Related Comments Predicting Child Self-Regulation

	Physiological self-regulation at 4 1/2 years		Temperamental effortful control at 4 1/2 years		Behavioral self-regulation at 4 1/2 years	
Predictors	*B* (*SE*)	*p*	*B* (*SE*)	*p*	*B* (*SE*)	*p*
Mothers' appropriate MRC (12 and 30 months)	−1.35 (2.61)	.604	−0.14 (0.08)	.091	−0.09 (0.08)	.238
Fathers' appropriate MRC (12 and 30 months)	−1.35 (2.58)	.600	0.17 (0.08)	.030	0.23 (0.08)	.004
Mothers' nonattuned MRC (12 and 30 months)	−5.06 (2.60)	.051	−.30 (0.08)	<.001	−.09 (0.08)	.242
Fathers' nonattuned MRC (12 and 30 months)	−5.66 (2.47)	.022	−.20 (0.08)	.010	−.09 (0.07)	.205

Note. MRC = mind-related comments.

Table 4
Unstandardized and Standardized Parameters for Mothers' and Fathers' Appropriate Mind-Related Comments at 12 and 30 Months Predicting Child Self-Regulation

Predictors	Physiological self-regulation at 4 1/2 years			Temperamental effortful control at 4 1/2 years			Behavioral self-regulation at 4 1/2 years		
	B (*SE*)	β	*p*	*B* (*SE*)	β	*p*	*B* (*SE*)	β	*p*
Mothers' appropriate MRC 12 months	5.19 (7.38)	.08	.482	−4.75 (2.35)	−.21	.044	−0.91 (2.16)	−.04	.673
Fathers' appropriate MRC 12 months	0.94 (6.55)	.02	.886	2.17 (2.11)	.10	.303	2.03 (1.92)	.11	.292
Mothers' appropriate MRC 30 months	−8.90 (10.25)	−.10	.386	0.43 (3.30)	.01	.896	−2.33 (2.99)	−.08	.435
Fathers' appropriate MRC 30 months	−15.01 (10.67)	−.15	.159	−0.03 (3.43)	−.00	.993	6.60 (3.10)	.21	.033

Note. MRC = mind-related comments.

any of the self-regulation indices of the child (for details, see online supplemental material, Tables S5 and S6).

Discussion

Here, we aimed to investigate the unique role of mothers' and fathers' mind-mindedness in preschool-aged children's self-regulation. We found that higher levels of fathers' appropriate mind-related comments in infancy and toddlerhood predicted children's better temperamental effortful control and behavioral self-regulation at preschool age. Furthermore, we found that both for mothers and fathers, higher levels of nonattuned mind-related comments in infancy and toddlerhood predicted children's lower physiological self-regulation and temperamental effortful control at the preschool age. The findings were robust and held after controlling for indices of self-regulation in infancy. This suggests that parents, with their use of appropriate or nonattuned mind-related comments in the first years of their child's life, may improve or worsen their children's self-regulation.

As expected, parents' appropriate mind-related comments predicted higher child self-regulation and nonattuned mind-related comments predicted lower child self-regulation. This is in line with accumulating evidence that parental mind-mindedness contributes to children's various abilities reflecting self-regulation, such as regulating physiological arousal (Zeegers et al., 2018), executive functioning (Bernier et al., 2010), inhibitory control (Cheng et al., 2018; Gagné et al., 2018), and delay of gratification (Senehi et al., 2018). Our study adds to this line of evidence by showing the unique contributions of mothers' and fathers' mind-related comments in infancy and toddlerhood on different aspects of self-regulation (physiological and behavioral self-regulation, and temperamental effortful control) at preschool age.

Contrary to our expectations, we found that only paternal but not maternal appropriate mind-related comments predicted better self-regulation in preschoolers, and more specifically behavioral aspects of self-regulation and temperamental effortful control, although the latter was not robust. As expected, both mothers' and fathers' nonattuned mind-related comments predicted lower self-regulation, specifically physiological self-regulation (although the results for mothers were less robust) and temperamental effortful control. First of all, these results underline the importance of fathers' mind-reading abilities and suggest that fathers' level of mind-mindedness could positively as well as negatively influence their child's self-regulation, depending on how often and how accurate fathers read their child's mind. We did not find robust evidence that mothers' ability to read their child's mind appropriately helps children better self-regulate at preschool age. It is possible that mothers' appropriate reading of their children's minds has an important role in children's self-regulation early on, in infancy. Our previous findings from the same longitudinal study indeed found that mothers' appropriate mind-related comments at 4 months predicted higher baseline HRV of 12-month-old infants (Zeegers et al., 2018). It may be that once this early influence of mothers' mind-mindedness on infants' self-regulation is established, mothers' appropriate mind-mindedness does not further influence the development of children's self-regulation beyond infancy.

