

Descriptive title: The influence of mothers' and fathers' sensitivity in the first year of life on children's cognitive outcomes at 18 and 36 months.

Short Title: Mother and Father Sensitivity

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Figures: 2

Abstract

Background: There has been increasing interest in the relative effects of mothers' and fathers' interactions with their infants on later development. However to date there has been little work on children's cognitive outcomes.

Methods: We examined the relative influence of fathers' and mothers' sensitivity during interactions with their children at the end of the child's first year (10-12 months, $n = 97$), on child general cognitive development at 18 months and language at 36 months.

Results: Both parents' sensitivity was associated with cognitive and language outcomes in univariate analyses. Mothers' sensitivity, however, appeared to be associated with family socio-demographic factors to a greater extent than fathers' sensitivity. Using path modeling the effect of paternal sensitivity on general cognitive development at 18 months and language at 36 months was significantly greater than the effect of maternal sensitivity, when controlling for socio-demographic background. In relation to language at 36 months, there was some evidence that sensitivity of one parent buffered the effect of lower sensitivity of the other parent.

Conclusions: These findings suggest that parental sensitivity can play an important role in children's cognitive and language development, and that higher sensitivity of one parent can compensate for the lower sensitivity of the other parent. Replication of these findings however, is required in larger samples.

Introduction

Since the importance of parent-child relationships was established by the work of Bowlby and others, the last two decades have seen an increase in research into the respective roles of both mothers and fathers in child development. It is now established that the quality of early parent-child relationships does have an influence on later child cognitive and language development (NICHD Early Child Care Research Network 2005). More remains to be learned, however, about the mechanisms of this effect, the interplay between the parenting relationships and what aspects may be most amenable to intervention (O'Connor and Scott 2007).

As well as mother-child, the importance of father-child relationships has become increasingly evident (Lamb and Tamis-Lemoda 2004, East *et al.* 2006, Pancsofar and Vernon-Feagans 2010). There has been considerable interest in whether fathers' and mothers' relationships with their children are similar. Most research has focused on attachment styles, which suggests that maternal and paternal styles are often concordant, but they are not necessarily so (Fox *et al.* 1991). Furthermore, mothers and fathers have been shown to have similar physiological response to infants, but differences in behavioural responses have been demonstrated (Malmberg *et al.* 2007, Pruett 1998). This suggests that the determinants of parental sensitivity and their effects on later development may differ between father-infant and mother-infant dyads (Easterbrooks and Goldberg 1984, Braungart-Rieker *et al.* 2001, Grossmann *et al.* 2002). To date, studies of the differential effects of sensitivity have largely focused on the impact it can have on attachment, but not on cognitive development. To our knowledge the effects of mothers' and fathers' early parenting behaviours on child cognitive outcomes (Bayley Scales of Infant Development at 24 and 36 months, and math and language

scores at five years) have been studied in only one sample (the Early Head Start Research and Evaluation Project). These studies found the positive effects of maternal and paternal supportiveness to be additive (Martin *et al.* 2007, Ryan *et al.* 2006). Furthermore, to our knowledge, there has also been one study that examined mothers' and fathers' contributions to children's language development, which found paternal education and vocabulary during a book-reading interaction, in addition to maternal education, to be predictive of more advanced language development at 36 months (Pancsofar and Vernon-Feagans 2010).

One key question is whether and to what extent one sensitive parent can act as a buffer (Murray and Cooper 2003) against the effects of lower levels of sensitivity of the other parent. This would have important implications for families where one parent's parenting is affected, because of mental or physical illness or other stressors. In the present study we aimed to explore the effects of both paternal and maternal sensitivity on child developmental outcomes, and the ways in which one parent might compensate for the effects of the lower sensitivity of the other parent. In other contexts mother-child relationship was found to buffer the effect of economic deprivation on children's emotional symptoms at three years of age, but father-child relationship did not (Malmberg and Flouri 2011).

Research questions

- (1) What is the relative influence of paternal and maternal sensitivity on cognitive outcomes at 18 and 36 months; controlling for socio-demographic factors?
- (2) Can sensitivity in one parent compensate for lower levels of sensitivity in the other?

