Culture-specific Links between Maternal Executive Function, Parenting, and Preschool Children's Executive Function in South Korea

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Background. Research on the relationships between parental factors and children's executive function (EF) has been conducted mainly in Western cultures. ***Aim***. The present study provides the first empirical test, in a non-Western context, of how maternal EF and parenting behaviors relate to child EF. ***Sample.*** South Korean mothers and their preschool children (*N*=95 dyads) completed EF tasks. ***Method***. Two aspects of parental scaffolding were observed during a puzzle task: *contingency* (i.e., adjusting among levels of scaffolding according to the child's ongoing evidence of understanding) and *intrusiveness* (i.e., directive, mother-centered interactions). ***Results and Conclusions.*** Maternal EF and maternal contingency each accounted for unique variance in child EF, above and beyond child age, child language and maternal education. Maternal intrusiveness, however, was not significantly related to child EF. Additionally, no mediating role of parenting was found in the maternal and child EF link. However, child language was found to partially mediate the link between maternal contingency and child EF. These results complement prior findings by revealing distinctive patterns in the link between maternal EF, parenting behaviors and child EF in the Korean context.

Executive function (EF) refers to higher order cognitive and self-regulatory processes underlying goal-directed behaviors (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Despite well-established evidence concerning the development of EF and its relation to child social and cognitive functioning, research on individual differences in EF lags behind (Cuevas, Deater-Deckard, Kim-Spoon, & Watson, 2014a). In a quest to explain the etiology of EF, recent research has focused on parenting (Bernier, Carlson, Deschênes, & Matte-Gagne, 2012; Bernier, Carlson, & Whipple, 2010; Bibok, Carpendale, & Müller, 2009; Hughes & Ensor, 2009), and maternal EF (including heritability of EF: Cuevas et al., 2014b; Friedman et al., 2008) as factors in the development of children's EF. Little is known, however, about how parenting and maternal EF may simultaneously work in relation to child EF. Furthermore, research on the link between parental factors and child EF has been conducted mainly in Western cultures, while socialization practices vary across cultures, and so it is possible that relations between parenting practices and child EF that hold in one culture do not bear out in another culture (Baumrind & Thompson, 2002). Accordingly, the present study examined the relative contributions of maternal EF and maternal parenting to child EF in preschool children in a non-Western culture, the South Korean (Korean hereafter) context.

1. Executive function development

Working memory (updating and manipulating mental representations, WM), inhibitory control (suppressing prepotent responses, IC) and shifting (directing one's attention as necessary to a given stimulus, SH) are three distinct yet interrelated EF subcomponents observed in adults (Miyake et al., 2000). There is only weak empirical evidence distinguishing these three EF subcomponents in preschool children, suggesting that EF comprises a unitary factor in early childhood (Hughes, Ensor, Wilson, & Graham, 2010; Wiebe, Espy, & Charak, 2008; Senn, Espy & Kauffman, 2004). Evidence also indicates increasing divergence of the EF components as a function of age (Lerner & Lonigan, 2014). Specifically, during the latter half of the preschool period, children are increasingly able to perform on more complex tasks involving WM, IC and SH, and the development of EF thus can be characterized as fine-tuning of the basic EF skills that emerge before 3 years of age (Garon, Bryson, & Smith, 2008). Although there are cross-cultural differences in the timescales of EF development, the general pattern replicates in a variety of cultural contexts (Sabbagh, Xu, Carlson, Moses, & Lee, 2006; Wang, Devine, Wong, & Hughes, 2016; Ellefson, Ng, Wang, & Hughes, 2017).

2. Factors in child executive function

Given the well-established pattern of EF development across cultures, it is fair to ask whether there are any systematic factors that influence EF development and lead to individual differences in EF (Jaramillo, Rendón, Muñoz, Weis, & Trommsdorff, 2017).

