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Executive functions in early childhood: The role of maternal and paternal parenting practices

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We investigated the association between mothers' and fathers' harsh parenting and sensitive parenting practices and child's executive functions (EF) in early childhood in 607 families. We focused on three broad dimensions of child EF: Emergent metacognition, inhibitory self-control, and flexibility measured with the parent-reported Behavior Rating Inventory of Executive Function-Preschool Version. Less sensitive parenting of the mother and harsher parenting of the father were related to lower scores of emergent metacognition and inhibitory self-control. Parenting was not associated with child flexibility. This study extends previous research on the association between parenting and EF by the focus on the role of the father and demonstrates independent effects of mother and father on child EF.

Executive functions (EF) is an umbrella term for several higher order, self-regulatory functions such as inhibitory control, working memory, planning ability, and attention shifting (Garon, Bryson, & Smith, 2008; Hughes & Ensor, 2009). Normative variation in EF of children is related to various aspects of child functioning such as theory of mind (Hughes & Ensor, 2005), academic achievement (McClelland *et al.*, 2007), social and moral competence (Kochanska, Murray, & Harlan, 2000), and emotion regulation

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(Carlson & Wang, 2007). Therefore, studying the factors that underlie the development of individual differences in child EF is an important target for developmental research (Matte-Gagné & Bernier, 2011). In the current study, we examined the influence of parenting on broad dimensions of EF in a cohort of 607 families, with a focus on both parents.

There is some agreement that the complexity of EF does not support the assumption of a unitary construct (Jurado & Rosselli, 2007). Toplak, West, and Stanovich (2013) conclude in their review that the most typical domains of EF are updating (monitoring and working memory), inhibition (deliberate overriding of dominant responses), and shifting (switching flexibly between tasks or mental sets). Some studies suggest that in *young* children, EF may be best described as a single factor (Fuhs & Day, 2011; Hughes, Ensor, Wilson, & Graham, 2009), while other studies identified distinct domains of EF in young children (Van der Sluis, De Jong, & Van der Leij, 2007; Van der Ven, Kroesbergen, Boom, & Leseman, 2013). EF may develop from a unitary factor very early in life but differentiate during childhood when multiple, separable control processes evolve (Jurado & Rosselli, 2007).

Typically, EF is conceptualized within a biological framework in which the developmental trajectory of EF during child development parallels the development of the prefrontal cortex (Bernier, Carlson, Deschênes, & Matte-Gagné, 2012), which supports cognitive functions necessary to organize behaviour in time and context. EF starts to develop in the first 5 years of life (Huizinga & Smidts, 2010). There is emerging evidence that environmental experiences, like parenting, influence the development of the prefrontal cortex. Thus, early childhood, when children are particularly dependent on their caregivers, is a key period to study parenting influences on child EF (for a review, see Fay-Stammbach, Hawes, & Meredith, 2014).

Sensitivity, defined as the ability to perceive and to interpret accurately the signals implicit in the child's behaviour, and to respond to these signals promptly (Ainsworth, Blehar, Waters, & Wall, 1978), is a key element of parenting. Sensitive parenting is associated with more optimal cognitive, behavioural, and socio-emotional child outcomes (Mesman, Van IJzendoorn, & Bakermans-Kranenburg, 2012; NICHD Early Childcare Research Network (ECCRN), 2004; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). The majority of studies on the influence of sensitivity on young children's cognitive development focused exclusively on mothers (Martin, Ryan, & Brooks-Gunn, 2007). Little attention has been paid to the independent effects of mother's *and* father's parenting while there is evidence that father's positive parenting predicts better cognitive outcomes controlling for mother's positive parenting (Kelley, Smith, Green, Berndt, & Rogers, 1998; Tamis-LeMonda *et al.*, 2004). It is suggested that independent father effects can also be found in the association between negative parenting and child cognitive development. Harsh discipline, which refers to coercive acts and negative emotional expressions directed towards children (Chang, Schwartz, Dodge, & McBride-Chang, 2003), is an almost universal negative parenting practice (Straus & Field, 2003). Previous studies have shown that harsh parenting is related to child EF problems (Glaser, 2000); however, effect sizes might vary by parent gender (McKee *et al.*, 2007).