Methods

Sample

The study was approved by relevant NHS research ethics committees of Oxfordshire and North London Universities and informed consent was obtained prior to participation. The fathers and mothers were drawn from the Families, Children and Child Care study (FCCC; www.familieschildrenchildcare.org). The FCCC followed 1201 children from two fieldwork sites in the UK (Oxfordshire and North London), at 3, 10, 18, 36 and 51 months. Exclusion criteria for entry to the study included multiple births, infants with significant developmental delay, infants born to mothers under 16 years of age, and infants who spent more than 2 days in a special care unit immediately after birth. Parent-child interactions were video-taped during a semi-structured play session in conjunction with an interview with the mother 10-12 months postnatally ($N=1077$). A sub-sample of 100 families was selected for an intensive study of the role of fathers (Malmberg *et al.* 2007, Lewis *et al.* 2009, West *et al.* 2009). In this subsample, fathers were the primary caregivers (PCGs; defined as a minimum of 20 waking hours a week of sole child-care) in 25 families, mothers were the PCGs in 30 families, and there was non-parental care arranged for the infant in 45 families. The final sample consisted of 97 families (47 girls, 50 boys) who had videotaped assessments of both father-child and mother-child interactions. The mother-infant observations were conducted when the average infant age was 10.6 months ($SD = 0.47$), and the father-infant observations when the average infant age was 11.9 months ($SD = 0.73$), across two visits. Field researchers conducted assessments of the children's general cognitive ability at 18 months of age, and language development at 36 months of age. Data was available for all three time points (10, 18 and 36 months) in 83 cases, 3 cases had data at 10 and 36 months, 9 cases had data at 10 and 18 months, and 2 cases had data at 10 months only.

At the video-taped play sessions the average age of mothers was 32.8 years ($SD = 4.98$), and the fathers was 36.0 years ($SD = 6.40$). The mothers' and fathers' mean educational level was

scored on a six-point scale (1= no qualifications, 6 = higher degree), with mothers having a mean education score of 4.51 ($SD = 1.41$) and fathers' 4.33 ($SD = 1.42$). In order to reduce the number of covariates, a composite variable, 'family sociodemographic background' was created by averaging the standardized z -scores of both parents' educational level, socioeconomic class, and the family income at the time the child was three months old (Barnes *et al.* 2006). With the exception of two families, all infants resided with both parents. Of the children, 46 were firstborn, 38 second born and 12 third or later born.

Table 1 here

Procedure

All assessments were conducted at home. The play session consisted of five two-and-a-half minute consecutive segments with standardized sequential introduction of toys provided by the researcher as follows: (1) free-play without toys; (2) exploration of a textured, age-appropriate book; (3) a stacking ring toy; (4) a wooden shape-sorting toy, and (5) a battery-operated musical toy. The parents were asked to share each toy with their child. Independent raters coded the video-taped father-infant and mother-infant interactions during each of the five play segments. Inter-rater reliability was assessed using videos of 10 mother-infant dyads and 10 father-infant dyads (10.3% of subsample), with each coder assessed against an independent coder (three coders total). No rater coded both mother-infant and father-infant dyads of the same infant. Inter-rater reliability was assessed using the kappa statistic.

Measures

Observed parent-infant play-interaction at ten months

The following variables were coded for each segment (Malmberg *et al.* 2007):

Parental Sensitivity was measured using two observation scales; one based on the original global sensitivity scale of Ainsworth (1973) and the second scale, facilitation (Stein *et al.* 1999, Stein *et al.* 1994).

Global sensitivity was rated on a five-point scale (from 1 = highly insensitive to 5 = highly sensitive). The average inter-rater agreement between the coders and an independent coder was $\kappa = .84$ for the father-infant tapes, and $\kappa = .84$ for the mother-infant tapes (weighted Kappa; Gwet (2001)).

Facilitation was defined as an action by the parent which assisted the child in an activity in which he/she was already engaged, or had signaled he/she wished to do (Stein *et al.* 1994, Stein *et al.* 1999). This definition is consistent with the original conceptualization of maternal sensitivity by Ainsworth (1973) as a parent's ability to respond to the child's signals promptly and appropriately. Facilitation was scored on a five-point scale (from 1 = no facilitations at all to 5 = skilled and appropriate facilitation most of the time). The inter-rater agreement was $\kappa = .78$ for fathers and $\kappa = .90$ for mothers.