2.1 Maternal scaffolding and child executive function

2.1.1 Contingency

One parenting practice that has been consistently found to relate to child EF is scaffolding (parental support for children to accomplish goals that would otherwise be beyond their ability; Wood, Bruner, & Ross, 1976). Various aspects of parental scaffolding positively relate to child EF, for example maternal elaboration, open questions and praise (Hughes & Ensor, 2009), maternal support in making conceptual associations (Lowe et al., 2014) and maternal concern for the child's sense of competence and autonomy (Bernier et al., 2010). A crucial feature common to these approaches is parental adjustment of levels of support to create an optimal challenge for the child, which has been operationalized as *contingency* (Wood et al., 1976; Wood, 1980). Parental contingency implies that parents take over or relinquish levels of support or control according to the ongoing evidence of the child's mastery of a task. Contingency therefore hinges not just on what the child does alone, but on the bi-directional nature of the parent-child interaction (Conner & Cross, 2003; Pino-Pasternak, Whitebread, & Tolmie, 2010). Maternal contingency was focused on in the present study as a parenting factor explaining the development of child EF, which has not been empirically related on its own to child EF.

2.1.2 Intrusiveness

By contrast, another prominent aspect of scaffolding that negatively relates to child EF is parental control (parental directives that discourage the child's autonomous decision-making; Bibok et al., 2009; Bindman, Hindman, Bowles, & Morrison, 2013). One type of parental control is intrusiveness (parent-centered interaction marked by negative affect, overstimulation or an overwhelmingly increased pace of activity; Cuevas et al., 2014a; noncontingent responses that are meant to override the child's actions; Holochwost, Gariepy, Propper, & Gardner-Neblett, 2016). Intrusiveness has a somewhat nuanced relation with child EF across cultural groups. For example, while parental intrusiveness has typically been found to negatively relate to child EF in predominantly European American samples, a negative relation has not been consistently reported among African American families (Rhoades, Greenberg, Lanza, & Blair, 2011; Tamis-LeMonda, Briggs, McClowry, & Snow, 2008), and may depend on whether we examine parenting during infancy or toddlerhood (Holochwost et al., 2016). This trend is in line with a broader literature suggesting that for African Americans, increased levels of parental intrusiveness may not negatively affect parent-child relationships or child development more generally (Deater-Deckard, Dodge, Bates, & Pettit, 1996).

There are a number of possible explanations for these cultural differences, which are not mutually exclusive. One account of varied relations between parental intrusiveness and child EF across cultures addresses differences in the meaning of intrusiveness across groups (Clincy & Mills-Koonce, 2013; Ispa et al., 2004). Parental practices that are viewed as intrusive from one cultural perspective may not have an adverse impact in another culture, since the extent to which children benefit from a certain parenting behavior is likely to depend on culturally normative trends (Grusec, Rudy, & Martini, 1997). It is also possible that the impact of parental intrusiveness is moderated by the affective context in which parental intrusiveness is exercised, namely how much warmth the parent shows (Ispa et al., 2004; Pungello, Iruka, Dotterer, Mills-Koonce, & Reznick, 2009). In addition, ecological and developmental factors within the same ethnic/racial group, such as parental socioeconomic status (Tamis-Lemonda et al., 2008), the child's developmental phases (Holochwost et al., 2016), and the child's age (Smetana, 2000), could have an effect. Finally, while some universal mechanisms may link parental factors to child EF, the same mechanisms may not operate uniformally across all cultural groups (Shweder & Sullivan, 1993). While fundamental developmental processes (e.g., the maturation of the prefrontal cortex supporting growth of EF and beneficial impacts of parental autonomy support on child EF) may be similar across cultures, lending support to universalism (Diamond, 2006), particular parenting practices may be emphasized differently across cultures, lending support to non-uniformity (e.g., developmental gains in autonomy predict children's enhanced emotional functioning more in the US than in China; Qin, Pomerantz, & Wang, 2009).

For the present purposes, we examined interactions between Korean mothers and children. Korean parents generally employ so-called authoritarian parenting styles; however they are not viewed by their children as particularly controlling (Vinden, 2001). Parental control may be conceived of as not mutually exclusive of parental warmth in the Korean context in that highly controlling parents can be viewed as warm and loving, whereas such types of parents can be regarded as hostile and rejecting in Western cultures (Rohner & Pettengill, 1985). Korean parents feel a strong sense of responsibility for the child's education, actively guiding and structuring children's environment and behavior from early in life (Lim & Jung, 2004), and tend to take initiatives in directing parent-child interactions (Sung & Hsu, 2009). Thus, given the mixed evidence that seems to vary across different cultural groups, parental intrusiveness may not be directly associated with negative outcomes in the Korean context.