To our knowledge, only a few studies examined the association of maternal and paternal parenting and EF in nonclinical samples of young children. Bernier *et al.* (2012) studied the role of maternal and paternal interactive behaviour and mother–child attachment security in the development of child EF in 62 families. Parenting and attachment were related to child performance on EF tasks including working memory, set shifting, and inhibitory control, but not impulse control. However, the design of this study precluded the possibility to examine the unique role of the father as the parenting scores for mothers and fathers were aggregated into one single factor. Furthermore, negative parenting practices were not

included. Towe-Goodman *et al.* (2014) showed in a diverse sample of 620 families that fathers' and mothers' sensitivity at 2 years predicted child's EF at 3 years, suggesting that both fathers and mothers play a distinct role in the development of EF. EF was represented by an overall score of tasks assessing working memory, attention shifting, and inhibitory control, precluding insight into differences between EF dimensions.

The purpose of this study was to investigate the association between mothers' and fathers' parenting and child's EF at age 4 in a large cohort study of 607 families. We included sensitive parenting and harsh parenting because previous studies showed that child EF is differently influenced by both parenting aspects (Bernier, Carlson, & Whipple, 2010; Blair *et al.*, 2011; Kok *et al.*, 2014). Sensitive parenting and harsh parenting are related constructs, but not opposite ends of one continuum (Pettit, Bates, & Dodge, 1997).

As not all EF domains might be similarly affected by early harsh and sensitive parenting of mother and father (Bernier *et al.*, 2010; Hughes & Ensor, 2009; Kok *et al.*, 2014), we studied the influence of parenting on multiple domains of EF. Following the dimensions suggested in previous research as typical domains of EF (updating, inhibition, and shifting; e.g., Miyake & Friedman, 2012; Toplak *et al.*, 2013), we explored the relation between parenting and three dimensions of EF labelled *emergent metacognition* (the child's ability to initiate, plan, organize, implement, and sustain future-oriented problem-solving), *inhibitory self-control* (the child's ability to modulate actions, responses, emotions, and behaviour via appropriate inhibitory control), and *flexibility* (the child's ability to move flexibly among actions, responses, emotions, and behaviour; Gioia, Espy, & Isquith, 2003). In the current study, we made use of the Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P), a parent report of child executive functioning (Gioia *et al.*, 2003). The BRIEF-P specifically assesses the extent to which children accomplish goal pursuits under unstructured conditions, which is different from performance-based measurements of EF used in the majority of studies that focus on processing efficiency of cognitive abilities under highly structured conditions (Toplak *et al.*, 2013).

Based on previous studies, we hypothesized that (1) maternal sensitive parenting was positively associated with all dimensions of child EF; (2) maternal harsh parenting was negatively associated with all dimensions of child EF. Based on earlier studies on the independent effects of parenting of mothers and fathers on child developmental outcomes (Martin *et al.*, 2007), we expected that (3) paternal sensitive and harsh parenting were associated with child EF above and beyond maternal parenting (McKee *et al.*, 2007; Towe-Goodman *et al.*, 2014). As only few available studies included fathers, we had no specific hypotheses for the relation between paternal harsh and sensitive parenting and the different EF domains, but we wanted to examine whether paternal effects on child EF domains were similar to or different from the effects of maternal parenting.

Method

Setting and procedure

The current study was embedded within the Generation R Study, a prospective cohort study investigating growth, development, and health from foetal life onwards in a population-based birth cohort in Rotterdam, the Netherlands. In a subgroup of the Generation R cohort (N = 1,106), additional detailed measurements of the child's development were obtained after birth, using physical and ultrasound examinations, interviews, and behavioural observations. Eligibility criteria for participation in this study were as follows: (1) Dutch national origin, meaning that the children, their parents, and

their grandparents were all born in the Netherlands to reduce confounding and effect modification and (2) a delivery date between February 2003 and August 2005. The study was conducted in accordance with the ethical standards for human experimentation established by the Declaration of Helsinki and was approved by the Medical Ethical Committee of the Erasmus University Medical Center, Rotterdam. More information about the study design can be found elsewhere (Jaddoe *et al.*, 2012).

Study population

Of the 1,106 included families in our study postnatal, EF problems when the child was 4 years old were measured in 975 children. Of these 975 children, we had data on reported harsh parenting when the child was 3 years old for 830 mothers and 844 fathers; and data on observed sensitive parenting when the child was 4 years old for 576 mothers and 671 fathers. In eight families, parents participated with two children. One child of each sibling pair was randomly excluded to avoid bias due to paired data. Missing data were imputed. To be included in the multiple imputation data set, participants were required to have data on harsh parenting from one or both parents and data on sensitivity from one or both parents. We had full data on harsh parenting and sensitive parenting of both parents in 518 families; we had one missing variable out of the four independent variables in 87 families; and in two families, we had two missing variables out of the four independent variables. Finally, we thus included 607 families with data available for analyses.