The average sensitivity score across facilitation and global sensitivity across the five play sessions was used as an index of parental sensitivity (Malmberg *et al.* 2007).

Child developmental outcomes at 18 and 36 months

Children were assessed at 18 months using the Bayley Scales of Infant Development-II (BSID-II) Mental Development Index (MDI), which is an age-standardised test requiring children to perform a number of cognitive and language tasks. The number of correctly performed tasks is summed into a score, and that score is standardised into an index score based on normed samples (Bayley 1993).

Child language was assessed at 36 months using the Reynell Developmental Language Scale (RDLS), a widely used and standardized instrument consisting of two subscales, comprehension and expressive language, summed into one total score (Reynell and Gruber 1990).

Analysis

First, *t*-tests were conducted examining the difference in quality of mother-infant play between the full dataset for which mother-child interactions were available (N=1077) and the subsample in the current study (N=97).

Univariate analyses were conducted examining the associations between all the key independent and dependent variables.

We conducted path-model analyses in Mplus 7.0 (Muthén and Muthén 2012). The initial path models were saturated so no goodness of fit was assessed. The path models which included the interaction effect (precalculated as a multiplicative effect) were near-saturated having two degrees of freedom. We used a non-significant χ^2 as an indicator of good model fit. In order to address the first research question, we included direct paths from family socio-demographic background to mothers' and fathers' sensitivity, and to the child outcome; and paths from

mothers' and fathers' sensitivity to child outcome. In order to investigate the second research question, whether the sensitivity of one parent could compensate for reduced sensitivity in the other, we included the father \times mother sensitivity effect as a predictor of child outcome. We conducted these analyses for each outcome separately (see Figure 1). In a series of further analyses, we included additional predictors in the path-models: mothers' and fathers' age, child's sex and birth order, and father's caregiving status (less than 20 hours, versus 20 hours or more of sole childcare per week).

Results

Between-group t-tests showed that there were no differences ($p > .05$) on quality of mother-infant play between the full dataset for which mother-child interactions were available ($N=1077$) and the subsample in the current study ($N=97$). **Can we get the table uploaded on their website, or make available to researchers at request**

Univariate analyses indicated that both maternal and paternal sensitivity were positively related to higher cognitive and language functioning in the child (Table 1). We also found that paternal and maternal sensitivity were not significantly related to each other. Maternal sensitivity was strongly associated with the composite socio-demographic variable (including socio-economic status (SES), income and education) while paternal sensitivity was not significantly associated with this socio-demographic variable.

Direct and indirect paths between socio-demographic background, parental sensitivity and child outcomes were examined for each outcome separately. Two patterns of path-coefficients were common across the three models. First, socio-demographic background was a stronger predictor of mother's sensitivity than father's sensitivity. When adjusting for all other

variables in the model, a direct effect of family socio-demographic background on cognitive development at 18 months was observed, but there was no significant direct effect on language development at 36 months. Second, the direct path between father sensitivity and child outcomes was stronger than that between mother sensitivity and child outcomes for both cognitive development (MDI) at 18 months ($\beta = .23$ for fathers; $\beta = .03$ for mothers), and language at 36 months ($\beta = .31$ for fathers; $\beta = .21$ for mothers).

 Figure 1 here

To explore the possible interaction of father and mother sensitivity we included father \times mother sensitivity as a predictor of each of the child outcomes. An interaction effect was found for language development at 36 months ($\beta = .18$; $p < .05$; model fit $\chi^2_{[2]} = .10$; $p = .95$), but not cognitive development at 18 months (Figure 2) (model fit $\chi^2_{[2]} = .14$; $p = .93$). When either parent had relatively lower sensitivity (i.e. - 1 SD) the effect of the other parent's sensitivity compensated for that effect (Figure 2). When paternal sensitivity was high (i.e. + 1 SD) the effect of maternal sensitivity did not have an added effect on the child outcome (Figure 2, right), but when the mother was sensitive (Figure 2, left) the father's sensitivity still had an added effect.

 Figure 2 here

In a series of further analyses, we included additional predictors in the path-models. Mothers' and fathers' age, birth order, and father's caregiving status (less than 20 hours, versus 20

hours or more of sole childcare per week) were not found to have any significant additional predictive effect than family socio-demographic background.