2.2 Maternal executive function and child executive function

Maternal EF is another close correlate of child EF, suggesting some degree of heritability. Studies point to moderate or strong positive associations between mother EF and child EF at 7 years of age (Wang, Deater-Deckard, Petrill, & Thompson, 2012) and during adolescence and young adulthood (Jester et al., 2009). Research using preschool children has shown that mother EF-child EF links in attention-based aspects of EF appear to increase over the transition from early to middle childhood (Deater-Deckard & Wang, 2012). In addition, the maternal-child EF link was found to modestly correlate at 24 months of age, with this association remaining stable through 48 months, even when controlling for the child's verbal ability and maternal education (Cuevas et al., 2014a). Behavioral and genetic mechanisms may both explain this link (Jester et al., 2009; Rueda, Posner, & Rothbart, 2004; Kovas, Haworth, Dale, & Plomin, 2007). On the behavioral level, mother-child interactions offer the opportunity for both the mother and the child to practice their EF skills, for example by taking turns, taking each other's perspective, and recalling and updating shared experiences (Calkins, 2011; Sanders & Mazzucchelli, 2013). Maternal EF may be involved in the mother's own self-regulation, which determines quality of mother-child interactions and thus serves as a context for the child to practice emerging EF skills (Calkins, 2011). This account can be extended to include the mechanism on the genetic level. Mothers' consistent exercise of EF skills over time through parenting practices and mother-child interaction may lead to epigenetic modifications of genes that produce changes in neural functioning in children, which in turn influences EF skills (Barrett & Fleming, 2011). Genes seem to predispose to certain behavioral phenotypes through their effects on exposure to risk environments rather than through direct mechanisms (Rutter, Moffit, & Caspi, 2006). Consistent with this explanation, mothers with poor EF skills are more likely to exhibit negativity or harsh parenting when confronted with children's challenging behavior (Deater-Deckard, Sewell, Petrill & Thompson, 2010; Deater-Deckard, Wang, Chen, & Bell, 2012). Mulitple lines of

evidence suggest mechanisms by which maternal EF may relate to child EF: minimized impacts of the 7-repeat allele (in the D4 dopamine receptor gene) on inattentive behavior particularly for children whose parents practice high levels of sensitivity (Berry, Deater-Deckard, McCartney, Wang, & Petrill, 2013); synaptic pruning during the first 2 years of life, which is largely determined by experience that parents provide during this period (Nelson & Bloom, 1997), and the study of children in severely deprived environments, such as abuse and neglect (Curtis & Cicchetti, 2007; De Bellis, 2002; Marshall, Fox, & The BEIP Core Group, 2004).

2. 3 Mediators between parent factors and child executive function

Given increasing interest in the mechanisms through which parent EF relates to child EF, potential mediating factors merit further examination. One such factor is parenting, which has been found to account for part of the relation between maternal EF on child EF (Cuevas et al., 2014a). As such, negative parenting resulting from low maternal EF could potentially create an adverse context for the development of child EF (Cuevas et al., 2014a). Another mediator is the child's language ability (Hughes & Ensor, 2009; Lewis & Carpendale, 2009). Theoretically, child language has been suggested as a tool with which the child reflects on and regulates their own thoughts and actions (Vygotsky, 1987). Children with more proficient verbal skills are better able to develop mental tools such as self-directed speech to regulate their own thoughts and behavior (Vallotton & Ayoub, 2011). This notion is supported by abundant empirical research demonstrating the close relation between child verbal ability and child EF (Carlson & Beck, 2009; Fuhs & Day, 2011; Hughes & Ensor, 2009; Jacques & Zelazo, 2005; Landry et al., 2002; Sarsour et al., 2011). Given that the child language-EF link is likely to stem in part from parent-child interactions, it may be plausible that the child's language ability acts as a mechanism through which parent-child interactions affect child EF (Matte-Gagné & Bernier, 2011). Indeed, research has broadly shown that the child's verbal ability mediates the link between EF and such distal factors as family SES (Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005). More recently, the child's language ability has been found to mediate the link between parental autonomy support and child EF (Matte-Gagné & Bernier, 2011). Early in life children may particularly benefit from their verbal interaction with caregivers, which serves as a context in which to create psychological distance between themselves and their immediate spatial-temporal surroundings and thus contributes to regulating thoughts and action (Giesbrecht, Muller, & Miller, 2010). These findings notwithstanding, research on the mediating role of parenting (in the maternal EF-child EF link) and child language (in the parenting-child EF link) has been conducted only in Western cultures and needs to be extended with culturally diverse samples.