Family characteristics are displayed in Table 1. Of the 607 families, data on cohabitation were available for 574 families: In 555 families (96.7%), mother and father lived together. Mother's mean age at intake of the study was 32.1 years (SD = 3.6), and 71% had at least higher vocational training. Father's mean age at intake of the study was 34.1 years (SD = 4.8), and 67% had at least higher vocational training.

Non-response analyses comparing the 607 families included in our analyses with the families excluded from the analyses revealed that there were more highly educated mothers and fathers in the current study sample (70.6% resp. 67.3%) than in the group excluded from the analyses on predictors (55.4% resp. 57.1%, $p < .01$ for both analyses). In the current sample, 15.7% had a lower household income versus 22.3% in the families not included in the analyses ($p < .01$). Boys were more often excluded than girls (48.4% boys in the current sample; 56.3% boys in the excluded sample, $p < .01$). The two groups did not differ regarding cognitive development of the child, child problem behaviour, and maternal or paternal symptoms of distress.

Measures

Harsh parenting

Harsh parenting was measured with a self-report questionnaire filled in by mother and father when the child was 3 years old. Various types of discipline were assessed by 10 items that were based on the Parent–Child Conflict Tactics Scale (Straus, Hamby, Finkelhor, Moore, & Runyan, 1998). Three items on the Physical Assault Scale on hitting and spanking (e.g., 'hit child on the bottom with something like a belt, stick or some other hard object') were excluded as these encompass possibly illegal practices in Netherlands (see Diderich *et al.*, 2014 and Ministry of Health, Well-being and Sport, 2013). Additionally, one item of the Psychological Aggression Scale ('said you would kick child out of the house') was excluded to make the assessment more appropriate for the study population of 3-year-old children. Parents rated their use of discipline types during the

Table 1. Descriptive characteristics (N = 607)

Child/family characteristics	
Parents cohabitating, %	96.7
Household income, % higher	84.3
Gender of the child, % girls	51.6
Gestational age at birth in weeks	40.1 (1.7)
Cognitive functioning at 30 months	21.6 (2.5)
Problem behaviour at 3 years	21.0 (13.9)
Age of the child at measurement executive function in months	48.4 (0.9)
Executive functions problems sum score	84.9 (14.6)
Working memory problems	21.5 (4.6)
Plan/organize problems	13.4 (2.8)
Inhibition problems	22.1 (4.8)
Emotional control problems	14.2 (3.4)
Shift problems	13.7 (3.2)

Parent characteristics	Mother	Father
Age at intake in years	32.1 (3.6)	34.1 (4.8)
Educational level, % higher	70.6	67.3
Recent symptoms of distress, % yes	68.1	58.8
Harsh parenting	1.8 (1.6)	1.8 (1.7)
Observed sensitivity		
Etch-a-Sketch task	3.8 (1.6)	4.1 (1.6)
Tower Building task	3.4 (1.3)	3.2 (1.2)

Note. Unless otherwise indicated, values are mean (*SD*).

past 2 weeks on a 6-point scale ranging from 'never' to 'five times or more'. The categories 'twice', 'three times', 'four times', and 'five times' were combined due to low prevalence rates. This resulted in three categories: 'Never' (0), 'once' (1), and 'twice or more' (2). The six items we used in our study ('shook my child', 'shouted or screamed angrily at my child', 'called my child names', 'threatened to give a slap, but I didn't do it', 'angrily pinched my child's arm', 'called my child stupid, lazy, or something like that') match previous definitions and assessments of the construct of harsh parenting. Confirmatory factor analyses for both the mother and the father sample indicated good fit for the harsh parenting factor in both mothers and fathers. The modest Cronbach's alphas (.63 for mothers; .57 for fathers) reflect the relatively small number of items and low base rates in a population-based setting. A study of ecological validity showed that psychosocial characteristics of parents, such as psychopathology, delinquent behaviour, and family dysfunction, predicted the use of harsh discipline by mothers and by fathers (for further details, see Jansen *et al.*, 2012).

A harsh discipline sum score was calculated by adding the six items. This yielded a score ranging from 0 to 12, with higher scores reflecting higher frequencies of harsh discipline. The distributions of the scores on harsh parenting of mother and father were skewed, and therefore, scores were log-transformed to approach normality.