Child sex was found to be associated with Reynell scores in the regression model ($\beta = .18$; $p < .05$), although not in bivariate correlations ($r = 0.21$, $p > .05$). The inclusion of child sex also modified the father \times mother interaction effect (to $\beta = -.15$; $p = .09$), although there were no significant child sex \times sensitivity interactions for either fathers or mothers when examined separately. When analysis was conducted separately for boys and girls, mothers' sensitivity appeared to have a stronger effect on the language outcomes of boys than on girls."

Discussion

The relative effects of mothers' and fathers' early parenting behaviours on child cognitive and language outcomes have been studied in a small number of previous studies, in which the effects of paternal and maternal parenting behaviours were found to be additive (Martin *et al.* 2007, Ryan *et al.* 2006, Pancsofar and Vernon-Feagans 2010). In contrast, the findings from the current study suggest a more complex picture, which suggests an interactive model. We found both maternal and paternal sensitivity to be related to child cognitive outcomes in univariate analyses, but in multivariate path analyses, family socio-demographic background (including socio-economic status (SES), income and education) was strongly associated with maternal, but not paternal sensitivity. Paternal sensitivity predicted the children's cognitive and language outcomes at 18 and 36 months, respectively, and it is important to note that socio-demographic background did not appear to moderate or diminish this effect. Maternal sensitivity on the other hand was not related to outcome when socio-demographic factors were included in the model. The interaction effects showed that one sensitive parent, either mother or father, could compensate for the other parent's lower sensitivity, but also that sensitive fathers had an additional effect when mothers were also sensitive. Exploratory analyses investigating the effects of sex suggested that this effect, was reduced when

accounting for sex differences, and further analysis suggested that mothers' sensitivity may be more important in boys

These findings suggest that sensitivity from one parent could potentially compensate for the effect of the other parent's lower level of sensitivity. It is possible that fathers provide support for sensitive mothering by maximizing the family SES but they can also make a more direct contribution in the form of sensitive fathering (as father's sensitivity was unrelated to family socio-demographic variables).

Furthermore, fathers' sensitivity was more strongly related to child cognitive and language outcomes than mothers' sensitivity. This finding was somewhat unexpected, as previous studies have identified fathers' and mothers' sensitivity to have similar effects on child cognitive outcome (Martin *et al.* 2007, Ryan *et al.* 2006). One study however, identified fathers' supportiveness (a measure including sensitivity, positive regard and cognitive stimulation) to be associated with child emotional regulation at two years and orientation-engagement at both two and three years, whereas there was no association identified with mothers' supportiveness (Cabrera *et al.* 2007). Both emotional-regulation and orientation-engagement are components of self-regulation, which enables children to perform well in cognitively demanding situations (Raikes *et al.* 2007). One possible explanation could be that the effect of fathers' sensitivity on child cognitive outcomes may be further enhanced by an indirect effect mediated by self-regulation.

Sensitive fathering may be particularly important in families where the father takes on the role of the primary care-giver (PCG), a decision influenced by a range of economic, cultural and attitudinal variables (West *et al.* 2009). Lewis *et al.* (2009) found that PCG fathers have lower

occupational status and provide a lower proportion of family income than non-PCG fathers. Given that women's earnings are, on average, significantly lower than men's (Office of National Statistics 2011), this suggests that families where the father takes on primary caregiving role because the mother's earning potential exceeds that of the father's, may be of lower economic status.

There is clearly a complex interplay between socio-economic factors and parental sensitivity, and further exploration of this is warranted. Further research could examine the relative effects of parental sensitivity later in childhood, and account for differences in child sex and parenting styles. It appears that fathers may have an additional positive effect in early child development, even in families where maternal sensitivity is also high. These findings have potential policy implications, such as the importance of promoting early intervention strategies to engage fathers in children's early years (for a recent systematic review of father-inclusive parenting and co-parenting interventions worldwide, see Panter-Brick *et al.* (2014)).

There are a number of strengths to this study, including its prospective design, direct observation of both mothers and fathers with their infants in the first year of life and the use of standardized reliable measures of general cognitive and language development at 18 and 36 months, respectively. There was good retention from the first year to the third year of life, and the sample was fairly representative (Malmberg *et al.* 2005) (although the socio-economic distribution of the sample was somewhat biased towards more advantaged groups (for details see Lewis *et al.* (2009)). The limitations of the study include the relatively small sample size and that assessments of maternal and paternal sensitivity were based on a single observational session. Furthermore the original subsample of fathers was weighted to have a proportion of

fathers who provided a significant amount of principal caregiving to the child. Further details of this original subsample is presented elsewhere (Malmberg *et al.* 2007).

