# The beginning of infant self-regulation: a longitudinal study involving infants, mothers and fathers in the Netherlands and China

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# Chapter 5

## The Role of Grandparental Sensitivity and Parental Sensitivity in Infant Cognitive Development in China: A Pilot Study

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## Abstract

Grandparental caregiving is common in China, which can directly impact grandchild development. In addition, grandparents may have an indirect impact on children through their relationship with and support of the parents. However, relatively little is known about the relation between grandparenting and parenting or the effect of multiple caregiving on child development. The current study is a pilot study which includes 42 mothers, fathers, and co-residing grandparents in China, and examines whether grandparental sensitivity relates to parental sensitivity (biological child of the grandparent), and whether grandparental sensitivity and maternal and paternal sensitivity each uniquely contribute to 14-month-old children's Executive Function (EF). Results did not show a significant relation between parental and grandparental sensitivity or a unique contribution of sensitivity from mothers, fathers, or grandparents to infant EF. Our findings showed differences in sensitivity of grandparents and parents towards the third generation but did not confirm a combined effect of multiple caregivers on infant EF development in China.

*Key words:* sensitivity, grandparents, mothers and fathers, infant EF

Three generations living under the same roof is common in Chinese society. Grandparents not only help with housework, but also function as joint parental caregivers in raising young children, and therefore may have both indirect and direct impact on child development. The indirect effect of grandparents (G1) on grandchildren (G3) can take place through parents (G2) in two ways. First, G1 supports G2 who can then be more attentive parents to G3 which positively influences G3 development (Chen et al., 2000). Second, G2 may parent the young children based on their own experience with G1 (e.g., Belsky et al., 2005). Grandparents may also have a direct effect on G3 development through their daily interactions with their grandchildren. However, associations between grandparenting, parenting, and child outcomes are rarely investigated. The current study is a pilot study which examines G1 and G2 parenting quality (specifically sensitive responsiveness) on G3 development (specifically Executive Function - EF) in families with 14-month-old children in urban China.

Different from the elderly in most of the Western countries where independent living is highly valued, Chinese grandparents are expected to play a major role in taking care of grandchildren (Burnette et al., 2013). The involvement of both co-residing and non-coresiding grandparents in childcare is a common experience in many Chinese families (Chen et al., 2011; Wang et al., 2019). Ko and Hank (2014) found that among 772 Chinese families around 58% of grandparents are involved in daily childcare of their grandchildren. The reasons for a high prevalence of grandparenting in China can often be found in social and economic factors. Chinese women's labor force participation is the highest in the Asian Pacific region with limited flexibility in the work arrangement, especially in waged jobs (World Bank, 2018a). Working part-time is generally impossible as labor supply exceeds demand (e.g., Chen et al., 2011). Moreover, there is a shortage of daycare facilities, especially for children under 3 years of age (e.g., Zhai & Gao, 2010). Given all of this, help from grandparents is the main reason that parents can maintain their paid jobs and balance work and childcare (Goh & Kuczynski, 2010). In addition, the current early retirement age for women (50 to 55 years) and men (60 years) makes grandparental childcare possible (Feng & Zhang, 2018).



The impact of G1 parenting on G3 is generally studied as indirect through G2 parenting as the latter is likely to be influenced by their own childhood experiences being parented by G1 (e.g., Conger et al., 2009; Chen et al., 2008). For example, mothers who experienced a positive family atmosphere and had more trusting, communicative relationships with their parents were more likely to show more warm-sensitive parenting. Sensitivity refers to caregivers' capability to accurately interpret the child's signals, and to respond to them promptly and appropriately (Ainsworth, 1964; Mesman & Emmen, 2013), to their own young children (Belsky et al., 2005). Another possibility is that G2 parents may follow G1 grandparents' current behaviors on how to take care of G3 grandchildren as grandparents have more experience with young children in general. In China, this imitation may happen more often as parents are likely to show respect and adopt grandparents' advice due to the traditional value of filial piety (Yeh et al., 2013).