Parental sensitivity

Parental sensitivity was observed during home visits at the child's age of four using problem-solving tasks that required interaction between child and parent (Erickson,

Sroufe, & Egeland, 1985). The first task was the Etch-a-Sketch, a drawing toy that can be considered a simplified version of a plotter with the parent controlling one knob and the child controlling the other. The second task was building a tower together as high as possible within 3 min. Both tasks were video-recorded and parental sensitivity was coded with the revised Erickson scales (Egeland, Erickson, Clemenhagen-Moon, Hiester, & Korfmacher, 1990). Sensitivity scores were based on the subscale for *supportiveness*, scored on a 7-point rating scale with higher scores indicating more sensitivity. Parents with high scores on this scale express positive regard and emotional support to the child. This may occur by acknowledging the child's accomplishments and encouraging the child with positive emotional regard, support, and expression of confidence. Parents with low scores on this scale fail to provide support. They may be passive, uninvolved, aloof, or otherwise unavailable to the child.

Eleven trained coders independently coded the two tasks. Coders were unaware of other data concerning the mother–child and father–child dyads. Reliability of the coders was assessed directly after the training and at the end of the coding process to detect possible rater drift. Intercoder reliability was established on 40 cases. The average intraclass correlation coefficient for both tasks was .80 (range .63–.87). Supportiveness was correlated in both tasks ($r = .20, p < .001$ for mothers; $r = .27, p < .001$ for fathers). To examine the parent's predominant parenting behaviour, it is strongly advised (e.g., Notaro & Volling, 1999) to measure parenting behaviour across various tasks. Even in case of modest cross-setting associations, Joosen, Mesman, Bakermans-Kranenburg, and Van IJzendoorn (2012) showed in their longitudinal study on the stability and main-level differences between measures of sensitivity that the same underlying construct of sensitive parenting is observed. In our study, we found moderate correlations between the two subscale scores within each task, which provides another rationale for using the composite scores of the subscales of sensitivity. The scores on supportiveness for the two tasks were standardized, summed, and divided by 2, for both mothers and fathers.

Executive function problems

When the children were 4 years of age ($M = 48.4$ months, $SD = 0.9$), the BRIEF-P was used to measure EF problems (Gioia *et al.*, 2003; Van der Heijden, Suurland, de Sonneville, & Swaab, 2013). The BRIEF-P is a parent-completed questionnaire to assess EF behaviours in preschoolers (2–5 years). It contains 63 items within five related but non-overlapping theoretically and empirically derived clinical scales that measure children's ability in different aspects of EF: *Working memory*, *plan/organize*, *inhibition*, *emotional control*, and *shifting*. Factor analyses identified three dimensions that accounted for 87% of the variance: *Emergent metacognition*, *inhibitory self-control*, and *flexibility* (Gioia *et al.*, 2003; see Figure 1). Emergent metacognition represents the child's developing ability to initiate, plan, organize, implement, and sustain future-oriented problem-solving. It is composed of the working memory (17 items; range 17–51) and plan/organize scales (10 items; range 10–30). The internal consistency of emergent metacognition was .90 in our study. Inhibitory self-control represents the child's ability to modulate actions, responses, emotions, and behaviour via appropriate inhibitory control. The index is composed of the inhibition (16 items; range 16–48) and emotional control (10 items; range 10–30) scales. The internal consistency in our study was .89. The third factor, defined as flexibility, is composed of the shift (10 items; range 10–30) and emotional control scales and represents the child's ability to move flexibly among actions, responses, emotions, and behaviour. The internal consistency of flexibility was .87. The