3. The present study

The present study firstly explored whether the findings in Western cultures on the association between parent factors (maternal contingency, maternal intrusiveness and maternal EF) and child EF would replicate in Korea. Maternal contingency and maternal EF were expected to positively relate to child EF, similar to the direct pathways between these factors that have been reported in Western samples. Maternal intrusiveness, however, was expected to have a weak or non-significant relation to child EF, given culture-specific parenting practices and values relating to parental control (e.g., Rohner & Pettengill, 1985; Sung & Hsu, 2009; Vinden, 2001).

Second, we examined the relative relations of parent factors (parenting behaviors and maternal EF) to child EF. Regarding relative relations between parent factors and child EF, we did not have specific hypotheses based on existing findings, because only negative parenting was explored in a similar US study (Cuevas et al., 2014a). As stated above, we did not expect the so-called negative parenting indexed by intrusiveness to be negatively related to child EF in our sample and so analyses of relative relations were exploratory.

Finally, if we established that both parent factors and child language made unique contributions to child EF, then we would examine indirect pathways between parent factors and child EF via mediating factors. Thus, for our third research question, we sought to examine the mediating role of parenting between mother EF and child EF, for which, once again, we did not have a strong hypothesis based on previous work. For our fourth research question, we expected child language to mediate between parenting and child EF, based on previous work on the instrumental role of the child's own language skills in their cognitive development (Matte-Gagné and Bernier, 2011).

Method

Participants

Ninety-five middle class mother-child dyads (47 boys, 48 girls) were recruited by advertising the present research through kindergartens, which were located in predominantly middle-class areas in Seoul. Only children who were reported by their mothers not to have experienced developmental issues were included (M = 55 months, SD = 3.7, range = 48-64). Mothers were between 28 and 47 years old (M = 36.9 years, SD = 3.5) during the maternal assessment. All mothers were the biological parent of the child, and most of them had a college degree or higher (6% high school; 4% technical two-year-college; 59% four-year-college; 30% post-graduate degree).

Procedure

This research was approved by the ethics committee of the [BLINDED FOR PEER REVIEW]. The mothers submitted written consent and the children assented verbally. Mother-child dyads took part individually in one videotaped session lasting about 40 minutes. In a quiet room in

kindergarten, mothers performed computerized EF tasks, while the researcher administered EF tasks with children. Following EF tasks, the mother-child dyad worked together on a problem-solving puzzle, during which the researcher left the room with a video camera focused on the dyad for five minutes for off-line coding. Mothers were then finally asked to fill out a demographic questionnaire. At the end of the session children received small prizes, and mothers received further information on child EF and cognitive development.

Measures

Child tasks

Tasks were chosen that were easy to administer and had been used before with this age group. Below we describe them in terms of the principal EF subcomponent they tapped into (Table 1), although some measurement impurity is possible, particularly when we acknowledge that young children's EFs may not be entirely dissociable (Wiebe et al., 2008).

See Table 1

Children's WM performance was tested on the Block Recall Task. Trials discontinued when the child failed at least four out of six trials in each span level (maximum span = 9; 54 trials total). Performance was equal to the number of trials recalled correctly. To measure inhibition, the HTKS comprised 30 trials, scored 0 (incorrect), 1 (self-correct), or 2 (correct) for each trial. To measure switching, the FIST comprised a total of 15 trials. One point was given when children responded with two correct selections in a given each trial. Detailed administration protocols can be found in the original sources (see Table 1). Split-half consistency using Spearman-Brown adjustment for the Corsi, HTSK, and FIST were 0.70, 0.92, and 0.94, respectively.