To date, relatively few studies on the concurrent relation between grandparenting and parenting have been conducted, especially in non-Western samples such as China even though caregiving grandparents are very common there. As far as we know, one study focused on sensitive parenting in two generations in China (Xing et al., 2016). Results showed that grandmaternal sensitivity towards their 17-month-old grandchild was positively related to maternal sensitivity towards the same child. However, it is not clear whether the participating G1 grandmothers had blood relations with G2 mothers, so we do not know whether the association was due to G2 childhood experiences, G2 assortative mating (i.e., choosing a partner with sensitive parents) or current imitation. Differences and similarities between caregiving quality between generations can be partly due to educational patterns. In China, the educational differences between parents and grandparents may be bigger than in Western countries, because the educational system has undergone expansion and modernization with enriching educational resources and rising public awareness of the importance of educational quality along with the rapid economic growth. Thus, the current parent generation has more opportunities to pursue higher education than the current grandparent generation. In 1970, less than 1% of Chinese people had attended higher education. This number continued to increase to 19% in 2005 and 46% in 2015 which was even higher than the average level of the whole world (38%) (World Bank, 2018b). Besides, parent gender may also play a role on the similarity of parenting across generations. In the current study we included both the educational gap between parents and grandparents and parent gender as potential moderators in the relation between grandparenting and parenting.

Co-resident grandparents interact frequently with the third generation. Thus G1 grandparents may have a direct impact on G3 grandchildren through child rearing, for example during feeding and playing (Dunifon, 2013). Previous studies have showed that greater grandmaternal involvement was associated with more adolescent prosocial behavior in South Africa (Levetan & Wild, 2016), and grandparents could also contribute to grandchildren's academic achievement in the US (e.g., Monserud & Elder Jr, 2011). In China, although there have been some studies about grandparents' childrearing beliefs that point towards an emphasis on physical health and nutrition (Jiang et al., 2007; Li et al., 2017) and schooling (Zeng & Xie, 2014), there is very little research on how grandparenting is related to child development.

An important aspect of early childhood development is the development of Executive Function (EF) which is an umbrella term underlining complex cognitive processes that include goal-directed actions such as inhibitory control, working memory and cognitive flexibility (Miyake et al., 2000; Zelazo et al., 1997). EF emerges as early as in the first year of life (Best et al., 2011) and is critical for later academic achievement (e.g., Sulik et al., 2018), better language development (e.g., Muller et al., 2009), better motor performance (e.g., Livesey et al., 2006) and fewer behavioral problems (e.g., Hughes & Ensor, 2011). Parental sensitivity is a central dimension of parenting that has been shown to have an impact on EF development (e.g., Cabrera et al., 2011). Sensitive parents are attuned to their child's signals, quickly adapt to the changing environment, and respond appropriately to the child. For example, if the child is getting frustrated when they cannot figure out how a toy works, sensitive parents notice this frustration, and provide help that is appropriate to the child's developmental level. Thus, children may feel supported by their parents and are therefore more motivated to seek new challenges and explore their surroundings (Mills-Koonce et al., 2015). Previous research shows that sensitivity of mothers and fathers generally contributes to higher levels of cognitive skills (e.g. Bernier et al., 2010; Li et al., 2019; Towe-Goodman et al., 2016).

Mothers, fathers, and grandparents may contribute uniquely to individual differences in child EF skills (e.g., Meuwissen & Carlson, 2015). To the best of our knowledge, three studies have investigated the roles of maternal and paternal sensitivity in relation to child EF (Li et al., 2019; Lucassen et al., 2015; Towe-Goodman et al., 2016), and the results of these studies are inconsistent. Two of them support the unique role of maternal and paternal sensitivity in EF skills, concurrently at 14 months (Li et al., 2019) and over time from 24 months to 36 months (Towe-Goodman et al., 2016). Lucassen and colleagues (2015), however, only found a relation between maternal sensitivity at and child EF, but not between paternal sensitivity and child EF at 4 years of age. There is limited research on the effect of grandparenting on child development. As far as we know, only one study in rural China showed that living with higherF educated grandparents was related to lower children's school dropout rates (Zeng & Xie, 2014). To date, no studies have investigated the roles of mothers, fathers and grandparents together in children's development in general, or EF development in particular.

## The Current Study

The goal of the pilot study is to extend existing work on parenting and child EF by including mothers, fathers, and co-residing grandparents, and examine whether grandparental sensitivity relates to parental sensitivity (biological child of the grandparent), and whether grandparental sensitivity and maternal and paternal sensitivity each uniquely contribute to 14-month-old children's EF in China. We hypothesized that: 1) grandparental sensitivity is related to parental sensitivity towards 14-month-old children and 2) grandparental sensitivity and maternal and paternal sensitivity each uniquely contribute to child EF at 14 months.