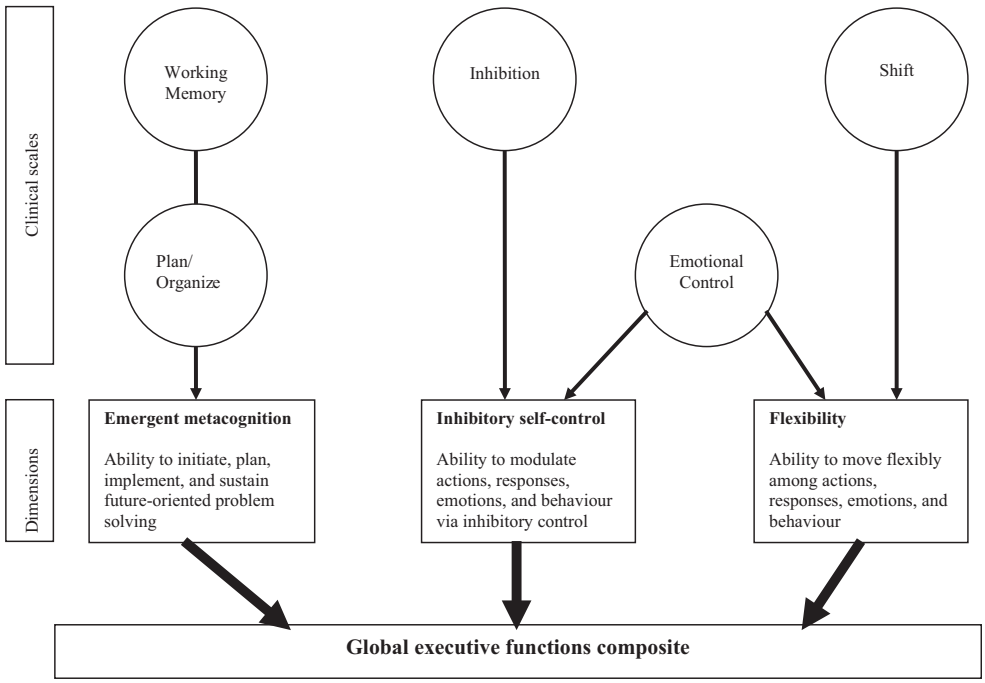

Figure 1. Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P): Overview of measurement of executive functions. *Note.* Adapted from Sherman & Brooks (2010) (reprinted by permission of the publisher Taylor & Francis, Ltd).

content validity and internal consistency of the BRIEF-P are adequate, and the subscales of the BRIEF-P show adequate to high test–retest reliability (Sherman & Brooks, 2010).

In this study, parents were asked to rate how often a particular behaviour was problematic in the preceding month on a 3-point scale (never, sometimes, and often). Higher scores indicate more problems with EF. The BRIEF-P was predominantly rated by mothers (88% mothers, 11% fathers, and 1% others). In this study, the distributions of the scales were skewed, and therefore, scores were inverse-transformed (and reversed for interpretation purposes) to approach normality.

Covariates

Gender and gestational age at birth were obtained from community midwife and hospital registries at birth. Child gender was taken into account in the analyses as a confounding variable because small gender differences in EF abilities have been previously reported (Anderson, 2002; Sherman & Brooks, 2010). Gestational age at birth was included as an indicator of the biological risk of developmental delays (MacKay, Smith, Dobbie, & Pell, 2010). The age of the child at the assessment of EF was reported by the rater. Information about the age and educational level of the parent (at least higher vocational training or a bachelor's degree, or not), household income (net household income lower or higher than 2,200 euro per month), was determined at enrolment during pregnancy using questionnaires. Because age of mother and father was correlated ($r = .63, p < .001$), we averaged the age of mother and father. We categorized educational level into 1 = no parent highly educated, 2 = one parent highly educated, 3 = both parents highly educated.

To control for a baseline of cognitive abilities and behaviour problems of the child, we included child cognition and problem behaviour. Nonverbal cognitive development at 24 months of age was assessed using the parent report part of the Dutch version of the Parent Report of Children's Abilities (PARCA; Saudino *et al.*, 1998). The parent report part of the PARCA comprises 26 questions assessing quantitative skills, spatial abilities, symbolic play, planning and organizing, adaptive behaviours, and memory. A higher score indicated higher levels of cognitive development (range: 10–26). To assess behavioural and emotional problems of the child, the Child Behavior Checklist (CBCL/1½–5, Achenbach & Rescorla, 2000) was filled out by mothers and fathers at 3 years. A total problems score was created by adding the scores on the 99 items; a higher score indicated more problem behaviour. To limit reporting bias (child EF was predominantly rated by mothers), we included only father's report of child behaviour problems. In the current sample, the internal consistency of father-reported child behaviour problems was .85.

Information about maternal and paternal symptoms of psychopathology was obtained by postal questionnaires at the child's age of 3 years. Symptoms of distress were assessed using the Brief Symptom Inventory, a validated self-report measure that is widely used to assess psychological distress (De Beurs, 2004; Derogatis, 1993). To measure psychological distress, we included the combined subscales of *depression*, *anxiety*, *interpersonal sensitivity*, and *hostility*. In the current sample, the internal consistencies of mother- and father-reported psychological distress were .85 and .84, respectively. The distribution was highly skewed, and therefore, scores were recoded into a dichotomous score of 0/1 representing no symptoms of distress/one or more symptoms of distress.