In conclusion, this study confirms that early paternal sensitivity does have an effect on children's language and cognitive development and it appears to be less affected by socio-demographic background than maternal sensitivity. The data also suggest that sensitivity on the part of one parent might be able to compensate for reduction in the other parent's sensitivity in terms of the effects on language outcome. Further research is needed to replicate these findings and investigate these complex relationships in more detail and particularly in larger samples.

Key Messages

- This study confirms that early paternal sensitivity does have an effect on children's language and cognitive development and it appears to be less affected by socio-demographic background than maternal sensitivity.
- Sensitive fathering may be particularly important in families where the father takes on the role of the primary care-giver, a decision influenced by a range of economic, cultural and attitudinal variables.
- These findings have potential policy implications, such as the importance of promoting early intervention strategies to engage fathers in children's early years, which may be particularly important in low-socioeconomic settings.

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Tables

Table 1. Father- and mother-infant play interaction at 10-12 months, parental characteristics and developmental outcomes at 18 and 36 months (pairwise correlations (*ns* from 83-97), means and standard deviations]).

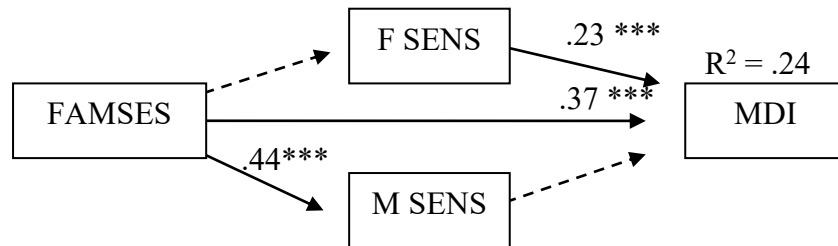
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) M's sensitivity (10 m)										
(2) F's sensitivity (10 m)	0.07									
(3) Bayley MDI (18 m)	0.22 *	0.29 **								
(4) Reynell total language (36 m)	0.30 **	0.36 ***	0.74 ***							
(5) Child's gender (0= girl, 1=boy)	0.03	0.06	0.10	0.21						
(6) Child's birth order (1 - 4+)	-0.11	0.08	-0.29 **	-0.12	0.04					
(7) M's age	0.27 **	0.04	0.02	0.09	-0.02	0.22 *				
(8) F's age	0.13	0.04	-0.15	0.01	0.15	0.19	0.76 ***			
(9) Family sociodemographic background (z) ^a	0.47 ***	0.19	0.43 ***	0.34 ***	-0.03	-0.29 **	0.39 ***	0.18		
(10) F care (0 = not primary, 1 = primary)	-0.20 *	0.01	-0.20	-0.18	-0.03	0.06	-0.08	-0.04	0.32 **	
N	97	97	92	86	97	97	97	95	97	97
M/%	3.75	3.63	94.37	98.85	48.5%	1.71	31.91	35.02	0.24	24.7%
SD	0.63	0.53	12.14	24.28		0.84	5.02	6.50	0.73	

^b = Composite of z-scored parental education, socio-economic class and family income. M = Mother, F = Father, ^a = the average of the z-scored educational level and occupational status of both parents, and family income when the infant was 3 months old.

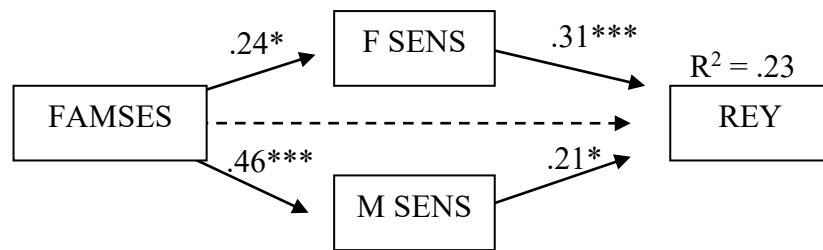
* = $p \leq .05$, ** = $p \leq .01$, *** = $p \leq .001$