## Method

### Sample

Sixty-three first-time mothers and fathers and their healthy 4-month-old infants (51% boys) were recruited at a maternity and child hospital, at yoga classes, and through online groups in urban Shenzhen, China. Participants participated in an international and longitudinal study. Both mother-infant and father-infant dyads were visited at home at 4 and 14 months of infant age. The inclusion criteria for participating parents were: 1) first-time parents; 2) 21 years or older during pregnancy (both parents); 3) had a singleton and full-term infant; 4) native Chinese speakers (Mandarin or Cantonese); 5) no history of any mental illness or substance abuse. The current study only used the data from the 14-months wave, as we only have grandparental data available for this time point. Two mothers and six fathers did not participate at 14 months due to time limitations. One grandparent from each family who co-resided with parents and grandchildren at 14 months of infant age and spent the most time with the grandchild was invited to take part in the 14-months home visit. A total of 42 grandparents (out of 46 co-residing grandparents) agreed to participate in this study (19 maternal grandmothers; 20 paternal grandmothers; 3 paternal grandfathers). There were no differences in age, educational level, family income, maternal and paternal sensitivity between the 42 parents with participating grandparents and the other 21 parents (*ps*: .160-.930). The data was collected between July, 2017 and February, 2018.

The average age of infants was 14.83 months (*SD* = 1.16, range 11.92 – 18.48 months). The average ages of mothers and fathers were 30 years (*SD* = 2.59, range 25-37 years) and 31 years (*SD* = 3.14, range 24-37 years) and the average age of grandparents was 56 years (*SD* = 4.65, range 47-66 years) when the infant was 14 months. Considering educational level, most of mothers (76.0%) and fathers (77.5%) were highly educated (bachelor's degree or higher). Some mothers (24.0%) and fathers (18.0%) had a medium educational level (post-secondary or short-cycle tertiary education). None of the mothers and rest of the fathers (4.5%) had a low education (upper secondary degree or lower). None of the grandparents were highly educated, some (18.4%) had medium educational level and most of them (81.6%) had a low educational level. Most families had middle-to-upper income levels with around 16% higher income than the average level in Shenzhen (Shenzhen Statistics Bureau, 2018).

## Procedure

Mothers and fathers were scheduled in two separate 2-hour home visits. Grandparents participated in one of the two visits (counterbalanced between grandparents). The order of parent visits was also counterbalanced. An informed consent form was signed by all fathers, mothers and grandparents for their own participation as well as the infants' participation. A small infant gift and a small amount of money were given to all families as compensation after each home visit. Families also received a DVD with a compilation of video footage from different home visits at the end of the study. The study was approved by the Ethics Committee [BLINDED] University in the Netherlands and [BLINDED] University in China.

Infants were tested in the first home visit (either the mother or the father visit). They completed a short battery of three EF tasks based on previous studies (Devine et al., 2019; Miller & Marcovitch, 2015; Johansson et al., 2016) in a fixed order: prohibition task, multi-location search task and ball run task. Infants sat on their parent's lap during the task. Parents were asked to remain silent and not give any verbal or behavioral instructions to infants. Infants had breaks and were praised after each task to maintain their interest in participating. If one of the tasks was not successful in the first home visit, that task was performed again during the next home visit with the other parent. After all infant tasks, the parent played with the infant with toys for 5 minutes. The grandparent and the infant played with a new set of toys after the parent-infant interaction (either the mother or the father). Parents and grandparents completed questionnaires about background information after each home visit.

## Measures

### Parent-infant and grandparent-infant interaction

Parental and grandparental sensitivity were measured with the Ainsworth Sensitivity Scales (Ainsworth, Bell, & Stayton, 1974) during free play with toys (5 min). Mother-infant dyads, father-infant dyads and grandparent-infant dyads were filmed separately. Sensitivity represents caregivers' ability to notice child's signals, interpret those signals correctly and give child appropriate and prompt response and was rated on a 9-point scale (1 = highly insensitive; 9 = highly sensitive). All videos were coded by 4 independent coders (1 Chinese, 1 Dutch-Chinese and 2 Dutch coders). English subtitles were used for non-Chinese speaking coders. The father, mother and grandparent within one family were coded by three independent coders. A quarter of the videos were double coded for reliability. Intercoder reliabilities (interclass correlation, single rater, absolute agreement) were >.72 for all coder pairs on all scales (mother-infant dyad > .72; father-infant dyad > .78; grandparent-infant dyad >.83).