Statistical analyses

Reports on harsh parenting were available for 601 of 607 mothers (1.0% missing), and for 603 of 607 fathers (0.7% missing). Data on observed sensitivity were available for 528 mothers (13.0% missing) and for 605 fathers (0.3% missing). Percentages of missing values of the covariates were on average 2.6%, with a range from 0% to 9.7%. Missing data were imputed using the multiple imputation procedure with predictive mean matching included in IBM SPSS Statistics, version 19.0.1 for Windows (Meulman, Heiser, & SPSS, 2010). Ten imputed data sets were generated. Data were analysed in each data set separately. Subsequently, the results of the imputed analyses were pooled and the standardized betas (β), *t*-values, and *p*-values were reported, and for each step in the analyses the proportion of explained variance (R^2). Analyses conducted with the imputed data set ($N = 607$) yielded similar results compared to analyses with the complete data set ($N = 409$). Results of the imputed data set are presented here.

The bivariate associations among parenting and covariates were explored with Pearson's correlations and phi correlations. Three separate hierarchical linear regression analyses were conducted to examine the associations between parenting and the dimensions of child EF. In the first step, the covariates were entered. In the second step, maternal harsh parenting and sensitive parenting were added. In the third step, paternal harsh parenting and sensitive parenting were added. For each step, we report the explained variance. To give insight into the independent results of maternal and paternal parenting, the betas from the final model are reported in the text and in Table 3. Finally, we examined the interaction between child gender and parenting. Interaction terms were computed after centring of the constituent variables. Non-significant interaction terms were removed from the model.

Results

The bivariate correlations among the study variables are presented in Table 2. Harsh parenting of the mother was correlated with harsh parenting of the father ($r = .36$, $p < .001$). Maternal sensitive parenting was modestly correlated with sensitive parenting of the father ($r = .15, p < .001$). Harsh parenting of the mother was negatively correlated with her sensitivity ($r = -.15$, $p < .001$), and harsh parenting of the father was not correlated with his sensitivity ($r = -.04$, $p = .36$).

We examined whether harsh parenting and sensitive parenting of mother and father were associated with problems in specific child EF dimensions. Hierarchical analyses were run for the composite scores of EF: Emergent metacognition, inhibitory self-control, and flexibility.

Parenting and child emergent metacognition

Table 3 shows that lower levels of observed sensitivity of the mother were associated with higher levels of problems in emergent metacognition of the child ($\beta = -.08$, $p = .04$), after controlling for the covariates. Harsh parenting of the mother was not related to emergent metacognition ($\beta = .04, p = .30$). Higher levels of harsh parenting of the father were associated with more problems in emergent metacognition, above maternal parenting ($\beta = .09, p = .03$). Sensitive parenting of the father was not related to emergent metacognition ($\beta = -.04, p = .31$). The total model accounted for 21.5% of the variance. This prediction was largely due to the covariates which altogether explained 19.3% of the variance.

Parenting and child inhibitory self-control

Similarly, lower levels of sensitive parenting of the mother were associated with more problems in inhibitory self-control ($\beta = -.09$, $p = .03$), and higher levels of harsh parenting of the father were associated with more problems in inhibitory self-control ($\beta = .14, p < .001$). The model accounted for 23.2% of the variance.

Parenting and child flexibility

Contrary to the other two dimensions of EF, the variance in the flexibility component could not be explained by parenting. Harsh and sensitive parenting of mother and father were not associated with problems in flexibility of the child at age 4 (harsh parenting mother: $\beta = -.04, p = .43$; sensitivity mother: $\beta = -.02, p = .69$; harsh parenting father: $\beta = .05, p = .21$; sensitivity father: $\beta = .03, p = .52$). The total model accounted for 11.5% of the variance, of which 0.5% was accounted for by maternal and paternal parenting.

For all three broad dimensions of EF, no significant interactions between child gender and parenting were found.

Discussion

The present study extended previous work on the association between parenting and EF by an additional focus on the role of the father. We demonstrated independent effects of mother's and father's parenting on child EF in early childhood. We focused on three dimensions of child EF: Emergent metacognition, inhibitory self-control, and flexibility.