Fathers' appropriate mind-related comments were not as stable from infancy to toddlerhood as mothers' appropriate mind-related comments. For some father-child dyads, the quality of their relationship may change later in child development due to several reasons (e.g., typical division of caregiving role, maternity leave, breastfeeding, see also Zeegers et al., 2018). It may be, thus, that for these fathers, appropriate mind-related comments become important for their children's outcomes only later in child development, when their mind-mindedness becomes stable. Similar effects have been reported in a study that found that fathers' appropriate mind-related comments

Table 5
Unstandardized and Standardized Parameters for Mothers' and Fathers' Nonattuned Mind-Related Comments at 12 and 30 Month Predicting Child Self-Regulation

Predictors	Physiological self-regulation at 4 1/2 years			Temperamental effortful control at 4 1/2 years			Behavioral self-regulation at 4 1/2 years		
	B (*SE*)	β	*p*	*B* (*SE*)	β	*p*	*B* (*SE*)	β	*p*
Mothers' nonattuned MRC 12 months	−34.68 (35.29)	−.10	.326	−15.58 (10.76)	−.13	.148	−12.64 (10.96)	−.12	.249
Fathers' nonattuned MRC 12 months	−39.06 (17.08)	−.24	.022	−3.61 (5.27)	−.06	.493	−8.17 (5.32)	−.16	.125
Mothers' nonattuned MRC 30 months	−54.00 (48.62)	−.12	.267	−35.61 (14.86)	−.23	.017	2.17 (15.02)	.02	.885
Fathers' nonattuned MRC 30 months	−32.46 (35.73)	−.10	.364	−37.64 (10.84)	−.32	<.001	4.31 (11.00)	.04	.695

Note. MRC = mind-related comments.

in toddlerhood predicted children's behavioral problems at preschool age, suggesting that fathers' mind-mindedness indeed, has an important role later in child development (Colonnesi et al., 2019).

Our results taken together with the previous study on fathers' and mothers' mind-mindedness and children's self-regulation in infancy (Zeegers et al., 2018) suggest that mothers and fathers both influence the development of their child's self-regulatory abilities, but they do so at different child ages—mothers at a younger age than fathers. This might have to do with the developmental stage and accompanying needs of the child that differ throughout childhood. Research shows that mothers and fathers, in general, have different interaction styles with their young children (i.e., calm/predictable vs. active/stimulating; Möller et al., 2013). In early infancy, a major goal regarding self-regulation is that the nervous system develops a way to organize basic sensory stimuli in the environment (e.g., Lickliter, 2011). This means that infants may benefit the most from caregivers who keep them from being overaroused by being calm, predictable and aware of overstimulation. In toddlerhood and preschool, good self-regulation requires the child to learn that demands and wishes cannot always be readily met, such as wanting to touch a present that the child just received. To inhibit behavior, preschoolers need to be able to down-regulate their feelings of excitement and curiosity. It may be that caregivers who cause excitement and emotional arousal, and are relatively more unpredictable, impact this particular ability to a larger extent. Hence, having a parent who evokes but also frequently notices a child's positive or negative arousal during play may particularly affect self-regulation in toddlerhood and preschool. Since we know from research on paternal caregiving styles that fathers (in general) have a more active, arousal-evoking interaction style (Möller et al., 2013), this might tentatively explain our findings concerning paternal appropriate mind-related comments.

Regarding different indices of self-regulation, parents' appropriate mind-related comments predicted better temperamental effortful control and behavioral self-regulation. In contrast, parents' nonattuned mind-related comments predicted lower physiological self-regulation and temperamental effortful control. Although we found that physiological self-regulation, temperamental effortful control, and behavioral self-regulation are associated with each other, each of these indices reflect unique capacities of self-regulation. This may be the reason as to why appropriate mind-related comments might be related to one and nonattuned mind-related comments to other measures of self-regulation. Unlike physiological self-regulation, which begins to develop in infancy but is unconscious and automatic (i.e., bottom-up processes; Nigg, 2013), behavioral self-regulation requires the child to suppress a dominant behavior and to perform, instead of it, a subdominant behavior (Kochanska et al., 2000). To do so, the child needs to intentionally delay their action and comply with the rules (Nigg, 2013). This ability is known to develop later in child development, during toddlerhood and early childhood years (Kochanska et al., 2001). It seems that reflecting appropriately upon the child's mind, especially when done by the father, supports this top-down intentional and conscious self-regulation of the child, which allows them to comply with social rules and expectations. It is likely, thus, that a mentalizing father, who appropriately reads and comments on a wide range of children's thoughts, wishes, and emotions provides his child with an opportunity to learn about the self and their own mind, which can help the child organize and regulate their internal states intentionally. A similar finding that fathers' appropriate mind-related comments influence children's intentional behavioral self-regulation has been reported before (Gagné et al., 2018).

Also, these results may appear because appropriate and nonattuned mind-related comments reflect two orthogonal dimensions (Meins et al., 2003, 2012). The results of this study indeed underline that the frequency and accuracy of mind-related comments seem to reflect unique dimensions of mentalizing as they influence different child outcomes, and should be incorporated both when predicting children's development.