### Infant Executive Function at 14 Months

*Inhibition (IB).* The Prohibition Task (Friedman et al., 2011) was used to assess infants' inhibition ability. Infants were asked to resist touching a shiny glitter wand ('Mystic Glitter Wand'). The examiner first showed the wand for up to 15 seconds and got infants' attention. Then the examiner placed the wand within arm's reach of the infant, and gave an instruction *"Look, <name child>. No, don't touch"*. After this, the examiner turned around for up to 30 seconds. The camera was placed to capture the infant's face. Scores on this task were collapsed into two categories (touches or waits before 30s; Devine et al., 2019). Double-coding of 60 of videos revealed high levels of inter- rater agreement, ICC = .99, $p < .001$.

*Working memory (WM).* The Multi-Location Search Task (Miller & Marcovitch, 2015) was used for working memory. Infants were asked to search for three cars (i.e., red, yellow and, blue plastic cars) hidden in a toy garage with colored doors (i.e., red, yellow and, blue). The examiner first introduced the cars to the child and placed all cars into a color-corresponding garage (e.g., the blue car in the blue garage). The examiner blocked the child's view using a white board (29.7cm x 42cm) and counted out loud for 5 seconds. After this, the examiner asked *"where is the car"*. As all garages have cars, all infants were successful on the first trial. After infants pointed to one garage, the examiner took the car out and let the infant briefly play with the car and praised the infant. Then the examiner took the retrieved car from the infant and showed the infant that the car was being placed in a bag. Before the next trial, the examiner closed the empty garage. For the subsequent trials, if infants pointed to the empty garage, the examiner opened it and said *"It's not there. Let's have another go"* and closed the garage. The examiner stopped the task if the infant failed to find a toy car for three consecutive trials or when the infant retrieved all toy cars. The total number of cars that the infant successfully retrieved was coded (0 = retrieved 1 car, 1 = retrieved 2 cars, 2 = retrieved 3 cars). Scoring took place offline and double-coding of 60 videos revealed excellent inter-rater reliability for each trial, Kappa =1.00.

*Cognitive flexibility (CF).* The Ball Run Task was designed as an age-appropriate shifting task measuring cognitive flexibility based on the Trucks Task developed by Hughes and Ensor (2005). There were three circular holes (i.e., green, yellow, red) in a row on the top of the adapted ball run toy. The middle yellow hole and either the green or red hole were closed by using two metal brackets. Infants were instructed to place either a red or green ball in the same colored and opened hole (e.g., place the red ball in the red hole or the green ball in the green hole) (counter-balanced across children) in the learning phase. If the infant scored four or more out of six trials (34% infants), the examiner continued the task to reversal phase. Before this phase, the examiner took the ball they were using in the learning phase (e.g., the green ball) and placed it in a bag in view of the infant. The examiner then retrieved a different ball (e.g., the red ball) and closed the open hole (e.g., the green hole) while the infant was attracted to the toy and opened the closed hole (e.g., the red hole). The rule then changed to place another colored ball in the same colored hole (e.g., place read ball in red hole). Infants who failed to pass the learning phase (scored 4 or less) scored 0. Infants received 1 point if they passed the learning phase and 2 points if they passed the reversal phase (scored four or more out of six trials). Scoring took place offline and double-coding of 60 videos revealed excellent inter-rater reliability for each trial, Kappa =1.00.

Consistent with findings from previous research (Devine et al., 2019; Miller & Marcovitch, 2015), the three component scores of EF were uncorrelated with one another ($r$s < .06, $p$s > .53), suggesting EF in infancy is better represented by multiple components rather than one overarching component.

### *Educational gap between parent and grandparent (control variable)*

Parental and grandparental educational level were measured on a 9-scale point: 0=early childhood, 1=primary education, 2=lower secondary education, 3=upper secondary education, 4=post-secondary education, 5=short-cycle tertiary education, 6=bachelor's or equivalent level, 7= master's or equivalent level, 8=doctoral or equivalent level. Educational differences between parents and grandparents were calculated by subtracting grandparental education from parental education. The higher the score, the higher educated the parent was compared to the grandparent.