Table 2. Correlations between the main study variables ($N = 607$)

	Education of M&F	Age of M&F	Household income	Gender C	Gestational age C	Cognfunc problems C	Behaviour problems C	Distress M	Distress F	Harsh M	Sens M	Harsh F	Sens F
Education of M&F	–												
Age of M&F	.13**	–											
Household income	.30***	.14**	–										
Gender C	.02	.02	.04	–									
Gestational age C	−.01	.00	.04	−.02	–								
Cognfunc problems C	.02	−.02	−.01	−.08	−.02	–							
Behaviour problems C	.00	−.08	−.07	−.04	−.10*	.11**	–						
Distress M	−.02	.04	−.02	.03	−.04	.05	.12**	–					
Distress F	.05	.03	−.03	.05	.04	.06	.24***	.16***	–				
Harsh M	−.06	.03	−.07	−.16***	−.04	.12**	.29***	.15***	.20***	–			
Sens M	.19***	−.04	−.03	.06	.01	−.07	−.01	−.02	.03	−.15***	–		
Harsh F	−.12**	−.03	−.11**	−.10*	−.03	.09*	.21***	.23***	.08*	.36***	−.12**	–	
Sens F	.17***	.03	.14***	.02	.00	.05	−.04	−.03	.03	−.08*	.15***	−.04	–

Note. M = mother; F = father; C = child; gender is coded as 0 = boy, 1 = girl; Cognfunc problems = cognitive functioning problems at 30 months; Harsh = harsh parenting; Sens = sensitivity.

For two continuous variables or a continuous variable with a dichotomous variable, *Pearson's* or *Spearman's correlation* is used; for two dichotomous variables, *phi correlation* is used.

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

Table 3. The associations of parenting with problems in executive functions (EF) in early childhood ($N = 607$)

	Emergent metacognition problems				Inhibitory self-control problems				Flexibility problems			
	β	*t*	*p*	R^2	β	*t*	*p*	R^2	β	*t*	*p*	R^2
Step 1												
Educational level of the parents (higher)	−.03	−0.76	.447	.193	.00	0.10	.925	.198	.06	1.37	.171	.110
Age of the parents (years)	−.03	−0.72	.471		−.02	−0.63	.527		−.01	−0.10	.922	
Household income (higher)	−.10	−2.62	.009		−.06	−1.46	.145		−.05	−1.14	.255	
Child gender (girl)	−.13	−3.47	.001		−.09	−2.35	.019		−.05	−1.17	.242	
Gestational age (weeks)	−.05	−1.43	.152		−.05	−1.49	.135		.02	0.41	.683	
Cognitive functioning at 2.5 years (score)	.10	2.39	.017		.03	1.35	.179		.03	0.80	.427	
Child behaviour problems at 3 years (score)	.26	6.37	<.001		.32	7.90	<.001		.29	6.79	<.001	
Maternal distress at 3 years (score)	.12	2.95	.003		.08	2.20	.028		.08	2.03	.043	
Paternal distress at 3 years (score)	−.04	−1.07	.283		−.02	−0.59	.558		−.01	−0.03	.975	
Age of the child at EF assessment (score)	−.01	−0.37	.711		.00	0.05	.960		.01	0.37	.709	
Step 2												
Parenting mother												
Harsh parenting (score)	.04	1.03	.304	.207*	.05	1.14	.254	.216*	−.04	−0.79	.433	.111
Observed sensitivity (score)	−.08	−2.04	.042		−.09	−2.15	.032		−.02	−0.40	.693	
Step 3												
Parenting father												
Harsh parenting (score)	.09	2.23	.026	.215*	.14	3.54	<.001	.232*	.05	1.26	.209	.115
Observed sensitivity (score)	−.04	−1.01	.312		−.02	−0.53	.593		.03	0.65	.519	

Note. Averages taken from the final regressions models of the 10 imputed data sets. Betas are taken from the final models.
*$p < .05$.

Less sensitive parenting of the mother and harsher parenting of the father were related to lower child scores on emergent metacognition and inhibitory self-control, controlling for child cognition and child behaviour problems. Parenting of either mother or father was not associated with child flexibility.

Traditionally, mothers and fathers appear to engage in different types of interaction with their child, starting from birth. Fathers tend to focus more on stimulating, exploratory, and physical play while mothers tend to focus more on emotional support and warmth (Lamb & Lewis, 2010), which might explain the specific association between sensitive parenting and child EF in mother–child dyads. Fathers' harsh parenting, not sensitivity, was related to child EF. Previous studies confirm the finding that paternal negative parenting affects child development and behaviour above maternal parenting (McKee *et al.*, 2007; Ramchandani *et al.*, 2013). Chang *et al.* (2003) studied harsh parenting of mothers and fathers in relation to child emotion regulation and aggression and found that mothers' harsh parenting affected child emotion regulation more strongly than fathers', whereas paternal harsh parenting had a stronger effect on child aggression. Our findings suggest it is important to take both parents' parenting practices into account as maternal and paternal parenting might have differential consequences for child EF.