Child language. The vocabulary subset of the Korean-Wechsler Preschool and Primary Scale of Intelligence (Park, Kwak, & Park, 1995) was used to assess children's expressive language ability. We used raw scores of the vocabulary subtest.

Maternal tasks. Mothers completed three computerized EF tasks (Psychology Experiment Building Language system, Mueller & Piper, 2014; Table 2).

See Table 2

For the Corsi Block-tapping Task each span level consisted of two trials (starting with two blocks). The task continued to the next level if at least one of the trials was tapped correctly. The trials discontinued when the participant failed two trials in a given span level (maximum span = 9; 16 trials in total). Performance was the product of the block span (i.e., the last correctly repeated sequence) and the total number of correct trials. Performance of maternal inhibition on the Stroop was the difference in reaction times between the two categories: congruent (i.e., colour words in the same colour ink) and incongruent (i.e., colour words in different colour link) trials during 96 trials. For the WCST, a total of 128 cards were presented to sort until either ten sorting categories were achieved or all the cards were sorted. Performance was the proportion of correct responses. Split-half consistency using Spearman-Brown adjustment for the Corsi, Stroop, and WCST were 0.75, 0.90, and 0.95, respectively

Puzzle dyad task. The mother-child dyad was given a picture of a flower and wooden pieces differing in curvatures and lengths. The child was asked to match the target shape using the pieces, which was more challenging than four-year-olds could complete alone. The task difficulty was established during a pilot study by observing mother-child interactions, and by informal discussions with the mothers in the pilot study. Mothers were told to feel free to give the child any help they wished, as they would naturally.

Coding of the puzzle task.

The unit of coding for the puzzle task was an episode, which consisted of maternal behavior or utterances and its subsequent child behavior. We observed an average of 13.5 episodes per dyad (range: 8-26). Maternal contingency in an episode reflected maternal scaffolding that adjusted among levels of support according to the child's ongoing evidence of understanding (Wood, 1980). We first coded the level of maternal support of each episode, in the presence of errors or requests that the child made. There were six levels of support, with 0 being least involved and 5 being most involved (Table 3; adapted from Conner & Cross, 2003). The contingency of an episode was coded in relation to the maternal support in the mother's preceding turn. The episode was coded as contingent if the mother took over more control by increasing her level of support when the child failed, or if the mother relinquished some control by reducing her level of support when the child succeeded (Wood, 1980).

See Table 3

Maternal intrusiveness was operationalized as mother-centered intervention: providing directions (telling or showing) in the absence of the child's errors or requests. Maternal intrusiveness

implied the mother was prioritizing her own agenda rather than the interest or activities the child was presently engaged in (Bibok et al., 2009).

Interrater reliability using the above coding scheme was checked by a second rater who coded a random selection of 20% of the video data. Cohen's kappa was .87, which indicated a high level of agreement between raters.

Results

Our analytic strategy involved first examining the raw data distributions for all variables, and checking for confounds of EF (e.g. gender, age, maternal education). Then we conducted correlations to examine associations between parent factors and child EF, as well as child language. Finally we ran regression and mediation models to elucidate the relative contribution of various factors to child EF.

Preliminary analysis

Table 4 shows descriptive statistics for the child EFs, child verbal ability, maternal EFs and parenting behaviors. Child working memory (WM), maternal EFs and maternal contingency were not normally distributed. Accordingly, when these variables were included in further analysis, non-parametric methods were applied, such as Spearman's correlations and bootstrapping for testing the significance of mediation analysis. Preliminary analyses of variance showed there was no significant gender difference on child EF scores, so child gender was not included in further analysis.

See Table 4

Association between parent factors (contingency, intrusiveness and maternal EF) and child EF

The first research question regarding the association between parenting (contingency and intrusiveness) and child EF was explored via correlation analyses (Table 5). Due to our directional hypotheses, we report one-tailed *p*-values.