### Statistical Analysis

We conducted our primary analyses using IBM SPSS 25.0. Descriptive statistics and bivariate correlations were carried out for all variables first. The percentage of missing data ranged from 0% (grandparental sensitivity) to 10% (educational gap between parents and grandparents). Multiple (20-fold) imputations were carried out for all missing values based on predictive mean matching which assumes that the missing values are missing at random (Van Buuren et al., 2006). Background information (child's gender and age, the age and education level of mothers, fathers and grandparents) and all the variables in the full mediation model were included in the imputation model. The multilevel regression coefficients and their standard errors were pooled in SPSS, using Rubin's combination rules (1987) which were carried out using a SPSS macro developed by Van Ginkel (2014). No outliers have been found for all variables (larger than 3.29 *SD* above or below).

To address our research questions, two sets of analyses were undertaken. In the first set, data of the biological child (mother or father of the child) of the grandparent (i.e., if maternal grandparent participated, the mother was selected; if paternal grandparent participated, the father was selected) was used to test the relation between parental sensitivity and grandparental sensitivity towards the grandchild using Pearson correlations. In total, 19 mothers and 23 fathers and their parent were included in this analysis. Two hierarchical regression analyses were performed to test whether biological parent gender and differences in education between this parent and grandparent moderated the relation between grandparental and parental sensitivity. For the second set of analyses predicting infant EF, data from all 42 infants, mothers, fathers, and grandparents were included. Pearson correlations were first used to test the relation between grandparental sensitivity, maternal sensitivity and paternal sensitivity. To test whether grandparental sensitivity, maternal and paternal sensitivity uniquely predicted infant EF at 14 months, we used one binary logistic model (outcome: inhibition), two hierarchical regression model (outcome: working memory and cognitive flexibility). As family socio-economic status (SES), child gender and child age were not related to child outcomes, those variables were not controlled for.



## Results

Descriptive statistics of and correlations between the main variables (both data sets) are presented in Table 1. The mean levels of maternal sensitivity and paternal sensitivity were 5.31 and 4.73, and for grandparental sensitivity it was 4.21. Maternal sensitivity was higher than grandparental sensitivity, $t(41) = -2.67$, $p = .011$, $d = .62$, but there were no significant differences between paternal sensitivity and grandparental sensitivity, $t(38) = -1.27$, $p = .211$, or between maternal sensitivity and paternal sensitivity, $t(38) = 1.66$, $p = .105$. The average difference in educational level between parents and grandparents was 4.28 (on a scale ranging from 0 to 8). In the Prohibition task, 15% of the infants did not touch the wand (waited for 30s). In the Multi-location Search task, 44% infants successfully retrieved 2 cars while a small number of them (20%) retrieved 3 cars. In the Ball Run task, 34% infants proceeded to the reversal phase.

**Table 1.** Descriptive Statistics and Correlations between Main Variables in China

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | *M (SD)* | *Range* | *N* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Intergenerational similarity of sensitivity | | | | | | | | | | | |
| 1 | G1Sen | - | | | | | | | 4.21 (1.93) | 1-8 | 42 |
| 2 | G2PSen | .09 | - | | | | | | 4.85 (1.84) | 1-8 | 41 |
| Unique contribution of different caregivers to child EF | | | | | | | | | | | |
| 3 | G1Sen | | | - | | | | | 4.21 (1.93) | 1-8 | 42 |
| 4 | G2MSen | | | -.11 | - | | | | 5.31 (1.63) | 2-8 | 42 |
| 5 | G2FSen | | | .10 | .21 | - | | | 4.77 (2.01) | 1-8 | 39 |
| 6 | Infant IB | | | .35* | -.12 | .12 | - | | x[a] | x | x |
| 7 | Infant WM | | | -.07 | .35* | .18 | -.11 | - | 0.83 (0.74) | 0-2 | 41 |
| 8 | Infant CF | | | .25 | .08 | -.05 | -.01 | .05 | 0.60 (0.71) | 0-2 | 40 |

*Note*: * $p < .05$. G1Sen = grandparent sensitivity, G2PSen = parental sensitivity (biological child of grandparent). G2MSen = mother sensitivity, G2FSen = father sensitivity. IB = Inhibition. WM =Working Memory. CF = Cognitive Flexibility. a. Inhibition was a categorical variable which was calculated by percentage of infants waiting for 30s in the test for the descriptive statistics.