Parenting was related to child emergent metacognition and inhibitory self-control, but not to child flexibility. Several explanations for the different patterns of associations are conceivable. Parenting behaviours most consistently associated with individual differences in EF can be grouped into four theoretically derived dimensions: (1) scaffolding, (2) stimulation, (3) sensitivity, and (4) control (Fay-Stammbach *et al.*, 2014). So far, studies examining the relation between parenting and child EF have mainly focused on parental scaffolding, a form of parenting based on support and guidance of goal-directed activities (Bibok, Carpendale, & Müller, 2009). Although it is assumed that the variance in parenting is not explained by one single aspect of parenting (Bernier *et al.*, 2012), it might be that particularly EF flexibility is affected to a greater extent or even solely by parental scaffolding compared to sensitive or harsh parenting. Future research might be enhanced by taking the various parenting aspects into account, including parental scaffolding (Kraybill & Bell, 2013). A second explanation is that the child's shifting abilities are less well predicted by parenting than emergent metacognition and inhibitory self-control and that the variation in child performance on shifting is largely explained by other well-known determinants of EF like child cognition, candidate genes, and neurophysiology (Friedman *et al.*, 2008; Jester *et al.*, 2009; Polderman *et al.*, 2007).

The exact mechanisms behind the relation between parenting and EF are so far unknown. Previous studies have shown the role of early caregiving in the regulation of child stress (Gunnar & Quevedo, 2007). Concentrations of cortisol, a stress-response hormone that modulates activity in the prefrontal cortex, might mediate the association between parenting and EF (Blair *et al.*, 2011). An alternative mechanism for the influence of parenting on EF is that sensitive parenting provides the child with a safe and encouraging environment to practice self-regulation (Bernier *et al.*, 2010). Lastly, children with lower levels of problems in EF may elicit more positive responses from their parents and thus increase positive parenting or decrease negative parenting (Bernier *et al.*, 2010). Bidirectional influences cannot be ruled out in our study. Further investigation of the link between parenting and EF is recommended, with a special focus on the mediating role of (prefrontal) brain systems.

An important strength of this study is the inclusion of mothers and fathers which enabled us to examine the specific role of both parents in the EF capacities of the child. Furthermore, we studied the association of parenting and EF in a large cohort sample of 607 families. We included negative and positive parenting measures. The study has certain limitations as well. Our study was conducted in a homogeneous sample of families: Relatively highly educated families with a relatively high household income, and only Dutch native participants were represented. This implies less variation in parenting and in child EF problems, and thus, our findings may underestimate the association between parenting and child EF problems. The quality of parenting behaviour accounts for a significant, though small proportion of the explained variance in individual differences in child EF. The effect size of the relation between parenting and child EF seems to imply that little can be gained from prevention or intervention strategies directed at increasing sensitivity or decreasing harsh parenting. However, as Rose described (1981), even moderate alterations of modest risk factors can achieve major public health benefits. Finally, parental report cannot be interpreted as completely reflecting child executive functioning. The BRIEF-P specifically assesses the extent to which children accomplish goal pursuits under unstructured conditions (Toplak *et al.*, 2013), which is very challenging or not feasible to assess with performance-based measures. Performance-based measures of EF occur under optimal performance situations and assess the processing efficiency of cognitive abilities under highly structured conditions (Toplak *et al.*, 2013). Although both measurements are described and labelled to measure EF, they assess different aspects of EF, different underlying processes, and different cognitive levels of analysis. Both domains of assessment are useful and valuable and, importantly, cannot be used interchangeably as parallel measurements of EF (Toplak *et al.*, 2013). In the present study, logistical and financial constraints made performance-based measures of EF in over 600 children impossible.

In conclusion, parenting may play an important role in child EF. Future research should focus on the influence of various parenting practices of mothers and fathers on the development and capacities of specific dimensions of child EF during childhood. These studies should focus on a broader range of age and developmental stage of the child, to investigate whether the relation between parenting and child EF is stable or changing over time.

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Conflict of interest

Prof. F. C. Verhulst is a contributing author of the Achenbach System of Empirically Based Assessments, from which he receives remuneration. The remaining authors have no conflict of interest.

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