See Table 5

We first established that the three child EF scores were moderately positively correlated. Following prior research demonstrating that EF skills during the preschool period are unidimensional in nature (Fuhs & Day, 2011; Hughes et al., 2010), a composite of EF was calculated by standardizing individual EF scores, averaging them, and standardizing it again to form a composite *z*-score. These scores were also significantly positively correlated with child age and child language (Table 5). While

maternal education was not correlated with child shifting, it was correlated with child WM, inhibition, and the child EF composite.

The three maternal EF scores were not significantly correlated. We confirmed that the tasks had decent internal consistency (see maternal EF tasks under the Method Section) so the lack of correlation was unlikely to be due to poor psychometric properties of the tasks. Given that the three maternal EF scores were not significantly correlated, a composite maternal EF score was not created. Of the three maternal EF scores, only shifting was correlated with the child EF composite score (Table 5).

In terms of parenting factors, maternal contingency and intrusiveness were strongly negatively correlated. Nevertheless, the two behaviors were not combined into a composite, following prior studies demonstrating significant impacts of individually explored parenting behaviors, rather than as one overall composite, on child EF (e.g., Holochwost et al., 2016; Meuwissen & Carlson, 2015; Rochette & Bernier, 2014; Silk, Morris, Kanaya, & Steinberg, 2003). Table 5 demonstrates that maternal contingency, maternal intrusiveness and child EF were significantly correlated.

Due to their significant correlations with child EF, we retained maternal shifting, maternal contingency, maternal intrusiveness, child language, child age, and maternal education as predictors in subsequent analyses.

Relative contributions of parent factors to child EF

Exploratory hierarchical regressions were conducted to investigate the second question on relative contributions of parent factors (contingency, intrusiveness and maternal shifting) to child EF. Three covariates (child age, child language and maternal education) were entered in Step 1 to control for their impacts on child EF (Table 6). Then, maternal shifting and parenting behaviors were entered in Step 2. Maternal contingency and intrusiveness were entered separately due to their high correlation. Specifically, maternal shifting and intrusiveness were entered as predictors of child EF in Step 2a. Then, in Step 2b, maternal shifting and contingency were entered as predictors of child EF. Due to multiple testing involved in these processes, the alpha level for significance was adjusted to $p < .01$.

See Table 6

In both models, maternal shifting significantly predicted child EF (7% and 6% in Model 2a and 2b, respectively). Model 2a shows that intrusiveness did not predict variance in child EF above and beyond the other factors. In contrast, Model 2b shows that maternal contingency significantly predicted variance in child EF (9%), beyond the other factors (child age, child language, maternal education and maternal shifting).

Mediators between parental factors and child EF

The third and fourth questions on the mediating role of parenting in the maternal and child EF link and the mediating role of child language the link between parenting and child EF were addressed by carrying out mediation analysis using Bias Corrected Bootstrapping. The confidence interval was set to 95% with 1000 resamples. We found that there was no mediating part that maternal parenting (contingency and intrusiveness) played in the maternal and child EF link. Our finding suggests distinct mechanisms for the associations between maternal shifting and maternal contingency on the one hand, and child EF on the other hand (Table 7). The mediating role of child language, however, was found to be significant in the link between maternal contingency and child EF but not between maternal intrusiveness and child EF.

See Table 7

Whereas there were no significant mediating factors between maternal shifting and child EF, the link between maternal contingency and child EF was mediated by child language, with a point estimate of 0.08, *S.E.* = 0.04, and a 95% bias-corrected bootstrap confidence interval of 0.016 to 0.16. This indicated that 18% of the total impact of maternal contingency on child EF was mediated by child language (Fig. 1 & Table 7). This is consistent with the findings from the regression analysis, which showed more variance in child EF accounted for by contingency than by shifting. Our mediation analysis shed more light on this, suggesting that child language partially explains the mechanism that links maternal contingency with child EF.