## The relation between grandparental sensitivity and parental sensitivity

The pooled bivariate correlation between grandparental and parental sensitivity (biological child of the grandparent) was not significant ($r$ = .09, $p$ = .590; Table 1). A hierarchical regression was carried out to examine the relation between grandparental sensitivity and parental sensitivity with parent gender as a moderator. Centered scores of grandparental sensitivity and parent gender were used. Pooled results show that the model was not significant, $F$(3,35.66) = .12, $p$ = .946. Neither grandparental sensitivity (B = -.02, $p$ = .742), parent gender (B = .11, $p$ = .666) nor the interaction between parent gender and grandparental sensitivity was significant (B = .02, $p$ = .874) in predicting parental sensitivity. Moreover, educational differences between parents and grandparents also did not moderate the relation between grandparental sensitivity and parental sensitivity, $F$(3,34.23) = .74, $p$ = .535. Neither grandparental sensitivity (B = -.03, $p$ = .669), educational differences (B = -.10, $p$ = .168) nor the interaction between grandparental sensitivity and educational differences (B = -.03, $p$ = .571) were significant.

## Unique contribution of different caregivers in child EF.

The pooled bivariate correlations between variables were also examined first (Table 1). There were no significant correlations between grandparental sensitivity and maternal sensitivity ($r$ = -.11, $p$ = .503), or between grandparental sensitivity and paternal sensitivity ($r$ = .10, $p$ = .544). Grandparental sensitivity was positively correlated with infant inhibition ($r$ = .35, $p$ = .025) but not with working memory ($p$ = .669) and cognitive flexibility ($p$ = .118). Maternal sensitivity was significantly correlated with infant working memory ($r$ = .36, $p$ = .022) but not with inhibition ($p$ = .513) and cognitive flexibility ($p$ = .658), while paternal sensitivity was not significantly related to any infant EF abilities ($ps$ > .280). Next, one binary logistic analysis (outcome: inhibition), two hierarchical regression analysis (outcome: working memory, cognitive flexibility) were performed to predict the three infant EF outcomes. All model details are presented in Table 2. Pooled results showed that neither the model for inhibition, working memory nor for cognitive flexibility was significant (IB: $F$(3, 1601.04) = 1.50, $p$ = .214; WM: $F$(3, 35.48) = 1.99, $p$ = .133; CF: $F$(3, 24.32) = .84, $p$ = .485), although the relation between maternal sensitivity and working memory was significant (B =.15, $p$ = .045) in the nonsignificant WM model. This means that based on the current design, grandparental sensitivity, maternal sensitivity and paternal sensitivity did not significantly contribute to infant EF abilities.

**Table 2.** Regressing Grandparental Sensitivity, Maternal and Paternal Sensitivity on Three EF Outcomes

| Predictors | B | SE | t | p | $R^2$ |
|---|---|---|---|---|---|
| *Model 1 (predicting infant inhibition)* | | | | | *.14* |
| Constant | -3.72 | 2.34 | -1.59 | .113 | |
| Maternal sensitivity | -.23 | .28 | -0.85 | .542 | |
| Paternal sensitivity | .21 | .27 | 0.79 | .878 | |
| Grandparental sensitivity | .48 | .27 | 1.79 | .072 | |
| *Model 2 (predicting infant working memory)* | | | | | *.14* |
| Constant | -.09 | .53 | -0.18 | .858 | |
| Maternal sensitivity | .15 | .07 | 2.08* | .045 | |
| Paternal sensitivity | .04 | .06 | 0.71 | .480 | |
| Grandparental sensitivity | -.02 | .06 | -0.26 | .798 | |
| *Model 3 (predicting infant cognitive flexibility)* | | | | | *.09* |
| Constant | .09 | .61 | 0.15 | .886 | |
| Maternal sensitivity | .05 | .10 | 0.53 | .611 | |
| Paternal sensitivity | -.04 | .06 | -0.62 | .546 | |
| Grandparental sensitivity | .10 | .06 | 1.71 | .095 | |

*Notes*: * $p < .05$.