Figures

(a) Bayley MDI (n = 92)



(b) Reynell total 36m (n = 86)



(c) Reynell total 36m (n = 86)

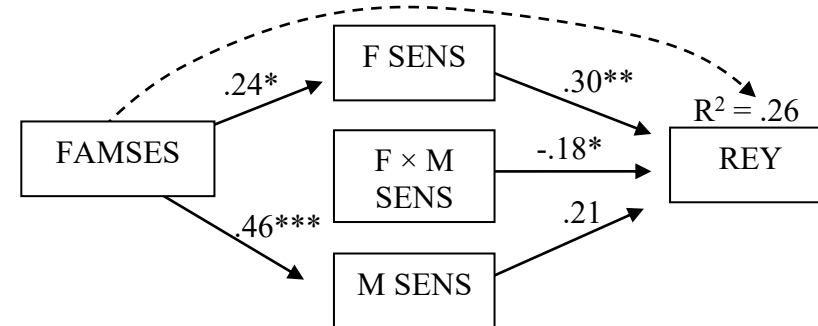


Figure 1. Socio-demographic background, parental sensitivity and child outcomes

Note: All paths are standardized beta-coefficients from *Mplus* 7.0. F SENS = Father sensitivity, M SENS = mother sensitivity, FAMSES = family socio-demographic background composite, MDI = Bayley Mental Development Index, REY = Reynell total score (Expression and Comprehension), dashed arrows indicate non-significant estimated paths. Correlation between father and mother sensitivity was estimated, found non-significant, and for clarity not shown. Models were saturated so no goodness of fit is estimated.

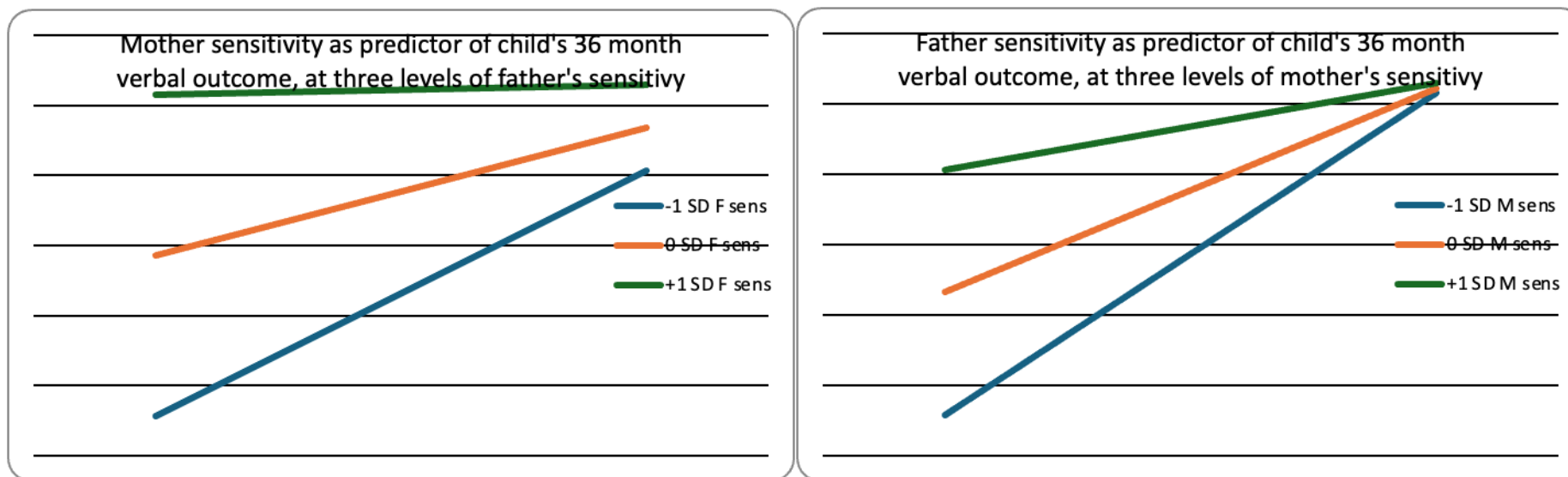


Figure 2. Interaction of parental sensitivity and verbal development at 36 months, mother \times father (left) and father \times mother (right).