See Figure 1

Discussion

The present study was designed to broaden our understanding of the universal and culture-specific links between maternal EF, parenting, and child EF by examining these with Korean preschoolers and their mothers. The present study adds to the literature by replicating existing findings in a new cultural context and by providing novel findings on the link among parenting, maternal EF and child EF. Specifically, our findings are consistent with prior findings highlighting the importance of parental scaffolding for child EF (e.g., Bernier et al., 2010; Bibok et al., 2009; Hughes & Ensor, 2009). We maintained separate variables in our analyses for contingency and intrusiveness, despite these two aspects of scaffolding being closely related on the conceptual level. Our rationale was fruitful in that subsequent analyses showed these two aspects of scaffolding contributed differently to explaining

child EF, with maternal contingency being a significant factor, but not intrusiveness. Maternal contingency during parent-child interactions can render tasks more manageable that would otherwise be more challenging without the adult's support (Vygotsky, 1978). This in turn allows the child to experience a cognitive challenge at just the right level, which can extend their EF capacities by exercising them in the most effective way with tasks that are in the "sweet spot", neither too easy nor too hard (Diamond & Lee, 2011).

The link between maternal intrusiveness and child EF established in some European-American samples, however, did not hold in our Korean sample, when controlling for the impact of child language, child age, and maternal education. One possible account of this null finding is that the same intrusive parenting may be interpreted differently across cultures (Deater-Deckard & Dodge, 1997; Fu & Markus, 2014; Qin et al., 2009; Rohner & Pettengill, 1985). Namely, intrusive parenting may be more normative, and have different impacts on children, in collectivistic cultures (like Korea) than individualistic cultures (like Western Europe and the United States; Chao & Tseng, 2002; Grusec et al., 1997). Specifically, this finding does not imply the denial of the universal positive relation between parental autonomy support and child outcomes in the Korean context (Jang, Reeve, Ryan, & Kim, 2009). This finding may suggest instead that the extent to which children benefit from parental autonomy support may be contingent in part on culturally normative trends (Qin et al., 2009). This possibility merits further research, given that evidence also suggests Korean mothers may well hold some Westernized beliefs and practices about their children's education (Shim, Kim, & Martin, 2008) and that emotional contexts surrounding parental intrusiveness, such as maternal warmth, should also be taken into account as a possible moderator in the Korean context (Rohner & Pettengill, 1985). In addition, the association between parenting and child outcomes may change over time, leading to different sequela as a consequence of parent factors in one developmental period relative to another (Clincy & Mills-Koonce, 2013; Holochwost et al., 2016).

The second research question concerned the relative associations of parent factors (maternal EF, maternal contingency and maternal intrusiveness) with child EF. Surprisingly, the three maternal EF measures were not correlated, and only maternal shifting correlated with child EF. Future studies can explore maternal shifting in more detail to determine whether indeed it is the most critical factor in maternal EF for child EF in similar research contexts. We established that each of the three maternal EF tasks had good internal consistency, implying that the measures were reliable. Measurement impurity is one possible account for the lack of correlation between the three maternal EF tasks (c.f. Greve, Stickle, Love, Bianchini, & Stanford, 2005), though all three tasks have been used widely to measure EF in other adult populations. Future research can examine whether other ways of assessing EF in mothers yield different findings in relation to child EF.

Notwithstanding the maternal EF measures, we found that maternal contingency accounted for more unique variance in child EF than maternal shifting, and than child age and language.

Whereas Cuevas et al. (2014a) examined factors in parenting that were negatively related with child EF, our study extends this finding by demonstrating the unique contribution of positive parenting (contingency). Nevertheless they also reported that parenting accounted for more unique variance in four-year-olds' EF than maternal EF. Thus, our study in the Korean context builds on their findings in the US context by confirming that parenting was a better predictor of four-year-olds' EF than maternal EF, while also revealing culture-specific patterns in the specific parenting practices that are relevant.

The third research question addressed the mediating role of parenting in the link between maternal EF and child EF, which was not significant in the present study. We found only a direct relation between maternal EF and child EF. Maternal contingency and intrusiveness did not mediate the maternal EF-child EF link, which was not consistent with the finding by Cuevas et al. (2014a). This discrepant finding may be attributed to the differences between the two studies in the parenting behaviors being investigated (negative caregiving versus scaffolding and intrusiveness), participants (2- to 4-year-olds versus 4-year-olds), and cultural setting (the US versus Korea). Even though the parenting behaviors of interest to the present study were not found to mediate the maternal EF-child EF link, this finding does not exclude the possibility of other parenting practices that were not included in the present study playing such a role.