## Discussion

The current pilot study investigated the relation between grandparental sensitivity and parental sensitivity (biological child of the grandparent) on child EF at 14 months and the unique impact of grandparental sensitivity, maternal and paternal sensitivity on child EF at 14 months in China. Our findings showed that: 1) grandparental sensitivity was not related to parental sensitivity; 2) grandparental sensitivity, maternal sensitivity, paternal sensitivity did not uniquely contribute to child EF at 14 months in the multivariate models, although bivariate correlations between grandparental sensitivity and infant inhibition and between maternal sensitivity and infant working memory were significant.

Contrary to our hypothesis, the relation between grandparental sensitivity and parental sensitivity was not significant, which means that there was no intergenerational similarity regarding sensitivity towards 14-month-old children in China. This result remained the same after including educational differences between grandparents and parents and parent gender as potential moderators. One possible explanation for this result is the increased Westernization of China that occurred in the past decades that separate the adult experiences of the two generations. The massive growth in China's economy dramatically improved living conditions and increased the opportunities for Chinese society interacting with Western countries. The increased Western influence gives new generations exposure to Western values including more child-centered and supportive parenting styles. Contemporary urban Chinese parents regard happiness and good mental health (*Xin Li Su Zhi* in Chinese) more important than "Excellence" (*Youxiu* in Chinese) (e.g., Way et al., 2015). Parents increasingly believe that raising autonomous children with high 'qualities' such as social and communication skills are important for their success in this competitive world (Way et al., 2013), and research indeed shows that parental child-rearing attitudes and values are shifting (e.g. Cheung et al., 2016; Cheah et al., 2015). This may be a reason that G2 parents showed different levels of sensitive parenting towards G3 children compared to G1 grandparents. Moreover, the absence of intergenerational similarity in sensitivity in the current study was consistent with results of a survey of 1627 urban parents in China. More than half of parents reported that the key challenge of grandparental joint caregiving was the differences in child-rearing methods (Goh & Kuczynski, 2010).

Second, inconsistent with our hypothesis, grandparental sensitivity together with maternal and paternal sensitivity did not significantly predict child EF. There were some significant bivariate associations between grandparental sensitivity and infant inhibition, and between maternal sensitivity and infant working memory, but these associations did not hold in multivariate models. One possible explanation may be that in the current study we used a broad definition of sensitivity not specified to cognitive challenges, in a free play setting rather than in an EF-related task. A more cognitively stimulating situation such as completing a puzzle may be more likely to show differences in those aspects of sensitive responsiveness that are particularly relevant to EF development, such as autonomy support and scaffolding. Bernier and colleagues (2010) found that compared to general sensitivity, maternal autonomy support during problem-solving tasks was the strongest predictor of child EF at 26 months. Another possible explanation lies in the fact that the current sample size was underpowered to detect smaller effect sizes. Assuming a power of at least 80% and an alpha of .05, a group size of 42 participants could only detect a medium to large effect size (e.g., $f^2 = 0.3$) for testing main and interaction effects with 3 predictors. However, because this is the first study to investigate maternal sensitivity, paternal sensitivity, and grandparental sensitivity together in relation to child EF, relations between sensitivity of multiple caregiver and child EF remain an open question that needs to be examined further in larger samples.



There are some limitations for the present study. First, the sample size of 42 was small, which reduced power for detecting smaller-sized effects (Hackshaw, 2008). Second, most of the families are from middle-to-high socioeconomic classes, which limited the possibility to investigate an association between parenting and child EF in a more vulnerable group such as families from lower socioeconomic status. Research has shown that those families are more likely to experience stress which may have an impact on parenting and child EF (e.g., Mesman et al., 2012). Third, sensitivity was measured in a general setting instead of a cognitive task. Although free play can and did certainly also evoke cognitive support in the form of showing a child how to use a new toy, the effect of sensitivity of multiple caregivers in a specific cognitive setting such as completing a puzzle task needs to be further investigated. Fourth, we only measured sensitivity of multiple caregivers separately with the infant. As grandparent and parent may also involve in playing or taking care of the infant at the same time, coparenting behaviors during triangular interactions can be further investigated.

In conclusion, the current pilot study did not find a significant relation between parental and grandparental sensitivity or a unique contribution of sensitivity from mothers, fathers and grandparents to infant EF. Our findings showed differences in sensitivity of grandparents and parents towards the third generation but did not confirm a combined effect of multiple caregivers on infant EF development in China.