We found that high levels of nonattuned mind-mindedness of mothers and fathers are related to lower child self-regulation indexed through baseline HRV and temperamental effortful control. The effect of mothers' nonattuned mind-mindedness on physiological self-regulation was not robust as it did not hold in all analyses. Both physiological self-regulation and temperamental effortful control involve an unintentional, biologically based capacity for self-regulation, which may, as our results indicate, worsen with time when parents constantly misinterpret children's mental states. It seems, thus, that parental nonattuned mind-related comments pose risk to children's healthy socioemotional development. This is in line with findings that showed that parental nonattuned mind-related comments are related to poorer physiological self-regulation in infancy (Zeegers et al., 2018) and that higher levels of nonattuned mind-related comments contribute to difficulties in child socioemotional development in general. For example, higher levels of nonattuned mind-related comments have been found to predict insecure attachment (Zeegers et al., 2017), lower social competence, and externalizing problems at the preschool age (Colonnesi et al., 2019). Misinterpreting a child's thoughts, wishes, and emotions likely translates into nonattuned attempts to help the child regulate their arousal and behaviors (e.g., Crucianelli et al., 2019). Thus, the child is left with no opportunity to learn from the caregiver how to understand their internal states and organize their behavioral responses. Also, being consistently misinterpreted by an important person, in this case, parent, may be related to frustration, anxiety, or intense emotional responses, which all preclude good self-regulation. These may be the reasons why particularly the presence of nonattuned mind-related comments impedes the development of self-regulation.

Finally, when looking at the developmental timing of the mind-mindedness effects on children's self-regulation, it can be seen that the most effects occurred in toddlerhood, when children were 30 months old. Only for physiological self-regulation did the effects occur at 12 months. We did not have specific a priori hypotheses about the developmental timing of the effects. Nevertheless, it is interesting to note that our results confirm previous findings showing that parental mind-mindedness in the first year of children's life plays an important role in physiological self-regulation (Zeegers et al., 2018) also beyond infancy. Parental mind-mindedness in toddlerhood, however, seems to be more important for preschool children's temperamental effortful control and behavioral self-regulation. It is at the toddlerhood age that conscious and intentional self-regulation starts to develop and it may be that it is most supported by mind-mindedness expressed in the same developmental period.

The present study has several strengths including its focus on a novel question about the influence of parental early mind-mindedness on children's self-regulation at preschool age—the period when self-regulation is expected to become stable across children. Our study also employs a prospective design, multiple measures of self-regulation that capture different regulatory capacities, and includes both mothers and fathers allowing us to test their unique contribution to child

socioemotional development. Importantly, our sensitivity analyses in which we took different approaches to analyze the data showed that the prospective associations found in the main models are robust and are not model-specific. The only result that appeared less robust was the effect of paternal appropriate min-related comments on temperamental effortful control and maternal nonattuned mind-related comments on children's lower physiological regulation as we noted above.

This study is not without limitations. First, our sample mostly consisted of relatively highly educated Dutch White parents with relatively high socioeconomic status, which precludes us from generalizing our findings to families with lower education and socioeconomic status and different cultural backgrounds. It may be that in families with lower socioeconomic status and different cultural backgrounds, mind-mindedness has a different influence on children's self-regulation. For example, past studies have found that mind-mindedness in infancy has the strongest effect on children's later internalizing and externalizing problems (Meins et al., 2013) and educational attainment (Meins et al., 2019) specifically in families from low socioeconomic backgrounds. As these outcomes are related to self-regulation, it can be expected that stronger associations between mind-mindedness and self-regulation would be found in children of parents with low socioeconomic status. Future research should, thus, focus on including families with diverse socioeconomic backgrounds when studying the effects of mind-mindedness on child development. Also, although we used a prospective design, we could not infer causality with our design. To test if parental mind-mindedness causes better or worse self-regulation in children, experimental designs, in which parental mind-mindedness is manipulated, are needed in the future. Finally, although we collected data for both mothers and fathers, the design of our study did not allow us to take into account that mothers and fathers are nested within a family. Thus, we were not able to investigate to what extent the concordance of mind-mindedness within a couple predicts children's self-regulation. Future studies should investigate this important question.

Our findings about the significant role of parental early mind-mindedness for children's later self-regulation bear important implications for clinical practice and parents' daily family functioning. First, interventions and prevention programs for children at high risk for developing problems with self-regulation and consequent psychopathology may focus on training parents to improve their mentalizing related to the child in infancy and toddlerhood. In addition, it would be especially important to reduce nonattuned mind-related comments to the child as our study shows that these negatively affect children's self-regulatory capacities.

In conclusion, this study adds to the accumulating evidence on the importance of parental mind-mindedness in children's socioemotional development. The results of this study extend prior knowledge by showing that early parental mind-mindedness influences different aspects of children's self-regulation at preschool age. Specifically, we found that more appropriate mind-related comments of fathers in infancy and toddlerhood contribute to children's better ability to consciously and intentionally regulate their behaviors according to social rules at preschool age. Nonattuned mind-related comments of both parents contributed to lower capacity to physiologically regulate arousal and to lower temperamental effortful control at preschool age. Considering the important role of parental mind-mindedness in child socioemotional development, efforts to improve parents' capacity to appropriately read their child's mind on a daily basis should be a priority as this may help them in raising mentally healthy children.

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Received November 23, 2021
Revision received June 1, 2022
Accepted June 7, 2022 ■