The fourth research question concerned the mediating role of child language in the link between parent factors and child EF. We confirmed that child language mediated the link between maternal contingency and child EF. Hence there were two pathways for contingency to predict child EF: one direct pathway and one that operated via child language. It is possible that mothers who are more contingent in their interaction with children tend to have children who are more likely to be verbally fluent, which in turn positively relates to increased EF skills in children. Our finding supports prior studies demonstrating that children who experience more competent parenting develop better verbal abilities, which in turn provide them with verbal tools for improving EF skills (Carlson & Beck, 2009; Jacques & Zelazo, 2005; Matte-Gagné & Bernier, 2011). Children with strong verbal skills are also more likely to understand adults' guidance and problem-solving strategies in situ, to communicate their own specific gaps in knowledge or skills, and to develop other mental tools such as self-directed speech to regulate their own thoughts and behavior (Vallotton & Ayoub, 2011). Thus, while maternal contingency accounted for the most variance in child EF, the child's own language was another important factor in explaining child EF. Indeed, these two factors were closely related.Finally, the present study is not without limitations in that causational mechanisms cannot be determined due to its correlational nature. Furthermore the current findings are based on highly educated mothers in the Korean context and may not apply to populations within different demographical and cultural settings. However, given the gap in our understanding on the development of EF, particularly in non-Western cultures, the present findings shed light on universal and culture-

specific links between parental factors and child EF. Parental contingent and sensitive support contributes to the development of child EF across cultures, but the extent to which particular aspects of parenting in a given culture can be beneficial to EF development may depend on children's cultural and ecological contexts.

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Table 1
Child Executive function tasks

EF component	Task	Description	Original source
Working memory (visuospatial short-term WM)	Block Recall Task	Children tap the blocks in the same order as the experimenter did.	Working Memory Test Battery for Children (Pickering & Gathercole, 2001)
Inhibition	Head-Toes-Knees-Shoulders task (HTKS)	Children are asked to do the opposite of what the experimenter says.	McClelland et al (2014).
Shifting	Flexible Item Selection Task (FIST)	Children select a pair of pictures that go together in a dimension (shape, color, and size).	Jacques & Zelazo (2001)

Table 2

Maternal Executive function tasks

EF component	Task	Description	Original source
Working memory (visuospatial short-term WM)	Corsi Block-tapping Task	After blocks are lit up on the screen, mothers reproduce the order they are lit in.	Milner, 1971
Inhibition	Colour-word Stroop	Mothers press keys that match the ink color in which words are written	Stroop, 1935
Shifting	Wisconsin Card Sorting Task (WCST)	Mothers match a card to one of four key cards, according to a rule (i.e., number, color, or shape)	Berg, 1948

Table 3

Levels of maternal support

Levels	Operational definition & example
0	No support
1	Questions/comments to trigger former knowledge and cognitive processes/plan actions
2	Verbal hints at errors (“Something seems to be wrong...why don’t you check it?”)
3	Specific verbal explanation of errors (“That piece is too big.”)
4	Specific directive of what to do (“Find something like this.”)
5	Demonstration, followed by the child’s performance acting on the maternal intervention (“This piece should go here …. Now, can you do this part as I did?”)

Note. Adapted from Conner & Cross (2003)

Table 4
Descriptive statistics of maternal and child measures

Variable	Mean	*SD*	Observed range	Possible range
Child WM	19.77	4.04	13-31	0-54
Child Inhibition	31.36	11.89	5-59	0-60
Child Shifting	9.39	3.83	1-15	0-15
Child EF Composite (z-score)	-0.02	1.001	-1.84-2.41	*n/a*
Child language	20.56	5.47	8-38	0-47
Maternal WM	51.58	17.69	24-112	0-144
Maternal Inhibition*	17.03	71.20	-129.3-286.13	*n/a*
Maternal Shifting**	0.78	0.10	0.42-0.9	0-1
Maternal contingency	0.36	0.23	0-1	0-1
Maternal intrusiveness	0.49	0.26	0-1	0-1

Note. *N* = 95, WM = working memory, EF = executive function
*the difference between the reaction times needed for congruent and incongruent stimuli
**the proportion of correct responses